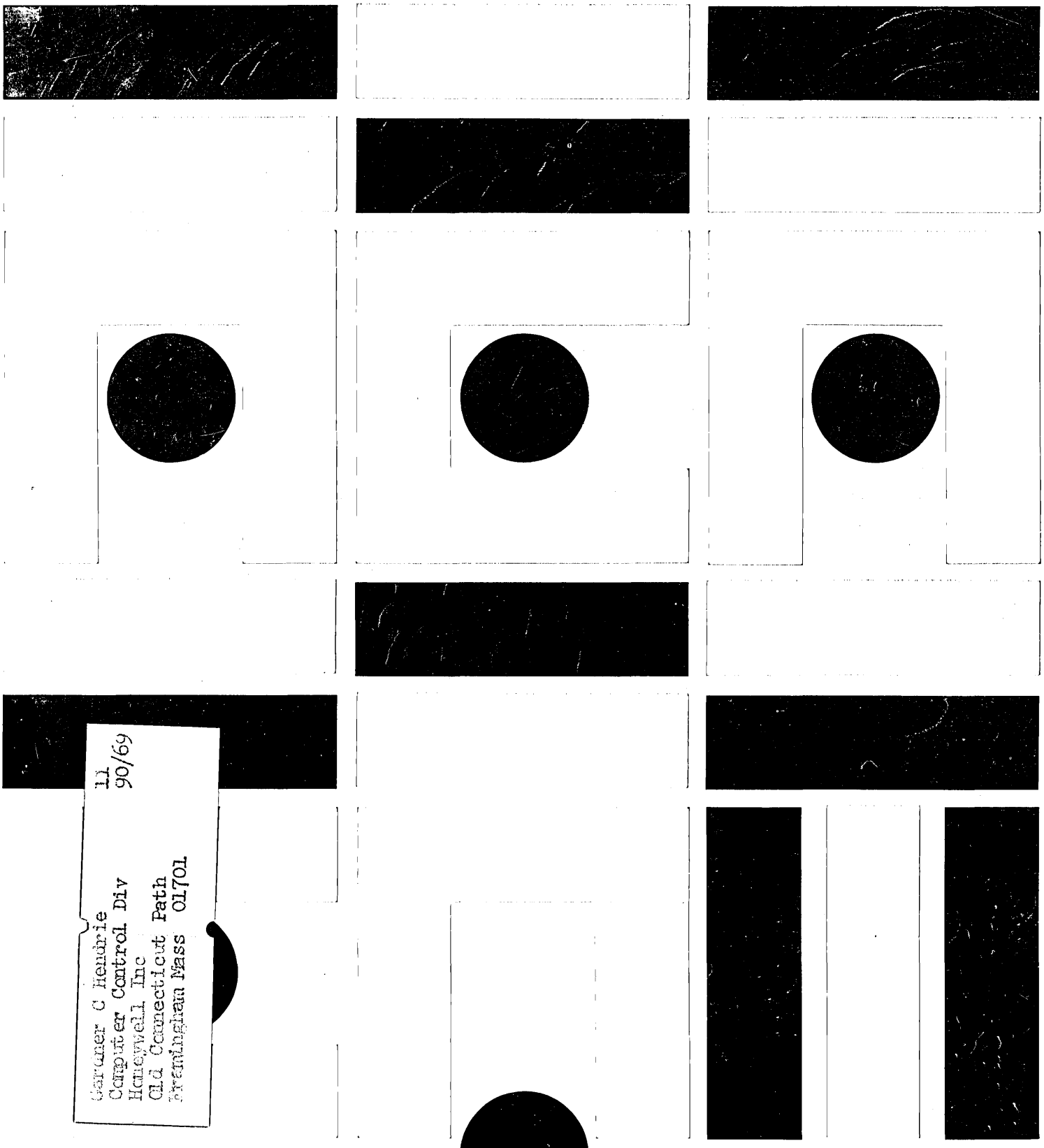
DATAMATION®

68

March



information storage & retrieval

Tape transports shipped 30 days after order received

Our TM-7, 9, 11 & 12 single capstan tape transports have long since passed through the "opening night jitters" so many new products encounter. We're in full scale mass production with them and can promise to ship yours within 30 days after we get your order.

This means that you can have exactly the product you need, and have it *fast*. 36 to 150 ips. (Non-standard speeds are available too, down to 7½ ips.) Data transfer rates from 2000-120,000 cps. And they're all IBM compatible in 7- or 9-track ASCII formats.

. . . and 60 day delivery for the ATM-13

This digital tape drive for high environmental use weighs only 150 lbs and measures 15.12 x 25.75 x 12.50 inches. Power use peaks at 1350 watts, normally uses only 1000 watts. It is still the only flight-weight tape memory which meets MIL-E-5400, Class 1A. Standard tape speed is 75 ips. Single speeds from 10 to 112.5 ips are available for special requirements.

TM-7 and TM-9 transports/memories are ideal for systems that require tape speeds of 75 ips and less. They allow you to transfer data at rates from 2000 to 60,000 cps. The single capstan drive makes these transports very reliable, yet keeps the cost down. Both of these units are available in lowboy, regular cabinet, and shared electronics configurations.

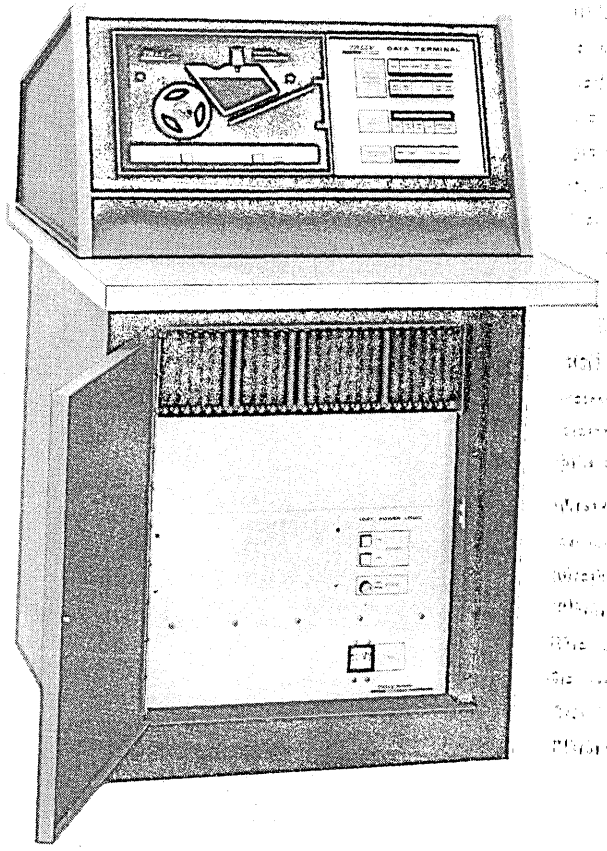
TM-11 and TM-12 transports/memories are designed for systems that need their data transferred at higher rates—up to 120,000 cps—with tape speeds ranging from 75 to 150 ips. Up to four transports can share the same memory electronics, if that is desirable for your system. And all TM-series transports and memories are interface interchangeable, which lets you expand your system simply by plugging in new units.

The ATM-13 airborne recorder can be procured without its RFI shielding box, reducing the weight of the unit to 75 lbs.

AMPEX

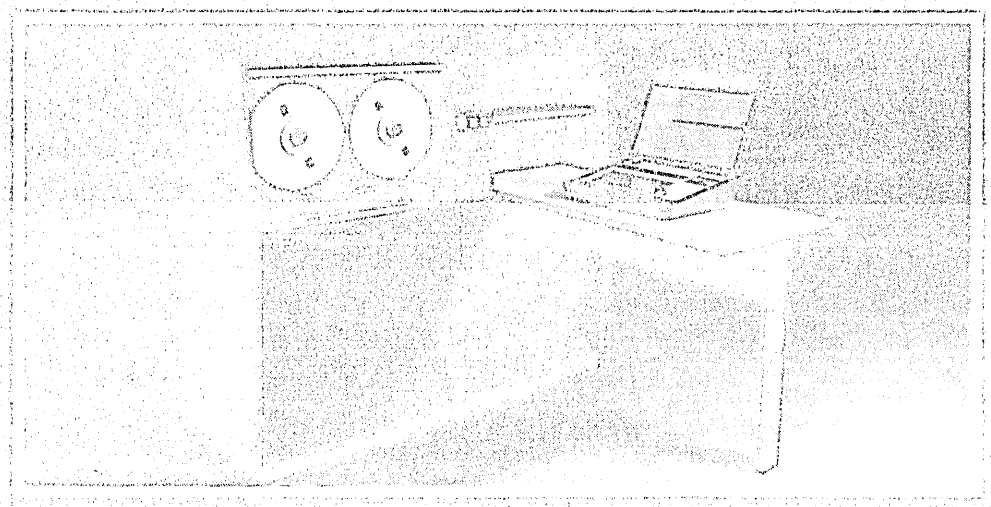
CIRCLE 1 ON READER CARD

Tally Data Terminals go "on line" with the IBM 360!



CIRCLE 4 ON READER CARD

Honeywell introduces Keytape. Pardon our dust, keypunch.



Here it is, 1968. We have third-generation computers that'll process 2,000,000 characters of data per second. Incredible.

And what do we feed these super-speed computers?

Punched cards. Which the computers process at the first-generation rate of 2,000 characters per second.

Super-speed data preparation.

Isn't there something ridiculous about that? Isn't it about time data preparation made it into the third generation, too?

Well, it just did.

Keyboard to magnetic tape.

The Honeywell Keytape unit functions very much like a keypunch. Except for one big difference: it records data directly on magnetic tape instead of on punched cards.

Keytape increases data preparation productivity by an average of 35%. And with your input data on tape, you can feed your computer up to 1,000% faster.

Plus.

You can store more data on one standard Keytape reel than in 40 boxes of punched cards. And, of course, you can use tape over and over again.

The Keytape operation is quiet, and the units are easy to learn and to use. So you end up with happier operators and less turnover.

On top of that, you even end up spending less money.

So if you've got a tape computer to feed, stop feeding it holes. Feed it tape. With Keytape.

The Other Computer Company: Honeywell

DATAMATION

march 1968

volume 14 number 3

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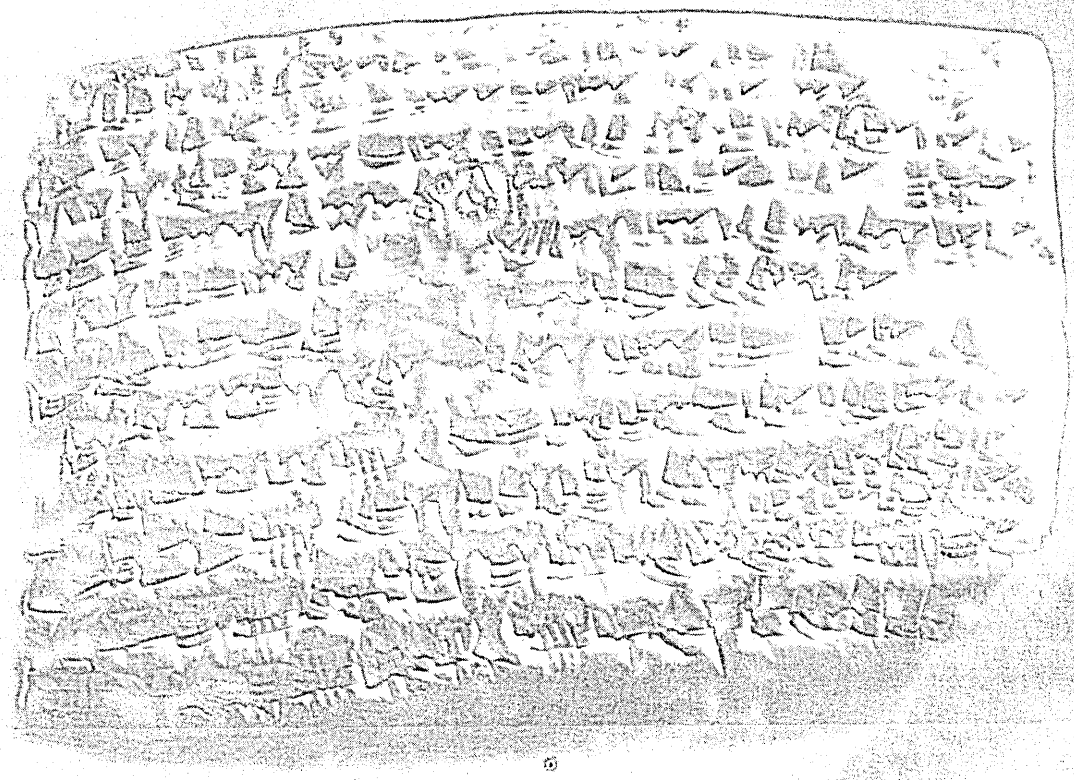
This issue 72,869 copies

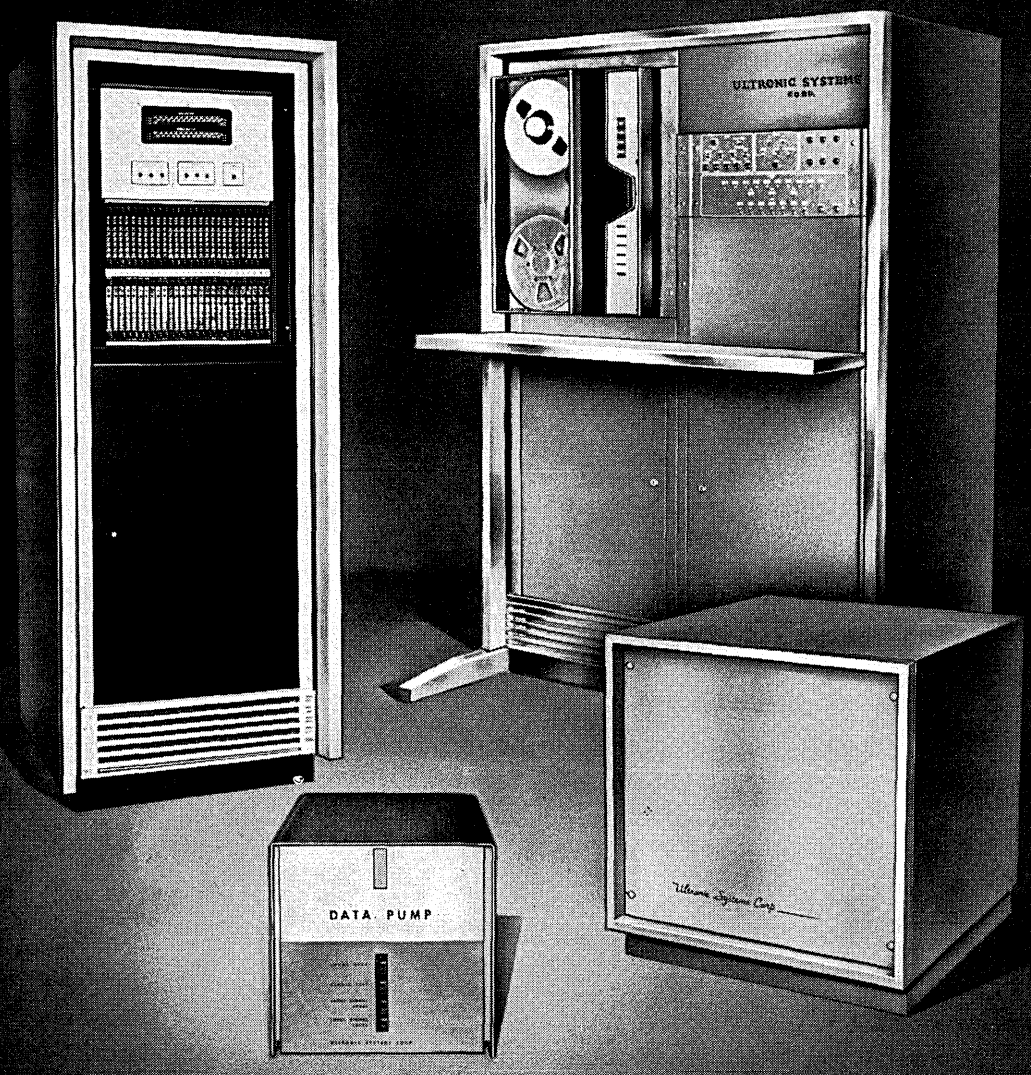
Babylonian tablet recording the sale of a female slave named Ilkanu 4000 years ago. Courtesy of Lowie Museum of Anthropology, University of California at Berkeley



In ancient Babylonian times, important transactions were laboriously recorded on clay cuneiform tablets. Today, up to 14.5 million bits of data can be recorded and retrieved on a 14 inch CM VI magnetic disk pack. Using IBM 360 or compatible equipment, access time is in the 75-85 millisecond range. □ Caelus CM VI surfaces are up to 50% smoother than comparable packs, and infinitely more efficient than clay tablets. Write for technical details. Caelus Memories, Inc., 967 Mabury Rd, San Jose, Calif. 95133

CIRCLE 7 ON READER CARD

Are operating costs choking your Data Communications System?



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If you're looking for solutions to the spiralling costs of data communications . . . *here's how!*

CUT YOUR TTY LINE CHARGES! Reader Service No. 50
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DATA COMMUNICATIONS SYSTEMS • SYSTEM MODULES • KEYBOARDS

DATAMATION 68®

march
1968

volume 14 number 3

automatic
information
processing
for business
industry & science

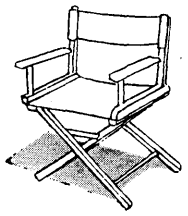
datamation departments

if you think the story is spectacular wait till you see the picture

As the complexity of CRT displays increases, and as the need for user manipulation of the picture increases, it is more and more the case that the central computer cannot provide the required on-line processing — or that communication lines cannot handle the high throughput rates. The graphics I/O terminal itself must include the necessary display-processing capabilities. That's why every Adage Graphics Terminal has its own Ambilog 200 computer with special arrays for high speed coordinate transformation.

Hybrid techniques exclusive with Adage provide extraordinary image-processing power and make possible dynamic 3-D displays which move with full six degrees of freedom. Objects containing over 5000 lines can be presented without flicker even with frame-to-frame dynamic changes. And pictures are always bright and clear, thanks to scope-driving circuitry that's way ahead of its time.

Starting with the AGT/10 at $60,000, standard models are available with either 2-D or 3-D capability, perspective generation, three-dimensional windowing, and intensity-modulated depth cueing. Options include dataphone interface, joystick control, analog tablet input, hardware character generation, and photographic hard-copy output. Complete systems software is provided with every terminal for local image control, for console I/O, and for communicating with the central facility.



Now that you've read the story, don't miss the picture. A free 16mm demonstration film of the Adage Graphics Terminal in action is yours just by writing on your company letterhead to David Sudkin, Manager of Marketing Services, Adage, Inc., 1079 Commonwealth Avenue, Boston, Mass. 02215

Adage INC

CIRCLE 8 ON READER CARD

calendar

DATE	TITLE	LOCATION	SPONSOR/ CONTACT
April 16-18	2nd Nat'l. Symposium on Law Enforcement Science & Technology	IIT Research Inst. Chicago, Illinois	IITRI, 10 W. 35 St., Chicago 60616
April 17-19	Users Meeting— Burroughs Equipment	Roosevelt Hotel New Orleans, La.	CUBE/John Dorosk, Financial Computer Services, Coronado Tower, El Paso, Texas
April 30- May 2	Spring Joint Computer Conference	Convention Center Atlantic City, N.J.	AFIPS
Apr. 30- May 2*	Annual Convention	Ft. Worth, Texas	Assn. for Educational Data Systems, 1201 Sixteenth St., N.W., Washington, D.C. 20002
May 3-4	5th Annual National Colloquium on Info. Retrieval	Univ. of Pa. Philadelphia 19104	Dr. D. Lefkowitz, Moore School, Univ. of Pa.
May 22-24*	4th Annual Data Processing & Automation Conf.	Sheraton-Chicago Chicago, Illinois	Nat'l. Rural Electric Cooperative Assn.; 2000 Florida Ave., N.W., Washington, D.C. 20009
June 3-5	National Conference	Kingston, Ontario Canada	Computer Society of Canada, Box 445, Kingston, Ontario
June 11-13	Annual Conference	Univ. of Pittsburgh, Pa.	Council of Social Science Data Archives, 605 W. 115th St., New York, N.Y. 10025
June 11-14	Users Meeting— Large Scale IBM Machines	Conrad Hilton Chicago, Illinois	GUIDE International/Jack Eggleston, P.O. Box 1298, Omaha, Neb. 68101
June 12-14	Annual Meeting	Waldorf-Astoria New York, N.Y.	ADAPSO, 420 Lexington Ave., N.Y.C. 10017
June 17-19	Microelectronics Symposium	Sheraton-Jefferson St. Louis, Mo.	IEEE, 345 E. 47 St., New York, N.Y. 10017
June 25-27	2nd Annual Computer Group Conf., Impact of LSI	International Hotel Los Angeles, Calif.	IEEE, Suite 1920, 3600 Wilshire Blvd., Los Angeles 90005
June 25-28	International DP Conf. & Business Exposition	Washington Hilton Washington, D.C.	DPMA, 505 Busse Hwy., Park Ridge, Ill. 60068
June 26-28	9th Annual Joint Automatic Control Conf.	Univ. of Michigan Ann Arbor	IEEE, 345 E. 47 St., New York, N.Y. 10017

*Note change of date from previous Calendar listing.

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lower costs

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milgo

Milgo Electronic Corporation
7620 N. W. 36th Avenue, Miami, Florida 33147
*patent applied for

CIRCLE 10 ON READER CARD

letters

erma history

Sir:

As a footnote to several letters on ERMA, recently published in DATAMATION: ElectroData did the drums and tape drives; Bendix Computer Division did the electronics. SRI assembled and did the final checkout, which was no modest task. Al Zipf, currently the operating vice president of the Bank of America, was their project leader on this truly massive effort.

The original modules, such as a flip-flop, had 6, 7 or 8 tubes mounted on a board about 8 x 16 inches. When you got a cabinet full of them, you really had something. The power supply was in a two-car garage outside of the quonset hut that housed ERMA. One problem was a fire in the power supply that caused a monumental delay in checkout. Other problems that kept everyone happily at work were the selection and matching of tubes, which didn't seem to quite meet their specifications; the read/write heads, which were made by witches under some black art conditions; etc. However, the first ERMA eventually worked, and the big effort was to redesign in solid state and deliver about 30 systems.

Probably the nicest epitaph for ERMA was delivered by Al Zipf when he said "The Bank of America couldn't have grown to its present position without the use of this and subsequent equipment."

V. A. VAN PRAAG
Los Angeles, California

algorithmic anxieties

CORRECTION

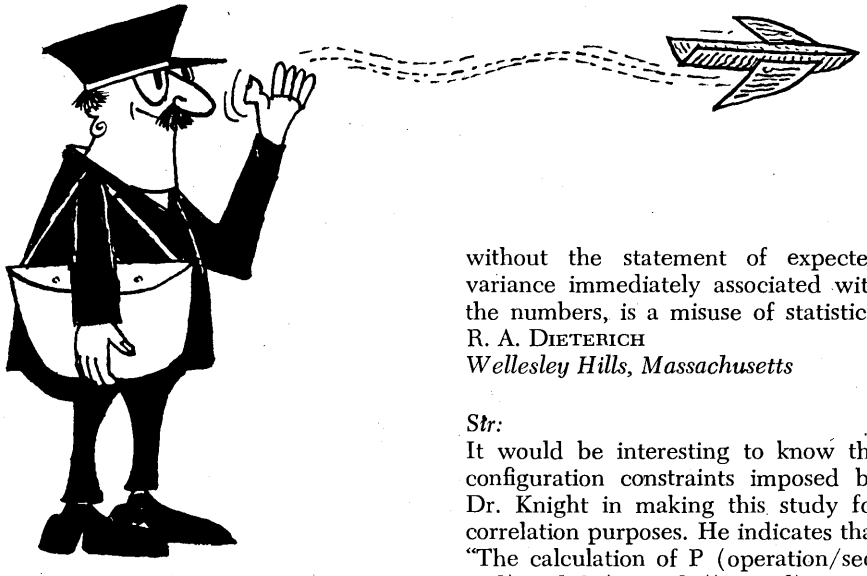
Figs. 1 and 2 in Kenneth E. Knight's January article (p. 31), "Evolving Computer Performance—1963—1967," were inadvertently reversed by DATAMATION. According to Dr. Knight, this reversal accounts for the bulk of comments on his article.

Sir:

Kenneth E. Knight's article "Evolving Computer Performance 1963-1967" (Jan., p. 31), is interesting, not so much for the main thesis it reports, but for the way it can be misinterpreted. The main thesis will surprise or excite no one, but the author's name will certainly be associated with a controversy which he disclaims credit for causing, and that is an art.

The professor has come up with an algorithmic "tale" with which to "wag" the computer industry. He employs a mathematical algorithm to describe various computer components. He then does several things which are valid mathematical techniques and consistent with his stated methods, but which are contrary to common practice in the industry and which are therefore subject to misinterpretation.

Dr. Knight labels the raw data of his study with commonly known computer names. He disclaims that the data should be taken as a description ("measure") of any of the machines, but the labeling is already done. The data does not in fact describe or measure any of the individual computers so labeled, and particularly does not measure them in any sense that anyone else in the industry would readily recognize. The data is concerned only with very limited aspects of components of computers, and only in a hypothetical sense and not in any applied mode. The author also disclaims that these hypothetical constructs can



be compared with each other, but because they are labeled and appear in a table blessed with all the right headings, the author's warnings appear as modest protest after the fact.

The study provides a statistical measure only. The approach taken is defined, although it is necessary to go back to the author's first study two years ago (Sept. 66, p. 40). It concerns computers in general. It is not a study of individual computers. In the study, the groups of computer components, which the author labels with computer names, were modified to fit the needs of his mathematical description.

In that sense, he established rather than "measured" what he calls computing power. In fact, by labeling P as "the computing power of the nth computing system," the author should call into question in the mind of any of his readers the results of his main thesis. The author has in fact not measured individual computer performance, or anything like what anybody else in the industry would recognize as computer performance.

The industry has come to accept that a statement of computer performance must be demonstrable—claims based on purely mathematical definitions are shunned. P, in the study, is a statistical result based on simplifying assumptions which produce extreme variations, i.e., P for any configuration is a number which by itself is good only to plus or minus several hundred per cent. In this sense, the numbers qualify as mathematical points to plot, but not as measures, much less as measures of real equipment. In his first article, the author points out the expected variance. Use of a computer name, though, in connection with the use of the term "computing power," without the statement of expected variance immediately associated with the numbers, is a misuse of statistics.

R. A. DIETERICH
Wellesley Hills, Massachusetts

Str:

It would be interesting to know the configuration constraints imposed by Dr. Knight in making this study for correlation purposes. He indicates that "The calculation of P (operation/second) and C (seconds/$ rental) *are* intended to provide over-all comparisons between machines of various sizes. . . . " (emphasis mine).

Also, the Burroughs B8500 was conspicuous by its absence.

For some, it might be useful to obtain the product of CP; thus arriving at a meaningful (?) OC (operations/$ rental)—mixing apples and oranges perhaps, but an interesting quick comparison.

CARLETON F. MATTHEWS
Los Angeles, California

(Continued on p. 12)

letters

counsel of the years

Sir:

A reminder to be aware of one's fellow man and oneself, especially in this technical age, the Editor's Readout (Jan., p. 21) is also proof, in light of the date (1692), that some things transcend the ages and can be heeded by all.

RICHARD H. FISHER
Oxford, Ohio

culture & technology

Sir:

January Letters (p. 12) contains a very interesting letter from Fred I. White in which he makes the point that in the "interaction of a technology and a culture," the culture is the more determinate factor. He then suggests that the political scientists take a "fresh look" at democracy in light of the possibilities offered by data processing and communications technology.

I would suggest that, like the systems analyst beginning his study of an information system in a business environment, we must ask ourselves not what the equipment can do, but what the objectives are. The new technology is such that we must take a good hard look at our basic social and political objectives rather than letting the technology guide. I hope Mr. White meant to say that, but he ended up suggesting that since we now can envision a ballot box in every home we should have one there. I fear that he has the cart before the horse.

WILLIAM J. A. BONWITT
Sudbury, Massachusetts

hexadecimal happenings

Sir:

Some 10 years ago, when constructing the Numaudo (numbers made audible) system of international spoken mathematics, I met the problem of non-decimal bases (such as sixteen, discussed in "A Hexadecimal Pronunciation Guide", by Robert A. Magnuson, Jan., p. 45) and provided for the principal ones. Numaudo is a syllable-system, founded upon the 900-year success of sol-fa, and looks forward to the requirements that will be imposed by voice-recognition machines.

When Numaudo syllables are spelt out according to international phonetic conventions, a typewriter-compatible code results, called Numalittera. This gives alphabetical representations of all signs in mathematics and symbolic logic—no special characters needed.

IVOR DARREG
Los Angeles, California

Sir:

I enjoyed "A Hexadecimal Pronunciation Guide" immensely. It is one of the best pieces of computer-oriented satire I have ever read; it reminded me of some of the early Granholm parodies. Like all good satire, this piece is deceptively close to the real thing. I wonder how many of your readers have taken it seriously.

T. A. DOLOTTA
Princeton, New Jersey

Sir:

In the ALWAC computer, which was using hexadecimal 14 years ago, we got around the problem of confusing 1A with "ay-teen" and A4 with "ayty-four" by calling them "one ay" and "ay four."

Mr. Magnuson says that one of the

chief problems is "the conflicting mental associations of the six letters in their dual roles." But then he gives two tables that are sure to bemuse the audially attentive key-puncher. The first table is

2F	twenty-frost
F2	frosty-two
5B	fifty-bet
3E	thirty-ernest
AF	annty-frost

in which it is cold all right—twenty—above, or below, doesn't matter much, but this frost-bitten bookie seems to have rounded up only thirty dollars of the fifty bucks that was bet, while the old lady stands around in the cold. In the second table

A01C	annty christeen
1EDO	ernesteen dotty
A007	annty-oh-seven
DEAF	dotty-ernest annty-frost
3A7D	thirty-ann seventy-dot
47FO	forty-seven frosty

the questions come thick and fast. Does christeen have the charm of Mame, or does the comment on poor ernesteen go for christeen too? Is annty oh-seven an agent? Isn't her al-

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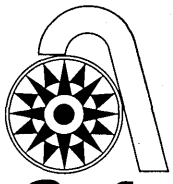

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CIRCLE 12 ON READER CARD

letters

phanumeric designation the definite clue? Is dotty ernest or is it ernest that's dotty? Annty's cool reception figures in either case. Was 47 really that cold?—certainly nowhere near. 88 (not to be confused with AA in the old system).

Somehow I doubt, too, whether the fact that ann is 10 and bet is 11 will help the average programmer or keypuncher one bit, so long as ann's and

bet's elders have plainly strayed from the pages of Lady Windermere's Fan, Private Lives, and the works of the late Damon Runyon.

ARTHUR DOWLING
Manhattan Beach, California

Sir:

While we're at it let's also rename zero. Suggestion: Ovaltine.

T. TODD BROWN
Ames, Iowa

texts for the blind

Sir:

Having a blind programmer at our installation, we are interested in communicating with other installations who have texts on IBM/360 languages, processors, etc. available either in braille or tape recordings.

DR. E. A. RACICOT
Manager—Information Systems
Litton Industries
25 Cityview Drive
Rexdale, Ontario, Canada

DATAMATION welcomes correspondence about the computer industry and its effects on society, as well as comments on the contents of this publication. Letters should be typed, double-spaced, and brief. Only those reaching the editors by the 5th can be considered for the next month's issue. We reserve the right to edit or select excerpts from letters submitted to us.

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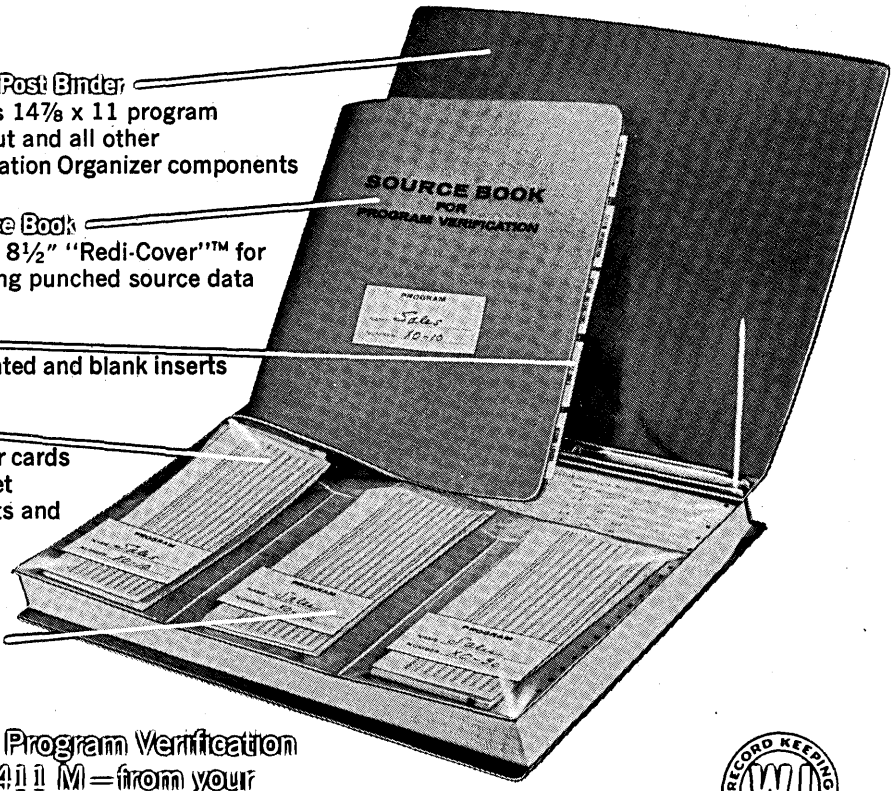

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CIRCLE 14 ON READER CARD

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Your local Burroughs representative will be happy to introduce you. Burroughs Corporation, Detroit, Michigan 48232.

Burroughs

look ahead

LEASING FIRMS LINK TO LOBBY, LAMBASTE IBM

Seven major leasing firms have formed an association; their first activity: a visit with the AntiTrust boys. While the topic was not disclosed, the division is reportedly pleased by the united action of these firms. And unity is what seems to be called for, since IBM has pulled out the stopper by declaring third-party lessors to be competitors as well as customers--only the latest in a series of policy changes affecting the leasing market.

New marketing strategies include sales policies which discourage a salesman from bringing in a lessor to clinch a deal or from losing an installed rental to these firms (he loses his commission). And there's a bigger purchase/rental ratio on '68 products than on earlier 360 models.

For instance, based on prices for cpu and 16K-byte memory only, arithmetic says the new 25 has a 64:1 ratio, while the 30 is 48:1. Based on cpu and 500-byte memory prices, the 65 has a 41:1 ratio; the new 85 is 50:1. These new improved systems and the promises of more may also discourage those with older 360's from being locked into third-party lease.

Other changes have included a mid-1966 switch on installment buying from 10% down and 60 months to pay to at least 25% down and up to 48 months to pay. These factors, plus unfounded rumors of longer-term IBM leases (generated by an investment firm), have hurt many leasing firms on the fickle stock market, which went wild when lessors had little money and income.

BEMA FINALLY GETS TO HEARING ON TIME

After a couple of delays, BEMA has filed its brief with the FCC on the inquiry into computer/communications industries interdependence (Docket #16979).

Aided by a special assessment, by participation of non-members, plus monumental documents from Booz Allen & Hamilton and Horace J. DePodwin Assoc., the report includes a survey of computer installations from 1955 thru '66.

The survey shows a compounded annual growth rate of installations of over 25% per year: from some 430 in '55 to over 35,000 by end '66. More germane to the inquiry is the growth of communications-connected installations, up from .5% to 7% in the same period.

CONTROL DATA READIES NEWEST CRAY CREATION

Look for the prototype of CDC's new supercomputer, the 7600, to be completed this summer. Announcement of the machine, privately previewed by 6600 users last fall, will probably be in the fall.

A bigger, faster (four times) 6600, with essentially the same design, the 7600 features discrete components (designer Seymour Cray evidently feels the world isn't ready yet for integrated

circuits), a 60-bit word, and 64K words of 275 nsec core memory. A built-in extended core (500K) runs a bit below 1.5 usec, but accesses eight words at a crack. Add and multiply are much faster than on the 6600, thanks to the fact that an instruction can be inaugurated every 27.5 nsec...1/10 of a cpu major cycle.

Cpu price will probably be around $5 million, which puts it in the class of the 360/95. But one observer feels the giant will be twice as fast as the /95.

Software--so far a Fortran compiler and a time-sharing operating system hopefully compatible with the 6600's--is reportedly being developed for CDC by a customer-to-be.

360 TURNS ANOTHER 180 DEGREES

IBM-watchers note the coming of generation 3.5 in the 360 line with the announcement of the 25 and 85. One user notes these two models are more alike than the 75 and 85. Both make more significant use of hierarchies of memory--and hence have a greater speed potential--than the rest of the line. And the writeable control store unique to these machines provides more emulation flexibility than the "hard-wire" read-only memory on the rest. The next edition using more of these same features should be model 58.

Meanwhile, some users of behemoth systems for massive problem-solving are unhappy with the price of the 85; it's the standard squared increase (roughly four times the speed of the 65 for twice the price). One 6600 user says he would have needed at least 10 times the speed for the money to induce switch. "We really need 500 times the speed, but could never afford to pay 22 times the monthly rental."

Some observers feel the lack of detailed specs for the 85, plus long lead-time (3rd quarter '69) indicates a replay of the IBM anti-6600 strategy, with the target this time the 1108, perhaps.

LITTLE TEN DOES IT IN NINE

Formed last July, Decade Computer Corp. Feb., p. 78) is so far on schedule in production within the first nine months of its new machine: a 16-bitter in the $20K price class. It will use monolithic i.c.'s, a one-usec memory currently running at 800 nsec, will operate in binary or decimal mode.

Software will include a Fortran compiler and interpreter for general engineering use...assembler and special program packages for vertical application markets. First target: CPA firms around L.A., Chicago and New York, where sales offices are being established. The CPA-oriented machines will stress paper tape, a byproduct of accounting work.

Some 30 people strong right now, the southern California firm will probably announce the new machine in May, will later tackle the systems market.

MUSICAL CHAIRS AT CAI

A severe case of revolving executive chairs has afflicted Computer Applications Inc. in the last few months. Charles Cooper, a CAI founder handling both NE region and NY duties, gave over NY office management to Dan MacLoon, who soon left to become president of Con-Data. Sol Seltzer replaced him, then left to help form new firm Bradford Computer & Systems, Inc.--along with Howard Waltman, who was

(Continued on page 149)

Sigma 7 does everything a 360/50 does. At a fraction of the cost.

Sigma 7 is a little cheaper than the 360/50 and a good deal faster. The combination gives Sigma a 25 to 65 percent edge in cost/performance.

To illustrate the point we took three program segments as examples and compared their execution times on both machines. Then we figured out the cost per million executions.

The first example was a matrix multiplication routine. That one was easy for us. It's just the sort of scientific computation that Sigma is built for. We did the job at about one third the cost. ($286.80 vs. $850.81)

Next we took a floating square root program. Also scientific, but less dependent on arithmetic capability. It was pretty easy for both machines. Still, we came in 30% under. ($7.11 vs. $10.44)

Finally we compared a field scan routine. Since that's a more or less typical data processing application, it frankly had us scared. That's supposed to be what the 360/50 is good at. But we needn't have worried. We did the job for less than 75% of their cost. ($68.36 vs. $95.64)

The three examples came out of a published study. We computed the cost figures ourselves because the published ones gave us the best of it. Any of our salesmen will be happy to go into the details. Or, we'll send you our complete figures and references in return for your name, address and a good reason for your curiosity.

But you must realize that in the final analysis the two machines aren't entirely comparable. Sigma 7 has time-sharing capability built-in. The 360/50 doesn't.

So before you buy your next 360/50 think twice. You may be getting only half as much for your money.

SDS

Scientific Data Systems, Santa Monica, California

CIRCLE 17 ON READER CARD

editor's readout

THE FACTS OF LIFE

Let's start by insulting your intelligence.

With the repetition of a couple of hoary truisms about our industry. To wit: the industry is still in its infancy. And: the industry is mushrooming like bamboo, if you'll pardon the mixed metaphor/simile.

So what? (That's you talking.)

So this. (That's us now.) Our youthfulness means, for one thing, that we still lack a sound theoretical base for our work. Which means it's hard to transfer learning from one particular experience to another. Which means in turn that it's extremely difficult to select, train and develop good edp systems people, programmers and analysts especially.

And it means that we lack perspective. As Ascher Opler pointed out last September (p. 31), we expect too much of our own efforts: we overestimate our goals and our abilities to achieve them, then underestimate the job to be done. We both over- and underestimate the people we call upon to implement our grand designs.

Our frantic, hasty growth has made us hire people with one year of experience seven times, has fostered a me-too philosophy which is leading inexorably toward an umpteen-billion byte machine in Great Bend, Kansas, to which every cash register, stethoscope, and telephone and IRS agent in the nation will be attached.

Our immaturity has inspired the borrowing of antediluvian management practices . . . which we apply to a new discipline which is supposed to revolutionize those same practices. We accept medieval management mandates which say it's better to hire five $12K Mickey Mouse programmers than three Captain Midnights who might make $20K. Meanwhile we refuse to impose any discipline upon our own efforts: we lack metrics for the productivity and effectiveness of our systems and our people; we pay lip service to documentation, then gnash our teeth at conversion costs and snarls.

So what do we do about it? (That's both of us talking.)

The theoretical base—remember that it's missing.

Our attitudes—let's not expect so much of our systems; remember that we're attempting giant-size feats with plain old puny people. How about a realistic attempt at organizing our activities to allow us to begin to collect *some* of the data which can lead *eventually* to establishment of sensible norms and performance goals?

But don't be cowed by science: let's not be afraid to hire someone because we feel he has what it takes . . . or fire someone because he doesn't. Let's remember that it's irrational to expect people to be rational.

And let's try to find the time to educate top management on the facts of life in our crazy world, so that they too can learn to assess our efforts more realistically.

methods and problems

INFORMATION RETRIEVAL: AN INTRODUCTION

by ROBERT M. HAYES

This issue of Datamation brings together a group of articles, each concerned with one aspect or another of what has become an increasingly important type of computer application—*information retrieval*. This "introduction" has been written to provide a context and general framework within which to view them.

The computer was originally designed for application to scientific computation and later rapidly found application in business data processing. At an early time, however, other applications were foreseen. In 1947 Vannevar Bush wrote "As We May Think" in which he delineated the capabilities of *Memex*—the computer, but used for tasks such as information retrieval and language translation. Since then, such applications have become increasingly important, and the term "information retrieval" has become a broad one, covering the problems in management information systems, command and control, urban data banks, and dissemination of scientific information.

Information retrieval is certainly not a new concept: it is an integral part of the communication process. Knowledge has been recorded throughout the ages, and techniques and methods for storing and retrieving it have long been available. Yet, during the last several years, the size of some information retrieval tasks has become greater than previous techniques could handle. Equally important, the tools for new techniques seem to be available in modern data processing equipment. The purpose of modern "information retrieval" is to use computers, photographic processes, and techniques of magnetic recording, as they have developed over the past 20 years, to provide a capability for solution of these problems comparable to that given the scientist in the solution of his computing problems and the businessman in the solution of his data processing problems.

Information retrieval tasks where these new techniques seem necessary have been characterized by the feature of extremely rapid growth. It has been pointed out that information today is produced and disseminated in such vast quantities that human effort may be wasted over and over again, simply because it is not possible to determine what work has already been done. On the other hand, mere volume alone would not, in itself, be sufficient to warrant new approaches. Even more important is the fact that particular pieces of information are generated in the confines of more and more limited areas of specialization, combined with the high probability that eventually the same information will have utility in other areas of specialization. The growth of specialization is a well-recognized phenomenon which is probably an essential part of the solution of complex decision making problems. Yet the effects of specialization are to create specialized terminology and jargon, to limit the area of direct communication, and to make accessibility outside the specialized field increasingly difficult. Although data in one area may well contain information relevant to a decision in some very different area, the specialization of both the subject field and the language raises almost insurmountable barriers against recognition of this relevancy.

Illustrations of these problems in science and technology are near at hand. The exponential growth of the scientific publishing rate has already been pointed out many times. The specialization of scientific disciplines is well recognized. The multiple application of information is evident in the growth of inter-disciplinary fields such as biochemistry or mathematical psychology.

It must also be emphasized that these problems are equally apparent in business and government. The flood of paper work in modern industrial and governmental organizations is well recognized, and both specialization and multiple usage of information are also very evident in business and government. Thus, although most of the ra-

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tionale for work in the field of information retrieval has been based on the needs of science and technology, these other areas partake of the same characteristics and will benefit in much the same way.

The term "information retrieval" has become so broad that it is useful to classify the several different kinds of systems into three groups: data base systems, reference systems, and text processing systems.

Data Base Systems. The most widespread information retrieval systems are those for *data base file management,* which process records organized into fields, each containing a type of data in the record. These can be schematically represented:

	Field[1]	Field[2]	.....	Field[n]
Record	Data[1]	Data[2]	.....	Data[n]
Example of record for a person	Name	Social Security	.....	Birth Date
	J. Smith	123-45-6789	.....	12-03-26

A set of these records is arranged in order by a specified field (e.g., chronologically by birth date) and is called a *file.*

In recent years, there have appeared a number of "generalized file management programs." Table 1 presents a list of some of the generalized programs now operating or under development. (Descriptions of some of these programs appeared in the January 1968 issue of DATAMATION.) These provide capability for adding records to such files and changing the contents of specific fields of existing records. In this respect they are like typical data processing systems. Of more importance for purposes of subsequent information retrieval, they also provide capability for searching files in answer to requests phrased as *Boolean combinations* (using logical *and, or,* and *not*) of specified values in specified fields. One such request might be: "Find all records with A in Field 1 *and* B in Field 2 *or* with C in Field 1 *and* D in Field 3."

An example of a data base system occurs in business data processing, in which day-to-day clerical operations

GENERALIZED
FILE MANAGEMENT PROGRAMS

Program Name	Organization
GIS (Generalized Information System)	International Business Machines
INFOL	Control Data Corporation
TDMS	System Development Corporation
DM/1	Auerbach Corporation
Mark IV	Informatics, Inc.
CFSS (Combined File Search System)	Service Bureau Corporation
FFS (Formatted File System)	International Business Machines
ICS (Information Control System)	North American Rockwell

Table 1

generate large quantities of data. *Management information systems* are used to identify these data, store them, and retrieve them for further use, particularly decision-making. Another example occurs in cities and states, where *metropolitan data banks* are used to acquire data from the normal operations of government agencies, store and retrieve them, and analyze them using models of urban development. Table 2 presents a list of some existing efforts to create such data banks. Other examples are the hospitals and medical centers (among them Massachusetts General Hospital and the Veterans Administration) developing consolidated *medical records systems.* The data come from administrative forms (entry records, test results, prescriptions, etc.), from on-line monitoring of patients, and from direct input by doctors and nurses. They are used to aid in diagnosis, in care of critically ill patients, in research, and in hospital administration. Perhaps the most advanced examples are the systems for *command and control,* used to support military operations. The SAGE system, for example, monitors signals from radar and telemetry, correlates them with previous data, stores the results, retrieves and displays them when needed for evaluation by analysts, and transmits decisions to command posts for continental defense.

Reference Systems. Data base systems handle highly formalized descriptions in formatted records of defined field structure. The descriptions of many things—photographs, engineering drawings, subject content of books, etc.—require much more complex data structures. Information retrieval systems to process them can be called *reference systems,* since they are used to store and retrieve references to material rather than the content of it. Usually, the records include subject terms, as part of the description, which represent the content and provide criteria for selection. Such data are more difficult to search than those dealt with by file management systems, because of the complex relationships among subjects. Reference systems therefore must include the ability to handle *thesauri,* describing the structure of the vocabulary of subject terms and indicating for each subject term other terms which are more general, more specific, similar or synonymous, etc. Usually, the files in reference systems become so large that only a portion of the records can be examined for a request. Subfiles and indexes to them are established (at the extreme, one for each subject), so that only the references on a specific subject need be evaluated by the computer.

City or State	Purpose
Alexandria, Virginia	Administrative
Boston, Massachusetts	Planning
Chicago, Illinois	Land Use and Transportation
Denver, Colorado	Land Use
Detroit, Michigan	Social Welfare
El Paso, Texas	Land Use
Fort Worth, Texas	Business Development
Little Rock, Arkansas	School Planning
Los Angeles, California	Administrative
Louisville, Kentucky	Transportation and Land Use
Oakland, California	Police Files
Pittsburgh, Pennsylvania	Land Use, Economic Devel.
Portland, Oregon	Renewal
Rochester, New York	Land Use
San Francisco, California	Renewal
Santa Clara, California	Land Use
Tulsa, Oklahoma	Renewal
Wichita, Kansas	Capital Improvement
State of California	Administrative
State of Hawaii	Transportation and Land Use
State of Michigan	Economic
State of New York	Administrative

Table 2

The earliest reference retrieval systems were for scientific and technical information, particularly in support of projects in federal agencies. Computer produced indexes are published by a number of technical information centers, the largest being TAB by the Department of Defense Documentation Center, STAR by NASA, and *Nuclear Science Abstracts* by the AEC. In each case, the data base is available for reference retrieval services to qualified requestors. A Clearinghouse for Federal Scientific and Technical Information was established in the Department of Commerce to provide comparable indexes and reference retrieval services for the general public.

The same technique is used by libraries as a supplement to traditional cataloging. As libraries mechanize clerical processes—circulation control, ordering of books and journals, printing of catalogs and indexes, etc.—data bases have become available for reference search as well. The National Library of Medicine publishes *Index Medicus,* its monthly index to journal articles in medicine, using a computer. The magnetic tapes are then used, in a reference system called Medlars. The Library of Congress is now beginning to produce and distribute magnetic tape records of cataloging data for books they acquire. Scientific and professional societies and abstracting services, including *Chemical Abstracts* and *Biological Abstracts,* plan to use computers in publication, and tapes will be made available for reference searching. Table 3 presents a representative list of reference systems.

Reference systems frequently function as part of *document retrieval systems* which deliver the reports themselves. The output of the reference system indicates where the material can be found and made available to the

Organization	Use of Reference System
American Bibliographical Center	To Produce Index for Hist. Abstracts
American Petroleum Institute—Division of Refining	To Provide a Central Abstracting and Indexing Service
American Society for Metals	To Provide a Documentation Service
Applied Mechanics Review	To Produce Word and Author Indexes
Atomic Energy Commission	To Produce Nuclear Sciences Abstracts
BioScience Information Service	To Produce Biological Abstracts
R. R. Bowker Company	To Produce Pub. Weekly, BPR
Chemical Abstracts Service	To Produce Chem Titles, Chemical Biological Activities, Registry System
Clearinghouse for Federal Scientific and Technical Information	To Provide Federal Scientific and Technical Information
Institute for Scientific Information	To Produce Science Citation Index
Library of Congress	To Produce Machine Readable Catalog Data
NASA	To Produce NASA-STAR
National Library of Medicine	To Produce Index Medicus and Medlars
Office of Education	To Support the Educational Research Information Center
Scientific Information Exchange	To Provide Reference to Grant Supported Research Projects

Table 3

requestor. Historically, most document retrieval systems have stored the reports on printed pages. Over the last several years, however, the physical size of many document retrieval files has become so great that storage in microimage has become increasingly important. The variety of such storage systems is illustrated by the list in Table 4—a list which by no means exhausts the choices available. It includes microphotographic forms such as film reels, film cartridges, film cards (called *microfiche*), film strips, and even film plates as well as combinations of films with other forms of data storage. But it also includes microimage storage in magnetic analog form (the various video files).

Most recently consideration has been given to the storage of the full text of reports in magnetic digital form, since publishing by computer is becoming so widespread as to guarantee the availability of text in that form.

Microimage Form	Characteristics
Film Reels	Of varying length, width typically 35 mm, with images stored at a reduction of 20 x 1.
Film Cartridges	Usually 35 mm wide and 100 feet long, storing 2000 images of pages at 20 x 1 reduction.
Microcards	Cards, usually 3" x 5", containing up to 70 opaque positive images of book pages at 20 x 1 reduction.
Microfiche	Transparent cards, usually 4" x 6", containing up to 60 or more images of pages at 20 x 1 reduction.
Aperture Cards	Paper cards, usually punched card stock, with one or more holes cut in them, each containing a frame of 35 mm film with an image of a document or drawing, typically at 20 x 1 reduction.
Video-image Files	Magnetic tape video recordings of document pages, usually accompanied by digital identifying data.

Table 4

(Extracted from "Literary Works in Machine Readable Form," Dr. Gary Carlson, Brigham Young University, July, 1965)

Machine Readable Text	Organization
Journal of Chemical Documentation	American Chemical Society
Beowulf	IBM Research Labs
The Bible	University of Pittsburgh
Dictionaries (Various)	Lockheed Missile & Space Co.
Golden Book Encyclopedia	System Development Corporation
Encyclopedia of Science & Technology	McGraw-Hill
Webster's Medical Dictionary	RCA

Table 5

Program Name	Author and Date		Source
"ORACLE"	Phillips	1960	
"IDL"	Sable	1962	Communications of the Association for Computing Machinery
"Automatic Language Analyzer"	Householder	1962	
"Synthex"	Simmons	1963	American Documentation
"BASEBALL"	Green, Clonsky	1963	
"Protosynthex"	Simmons	1963	
"SADSAM"	Lindsay	1963	
"Fact Retrieval"	Cooper	1964	Journal of the Association for Computing Machinery
"SMART"	Salton	1964	
"STUDENT"	Bobrow	1964	American Documentation
"SIR"	Raphael	1964	
"DEACON"	Thompson	1964	
"PLM"	Kirsch, et al.	1964	
"SQA"	Black	1964	

Table 6

Text Processing Systems. In computer based publication, text is recorded in machine language, and the programs then establish page format, hyphenate, and control devices for photo-composition which then produce offset masters ready for printing. Table 5 lists a variety of existing text data bases.

From the standpoint of information retrieval the advantage of full text in magnetic tape form lies in the potential of language data processing. An almost classical example is the preparation of a concordance—an alphabetic list of significant words from a text, showing the context within which each appears. This technique has been used in reference systems to produce indexes for articles from keywords appearing in titles, and for books from their content. Computation of the statistics of text—word frequencies, lengths, distributions, associations, etc.—has linguistic in-

terest, to aid the analysis of written language. It also has application in reference systems. H. P. Luhn suggested that the relative frequency of occurrence of words in a text was a criterion by which the computer could select subject terms to be assigned to the text.

Deeper analysis of text requires an ability to handle syntax and semantics. Several approaches have been tried by which the computer might be programmed to derive the syntactic structure of a sentence from the syntactic classes of the words in it (as specified in a dictionary). For example, one approach, called *immediate constituent analysis*, considers simply the sequence of the words in the sentence. From them, possible sequences of syntactic classes can then be derived, and one of them hopefully will be the only acceptable sequence. Another approach is *phrase structure analysis* which, like traditional parsing, treats sentences as combinations of basic phrases (the "noun phrase" and the "verb phrase," for example). The most complex approach is *transformation theory* which treats sentences as variations of certain basic sentence structures. (For example, "The ball was hit by John." and "Did John hit the ball?" are both clearly describable as fairly simple variations of "John hit the ball.")

These kinds of text processing techniques have particular value in humanistic scholarship. Analyses of word frequency and of sentence structure have been used for analysis of style, since they reflect patterns of word usage. Concordances and mechanical "collations" of text have been used to aid textual criticism.

One of the major frontiers in information retrieval research is the use of text processing and logical analysis to find answers to questions by analysis of the implications derivable from statements made in the text. A number of experimental *question-answering* systems, listed in Table 6, have been used to demonstrate such capabilities and to explore the technical problems involved.

characteristic problems in information retrieval

In the development of each of these systems for application to information retrieval, several problems arise which are significantly different and more complicated than those in the more traditional computational and business data processing tasks. Roughly, these can be categorized into four classes of problems: utility, communication, pattern matching, and file organization.

The first, and most difficult to handle, are those problems relating to the utility of these systems. Their function is to collect and save data, which has been produced for some defined purpose, to serve later uses for other, usually unpredictable purposes. Thus, business data arising from accounting functions is saved for subsequent management decision making; scientific articles printed for a particular audience of readers are stored and referenced for the use of other audiences; etc. But, whereas the original recording of the data may have had clearly defined value, related to the purpose of its generation, the utility for other, unknown uses is not at all clear. Furthermore, the costs of acquiring data in the first place usually represent the major cost consideration. Since this is a "capital investment," it must be amortized, in some sense, over these future, unknown uses made of it. As a result, the costs of an information retrieval system are difficult to justify. Furthermore, inherent in its operation is a high degree of *uncertainty*, not only with respect to the uses to which the data will be put but even to the reliability of the data itself. In fact, a primary problem lies in determining what data will be acquired by an information retrieval system.

The second set of problems—communication—arises because the stored data must be selected so as to describe things external to the system in a form adequate for those later, uncertain uses. The description of people, signals, or ideas is not simple, since it is never clear what data will be needed nor is it clear how the data should be represented. The same issue arises in the translation of requests into a form in which they can be handled. In data base systems, this may mean simply the use of code books; in reference systems, it usually requires the creation of dictionaries and thesauri which, as described earlier, show the relationship among terms; in text processing systems, the internal logic for communication becomes extremely complex, to the point that some investigators have claimed it exceeds present day knowledge of language structure and the capacity of existing computers.

The third set of problems—pattern matching—arises because the purpose of retrieval is the selection of "relevant" data from the file, but the meaning of relevancy is so ill-defined that it is usually not clear how it should be measured. Furthermore, the uncertainty, or even actual error, in the description of both stored data and requests is so great that it is not clear that precise measures of relevancy are really meaningful. Usually, it is necessary to provide a succession of measures of match, the ultimate one being the judgment of the user. Each serves as a screen to limit the number of records to be examined, in more detail, by later screens. These increase the likelihood of missing desired items which may be rejected by one screen even though they would be accepted by a later, more sophisticated screen. Again, the difficulties created by the quality of the original descriptions becomes important; since not all descriptive data can or will be included and significant relationships among descriptive terms may be missed. The combination of communication problems with pattern matching problems has led most of the people developing information retrieval systems to the belief that man-machine interaction is a necessity. As a result, much attention has been paid to the use of "on-line" computing techniques.

The fourth set of problems—file organization—arises because in each of the important applications the size of the file becomes so great that it is impossible, or at least uneconomic, to scan every item in it. For example, whereas a large matrix, such as would arise in solution of a partial differential equation, might require at most 10^7 or 10^8 characters of storage or a very large inventory control file might require 10^8 to 10^9 characters of storage, the catalog of even an average university library requires 10^9 to 10^{10} characters. For large information retrieval problems the size of the file can be as large as 10^{11} to 10^{12} characters.

With such large files, it is necessary to structure them, to store them in different levels of memory, to provide indexing mechanisms, to use the succession of screens as means for reducing the number of records which need be examined in detail. It is this fourth set of problems which really constitutes the ultimate technical issue, since it is here that the size of file, the required response time, the available equipment, the degree of selectivity, and the accuracy of response all interact.

summary

In summary, information retrieval has become an area of widespread interest and application for the computer. Although a variety of types of systems can be identified, they all partake, to one degree or another, of certain fundamental problems—uncertain use of uncertain data, immense files, complex data structures, and marginal economic utility. But, in application after application, the problems have been solved and useful operating systems have been created. ■

SURVEY OF IS&R EQUIPMENT

by LAWRENCE H. BERUL

In the past year or two, there has been an important shift in the system approach taken to solve the problem of storing, retrieving, and distributing large amounts of semi-permanent reference information—an operation that is commonly referred to as IS&R or "information storage and retrieval." Until then, two approaches were prevalent.

One approach involved expensive special-purpose microfilm equipment, such as MINICARD, WALNUT, FILE SEARCH, CRIS and others, which typically automated only one or two functions such as the search function or the document retrieval (or fetching) function. The other approach, which has been widely written about, but achieved only to a limited degree in experimental settings, involved attempts to automate the entire IS&R process, including the indexing, abstracting and vocabulary control processes.

Both approaches fell short of producing a practical, effective solution to the problem. The computer-oriented approach ran into a few gaps in methodology and technology, such as the difficulties of automatic indexing and abstracting, the high cost of computer processing and storage, and the inadequacy of man-machine communication facilities. The result was a drastic scaling down of the computer's role to the point where most of the IS&R functions still had to be performed manually.

The microfilm approach dealt with too small a part of the over-all problem, and provided too few benefits, to justify a not unusual price tag of $200,000 or more.

With the two main system approaches bogged down in the mire of real-world practicalities, little progress was made toward fashioning a solution to the IS&R problem that was applicable across the entire application spectrum. The applicability of computers was limited to a relatively few, very large-scale systems, and the automated microfilm systems could be justified in only a handful of special situations. This condition continued until the introduction of the third generation of computer equipment, which provided a basis for a compromise between the two approaches.

The new computers provide a broad enough range of capability at a low enough price to justify their application across a much broader range of IS&R functions than ever before, and, in combination with microfilm and various types of special-purpose equipment, make it possible to automate IS&R operations sufficiently to produce a marked improvement in IS&R systems of almost every type and size.

mixed bag of requirements

One of the primary reasons there has been so much difficulty solving the IS&R problem is that IS&R applications are extremely diversified. They generally consist of six basic functions, whose difficulty of execution and relative importance vary according to the type of reference material being managed: data, documents, or graphic—exclusively, or in combination. Also variable from one application to another is the economics of automation which depends not only upon the type of material being managed but also upon the volume and the intended use.

The first basic IS&R function is input. This involves checking the material to make sure it doesn't duplicate something already in the collection, cataloging it, and creating some sort of bibliographic description of it, such as a citation, an abstract, and/or a series of index terms. In a data system, this function amounts to little more than what would normally be done in creating a data record. However, it is a major function in a system handling documents, which can be identified in an almost infinite number of ways. Each document must be descriptively cataloged in terms of the title, author, source, date, and any other information that is useful in identifying the over-all document. In addition, a more detailed description of the various types of information contained in the document must be generated in the form of an abstract and a series of index terms. This is typically considered to be an intellectual function.

The second function is storage. In systems handling pure data, or even a balanced mix of alphanumeric material, computer-based storage media is a practical option. In systems handling documents or graphic material, something considerably less expensive is needed. The usual

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choice here is microfilm, which offers archival protection and a choice of roll and unit-record formats. Document systems have another storage problem: bibliographic material. Unlike the primary material, the bibliographic descriptions are suitable for storage on computer-based media, and, in fact, the bibliographic files of most large-scale document-handling systems are computer-based for search purposes.

The next function is announcement—notifying the users of the system about new material that is available. In data systems, announcement is simply the compilation of special listings or reports, such as airline guides or recent statistical data. In document systems, a wide variety of announcement media are used for current awareness purposes. These range from Key Word In Context (KWIC) indexes to individually tailored Selective Dissemination of Information (SDI) notices mailed directly to the user. In each case, computers have an important role to play.

A fourth function is search—finding the material pertinent to a user inquiry. This is the area in which computers can make their largest contribution as an IS&R tool. The speed at which they can manipulate data and bibliographic files has radically reduced the time required to search large collections. However, there is another aspect to the search function that has not been susceptible to automation: the intellectual process of formulating productive search questions. This is done by constructing the question around the pertinent terms in the system's authority list. While this is more of a problem in document systems than in existing data systems, it will become a more important consideration in the latter type as the computer-based data stores become larger and more complex in their organization.

Another function is retrieval—physically accessing the material that has been identified by the search as being pertinent to the user inquiry. This is probably the easiest function to perform in both data and document systems. When the collection is computer-based, retrieval, of course, is fully automatic. Retrieval from microfilm-based collections may be either automatic or manual, with little difference in response time. Unit record microfilm packages, such as microfiche, generally have an eye-legible title and address and are filed in tub or motorized elevator files. Given the address of any single unit record, a person can retrieve the record manually within 10 seconds, which is nearly as fast as most of the automatic microfilm systems.

The final function is delivering the material to the user. In most applications, this has been done by mail because of the high cost of any other form of communication.

A review of these functions makes it obvious that the degree of automation that is technologically and economically feasible in an IS&R system varies greatly according to both the types of material being handled and the system requirements posed by the application. It is now generally accepted that it is not practical to replace the man in an IS&R system. Many functions require his intellectual capability and others can be performed cheaper manually than automatically.

Having recognized the impracticability of automating the entire process, and the poor economics of special-purpose systems addressed to a limited function, it is time to identify the role of computers in an IS&R system. There are three basic areas in which computers will have a major role: processing, man-machine interaction, and control over special-purpose peripheral equipment.

The computer clearly has a number of process functions to perform in the storage of bibliographic data, the compilation of indexes and other announcement media, the searching of index files and the printing out of search results. Because of the need for the man in the system, the computer has to provide for a degree of man-machine interaction, not heretofore available.

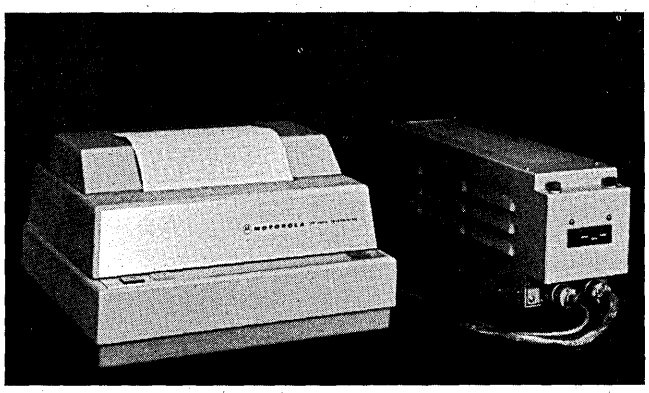
In addition, since there are a wide variety of devices which may be used to automate various aspects of the process, such as typesetting, reproduction, query-response, document fetching, and possibly facsimile transmission, it is desirable to provide some means of computer control over this variety of devices.

The third generation of computers provides sufficient capability to achieve these requirements, i.e., man-machine interaction, routine computer processing and control over a variety of devices.

flexibility, cheaper power

Third-generation computers have brought the cost of processing one million instructions down from $5.00 (on second-generation equipment) to $.15. This, and the development of multiprogramming operating systems, makes it possible to use a single computer for a mix of IS&R functions or to add IS&R functions to the workload of a machine that is devoted to other applications. Either way the cost of having a computer-based IS&R system is greatly reduced.

The availability of larger, cheaper storage, at both the primary and secondary level, has also made a difference. The cost and size of core storage has reached the point where a large operating system for multiprogramming operations can be accommodated without paying a severe penalty in the amount of core left for processing operations. Mass random-access storage devices are now both large enough and inexpensive enough to store large files on-line.



The Motorola TP4000 Teleprinter.

The cumulative effect of these developments is that the computer can now service on-line terminals in real-time while performing other background processing tasks. This makes it economically feasible for the computer to play an auxiliary but important role in a number of IS&R functions in which automation was formerly economically questionable.

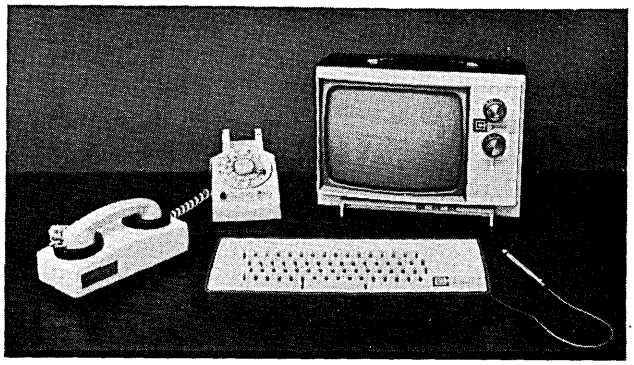
If the characteristics of the application justify it, inputs to a data system can be made directly from on-line terminals. In document systems, the entire cataloging operation can be done on-line. The advantage of this is that the amount of paper-handling involved in the system input process is greatly reduced. Also, the control procedures, which usually involve logging in and out batches of material as they move from one stage to another, is greatly simplified. The computer automatically keeps track of where things are by way of the on-line transactions it handles. In the case of a large system, this reduction in physical handling and simplification of control procedures adds up to a significant improvement in system efficiency.

On-line operation also affects the intellectual functions of indexing and formulating search questions. Both these tasks can be performed faster and more effectively with the aid of a computer-stored thesaurus or some other authority list, portions of which can be displayed upon demand. The search function can be speeded up even more by having the computer tell the searcher how many items in the collection are relevant to his questions and showing him samples that can help him formulate more specific questions.

man-machine interface

Main frame improvements, by themselves, do not completely account for the new air of optimism in the IS&R field. There have also been a number of key improvements in peripheral equipment.

One of them is the availability of display terminals for alphanumeric material that sell for $5-10,000 and rent for as little as $125 a month. These terminals all have a crt display and a cursor and keyboard for inputs and control. They also operate fast enough for such operations as entering and editing bibliographic material, and conducting searches to be carried out in a natural conversational mode with the system. Typical of this type of terminal are the IBM 2260, RCA 70/752, Raytheon DIDS-400, Sanders 720, Bunker Ramo Series 200, CDC 210, GE Datanet-760, and the Stromberg-Carlson SC1100. What these terminals lack is the ability to handle graphic materials and, unless equipped with auxiliary teleprinters, to produce hard-copy outputs.



The CC-30 Display Console Using CRT Receiver.

For applications requiring a modest graphic input-output capability, a relatively low-cost terminal available is one from Computer Communications, Inc., the CC-30. A configuration consisting of a controller, a light pen, a keyboard and a portable television receiver used as the display device, can be assembled for about $8,500. More sophisticated graphic input-output systems cost well upwards of $25,000 and generally require special interface equipment for remote use.

Hard-copy outputs can be provided, where needed, by a variety of devices, ranging in speed from typewriter rates of 10-15 cps up to 60,000 cps. The high-speed end of the range tends to be impractical because broad-band communications lines are needed, and they are very expensive. The low-speed devices have the disadvantage of not making full use of voice-grade communications lines, but this problem can be solved with a local communications controller, where several low-speed typewriter-type terminals are used in combination.

Between these two extremes there are a number of units that operate close to, or at, the speed of 300 cps needed to use the full capacity of the voice-grade lines. Typical of these units is the Motorola TP4000, a desk-top model capable of 120 to 300 cps and selling for something under $10,000. Teletype Corp. recently announced something similar, called the Inktronic KSR, with a speed of 120 cps.

Units of this type are not necessarily supplementary to display terminals. Probably a majority of the IS&R applications don't require display speeds, and in these cases, hard-copy devices with keyboards make a perfectly acceptable and less-expensive on-line terminal.

At the other end of the economic spectrum from on-line display terminals is voice response equipment. The obvious advantage of this equipment is that it converts a $5.50 a month telephone into an on-line terminal. The voice-response unit, of course, is an additional cost of about $500 per month. However, since a single unit can handle anywhere from 4 to 48 lines at one time, depending upon the configuration, the cost per user is quite low.

A number of voice-response units are available. IBM offers the 7770, which has a vocabulary of 128 phrases, and the 7772, which has a recorded vocabulary of 1000 words and can synthesize additional words from stored basic speech units. RCA has a Spectra 70/510 unit, with a maximum of 189 words. Cognitronics has a line of units, called the Speechmaker, which can be interfaced with nearly any computer.

One of the shortcomings of voice response is the limited vocabulary. IBM has solved this problem in its 7772 by storing basic sounds in digital code rather than pre-recording entire words. The sounds can be put together artificially by a synthesizing "vocoder" to form a sizeable variety of words. Another way of increasing vocabulary size is simply to increase the size of the word storage.

Whatever the size of the vocabulary, however, voice response has a place only in the type of data systems that are concerned with providing answers to very specific questions from a highly formatted file. Several applications of this type are using voice-response equipment with good results. Perhaps the best known is the American Stock Exchange system, which uses a Cognitronics Speechmaker to supply stock quotations. Another system is EDICT, which the space and information systems division of North American Rockwell uses to provide the company's engineers with design data. Data from more than 75,000 engineering drawings is available from any of the company's 42,000 telephones via an IBM 7770.

optical character readers

Another important peripheral equipment development, whose impact on the IS&R field is still limited but will increase in time, is optical character readers. OCR equipment falls into two classes. One consists of the readers that can recognize only special fonts, such as the IBM 1428, which reads the 1428 font, and the Farrington Model 3010 Optical Scanner, which reads the Farrington Self-Check and the IBM 1428 fonts, as well as the one developed by the U.S.A. Standards Institute.

The other class of OCR equipment consists of devices able to read a number of standard commercial business-machine fonts. These machines usually cost more than $500,000, which means that the keypunching volume must be quite high to justify their use. Another shortcoming is that the fonts the machine will recognize must be identified in advance.

Typical of these machines is the Electronic Retina Computing Reader, by Recognition Equipment, Inc., which can recognize virtually any fixed-pitch type style, including hand printing. Other machines in this class are the Philco-Ford General-Purpose Print Reader, which can recognize any eight basic typewriter and business-machine fonts plus many variations, and the IBM 1975 Optical Page Reader, which can recognize as many as 200 fonts.

Because of the multiple-font and cost problems, the

application of these machines in IS&R systems is currently limited to the system input of moderately high volumes of typed or hand printed data records. The use of OCR for inputting published literature typeset material will have to wait for more recognition flexibility.

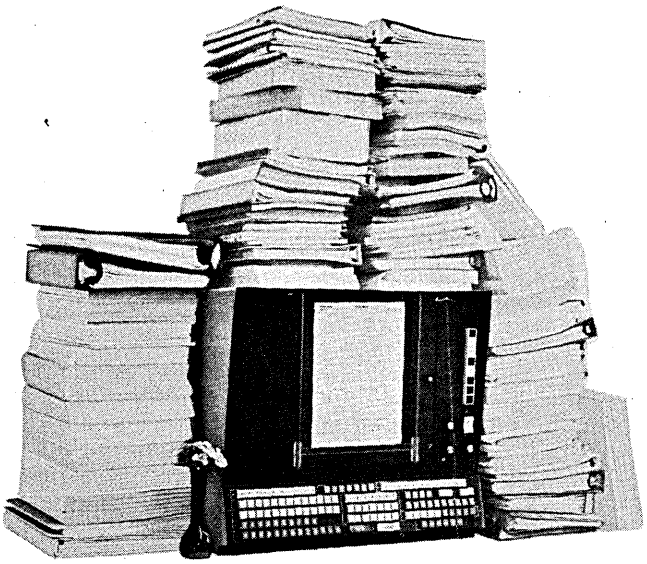
image storage and retrieval

A variety of special-purpose devices neatly complement the extended capabilities of the third-generation computer and its peripheral units by providing ways of improving the storage, retrieval, announcement, and delivery functions, primarily as they apply to systems handling documents and graphic material.

The equipment related to the storage and retrieval functions consists of microfilm devices for converting the original material to microfilm form and for retrieving material from a microfilm-based collection.

Cameras for converting hard copy to microfilm are marketed by Recordak, Bell & Howell, IBM, Xerox, Remington Rand, Stromberg-Carlson, 3M, NCR, Photo Devices, and others. A variety of devices are also available to convert roll film to unit record forms, such as aperture cards, microfiche, or magazines.

The area of microfilm-to-hard-copy conversion is not yet very advanced. There are a number of reader-printers, such as the Itek 1824 or the 3M Filmac 200, which under operator control can make copies from any type of microfilm. The problem, however, is that the process is too slow and the cost of the copies too high for production volumes. The only well-known production-volume machine for producing hard copy from microfilm is the Xerox Copyflo, but it handles only roll film.



The Houston Fearless CARD System.

In the retrieval area, there are a number of systems available that avoid the mistake of the early microfilm retrieval systems by offering a reasonable cost-performance compromise between a manual and a highly automated system. Most of these systems use unit-record formats, such as microfiche, and search only by direct address rather than by bibliographic description.

One, the Compact Automatic Retrieval Display (CARD) system is produced by the Houston Fearless Corp. Selling at under $5,000, it has a capacity of 73,500 pages and a response time of less than five seconds. Document address is entered by keyboard; however, it could be adapted to accept paper tape, or signals directly from a computer.

A higher capacity system for aperture cards or microfiche is the SELECTRIEVER, produced by the Mosler Safe Co. This system, costing upwards of $20,000, stores up to 200,000 microfilm units and provides retrieval in six seconds. It retrieves by accession numbers, which can be entered from the keyboard or on paper tape. A sophisticated version of the basic system provides automatic display and duplication of the retrieved material and transmission to a remote display.

The most successful of the systems built around roll microfilm is the Recordak MIRACODE which combines the search function with document retrieval. It uses 100-foot cartridges of 16mm microfilm. Each cartridge contains 2000 images, any one of which can be retrieved by attribute(s) in 10 seconds and either viewed or copied. If several cartridges have to be searched to respond to a request, the retrieval time, of course, goes up. A basic system consisting of a camera and retrieval unit sells for approximately $30,000.

announcement equipment

The equipment concerned with the announcement function also falls into two classes. One class consists of devices for producing frequent, low-cost current-awareness announcements of new material available. Since timeliness is of primary importance in current-awareness announcements, production quality is sacrificed for production speed.

The simplest device available to produce this type of announcement is the high-speed computer printer with an upper and lower case print chain. A more sophisticated class of equipment is available for converting material on magnetic tape into microfilm. This is done by generating the characters on the face of the crt and optically copying them onto microfilm.

Stromberg-Carlson has a line of such equipment to cover low, medium, and high volume applications. Its SC4460 recorder converts magnetic-tape material to roll film or microfiche at speeds of up to 90,000 cps. The characters are proportionally spaced and computer forms can be overlaid on the microfilm to eliminate expense of forms printing.

3M offers an extra refinement in its Series F Electron Beam Recorder by eliminating the wet development processing normally involved in producing material on microfilm. The advantage is faster processing.

Xerox has two machines for converting computer printouts into a form more convenient for announcement purposes. One is the Xerox 2400-IV, which reduces an 11" x 17" computer printout to 8½" x 11". In high-volume applications (over 200,000 copies per month), copy costs come down to approximately 1¢ per copy. By comparison with offset printing, the 2400-IV is especially suitable for small runs of 50 copies or less. A transparent forms overlay can be used to eliminate the need for preprinted forms.

The other Xerox device is the 3-2-1, which uses semimicro xerography (SMX) to produce a 3-diameter reduction of an image on card stock. The typical output format is a single image on a tabulating card on which other information can be keypunched or edge notched for machine processing. Since the image is large enough to be eyelegible, the card can be used both as an announcement and as an order form that can be processed by computer. The machine takes other size card stock, up to 8" x 8".

NCR recently took microimagery to a new extreme with its Photo-Chromic Micro-Image System (PCMI) that can reduce as many as 3200 pages to a single standard 4" x 6" microfiche at the rate of 1000 pages an hour. Because of

the high reduction ratio (200x), copy costs are very low. A duplicate copy of a 4" x 6" microfiche containing 3200 images can be produced for 50¢ to $1, depending on quantity. Viewers are available for rental at $10 to $15 a month and can be provided with attachments to produce hard copy.

The major application for PCMI is expected to be frequently-updated materials, such as catalogs and indexes. Copy costs are low enough to replace an entire catalog or index rather than update it. At a cost of $1 for a 3200-image microfiche, a 10,000 page catalog can be replaced for about $3. This is in contrast to a cost of approximately $30 for microfiche that use normal reduction ratios of 15X-18X.

The other class of announcement equipment is concerned with the production of book-form indexes and catalogs that are published on a relatively long semi-annual or annual cycle. This type of announcement is generally of graphic arts quality, which means that it uses a large number of type fonts and has undistorted and proportionally-spaced characters and a resolution of 250 to 500 lines per inch.

The most important advance made in this area is photocomposition.

One of the earliest photocomposition machines, developed in France, was the Photon. It is capable of producing camera-ready copy in a mix of as many as 16 different fonts in twelve sizes, ranging from 5 to 95 points, at a rate of 8-10 cps. Inputs can be made from either a keyboard or paper tape. A more recent model, the Photon 900, is capable of setting approximately 250 cps, with a restricted type repertoire.

Another recent development in photocomposition is the Mergenthaler Linotron, which functions at a rate of 1000 cps. A special model, designed for the U.S. Air Force, called the Lexicol-Graphical Composer-Printer, can combine text with photographs and line drawings stored on video tape.

RCA has successfully introduced its Videocomp system which is linked to a Spectra 70 computer and can set type at rates up to 600 cps.

Harris Intertype has also recently announced a 1000-cps machine, and there are several others on the market.

The last class of significant special-purpose equipment is facsimile equipment for delivering graphic material to remote locations. Slow speed fax has been used in the newspaper business for years. A business version of such equipment is available from Xerox for $35 a month. Called the Magnavox Telecopier, it requires approximately six minutes to transmit an 8½" x 11" page of material over a standard voice-grade telephone line.

Muirhead and Company, Ltd. has a faster device, called the Mufax Courier 500, that can transmit an 8½" x 11" page in approximately two minutes.

Alden Electronic and Impulse Recording Equipment has developed a number of facsimile units that can be linked directly to an automated microfilm retrieval system. The transmission speed of the system ranges from 4 minutes down to ½ minute for an 8½" x 11" page, depending upon the type of communications channel used.

The best known piece of high-speed facsimile equipment is the Long Distance Xerography (LDX) unit introduced by Xerox. This is designed to operate at speeds of up to 8 pages per minute. The monthly rental charges for the scanner and printer are $550 and $650 respectively, plus a surcharge of 2¢ a foot of copy for the scanner and 3¢ a foot for the printer. There are numerous other makers of facsimile equipment, mostly of the low-speed variety.

Relatively widespread use of facsimile transmission in IS&R systems is some years away. Only the high-speed devices are practical for handling transmission volumes of any size, and they require very expensive broad-band communications lines (Telpak C or D). Until the cost of broad-band communications lines comes down, facsimile delivery will be limited to a few applications where the number of images to be transmitted is small enough and the response-time requirements are lenient enough to use the slow-speed equipment and the cheaper channels. One promising development is Western Union's Broadband Switching Network, which provides a dial-up broad-band system on a toll basis that services 39 major cities. This approach obviates the need for large fixed costs for leased microwave or broad-band commercial data communications channels.

state-of-the-art system

With the computer and special-purpose equipment now available, it is possible and practical to put together a man-machine system that brings a new degree of efficiency and effectiveness to the management of collections of reference material. Figs. 1 and 2 show how such a system might be put together and used.

Fig. 1 looks at the input and announcement functions. New material is checked for duplication, cataloged, and indexed from an on-line display terminal, with a man

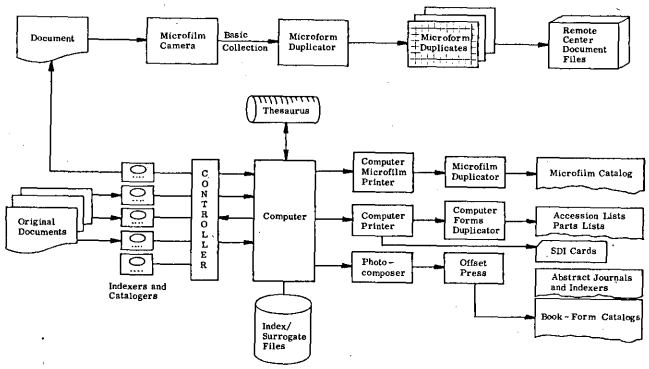


Fig. 1. Input and Announcement

performing the intellectual functions and the computer performing the necessary file-lookup and entry functions. In addition, the computer provides the man with the sections of the thesaurus, or other authority list, needed to perform his functions. The original document is then microfilmed and duplicated for remote centers.

The computer uses the bibliographic files to generate a variety of announcement materials. A microfilm catalog is generated by a microfilm printer. Selective-dissemination-of-information notices are generated by a computer printer equipped with an upper and lower case print chain. Other limited-distribution announcements, such as accession lists, are also run on the computer printer and then produced in the standard 8½" x 11" size, in quantity by a computer-forms duplicator, such as the Xerox 2400-IV. Abstract journals, indexes, and book-form catalogs are composed on a computer-driven photocomposition machine and reproduced on an offset press.

Fig. 2 shows how the system would provide a remote user with search and delivery services. The user formulates his questions at an on-line remote display console. The system could help him formulate his query by means of a series of questions and by displaying pertinent portions of the computer-stored thesaurus. The system's response to the query is a series of relevant bibliographic items, such as citations, which would include the address of the source documents in the microfilm file. The user evaluates the citations and selects the material he wants to receive.

Since this system envisions some duplication of the cen-

tral collection at remote user locations, the user's selections might be channeled to a local microfiche retriever-viewer, which displays the selected material in approximately four seconds. If the local file doesn't contain the required document material, the user's request is transmitted directly to the central computer, which sends a duplicate of the original either by mail or by slow-scan facsimile. The facsimile

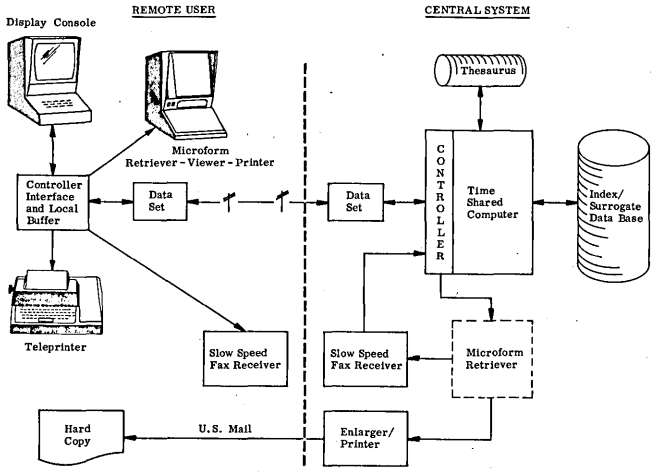


Fig. 2. Remote User/System Communication

form of delivery requires five minutes and costs 25¢ per page, plus toll charge. If all the user wants is a typed bibliography, he requests a citation print out. This is produced on a local teleprinter from the data in the controller buffer.

five-year projection

It is possible, by analyzing the trends in equipment described here, to project this typical system some five years into the future.

The equipment options available to designers of IS&R systems will not change radically. Keypunching will remain the most common way of entering data off-line, because of its long-standing position in the field and the size of the existing investment in card-handling equipment. However, magnetic-tape typewriters will begin to replace paper-tape typewriters in quantity.

Optical character readers will still be practical only for entering typewritten copy and material printed in a limited number of type faces. Stenotype devices will be an attractive alternative to the keypunch or typewriter for preparing inputs for the optical readers.

On-line terminals will be used much more widely because of the substantial economic advantage that lies in having the computer carry out editing and formatting functions. The cost of a crt terminal probably will come down to the $1,000-$2,000 range for six to ten terminals sharing common character-generation, control, and buffering facilities. Cost may be reduced even more by direct view storage tubes, which do not require any buffering to refresh the display, or the use of standard television receivers.

Voice inputs will be possible but will be used on a very limited scale.

Voice response will be used more widely but will remain limited to the application area of data systems dealing with highly formatted material.

The use of microfilm will continue to increase, both as a storage and publishing medium. Unit record microfilm, such as aperture cards and microfiche, will continue to be the most popular format. Ultra-high-reduction microfilm, such as NCR's Photo-Chromic Micro-Image System, will be used to publish frequently up-dated materials, such as catalogs and indexes. Portable microfiche viewers probably will be available for under $50 to make the use of microfilm as an information package more practical.

In addition, relatively inexpensive automated microfilm-retrieval systems, in the range of $1000-$5000, will become more popular. These systems will be concerned only with retrieving microfilm by address, and the more sophisticated, expensive systems, which combine the bibliographic search and retrieval functions, will probably disappear.

Facsimile transmission of image material will be somewhat more widely used than it is today but will still be limited, for the most part, to applications in which a case can be made for slow-speed transmission over voice-grade telephone lines.

The more important changes will take place in the organization of the central computer facility. Five years from now, the heart of automated large-scale IS&R systems may look something like the configuration shown in Fig. 3. It will differ from the current facilities in three basic respects.

First, "firmware" (a term coined by Ascher Opler in a Jan. '67 article for DATAMATION, "Fourth Generation

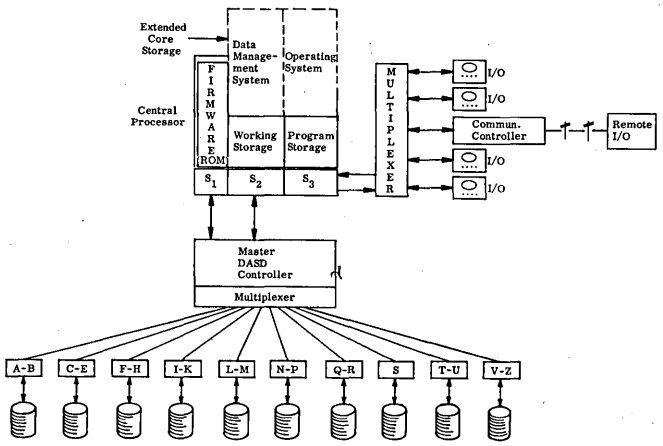


Fig. 3. Summary of Predicted Computer Organization Trends

Software") will be used to tailor the computer's capabilities more closely to the IS&R functions. This will be an extension of today's micro-programming techniques in which machine instruction sets are composed of micro-instructions stored in a very fast and relatively inexpensive read-only memory. By changing the micro-programs, it will possible to make the computer more efficient at search and language processing.

Second, modules will be used to extend core or other internal storage capacity up to as many as 20,000,000 bytes at a cost of 2-10¢ per bit. This will make large, complex data-management and operating systems much more efficient than is now practical.

Third, the data or bibliographic files will be stored in mass random-access memories which can be segmented on the basis of traffic levels. This will enable a number of users to have access to different segments of the files simultaneously.

The over-all consequences of these three changes will be to significantly lower the cost of automating IS&R functions. Therefore the trend that was started by third-generation computer equipment will continue and accelerate to the point where there will be no reason why anyone can't manage reference collections of all types and sizes in a highly effective manner. ■

CAS COMPUTER-BASED INFORMATION SERVICES

by W. C. DAVENPORT

The Chemical Abstracts Service (CAS), a division of the American Chemical Society, has been providing chemical and chemical engineering information services since 1907. The problem then, as now, was that the amount of chemical literature published full-length in such "primary" sources as technical journals, patents, reports, and books was too great to be readily absorbed by individuals. In response to the problem, *Chemical Abstracts*[1] *(CA)* was introduced to provide a condensed record of chemical knowledge in the form of abstracts and indexes, a combination designed to help the individual gain access to primary literature. Today, even the condensed record is large, and its rate of growth has reached alarming proportions. As a consequence, CAS retrieval techniques are being broadened and improved.

Computer technology plays a major role in these broadened techniques, and the manner in which men and computers must interact to create effective and responsive information storage and retrieval services is the topic of this paper. The approach taken is not the computerization of a manual system, but the development of integrated information processing designed to take full advantage of the computer's speed, accuracy, and flexibility while conserving the professional intellectual effort that must be the core of any information processing system.

This paper describes the key points that characterize CAS' approach to large scale scientific-technical information systems that must handle over 100,000 documents per year. The first of these points is the "single analysis/multiple use" concept. Intellectual ability is a rare commodity and essential to an information system. Therefore, it makes sense to conserve that commodity and not use manpower to perform repetitive jobs or to waste effort analyzing infor-

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[1] *Chemical Abstracts* is a weekly serial containing abstracts of selected original papers, patents, and reports of interest in chemistry. Since 1907, over 3.5 million abstracts have been prepared and published.

mation that somebody else has already analyzed. Ideally there should be only one intellectual analysis for any item of data that must be input to the system, with no other analysis required except for validation and error correction recycles.

At the same time, we also want the greatest flexibility in output. That is, we want the system to yield computer searches, manuals, "hard" documents, and increasingly more individualized services. To create this multiplicity of uses from a single analysis requires the creation of a data base, from which any number of different combinations of data can be drawn. Information added to the data base is not necessarily destined for a single specific service. It must accurately and completely cover the subject and be compatible with that already stored so that a single analysis of new information will result in a data base from which many services can be generated.

Another key concept is that computers should aid in the preparation of manual tools, such as printed abstract journals and indexes, and that computer searches should not be expected to entirely replace manual search. The computer will, instead, create new forms of manual tools and improve old forms to make them more effective.

This paper examines the above approaches and the extent of the computer involvement at CAS from three points of view: preparation of services, retrieval methods, and integration with other scientific-technical information processors.

preparation of services

CAS information services are designed both for retrieval and to help individuals keep abreast of developments concerning topics of interest: "retrospective search" and "current awareness." To provide these capabilities demands prompt accumulation and delivery of all useful news, based upon comprehensive coverage of primary literature, and in the organization, form (printed and mechanized), and degree of detail needed. Retrieval methods must provide access from many different points of view and must have built-in responsiveness to questions unforeseeable when the data is analyzed at input.

The publishing of abstract serials with indexes and the preparation of corresponding computer search files are complementary activities. Once an information processor has acquired, selected, and prepared information for publishing, the creation of computer search files is but a modest extension. However, to exploit fully the computer's capability, computer files cannot be simply "tacked on" to the established publishing sequence. Instead, the entire publishing operation must be converted to computer processes so that operational economies can be realized and additional services can be generated at slight incremental cost. CAS has therefore adopted the data base approach: all publications and search files are entirely computer produced from the data base. (See Fig. 1.)

The advantages of the data base-packaging approach are substantially improved currency, reduction in unit costs, new manual tools (indexes and brief "topic awareness" publications), and a computer-searchable data store. Further, the single analysis/multiple use characteristic makes effective use of the limited number of capable staff members who can be recruited for literature handling activities. The data base can also be used for future publications, such as handbooks and compendia, and can be stored in direct access units for on-demand inquiry from remote terminals.

The first phase is preparation of the base. It contains bibliographic and derived information for each document covered, identified by topic and component (for example, title, citation, author, abstract, index entries), recorded in sufficient detail for use in publications and computer search files. Computer involvement in this phase consists primarily of translating input forms (which have been designed to simplify the keyboarding task) to storage form,

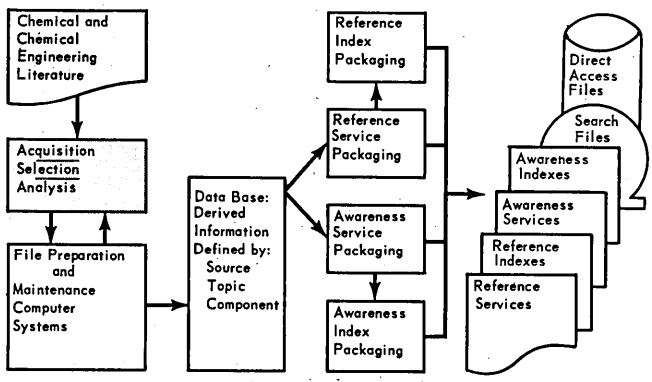

Fig. 1. Integrated publishing and search file preparation

☐ Primary publications
☐ Manual operations
☐ Machine operations

editing the input for consistency and completeness, and supporting manuscript revision and correction to avoid the complete re-input of any correct data.

The second phase of the operation is packaging; this phase produces reference and awareness services, indexes, and computer search files. Reference service is the condensed record published (via computer typesetting and conventional printing) in the form of serial abstract issues and indexes. CAS prepares volume indexes every six months and collective indexes every five years. The abstracts contain enough information to answer some inquiries without reference to the primary literature; however, their primary function is as a screening device for determining whether or not the original paper is of current value. Indexes are compiled as soon as the abstract issue is composed. The computer transfers the abstract page references to the appropriate index entries, arranges the indexes, and controls typesetting to prepare master printing plates.

The awareness services are compilations of abstracts dealing with a more limited topic. They are produced by combining material selected from the *CA* issues and formatting it to highlight chemical substances and other key points. This separate publication is a small collection of topic-oriented material that might otherwise be scattered throughout a large compilation and is organized to make searching efficient. Indexes to the awareness services are prepared on a current basis and collected into volumes every six months.

As a co-product of both reference and awareness services, computer files are generated for use in searching and selective dissemination processes. The advantages of computer searching are that vast quantities of material can be scanned *and the search need not be based on either a classification system or a hierarchical index.* This latter point is particularly important in handling inquiries unforeseeable during data base preparation. Because the computer can search a large store without regard to the hierarchical arrangement, the number of access points is increased to permit effective retrieval of information not

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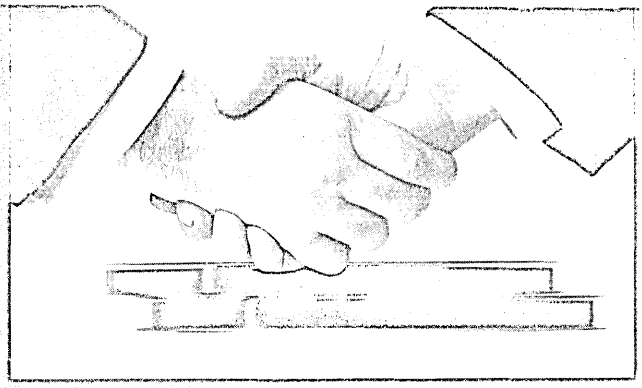

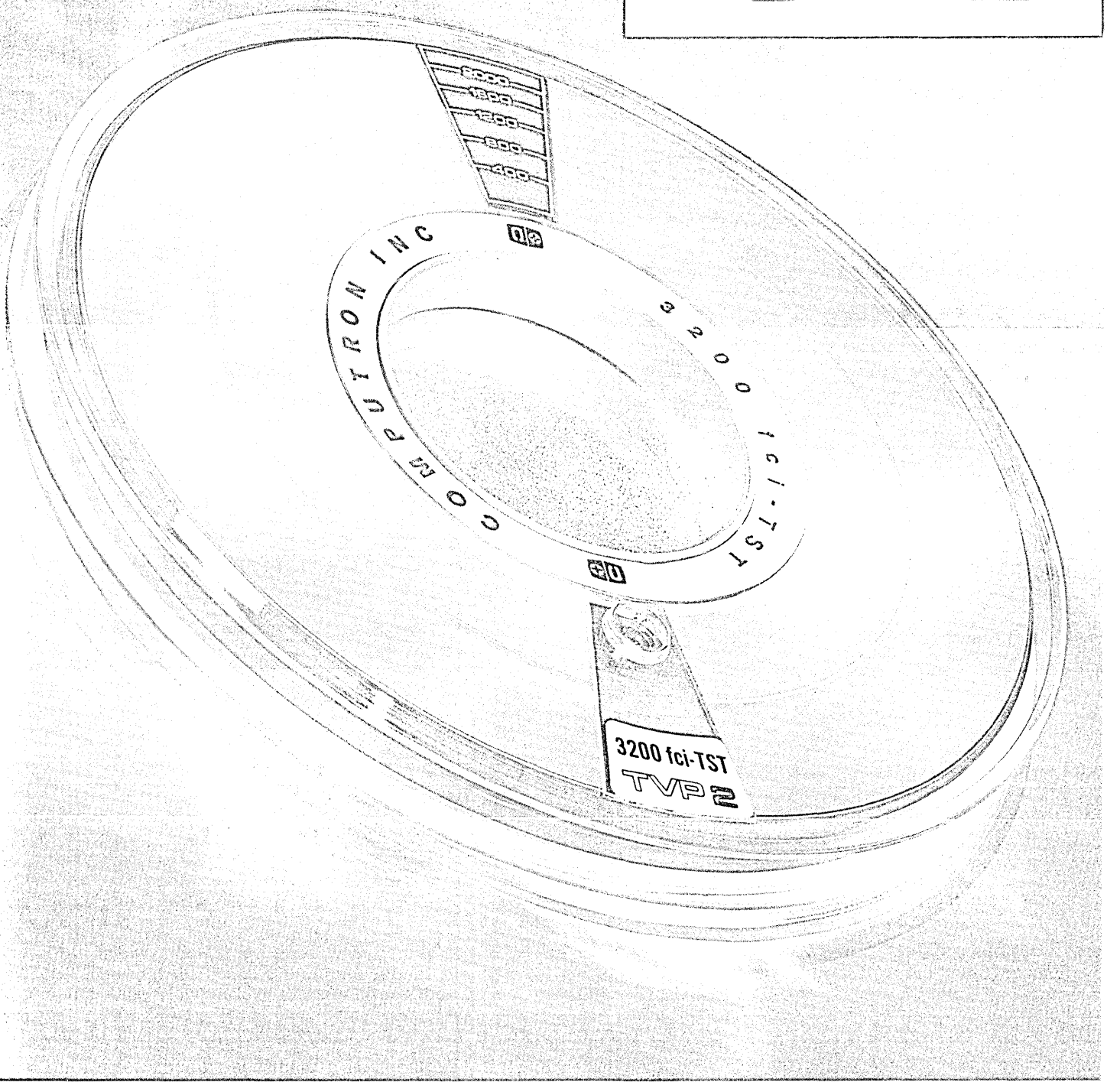

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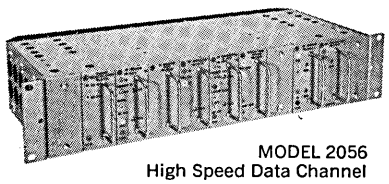

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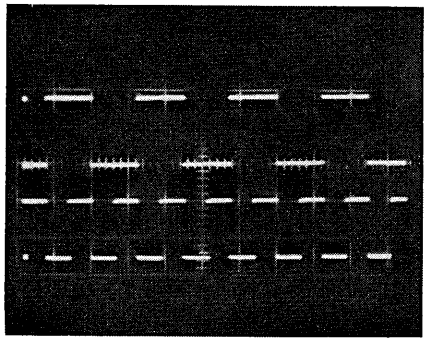


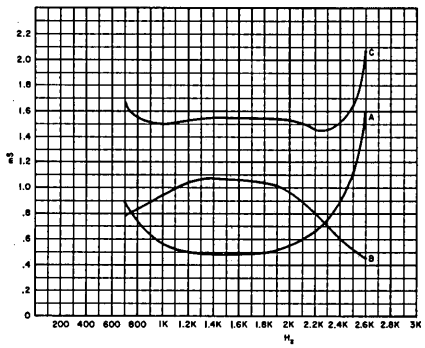
Input Data and Clock Synchronism

This new coherent modem, Model 3227, is capable of transmitting high speed binary coded data and clock information simultaneously. There is no need for accurate and expensive synchronized clocks in end-equipment. The need for accurate timing is also eliminated, permitting operation through adverse conditions. The 3227 makes more efficient use of transmission time since synchronizing pulses are not integrated with the data. It operates up to 1200 bits per second on telephone circuits and at higher speeds on wider bands.

SELF-CONTAINED CLOCK OUTPUT

The Model 4000 data channel provides its own synchronized output at both the receiver and transmitter. It is capable of high-speed rates for both clock and data information and operates at discrete bit rates of 600, 1200, 1800 and 2400 over telephone circuits, and higher speeds over wider facilities.

VARIABLE LINE CONDITIONING



Phase Delay Equalization

The newly designed Model 25400 Adjustable Delay Equalizer is totally compatible with all RFL data sets as well as all other data transmission facilities. This variable system provides precise equalization of communication paths with respect to either phase or amplitude, or both, which is essential to high-speed data transmission. Resultant flat response and amplitude attenuation insures distortion-free transmissions over minimum grade voice lines.

SYSTEM COMPATIBILITY

All channels are fully compatible with most other data sets including Western Electric types. Interfaces can be supplied for negative logic, positive logic and to EIA 232B specifications.

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Conservative circuit load design per Mil Handbook 217 results in high MBTF figures. Design features include silicon semi-conductors, I C circuits, tantalum capacitors, and extra strength epoxy glass base for etched circuit boards.

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There is practically no limit to the variations and modifications possible in RFL designs to suit specific applications. These include frequency, bandwidth, module configurations, accessories and mounting designs.

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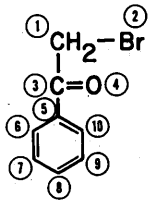
recorded at the highest index hierarchy levels. Awareness services are also important in this respect because they provide alternative (topic) organizations of the store. As a result, searches can be limited to the much smaller topic data base with which the inquiry is concerned.

Chemical information has a characteristic not found in other scientific disciplines. This is the "language" of chemistry, which is based upon pictorial diagrams representing molecular structures, and upon complex, lengthy names that are also related to molecular structure.

Because a complex structure can be drawn with different orientations by different chemists, it is difficult for chemists always to recognize a structure. Since 1965 CAS has been operating an experimental Chemical Compound Registry System based on a computer algorithm that normalizes a keyboarded record of the elements, bonds, and attachments symbols of molecular structural diagrams that define chemical substances. The algorithm efficiently converts the record to a unique and unambiguous form regardless of the drawing orientation or of the order in which the diagram symbols are recorded. (See Fig. 2.) Existing registry numbers are retrieved or file additions are assigned new registry



Acetophenone, 2-bromo-
C_8H_7BrO

Atom	Element	Attachment	Bond	Attachment	Bond	Attachment	Bond
1	C	2	1	3	1		
2	BR	1	1				
3	C	1	1	4	2	5	1
4	O	3	2				
5	C	6	1	10	2	3	1
6	C	7	2	5	1		
7	C	8	1	6	2		
8	C	9	2	7	1		
9	C	10	1	8	2		
10	C	9	1	5	2		

ACETOPHENONE, 2-BROMO-
C 0008H 0007BR001O 001

Diagram at left is a chemical structural formula. Circled numbers are references to the table at right. Table represents the computer record (connection table) for the structure prior to conversion to cannonical form.

Fig 2 Computer representation of chemical structural formulas

numbers. These registry numbers are unique for each substance. Among the uses of the registry numbers and structural representation files are: correlating information concerning each substance despite ambiguous names and separated data sources, searching the store for specified diagram subgraph characteristics, and linking inter- and intradisciplinary systems that are concerned with the properties of chemical substance.

required technology

Scientific-technical information processing in general, and chemical information processing in particular, requires technologies beyond state-of-the-art computer processing. As a result, implementation of data-base-oriented operations has required the development of specialized input, storage, and output capabilities. Primarily because of the complex chemical names, chemical information publishing demands the use of the Roman and Greek alphabets, upper and lower case letters, several type fonts (italics, boldface, small capital letters), and superior and inferior positions. In all, nearly 1500 symbols are used in *CA* issues. Storage problems are further complicated by the variability of the information components: for example, names of chemical substances range from two or three to several hundred characters in length. Considering the character range required, the extreme variability of the data and the fact that not all components are always present, the problem-oriented programming languages are, at best, very inefficient.

The representation problem is solved through the use of a double-byte character representation (one byte per unique character, with one additional byte to reflect the variations) in a double field arrangement that permits lexigraphical ordering unaffected by font and case. Standardization helps to reduce programming loads. The data base files are recorded in a data directed format; the same information component (field) is standardized; the same representation conventions are used in all CAS systems; and the major processing subprograms (keyboard-to-storage-form translators, edit routines, formatting routines, etc.) have been standardized.

CAS has also worked to make keyboarding more efficient. Conventional keypunching has been phased out in favor of computer compatible magnetic-tape-generating data recorders (Mohawk Data Sciences' 1101 and 1181). Typewriter keyboards and type elements have been modified so that common symbols are directly keyboarded in lower case with flagged or programmed provision of upper-case characters. Then the upshift positions are freed for other characters such as Greek letters. The least frequently used symbols are input via three-character mnemonic codes. This approach is based on a statistical analysis where it has been found that the most common 80 characters account for 99.5% of all characters in the data base. Case, font, superior-inferior, and special symbols are accommodated by conventions using the remaining eight keyboard positions for flags. In addition, several types of keyboarding shortcuts have been developed; for example, computer programs automatically provide italicized and capitalized characters in chemical names, and the computer also expands useful abbreviations.

Computer typesetting has also been a problem. Most computer-driven printing devices offer a very limited number of characters and virtually no typeface variation. Furthermore, quality is a problem for printed publications. In 1965 CAS began using a special 120-character IBM 1403 print chain that has the full Roman alphabet in upper and lower case, 12 commonly used Greek letters, 14 special symbols, and on-line, superscript and subscript numerals.

Now CAS composition is being converted to a modified IBM 2280 Film Recorder that can record all of the nearly 1500 symbols required to compose the *CA* issues. Characters are formed by program-controlled stroking of 35mm film with an electron beam. Soon, molecular structural formulas can be composed on-line with the text, eliminating the need for artwork and film-stripping. Film output is converted to offset plates for conventional printing. The quality obtained through this process is excellent (equivalent to hot type), and composition proceeds at a rate of between 1500 and 5000 characters per second, depending upon the character range used and the printing quality desired.

current status

CAS is now in the midst of a step-by-step conversion of all operations to a computer basis. Our approach during this conversion has been to proceed in an orderly fashion from pilot-scale operation to full-scale production, solving problems as we went along. For example, in developing the CAS Chemical Compound Registry System, we operated on a very limited basis for six months before we began registering compounds that we encounter in indexing *CA*. Similarly, the introduction of new computer-based current awareness services has been deliberately paced: *Chemical*

Titles in 1961, *Chemical-Biological Activities* in 1965, and *Polymer Science and Technology* in 1967. As a useful test of the problems to be encountered when all *CA* abstracts are computer based, we are now producing *Basic Journal Abstracts* containing the abstracts selected from 33 core journals. Each of these services has a corresponding magnetic tape search service and is available for subscription in magnetic tape form. During the next two years, we will convert *Chemical Abstracts* issues and indexes to a computer base and we will offer a new type of indexing/search service containing bibliographic identification and keyword index entries for all *CA* abstracts.

retrieval methods

In information systems such as CAS operates, retrieval is the process of identifying references to documents that are likely to contain information of interest to the inquirer. As such, retrieval can take the form of an archival search, an awareness service, or selective dissemination. Any of these retrieval forms accomplish the same mission: to get the right information to the right man at the right time.

Improvements in retrieval methods, then, can be measured in increased relevancy of the information retrieval, increased timeliness in making the information available, and decreased cost in preparing the information.

In respect to printed indexes, currency and cost can both be improved through single analysis/multiple use processing. Reducing the number of times an item must be handled reduces the time and cost required to prepare it for publication. Moreover, with a data base available from which index entries may be selected, a computer search or a magnetic tape index may precede a printed one by two or three weeks due to the savings of printing and binding time.

This must not be interpreted to mean that published indexes will be phased out in favor of computer searches. The value of indexes for manual use must be placed in proper perspective. Many information users do not have computers and many inquiries do not require the power (and expense) of computer searching. Although an over-all improvement in literature access often results from computer searching, the computer's contribution to improved manual access tools is equally significant. For example, computer generation of rotated indexes provides an increase in the useful access points available for manual use. An example is the KWIC (Key-Word-In-Context) indexes that are compiled by highlighting each non-trivial word in its preceding and following context. But although KWIC indexes have the advantage of being relatively inexpensive to prepare, the user must inquire under more than one entry; there are no "see" or "see also" cross references, and the number of index pages is greatly increased. CAS has also applied the KWIC approach to the element symbols in chemical molecular formulas to produce additional indexed access to the over-all information store without further intellectual effort. Such an index frees the user from the hierarchy used to arrange molecular formulas in a traditional molecular formula index.

As noted earlier, the primary purpose of awareness services is to deliver the information concerning a topic into a concentrated stream promptly so that a subscriber can more readily keep abreast of developments. However, related information is often appropriately included with other topics. For example, the biological effects of a given compound would be reported in *Chemical-Biological Activities* and the corresponding molecular structure is recorded in the Chemical Compound Registry. The data-base approach provides the means to interrelate these several pieces of information. Compounds discussed in *Chemical-Biological Activities* and *Polymer Science and Technology* are included in the Chemical Compound Registry System with cross-reference links established through the registry number in the awareness service and the awareness service reference in the Registry Files.

computer searching

The computer's ability to read the store of material rapidly, comparing the contents of the store with the content of an inquiry, and to select from the store those items which satisfy the inquiry, greatly exceeds manual capabilities. Although text searching does not always lend itself to exact answers, it is well to remember that where the flow or store of literature is large, comprehensive searching and scanning might not otherwise be practical. The impact of the computer text search is, simply stated, to extend man's ability to read great amounts of information; albeit, with reduced "comprehension." As a result, computer text searching is effective and useful, even when not exact. The

CAS PROFILE

Chemical Abstracts Service, along with the parent American Chemical Society, is converting information systems to computer-based operations that produce a variety of literature services including reference, awareness, computer search files, and manual indexes. Material covered by CAS comes from more than 11,000 periodicals published in 54 languages, from patents issued by 25 nations, and from numerous irregular sources. All told, some 300,000 bibliographic source items are examined each year. Abstracting is provided by 3200 volunteer abstractors located throughout the world. For the past 20 years, the chemical literature has grown at the rate of 9% per year, compounded, and there is no clear indication that this rate will decrease in the near future. In 1967 the printed output of the Chemical Abstracts Service was more than 60,000 pages bearing some 570,000,000 printed characters. **Chemical Abstracts,** the world's omnibus chemical and chemical engineering information service in the English language, carried abstracts from 258,000 papers and government reports and some 52,000 patents. By 1970, at the current rate of growth, the number of bibliographic items to be handled will grow to 360,000, and the volume of printed output will expand to some 74,000 pages, not including new services. It is expected that during the next 10 years, the number of items abstracted in **Chemical Abstracts** will exceed 3.5 million.

CAS text search systems match the inquirer's terms with terms appearing in the data base and list the bibliographic references for those information units that contain the specified terms. The search terms may be words, phrases, parts of words (prefixes, suffixes, imbedded letter sequences), authors' names, journal identification, or, in fact, any stored data. The terms may be assigned numerical weights to indicate their relative importance in the search. By applying Boolean logic operators, the searcher can construct correlative search questions requiring that several parameters be present (or absent) in a specified combination. This AND logic makes a search more restrictive. A question consisting of terms of A and B with AND logic would retrieve only references to documents that contain both terms. OR logic expands the basic search terms to include synonyms and related terms. For example, a request for references to sulfur compounds found in petroleum could be defined, in part: AND sulfur, OR sulphur, OR sulfide, OR sulphide, OR thiophene; AND petroleum, OR crude oil, OR gasoline, OR oil. A search of this type would retrieve references to documents containing any of the terms of the first group in combination with any terms in the second group. NOT logic specifies that a given term must not be present in the store being searched. The text search strategy can be very specific or quite general, as the user desires, and the search can cover the whole text of abstracts, titles, index phrases, or inverted term files.

Another CAS search system in experimental operation permits the searching of chemical structural formulas for structural subgraphs. This technique uses a comprehensive set of screens (bits indicating structural descriptors) to both provide rapid rejection of graphs and controlled degrees of question-to-file structural similarity. By including Compound Registry Numbers as parameters on a text search, it is possible to achieve correlated structural and text searching. When the entire data base is fully integrated, this correlative capability will be obtained in one run.

future capabilities

Although the current CAS search systems are serial tape-oriented processes, research in progress will result in on-line capability. Direct access storage and searching of chemical literature presents a formidable problem in the size of the store. By 1971 over 3,000,000 compounds will be in the store, abstracts will be accumulating at the rate of almost 400,000 per year, and index entries will accumulate at a rate of 3,000,000 per year. The files must be organized to obtain the best balance of storage costs and access time for a variety of access approaches and search strategies. There are suitable techniques (for example, list structuring) for direct access handling of stores limited to thousands of items. However, when the store grows to millions, these approaches become costly due to the excessive length of chains. CAS is investigating alternative approaches such as file partitioning and compact storage of efficient screens for rapidly scanning large blocks of information. It is too early to be able to determine the effectiveness of these approaches.

The packaging phase is being generalized to provide a wide range of customized services based on processing capabilities. This will make it possible to produce both standard and customized services through the application of standard processing subsystems, each controlled through parameters that specify the information sources, components, subjects, and character set options desired.

Another future capability about which we can speculate is the preparation of handbooks and compendia from the computer-based archives. Through reprocessing of the accumulated tape files, state-of-the-art compilations of abstracts and indexes can be prepared related to any topic definable in terms of the data base subjects and content. Through the combination of such periodic reviews with age-limited direct access capability, a powerful new set of tools will become available when data base achives accumulate to suitable size. Particularly attractive to the chemical community is the prospect of obtaining handbooks of molecular structures with corresponding references.

integration with other processors

As information processors convert to computer-based operations, the potential for efficient information interchange increases. To exploit this, CAS and the parent American Chemical Society are experimenting to develop techniques for mechanized information interchange on a large scale.

One form of interchange is the exchange of abstracts between primary journals and secondary services. Common standards have been adopted for the ACS primary journals and *Chemical Abstracts*, permitting the use of ACS abstracts in *CA* with minimum additional editing. CAS/ACS cooperative experience with the *Journal of Organic Chemistry*, and the *Industrial Engineering Chemistry Quarterly*, has demonstrated that the approach is sound and a third journal has been added, the *Journal of Physical Chemistry*. The significance of this experiment is increased by the ACS conversion to computer-based publishing. CAS and ACS are developing a compatible set of character representation standards, file formats, and field content and identification standards that will permit direct interface via magnetic tapes produced as co-products with publications.

Another form of cooperative interchange under way is the linking of systems where there are common information requirements. Information concerning chemical substances is of concern in petroleum technology, medicine, atomic energy, food technology, agriculture and, in fact, most technological disciplines. A means of interlinking the information files is provided through the CAS Chemical Compound Registry System. For example, compound structural information of common interest to CAS, the National Library of Medicine, and the Food and Drug Administration is being routinely processed in the CAS Registry System. Structural information concerning compounds tested for usefulness in cancer research has been processed in a separate, confidential chemical structure data base under contract to the National Cancer Institute. Close coordination has been maintained between the structural handling systems of several foreign chemical companies, professional societies, and the CAS systems. Through these cooperative exchanges, the data bases of CAS and other processors are becoming compatible and directly interchangeable. Through the registry link among the various systems, it is possible to approach the store of any compatible system and to retrieve compound-oriented information from any of the other systems.

Other experiments are under way aimed at illustrating the feasibility of combining retrieval files in dissemination centers. One of these experiments, conducted by the Nottingham Research unit of the Chemical Society (London), is a selective dissemination service based upon *Chemical Titles, Chemical-Biological Activities*, and the National Library of Medicine's MEDLARS (MEDical Literature Analysis and Retrieval System) retrieval tapes. The advantage of the dissemination center approach is twofold: (a) to provide local service to organizations too small to operate large scale computer-based search systems, and (b) to combine the data bases from several disciplines into one comprehensive data base that, in total, serves the interests of participating institutions. ■

COST AND ADVANTAGES OF ON-LINE DP

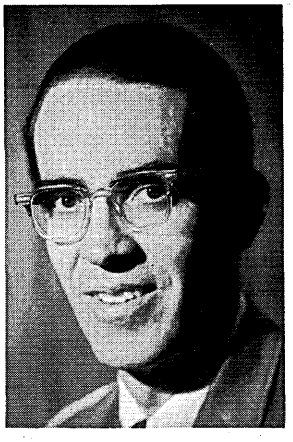
the way to go

by ROBERT R. BROWN

Many computing people believe on-line data processing costs more than traditional batch-mode data processing, and therefore is only justified when a significant dollar value can be assigned to improved user response time. The intent of this paper is to dispel this belief by showing that when batch and on-line processing are combined in a multiprogramming mode on a single computer the costs of on-line and batch are comparable for many applications and for some applications on-line costs less.

With comparable costs, the attendant advantages of on-line processing make it much more desirable than normal batch processing. Some of these advantages are:

1. Faster response time for both inquiry and update.
2. Simpler controls and audit procedures, due to fewer people involved in the update process.
3. User scheduling of his cut-off for updating becomes a negligible consideration in systems design and operation.
4. Revision of procedures becomes much easier since input and output are decoupled from each other.
5. Errors in files are less at any time because the correction procedure is fast and simple.
6. Return to the unit-record concept is now possible



Dr. Brown is director of computing and data systems services at the Space Division of North American Rockwell Corp. He was previously a special advisor to the government and has also been affiliated with Aerospace Corp., University of Southern California, and IBM. He has a PhD in mathematics from UCLA, specializing in numerical analysis.

since each record can be retrieved and changed on an individual basis without batching considerations.

Some of these advantages will be considered in more detail later.

Costs of on-line processing have become favorable with the advent of third generation computers. Factors effecting this advantage are:

1. Less expensive core storage.
2. Large capacity direct access storage devices (DASD) with reduced storage costs. Examples are IBM 2314 disc, RCA RACE, etc.
3. Multiplexers, terminals and appropriate computer hardware and interrupt logic to allow the physical attachment of these terminals in sufficient quantity (say 100) to do the job.
4. Software for multiprogramming, handling the terminals, and allowing easy use of direct access storage.

In this paper, the term batch processing refers to conventional processing on a tape-oriented IBM 360/50 with 256K bytes of memory (or a comparable computer) in a mono-pragramming mode. [Multiprogramming is feasible with this amount of memory only for simple procedures such as card-to-tape with the second initiator, or if the multiple applications each require only a small amount of memory. As an example, the multiprogramming with variable number of tasks (MVT) version of OS/360 requires upwards of 100K bytes for OS/360 itself, and the COBOL compiler requires about 90K bytes, thus leaving less than 66K bytes for additional programs while doing compilation. Also, to use multiprogramming effectively, additional DASD must be provided for at least the job input queue. Since this additional DASD adds to the cost of the system, but can only be exploited for applications with appropriate core requirements, operation of a 256K computer in mono- or with limited multiprogramming (multiprogramming with a fixed number of tasks) is the most logical choice from an economic viepoint.]

environment and workload

On-line data processing[1] refers to the following kind of computing environment:

1. The entire data base resides in direct access storage and is available for both on-line and batch processing at the same time. Some historical data sets may be kept on tape, but these are not used for normal processing.
2. Updating of the data base is done on-line by the user with custom designed message handling programs from keyboard terminals or data collection units.
3. Simple inquiries (i.e., messages that require only a few lines for input-output and are not of the search type) are done on-line by custom designed message handling programs.
4. Complex inquiries (i.e., those that generate large reports or require file search) are done daily in the batch mode.
5. On-line transactions are received, queued with other on-line transactions and processed to completion, all with priority ahead of batch processing.
6. Both on-line and batch processing use standard software and common subroutines to interface with the data bases.[2]
7. Interface to input and output message queues is similar to the data base interface.[2]
8. The on-line system must be in operation during the time the user needs it. In industrial plants this can vary from five days a week, one shift, to seven days a week, three shifts. During these periods the on-line system should be active except for emergencies. In order to get a high percentage of usable time during these periods, a backup computer is desirable. This required hardware redundancy is obtained by using another computer which normally runs in batch mode. Appropriate switching gear is needed so that switching can be done in a matter of minutes, not hours, when a hardware failure occurs.
9. On the same computer, many on-line applications are implemented. One or more on-line transactions and one or more batch jobs are being processed at the same time. The exact number of each is determined by total core memory size, amount of memory required for the batch applications, amount of memory required for on-line transaction programs, number and types of peripheral devices, etc.
10. If the on-line terminals are inactive for one or two shifts, the disc storage used for on-line data bases can be used for other purposes at that time (since the types of DASD used are dismountable).

The ultimate goal of data processing should be to keep all data bases current during the day, and to process reports reflecting this activity during the night so that they are available the next morning.

Since the level of on-line activity will vary significantly during a work day, the mix of on-line and batch is naturally complementary in this setting. When on-line activity is high during the day, batch activity is slightly reduced; however, during the night when on-line activity is low, batch throughput is at its maximum. This mode of activity is natural for an industrial plant and, therefore, will ultimately make the scheduling simpler.

Since the computer is used in a non-dedicated mode (that is, not dedicated solely to on-line processing), the cost of on-line processing is only the cost of the special assets acquired for that purpose (such as terminals, dedicated DASD, additional core memory, etc.), plus the prorated cost of the computer time used for on-line processing. In a multiprogramming environment the normal method of costing a job is to prorate common asset costs over all jobs processed. (Details of how this should be done are beyond the scope of this article.) Extra costs of the special assets should be borne by the on-line applications.

The ideal application for this kind of on-line system is one with a relatively high volume of on-line transactions of pre-definable types. The number of transaction types required per application is relatively small since only a limited number of kinds of updates and inquiries are needed. This kind of design is well suited for the typical industrial application of data processing; however, it may not apply to low activity data bases or activities where the set of transactions is large or undefinable, as in the general library information retrieval problems.

Message response time is an important consideration in a system such as this. A terminal user becomes unhappy if forced to wait what he considers to be too long for the system to digest his input. The response time for a message in this on-line environment is the time required to process the messages already in the queue plus the processing time for the message in question. Response time is, therefore, a function of processor speed, status of the queue when the message is entered, complexity of message processing programs, message priority, and number of active message processing programs.

Since complex transactions are to be held for overnight batch processing, all of the messages accepted on-line involve reasonably short processing times. The system offers reduced response time by multiprogramming several mes-

[1] In this context, an on-line system is not a time-sharing system nor does it support on-line programming, heuristic programming, interaction with processes, or cognitive processes.

[2] Both these characteristics minimize the need for additional training of programmers.

sage processing programs during periods of high transaction volume.[3] The other variables (processor speed, number of terminals and total message volume) must be controlled at system design time to yield acceptable response time during conditions of peak message load with assumed distributions by type.

The user should find this design entirely satisfactory. Since simple inquiries are answered quickly, the need for other than overnight services to complex inquiries is greatly reduced.

on-line cost elements

To illustrate the economics of on-line data processing systems, the following paragraphs enumerate the additional costs involved in on-line processing and indicate typical costs for the example which is to follow.

An IBM System 360 on-line system requires the following additional hardware:

1. Additional core for MVT and the appropriate teleprocessing software.
2. DASD for system residence and data bases sharable with the backup computer.
3. Multiplexer channel to control terminals (if not standard).
4. Interface control units for terminals.
5. Terminals.
6. Communication lines.
7. Manual switching gear for the teleprocessing equipment.

On a 360/50, the multiplexer is standard, resulting in no additional cost. The net cost of the interface control (IBM 2703), terminals (IBM 2740), communication lines, and manual switching gear is $60-$100 per week per terminal, depending on quantities. Take, as a typical number, $70 per terminal per week. For DASD using disc, the cost of putting either of the programming systems on disc is comparable.

The cost of storing 1,000 bytes of a 2314 is between $.03 and $.04 per month, depending on loading. Take $.03 per 1,000 bytes per month as average.

Another 256K storage for a Model 50 is approximately $6,400 per month; however, not all of this is needed for MVT and the on-line software. The remainder should make the batch processing more efficient. But let us assume $1,000 a week or $4,000 per month additional cost for the core memory needed for on-line processing. This amount is dependent on the number of lines used for applications, number of terminals used for all applications, etc., and is, therefore, difficult to estimate for a general example.

The incremental amount of core required for additional applications and terminals is small compared to the amount required for one application. This is due to the large amount of core required for the general purpose software as compared to the smaller amounts needed for the additional tables required to define the lines, transactions, etc., for added applications. As a result, proration of the core cost is very dependent on the total number of applications on the computer. One easy way to prorate core cost for a particular on-line application is to divide the number of transactions per week for that application by the total of transactions for the week of all applications.

Take as an example a data processing job which has 50,000 records in its data base, each 1,000 bytes long. The change rate on this data base is determined to be 5,000 records a week with an average change requiring two cards of data as input in the batch environment. Various reports are printed for this application, but in the batch environment the complete contents of it are printed weekly. Later on, assumptions concerning the total transactions for all applications will be made.

In batch processing, keypunching and verifying required for updating costs $.10 a card or $1,000 a week in our example.

For on-line processing, the question of how many transactions on the average can be processed on a terminal per day must be considered. During an 8-hour day, 100 transactions/terminal is a light load, while 300 is fairly heavy. With 5,000 updates a week, 10 terminals lightly loaded will do the job, with sufficient time remaining for inquiries. The requirement for inquiries is difficult to estimate, but let us assume 5,000 inquiries per week in addition to the updates.

By doing a careful job of system design, the people using the terminals can be the same people who were once doing other jobs in a batch processing environment. For example, under batch, some were transcribing data onto keypunch sheets, some were balancing batches and getting control totals, others were transmitting, carrying, signing receipts, keeping logs, etc. Therefore, little if any additional labor is needed to input data from the on-line consoles.

Controls of the updates in a batch system are conceptually easy, but because of the large number of persons and steps in the process many controls and control reports are required. (One complex application known to the author has 26 control reports.)

In an on-line system, the user gets an immediate hard copy plus an update transaction report daily. Discrepancies can be immediately corrected. Auditing is conceptually harder, but with careful design is not costly. To make sure that excessive errors are not made at the on-line consoles, careful selection, training, and control of personnel using the consoles is required.

The computer costs involved in the on-line update are similar to the computer costs in the batch process. Although updating is a complex process, the basic editing, locating the master record, changing the master record, replacing the master record, changing the control totals, etc., are about the same for batch and on-line systems, in terms of cpu time required.

The net result is a more accurate, timely file for the on-line system, with costs generally less than or equal to the batch process including the input phase, which in our example is $700 a week for ten terminals versus $1,000 per week for keypunching.

direct-access storage

Let's now look at DASD costs. The cost of storing a page of information with 40 100-character lines (4,000 characters) is $.12 a month. The cost of printing tapes is about $2.50 per thousand lines, or about $.10 per page.

The cost of the DASD device can be offset by the elimination of the printing of one report showing the entire data base during the month. The elimination of report printing is feasible with an on-line system since inquiries can be made at any time to answer the questions that were previously answered by referring to the printed report and to the changes made since the last printing. The on-line system gives better, shorter response time and more accurate responses to inquiries than any system using periodic printouts. If the printing of this data base report can be reduced from weekly to bi-weekly, the cost of DASD represents a significant savings compared to print costs.

In our example, the pro rata cost of DASD is 50,000

[3] "ICS—An information Control System," R. R. Brown and P. Nordyke, North American Rockwell Corporation, 1967.
(Presented to: FID/IFIPS 1967 Conference on Mechanized Information Storage, Retrieval, and Dissemination, at Rome, Italy, June 1967.)

records x 1,000 bytes/record x $.03/1,000 bytes = $1,500 a month. Printing the data base weekly costs:

50,000 records x 1,000 bytes/record x 1 line/100 bytes x $2.50/1,000 lines = $1,250 per week.

Printing the data base bi-weekly instead of weekly would obviously justify the cost of the DASD.

The cost of the additional core required for the on-line system depends on the number of on-line applications over which one can prorate this cost. A 360/50 should be capable of handling 100,000 simple on-line transactions a week and still have over 50% of its cpu cycles available for batch processing. This is an estimate based upon on-line processing time data collected on a limited set of applications on both IBM 1460 and 360/50. On a 360/50, data indicate that simple transactions require under 100 milliseconds (ms) of processing time. I/O times on a 2314 average between 200 and 300 ms per file access.

Since additional seeks are required to the index tables in order to locate data in an indexed sequential file, a typical transaction requires two or three accesses to DASD. The cpu is free for other processing during most of the disc seek time.

From this limited set of data we see that a 360/50 running 20 hours a day can process:

one transaction/sec. x 3,600 sec./hour x 20 hours/day x 5 days/week = 360,000 trans./week (for one message-handling program).

This, of course, is a maximum; a more reasonable number is 100,000 transactions a week. The amount of cpu time used is less than 100 ms/transaction; thus 100,000 transactions/week = 10,000 secs./week cpu time used. In one week of five 20-hour days, there are 5 days x 20 hours/day x 3,600 secs./hour = 360,000 secs. Thus, cpu time required for message processing is only 3% of the total available time. Other cpu time is needed for batch processing, file reorganization, restarting, etc. An estimate of 50% cpu time for on-line processing seems extremely generous.

Our sample application would then be charged 10,000 transactions/100,000 total transactions, or 1/10 of $1,000 a week or $100 a week for the prorated cost of the additional core storage, assuming a loaded system. This is about $.01 per transaction, or about $10 in addition to $70 terminal cost. In our example, this additional $100 per week still means that the terminal plus core allocation costs of $800 are less than keypunching costs of $1,000 per week.

Keeping the cost of core storage per application low is contingent upon effective loading of the system. The economics of computers demand heavy loading in order to keep the prorated cost for each job low. Overloading of on-line systems will ultimately lead to long queues and poor terminal response time. Insufficient data is available at this time to estimate optimum loadings for any given set of applications.

Careful system design is needed in order that the on-line system does not try to function as both a batch and on-line system and as a result incur the costs of both. Experience with early on-line systems often led to the misconception that these systems were necessarily more costly, but this was due to bad systems design and lack of adequate hardware and software.

In the early 1950's, many data processing designs were duplications of eam systems, generally very inefficient and very expensive. Some people still cling to the idea that you cannot beat a good eam system. This kind of thinking can also produce inefficient, high-cost on-line systems.

The development costs of a system have two parts, design and programming. Design costs are difficult to estimate and depend heavily on the experience of the designer. Design of on-line systems is demanding; but what good design isn't? Establishing a design team which understands a new technology is not easy, but the flexibility possible with on-line systems can soon overcome their lack of experience. The cost of design will in my opinion become less, but not before many expensive designs occur.

Programming costs are very similar for on-line and batch systems. This follows primarily from points 6 and 7 in our description of the on-line environment. North American Rockwell is writing its on-line transaction handling routines in COBOL with the exception of two standard subroutines which make concatenation and substringing easier.

other advantages of on-line processing

As was mentioned earlier, a major advantage of on-line processing is the separation of the updating and reporting process. Combined with careful system design, this makes it possible for changes to be made in either the input process, the output process, or the structure of the data base without affecting any of the other parts of the system. This advantage can also be achieved with a dedicated non-on-line disc storage system. To achieve this advantage, and at the same time standardize the programmer's approach to file organization and manipulation, North American Rockwell Corporation uses a system of standard disc routines called DL/I.[4] While the cost of developing DL/I is known, it is difficult to assess the savings it will produce. However, it is felt that the functional independence achieved may ultimately be the most important feature of this on-line system. One of the largest complaints about current data processing systems is not cost of operations but the large amount of elapsed time required to make changes in an implemented system. DL/I reduces such complaints.

Another economic advantage of an on-line system results from the fact that it is not subject to the large number of data errors in reports issued from batch systems, caused by the cyclic environment of batch processing. Many data changes take place while a batch is being collected. As a result, at processing time, some data are incorrect or already out of date. More important, in a rapidly changing data base correcting errors in a batch mode is very difficult and time consuming. With a large system having a two-week processing cycle, errors in the incoming data that are not caught prior to data base update remain in the file for four to six weeks at least. The amount of manpower used in trying to resolve these errors can be costly. Their existence is extremely frustrating to management. On the other hand, on-line systems are kept up to date perpetually, provide ease of error correction, and avoid lengthy cyclic re-processing. It is difficult to attach an economic value to file accuracy, but it may be a more significant factor than the direct costs already studied.

Though it is impossible to prove conclusively that on-line processing costs are less than batch processing costs, Brown's Conjecture states:

> *"In all data processing systems with high file activity, on-line processing costs are no more than conventional batch. With good systems design, on-line costs can be less for most cases. In all cases with nearly equal costs, the added effectiveness makes on-line systems vastly superior."*

For those who believe my conjecture, your organization should begin to plan your company's immediate entrance into on-line processing with your own equipment or through a data processing service bureau. For those in the service bureau business, establishment of a good capability to service this area is a key to future success. ■

[4] DL/I Manual—Space Division, North American Rockwell Corporation.

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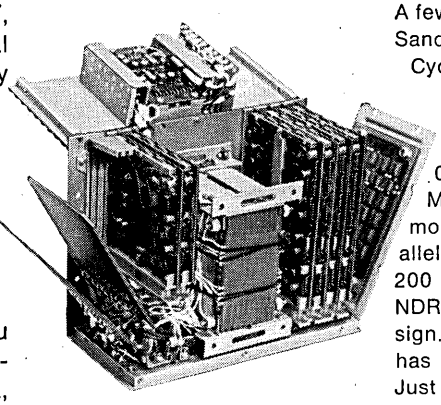

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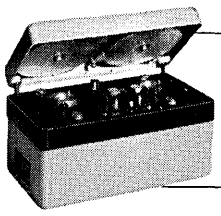

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CIRCLE 21 ON READER CARD

ncr's new offering

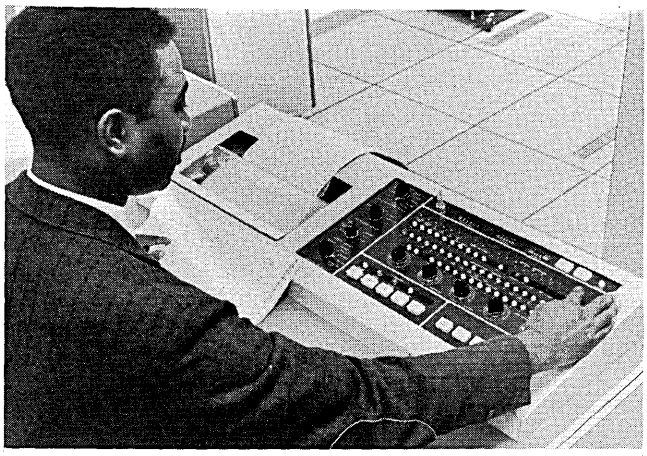
THE CENTURY SERIES

The long-anticipated introduction of NCR's new computer line took place with a series of worldwide meetings and demonstrations on March 5.

The launching covered a family of new systems, christened the Century Series. Two members of the family were demonstrated and announced as available for September delivery. The Century-100 is a low-cost configuration. With a rental under $2350 per month, this is said to be the lowest cost system yet introduced with disc file and full operating system capabilities. On long-term leases, the price will be under $2,000. The basic configuration is 16K core, disc drive, card or tape reader, and 450 lpm printer. The Century-200 is a medium-range system.

Also announced was a large-scale, multi-processing system, the Century-400, but details are not yet available and delivery is at least a couple of years away.

The family features upward compatibility of programs: any program written for the smallest configuration available can run, without modification or revision, on any other system within the family.



The company also noted that COBOL and FORTRAN are both available on all systems—including the basic, 16K model. The Century-100 is said to be the smallest system capable of using COBOL. This is achieved through use of a subset, supplemented with disc file references for extended commands. The Century-100 also offers a FORTRAN II. FORTRAN IV is available on larger models.

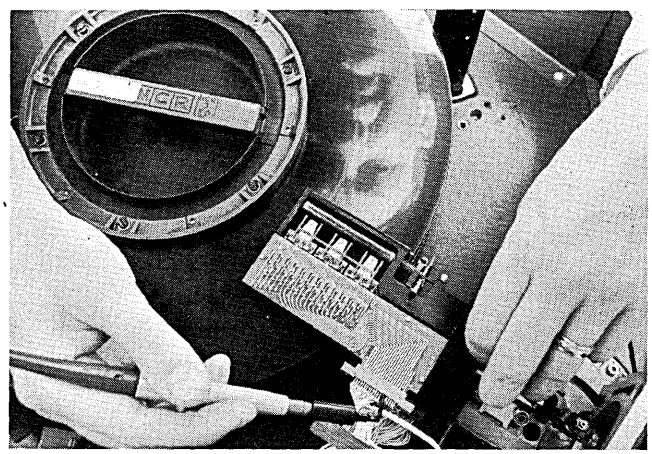
All Century systems offer NEAT/3, a proprietary programming language, as a major part of the software. This package is said to handle such functions as collating, merging, and file updating without requiring coding.

All Century Series systems use a basic 16K thin-film rod memory module, similar to that of the 315. Memory cycle time is 800 nanoseconds.

Each installation will get a disc file with one pack designated as the "system disc." The basic disc drive, newly introduced with the Century Series line, houses two removable packs, each with approximately 4.2 million bytes of capacity. One of these packs, subject to change, will be designated as the system disc. Up to 13% of the storage area on this pack will be dedicated for peripheral storage of software, diagnostics, peripheral identification tables and a continuous log of software utilization and system malfunctions.

At startup, resident executive routines are read from the system disc into main memory. Separate executive routines on the same disc are provided for monitor and I/O operations. Thus the disc represents a vehicle for software updating. As new software routines are written, they will be distributed on discs to NCR branch offices. The new routines will then be copied onto the system disc at customer installations.

All Century Series systems use a single monolithic circuit



throughout the logic, arithmetic and several functional areas. This single circuit is combined on a total of only 16 wiring boards for memory and logic operations.

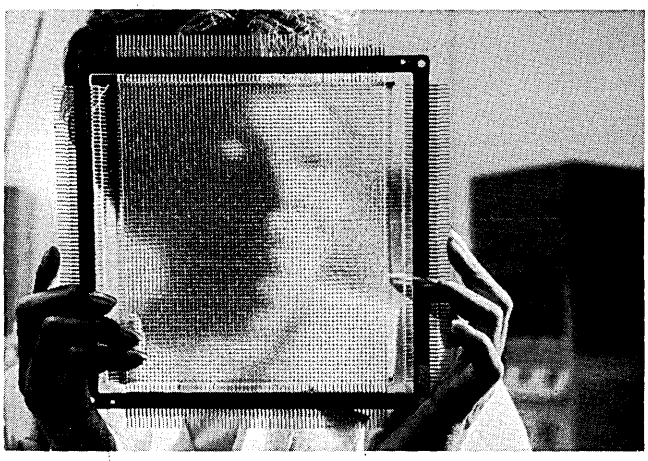
The Century-100 accesses one byte at a time; the 200, two; and the 400, four. Even the lowest cost system includes up to 63 index registers. Printers, disc drives, card and tape readers share memory, power supply, and logic elements with the central processor.

The removable-pack disc files include 12-head read/write assemblies which cover the 192-track cobalt-plated discs with 16 discreet moves of a maximum of .2". Movement time for the heads averages 40 milliseconds, with a maximum of 70 and a minimum of 0.

As peripherals to the new systems, NCR also introduced a new line of CRAM (Card Random Access Memory) files. Access time has been reduced to an average of 125 milli-

seconds while capacity has been expanded substantially to 125 million characters per file. Eight CRAM files may be linked with a single controller.

Interfacing of peripherals is through common trunks. The Century Series processors and software recognize all peripherals as equal and interchangeable. This is because all code conversion and formatting is done within the peripherals themselves.



Character formatting for all peripheral transmission and communications operations is in USASI codes.

The NCR accounting machine and data processing sales force has been given further training to support this new line, including systems indoctrination, application development and programming techniques. Some 2,000 marketing organization personnel have been trained for selling and supporting computer systems.

Two separate simulation/emulation packages are available for the Century-200. For NCR 315 systems, simulation is established through a combination of processor features and a cabinet with special circuitry. These features are supported by hardware emulation. Compute speed under simulation/emulation is at a ratio of 2.5:1 as compared with conventional 315 systems.

Simulation for IBM 1401, 1440 and 1460 systems is achieved through the addition of several circuit cards to the processor and the use of an emulator program. Compute speed is at a 1:1 ratio with the 1401. For the 1440 and 1460, compute speeds are proportionate.

With third generation systems, compatibility will be achieved through USASI standard COBOL and FORTRAN. ■

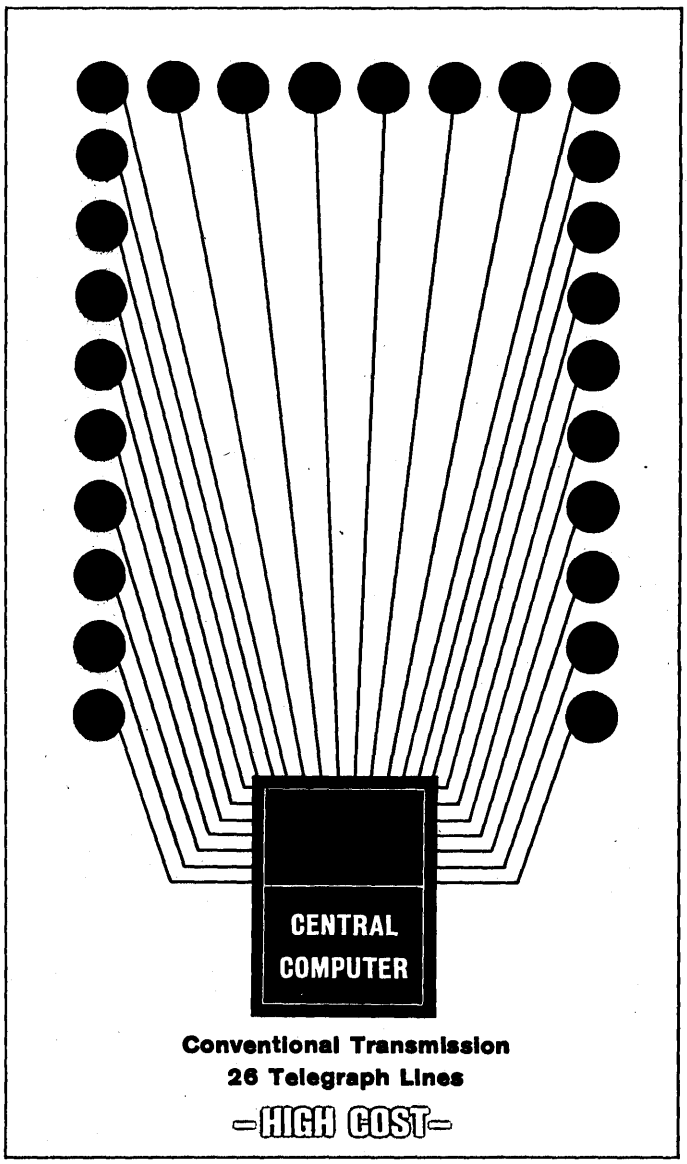
CIRCLE 190 ON READER CARD

CENTURY SERIES SPECIFICATIONS

PROCESSOR	Century-100	Century-200
Cycle time	800 nsec	800 nsec
Memory size	16K and 32K	32K, 64K, 128K, 256K, 384K, 512K
I/O common trunks (8 positions per trunk)	2	8
DISC FILES		
(REMOVABLE-PACK)		
Total capacity	8,388,600 bytes	
Capacity per pack	4,194,300 bytes	
Number of tracks per disc	192	
Disc size	7" i.d., 14.3" o.d.	
Disc coating	Nickel-cobalt plated	
Head structure	12 "flying" read/write heads per assembly	
Access time, maximum	70 msec	
Access time, average	48 msec	
Access time, minimum	20 msec	
CRAM FILES		
Capacity per file	125 million bytes	
Average access time	125 msec	
Re-access time	23 msec	
Transfer rate	64K cps	
LINE PRINTERS		
(REVOLVING DRUM)		
With Century-100	Slow speed: 450 lpm maximum High speed: 450 lines alphanumeric 900 lines numeric	
With Century-200	Alphanumeric speeds to 1,500 lpm; numeric to 3,000	
Characters	132 per line on Century-100 132 or 160 per line on Century-200 64 characters in full set; 52 when double set of numbers is used	
Lister attachment	Prints six 22-column tapes at 2,000 lpm	

OTHER PERIPHERALS

Full lines of magnetic tape handlers, card readers and punches, punched tape readers and punches, MICR sorters, optical journal tape readers, communications interfaces and terminals are available.



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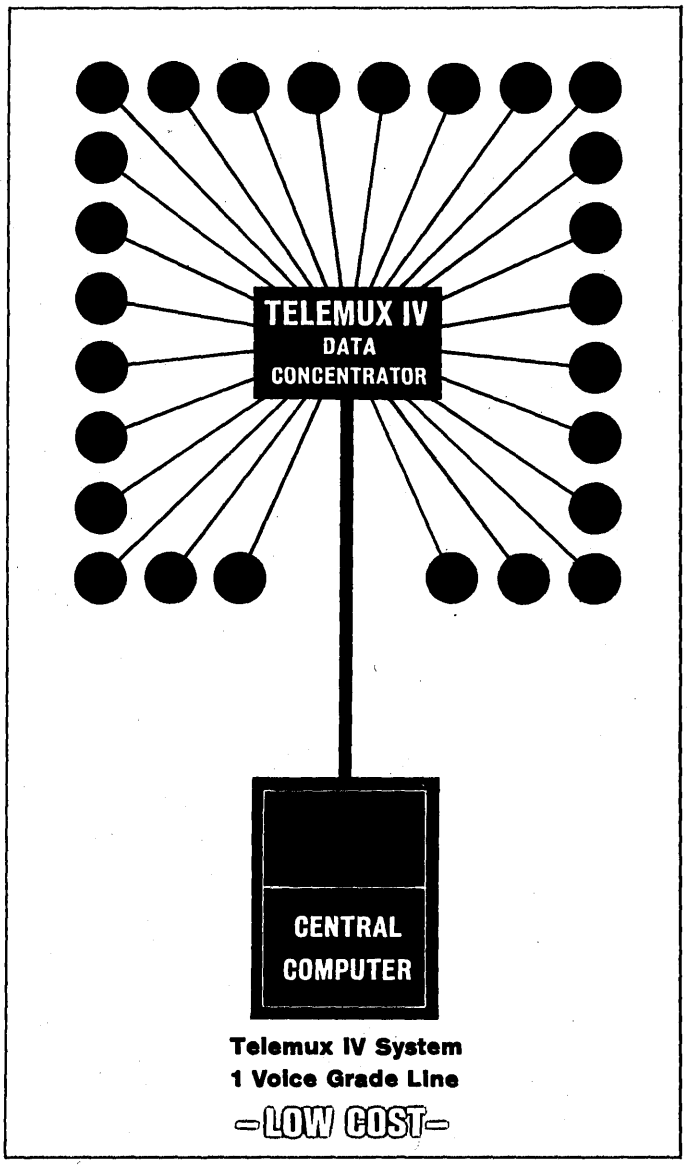

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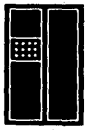

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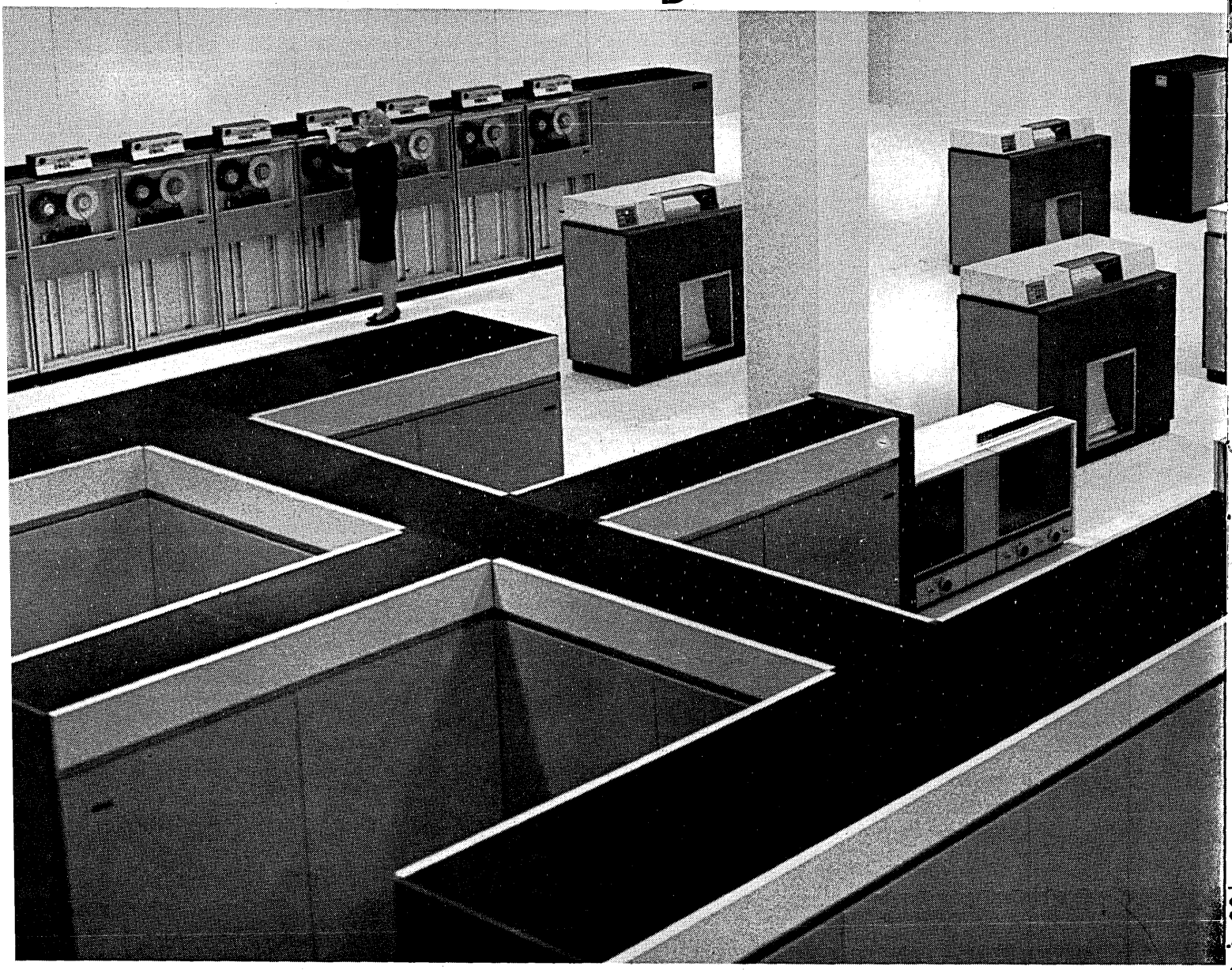
CIRCLE 22 ON READER CARD

IBM introduces the new System/360

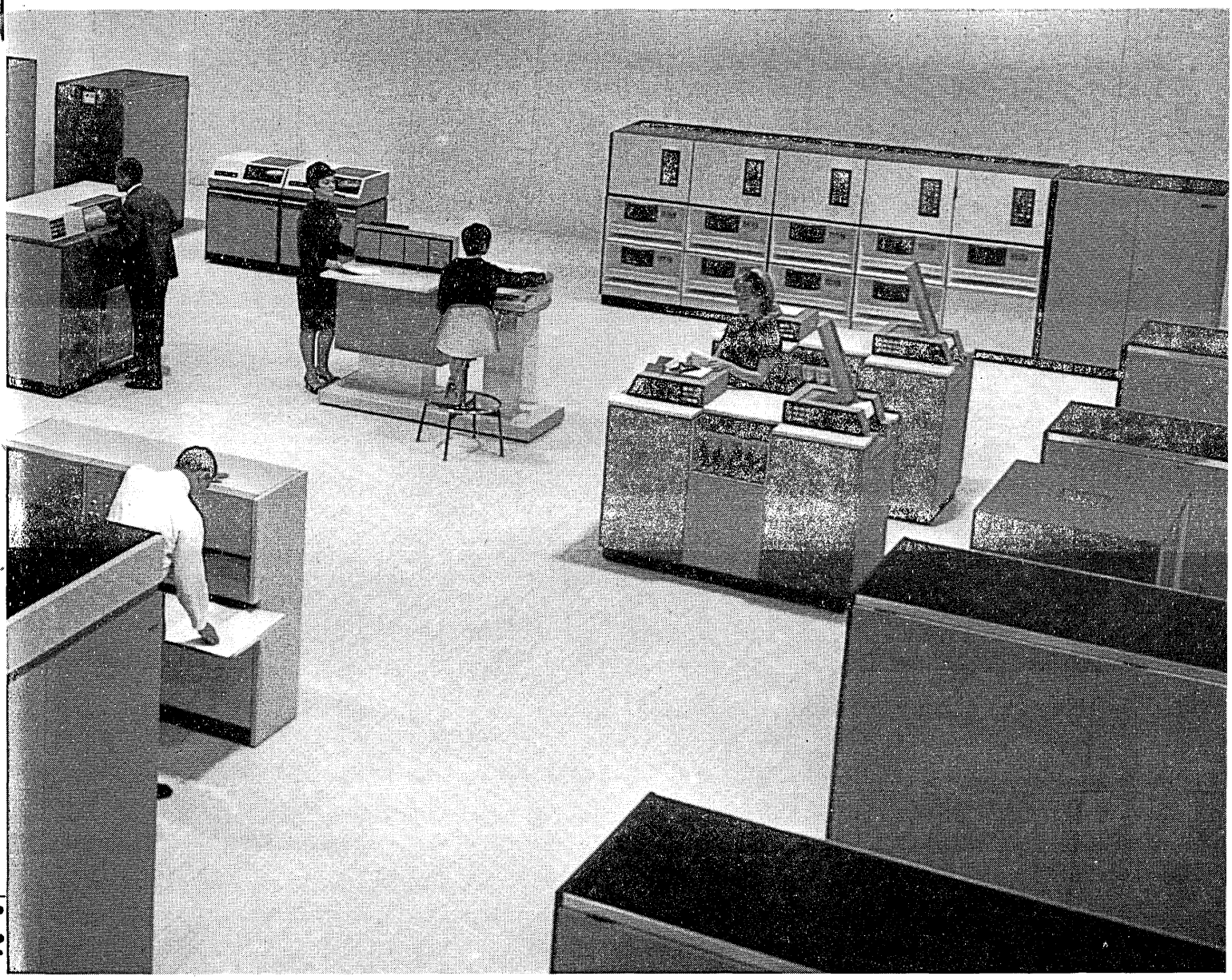


It's big. Big enough to take on scientific or commercial jobs for companies that need more powerful computing. It has an expanded main storage capacity four times greater than the next largest model of System/360. And it's fast.

This combination of size and speed means that in scientific areas you can solve more complex problems faster... problems like differential equations, linear programs, matrix inversions or simulations.

In commercial areas you can use Model 85 for the complete range of business applications, from determining optimum use of resources to general accounting. But now you can do them faster than before. Probably the most important feature

Model 85.



is compatibility—the ability to grow into this model from a smaller model, without reprogramming.

Model 85 is backed with tested programming support including FORTRAN, COBOL and PL/I. It's backed with a library of application programs for both science and industry. And it's backed with the IBM Operating System/360, a comprehensive set of language translators and service programs.

In 1964, IBM announced System/360 as an open-ended system capable of satisfying a wide range of computing needs. Model 85 is part of this concept.

Model 85 is not for everyone. But if you have large-scale and expanding computing needs, think Model 85.

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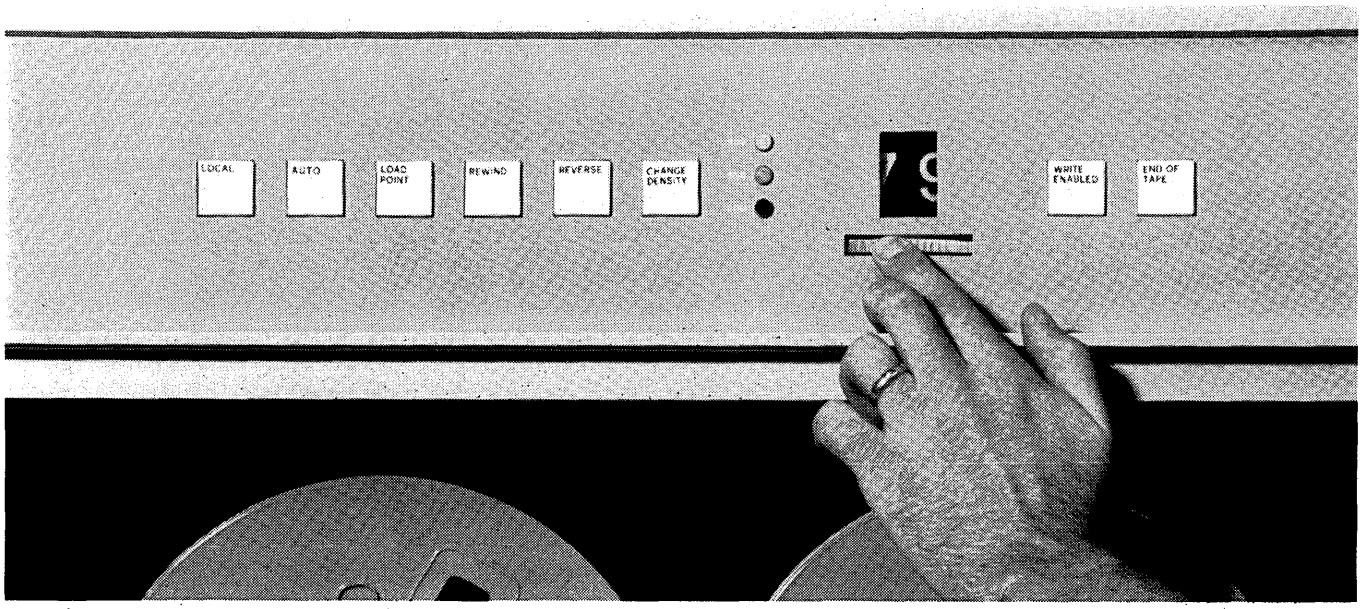

Reading both 7 and 9 track digital tapes?

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A single tape unit that reads both of the industry-standard digital tape recording formats—with format selection at the flip of a switch. You no longer need *two* tape units for those installations processing computer-written tapes; include a Hewlett-Packard READ/READ Tape Unit that will read *both*.

Think of the savings this offers in the design and production of *your* digital system—and the flexibility you'll be able to offer the *user*.

Your choice of tape units for READ/READ operation may be either the 3030 Series with tape speeds to 75 ips, or the 2020 Series offering the optimum in economy of tape speeds below 45 ips.

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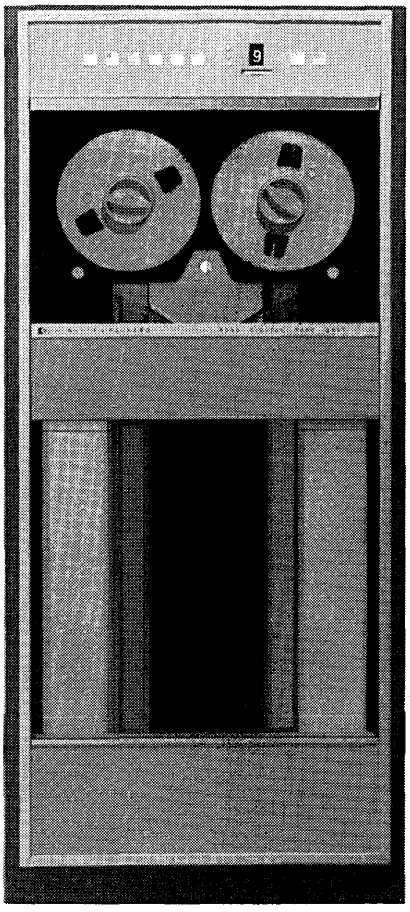
For more details, call your local HP field engineer or write Hewlett-Packard, 690 Middlefield Road, Mountain View, California 94040.



3030 SERIES

HEWLETT hp PACKARD

MAGNETIC RECORDERS

CIRCLE 23 ON READER CARD

THE DEMISE OF THE KEYPUNCH

new, inexpensive input devices

by MALCOLM K. LEE

Recently, a group of data processing management people from another department store visited the May Company of California headquarters in Los Angeles to compare notes about the newly-computerized charge account billing operations. The visitors were with a slightly smaller department store. They, too, were in the process of converting from a manual billing machine to a computerized accounts receivable system. It developed quickly that the real focal point of their interest was the cost of getting data into the computer. A little discussion showed why: In comparing notes, it developed that their expense for keypunches alone was equal to 50% of all the equipment rental in our two-computer installation.

cost sensitivity increasing

For our part, this encounter helped to crystallize some of our own thinking about input specifically, and about overall data processing costs in general. We are convinced that the data processing industry is experiencing two major, significant trends concurrently:

1. Increased capabilities are being introduced, largely through new generation hardware.
2. At the same time, management people are becoming increasingly sophisticated in the art (it is not yet a science) of evaluating data processing costs.

The area of expenses for data processing operations will, we are convinced, become increasingly sensitive in the immediate future—starting from right now and continuing for three to five years. This is partly because data processing users in general have been through, or are still experiencing, a financial blood bath through system conversions which are making a sham out of cost predictions and savings forecasts.

Increasing management sophistication bears on another facet of the same situation: There was a time when management was willing to accept internally-generated cost comparisons. That is, if a new data processing system could improve on a company's previous costs—if expenses were lower for bills issued by a computer than when the work was done manually—managers tended to feel they were ahead of the game. However, as applications have been standardized throughout whole industries, this has changed. Today, you have data processing costs at least as good as those of your competitor.

Our further experience leads us to believe that wherever cost consciousness becomes a factor, a serious review of input techniques will become mandatory. This, too, reflects the general industry situation. With present-generation hardware—supported by manufacturer-supplied application packages—computer processing itself is not likely to be the critical point of system efficiency for a business application. By comparison, however, our findings indicate that the chief input technique now being used, keypunching, has grown obsolete—that the day of the keypunch is finally drawing to a close.

At our data processing operations in both Los Angeles and Denver, keypunching either has been eliminated or is in the process of being phased out. In a variety of input applications, the transitions have delivered savings ranging from 30% upward. Depending on the specific application at hand, two separate, modern mechanical input techniques have been used to replace keypunching.

1. For alphanumeric data, we are using NCR 731 key-operated magnetic tape recorders.[1] Applications include master file conversions, file updating, program entry and program editing.
2. For entry of numeric transaction data, we are utilizing optical font sales registers and adding machines. These registers and adding machines make their entries on printed tapes in a series of stylized numbers and operating codes known as National Optical Font (NOF). Data en-

Mr. Lee heads his own company, Malcolm K. Lee & Associates, Minneapolis, which specializes in the design, development and installation of retail edp systems. His former position as manager of corporate data processing for the May Dept. Store Co. is the basis for the experiences related in this article.

[1]This machine, which closely resembles a keypunch, encodes data directly on magnetic tape for direct input through 200 bpi tape handlers. The 735, marketed nationally by NCR, is manufactured by the Mohawk Data Sciences Corp.

coded in this way can be read directly into data processing systems through optical journal tape reader peripherals. The adding machines are used primarily for accounts receivable numeric input from charge sales tickets. These units have built-in check digit verifiers for account number validation. The sales registers produce optical font journal tapes of all transactions. They are computer-processed as part of a highly automatic sales audit routine. In addition, we are well along, in Los Angeles, toward converting initial applications under which the sales registers will give input for detailed retail inventory control and buying operations.

Savings realized from these two new input techniques accrue, in turn, from two primary sources:

1. People
2. Equipment costs

beats labor shortage

In some instances, the chief advantage of the new input devices has been that they have enabled us to sidestep acute shortages of trained keypunch operators. With the 735, side-by-side tests have shown that output delivered by clerk-typists is comparable, both in productivity and accuracy, with that of trained keypunch operators.

In the case of the optical font adding machines, we have been able to use personnel with no previous applicable experience at all. They have been able to reach acceptable standards of productivity and accuracy within hours. In the case of adding machine input, over-all labor costs are down more than 25%.

Equipment costs, in the case of the 735 magnetic tape units, relate to flexibility and productivity. These machines, for example, can be switched for use in either input or verification mode with the simple flicking of a switch. One machine serves both purposes, providing greater flexibility. One of these magnetic tape units rents for about the same as a conventional keypunch and verifier. But, according to experience in converting a master file of some 165,000 accounts in Denver, the 735 input is easily one-third more productive than keypunching.

Significantly, the reasons for these improvements center chiefly around the elimination of features and capabilities generally regarded as advantages for keypunching. In the case of direct magnetic tape input, it is important to bear in mind that new concepts are at work. New standards of thinking must be accepted and adhered to by systems management people.

Specifically, the individual readable card is generally thought of as a major advantage in keypunching. In practice, however, our definitive tests have shown that operators spend altogether too much time handling cards. It is far better to backspace a "blind" magnetic tape and re-enter data than to take the time and trouble to examine cards column-by-column or patch the error hole.

When mistakes are made, they can be corrected on the magnetic tape unit through simple backspace and re-entry procedures. With a keypunch, the operator must throw away a card. All the work which went into creating it up to the point where the error is made is non-productive effort.

Further equipment savings can be realized in the computer room itself through the elimination of a card reading peripheral. In business data processing installations, card reading and punching capabilities can cost as much as 15-20% of total computer rental. When input is handled on the 735 units, these functions can now be processed, at magnetic tape speeds, on magnetic tape units.

With optical font adding machines, equipment savings are even more dramatic. This is illustrated by experience in the Los Angeles operation. Accounts receivable input is now handled on NCR TR-431 adding machines equipped with 411 check digit verifiers. These units were purchased outright at costs directly comparable with 20 months of rental on keypunch machines with check digit verification capabilities. Since input speeds of the adding machines and keypunches are about the same, our net effect is that we bring our input equipment costs to zero in 20 months. Based on the size of the Los Angeles operation, this one saving alone comes to close to $4,000 per month.

Savings just as substantial have been realized in the labor costs associated with accounts receivable input. Getting specific again, consider the average charge ticket document. It requires two lines of numeric data entries—a total of 17 digits. Per-ticket labor cost in Los Angeles today is a maximum of $.0039. In this particular labor market, keypunch entry costs would be at least 40% higher.

Cumulatively, then, accounts receivable input in Los Angeles is running less than half of what it would have been had we elected to keypunch the data.

As indicated, the new input techniques do require acceptance of different operating philosophies by data processing and systems management. These differences can be illustrated by looking briefly at the techniques used in the master file conversion in Denver and in accounts receivable input in Los Angeles.

master file conversion

In Denver, the accounts receivable master file was converted from manual posting on bookkeeping machines to an NCR 315-100 computer system. Concurrently, this store also converted a number of other applications including payroll and sales audit, from another computer system to the 315. This meant that up to eight keypunch machines were still available for master file conversion and other input applications. The 315 also had, on a temporary basis, a card reader.

This environment made for an ideal, head-to-head test between magnetic tape encoded and keypunch input. Source media were cards imprinted from the address plates. As indicated, the total conversion involved over 165,000 account master files.

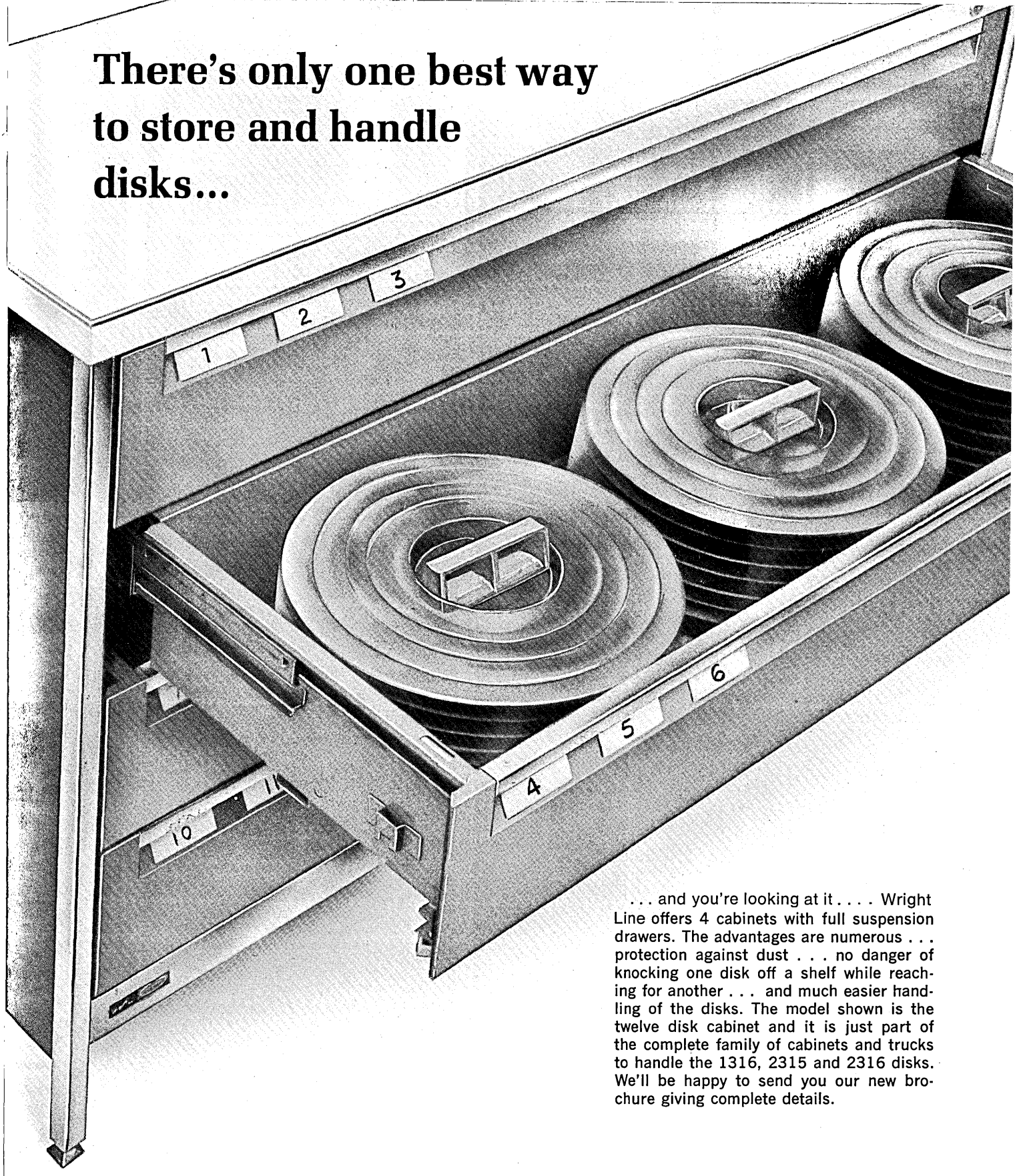
The great bulk of the conversion work was handled on two 735 units. On one of these machines, the work was done by clerk-typists with no previous data processing experience. On the other, veteran keypunch operators were assigned. The typists actually picked up the 735 operation a little faster than keypunch operators. Within a few days, however, both were averaging a minimum of 12,000 keystrokes per hour.

By comparison, a small amount of master file conversion input was processed on keypunch machines. Productivity, over-all, averaged 9,000 keystrokes per hour on the keypunches. Even where keypunches were used, our Denver people preferred the 735 for verification. Demonstrating the flexibility of the new input method, the original, unverified cards were run through the computer to capture their data on magnetic tape in 735 format. Verification was then handled on the 735 units.

Though outwardly a small point, it is worth noting that part of the preference which has emerged for the magnetic tape input devices on the part of the operators lies in the more pleasant surroundings which are generated. Specifically, the 735 machines are virtually noiseless. Veteran keypunch operators, in particular, find it immediately refreshing to get away from the constant din generated by conventional card punch machines.

File maintenance or program changes entered through a 735, incidentally, are generally set up for match-merge tape updating by the computer. The operator enters the file number, field number and new data. Updating is handled

There's only one best way to store and handle disks...



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DATA PROCESSING ACCESSORIES

Circle Reader Service Card No. 102

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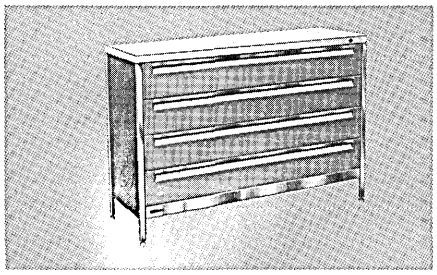

DISK PACK STORAGE

Full suspension drawer cabinets and library units for maximum safety and protection for both 4″ and 6″ disks. Counter height cabinets have plastic laminate tops.

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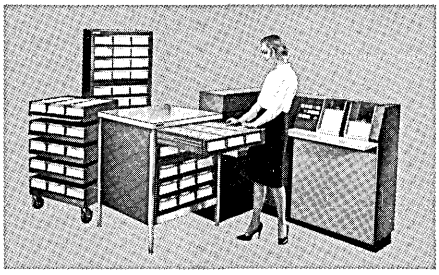

GOLD STAR FILES

The most beautiful and most versatile card files available today. Line includes counter top model with plastic laminate surface, truck and transfer files.

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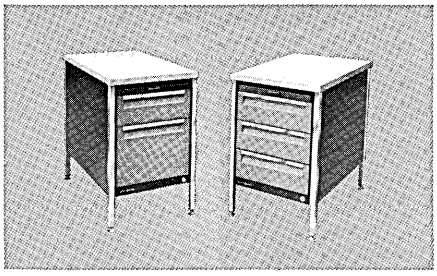

KEY PUNCH DESK

Provide complete work stations by adding work surface and drawer space at the key punch machines. Attractively styled units for use with all key punches.

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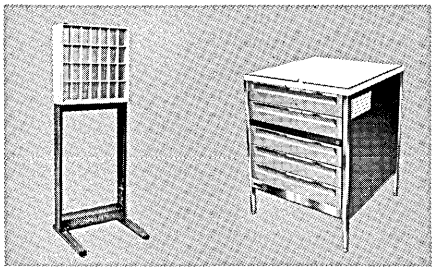

COMPUTER ACCESSORIES

Custom designed accessories for third generation computers. Line includes Data Stations and Control Centers with efficiency tops plus card handling and storage equipment.

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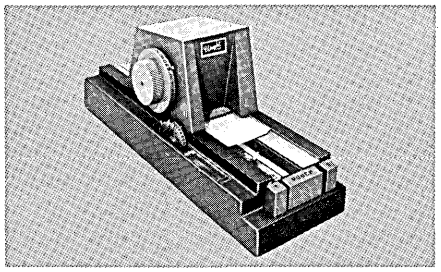

PORTABLE CARD PUNCHES

Models for punching only or for punching and simultaneously printing. Printing punch has tab stops. Plastic card punch for Hollerith and other coding in plastic badges and cards.

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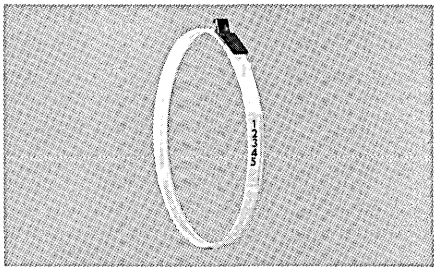

TAPE-SEAL® SYSTEM

The safest, easiest handling, most economical method of storing tape. Complete line of Tape-Seal cabinets, trucks and accessories is beautifully styled to compliment computer equipment.

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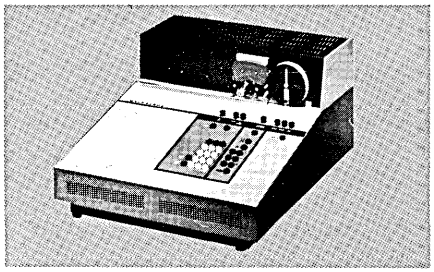

MATHATRON

Much more than just a calculator, Mathatron has the capability to solve complex problems that are written directly with the keys. Mathatron can also be programmed and can make logical decisions.

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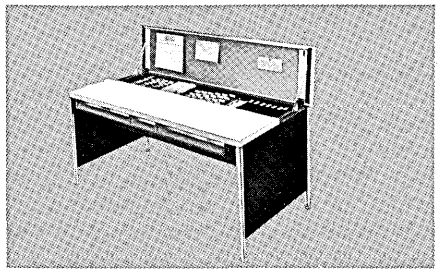

DATA STATIONS

Specifically designed for data processing applications, Data Stations combine the best features of a desk and a tub file with custom storage for cards and supplies.

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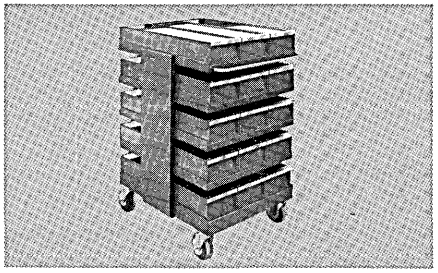

TRUCKS

Custom trucks for transporting cards, tape, disk packs and all other data processing supplies. Trucks combine straight tracking with easy turning and ramping.

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• TUB FILES • GUIDES • CONTROL PANELS • PANEL STORAGE • BINDERS • DATA-CELL STORAGE • SORTING RACKS • Wright Line serves the data processing field exclusively with full-time Wright Line field specialists in all areas of the United States, Canada and throughout the world.

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DATA PROCESSING ACCESSORIES

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A DIVISION OF BARRY WRIGHT CORPORATION

by the computer itself, which produces a printout of changes and/or new file records for visual auditing and verification.

accounts receivable input

The accounts receivable operation in Los Angeles is of major magnitude. This May Co. division maintains almost a million charge accounts. Transactions peak to over 100,000 daily.

Transaction input is routed through the sales audit department which handles its balancing partly with the help of the computer. As indicated, 40% of control registers in the Los Angeles area stores now produce optical journal tapes. Individual registers are computer balanced, with printed journals sent daily to the sales audit department.

For accounts receivable input, charge sale tickets are batched in groups of not more than 300. On each batch, sales auditors place a header document which includes an item count and charge balance.

These batches are distributed as working units to the operators of the new adding machines. At the beginning of each batch, the balance and other control data is entered by the operator. Then, for each charge ticket, the operator enters the account number first. This is authenticated with a light signal from the check digit verifier. Then, for actual transactions, the operator enters, in a single line, the department code and amount of purchase. At the completion of the batch, the adding machine total is pulled. In the great majority of cases, these zero balance against the input.

Before the input is released to the computer, all batches of documents are checked at an audit desk. Balance errors of less than $1.00 per batch can be written off on the spot, though the out of balance conditions are noted and accounted for. Errors of more than $1.00 are traced by comparing the printed adding machine tapes with the documents. Entry errors, when they are found, can be corrected simply by re-entering the transactions on an adding machine tape and attaching the corrections to the end of the original tape. The errors can either be crossed off to render them unreadable or they can be picked up and adjusted by the computer. If errors are spotted in the sales audit transmittal, it requires two signatures, one from the sales audit department, the other from the input section, to authorize the adjustment.

This degree of audit control over input items is, we believe, beyond the capacity of verification through any keypunch techniques short of full keystroke verification, which is out of the question, because of the expense, for a job of this magnitude. To illustrate: during the first three months of optical adding machine input, including both account conversions and new data entries, more than 300,000 transactions, worth some $6.5 million, were processed. In this entire volume, a total of $0.54 was out of balance. When this performance was brought to light, input department auditor, Arthur Spence, assured us that he knew where the out-of-balance condition existed and that he could correct it if we wished. However, Sam Shaffer, our controller, accepted the difference—provided it would not happen again!

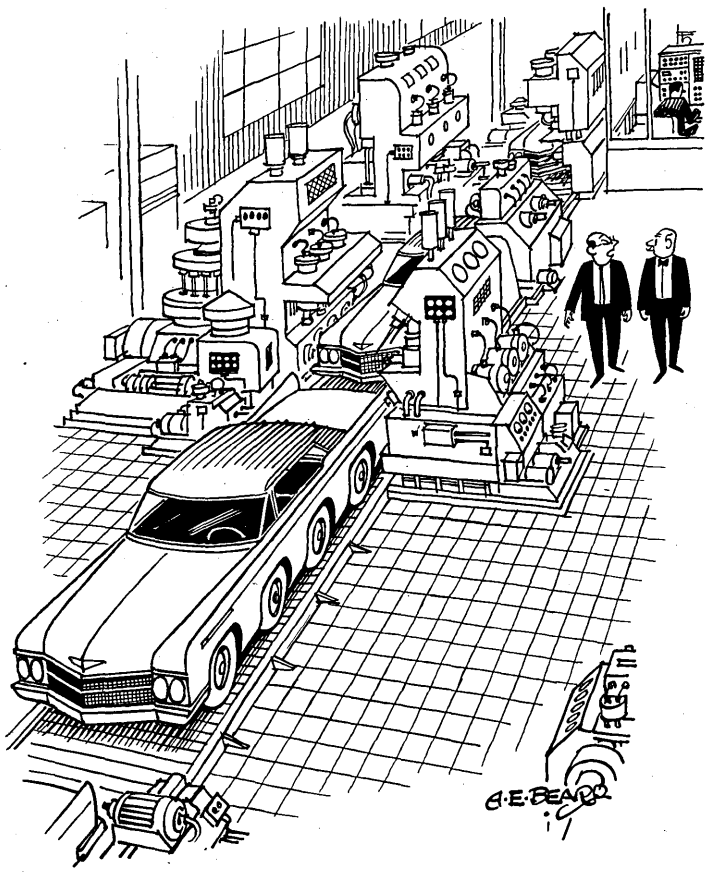
A feature worth noting in connection with both magnetic tape and optical journal tape input is that these methods eliminate the transmission of loose source documents to the computer room. With optical input, it is possible to get a caliber of input backup which has previously been unavailable. All entries are made on two-part, NCR carbonless paper tapes. After transactions for a batch of charge tickets have been captured, the duplicate tape is folded and kept with the batch. Should the original tape become lost or mutilated, the duplicate tape can be used for direct computer entry—eliminating the possible requirement for "re-punching" this data.

The cost of optical input is minimized by the technique used in our Los Angeles computer room. We actually have two separate systems installed there. Input, output and general housekeeping are handled on an NCR 315-100, while actual volume computation is handled on a tape-oriented NCR 315 RMC. Except for switchable tape drives, the two systems operate independently of each other.

The 315-100 is set up for multi-programming operation. On an interleaving basis, this system operates two NCR 420-2 optical journal readers at close to their full speed and also two 900-line-per-minute printers. This means that the I/O system can be converting optical input data to magnetic tape for processing on the RMC concurrently with the reading of RMC-created tapes for the writing of customer charge statements and management merchandising reports.

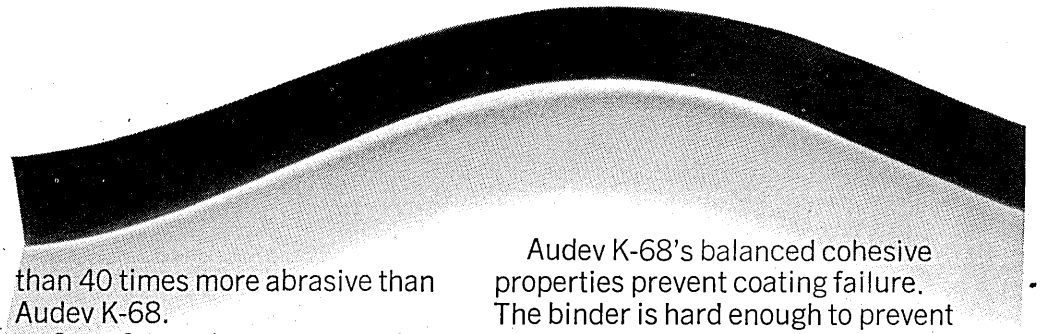
Under the conditions described here, it is clear that the keypunch has become obsolete as a device for handling the volume of data being processed. The savings of $16,000 to $18,000 per year in card costs alone are significant. But over-all improvements are far greater—into the range of six-figure dollar amounts annually.

Based on this experience, it would seem worthwhile for managers of data processing installations handling large volumes of keypunching to re-examine their input costs. The time has come when more efficient and economical methods are available to effect the savings for which cost-conscious management is continually pressing. ■



"Our only trouble at present is a shortage of really efficient computer programmers."

At last! The computer tape that's not "too good to be true."



Some tapes are. That is, certain of their properties are made "too good." Often at the expense of other, equally important characteristics.

Outstanding tape durability can be gained at the expense of increased head wear; remarkable coating adhesion could mask inherent internal weakness (and result in premature breakdown); "high-powered" magnetic properties may cause the tape to be electrically incompatible with your computer system.

Because magnetic tape properties are frequently interdependent, often conflicting, we make no boasts of specific superiorities for our new Audev K-68 computer tape.

Instead, we deliver a premium tape in which all the critical characteristics have been *balanced* to provide a high initial quality that will not deteriorate with storage or hard use.

What do we mean by balance? Read on.

It's a dirty shame what some "clean" tapes do to your heads.

To begin with, we know what happens when balance is lacking. There is, for example, one computer tape on the market that is excellent in its freedom from dropouts. It makes a remarkable "first-pass" impression. Yet, an imbalance in key properties makes this tape more than 40 times more abrasive than Audev K-68.

One of those key properties is friction, both static and dynamic. And one way to reduce friction is by lubricating the surface of the tape. But this "trick" solution is short-lived and tends to distort start/stop performance.

In Audev K-68, we attacked the problem differently. Carefully combining binder ingredients, processing and surface treatment for proper static and dynamic frictional balance, we've produced a wear-resistant surface that will not break down on high-speed transports.

But, you might ask, couldn't a really hard binder accomplish pretty much the same result? We say...

Don't get stuck by the "sticky tape" test.

Take one of those tough tapes and torture it. No amount of pulling, scratching or stripping off with pressure-sensitive tape will cause the surface to flake or shed oxide.

But this, too, may be an imbalance. What you may not see is a stiffness and brittleness which could make the edges particularly vulnerable to damage.

Audev K-68's balanced cohesive properties prevent coating failure. The binder is hard enough to prevent self-generated dirt caused by abrasion, yet tough enough to keep the edges from deteriorating.

At the same time, K-68's smooth, non-sticky coating provides few anchoring possibilities for ambient dirt or oxide redeposit. And its low resistivity virtually eliminates electrostatic pull on floating dust.

Balance also affects a tape's electrical characteristics.

We do our bit for today's high densities.

The higher bit densities of today's computer systems make demands that previously acceptable tapes can no longer meet. Use of a marginal tape in such circumstances often results in a gradual deterioration of quality. Dropouts increase; costly computer time is lost.

Audev K-68 takes these new, stringent conditions into consideration. Its magnetic properties, coating thickness and surface smoothness are balanced for total compatibility with all computer systems and for equal performance at densities from 556 bpi to 3200 fci and beyond.

How? A balanced interplay between low loss magnetics, precise

coating thickness and surface smoothness reduces pulse crowding, peak shift and dropout sensitivity without changing output or write current requirements.

K-68's balance also contributes to its environmental stability.

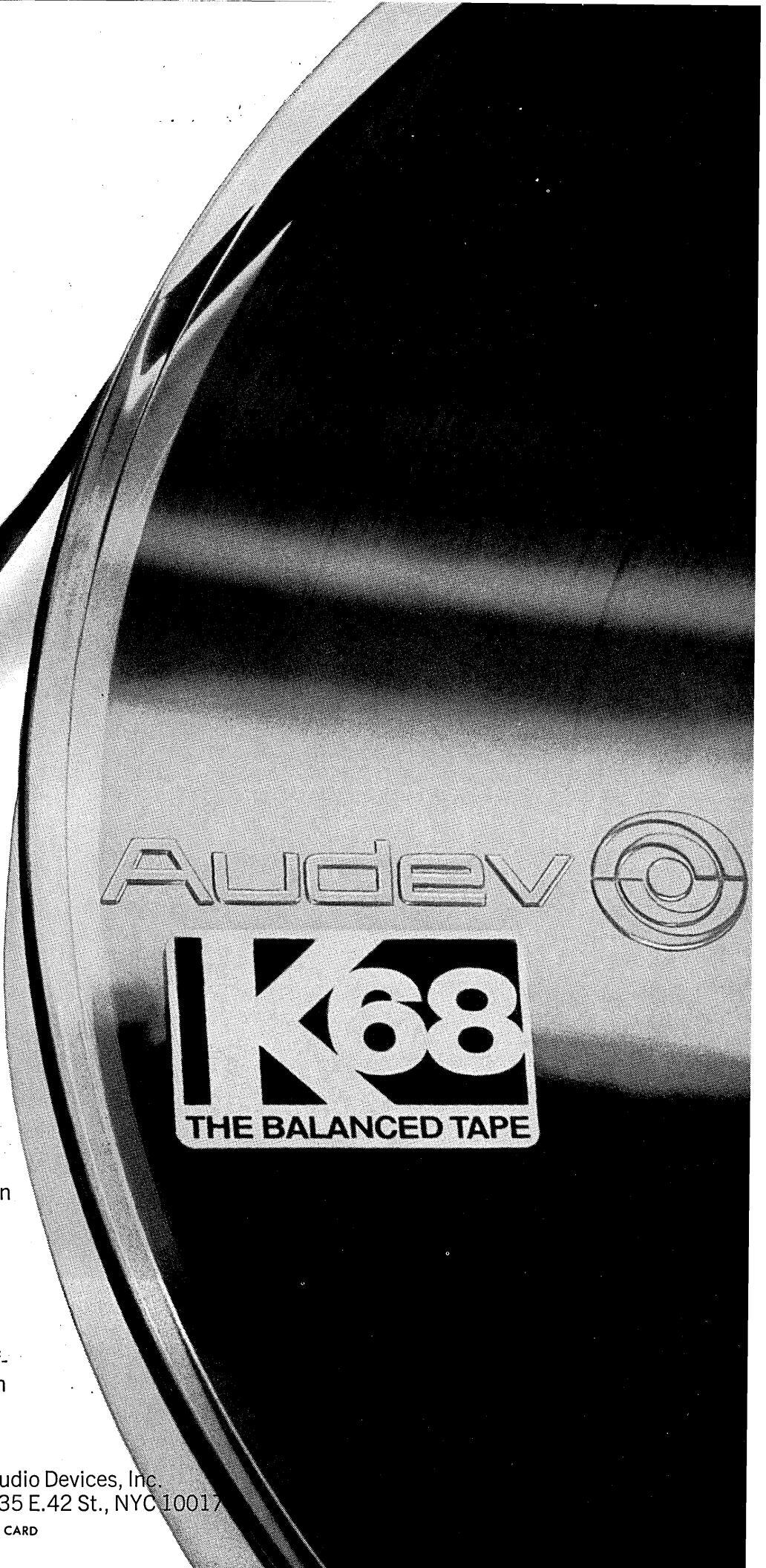
Keep cool. K-68 can take the heat.

Some tapes are as perishable as ripe tomatoes. They react poorly to temperature extremes in storage or transit; they "bruise" easily when moved from transport to transport.

Not Audev K-68. Base and coating properties have been balanced to provide uniform dimensional behavior. Cupping, curling and edge ripples caused by differential expansion or contraction of coating and base have been virtually eliminated.

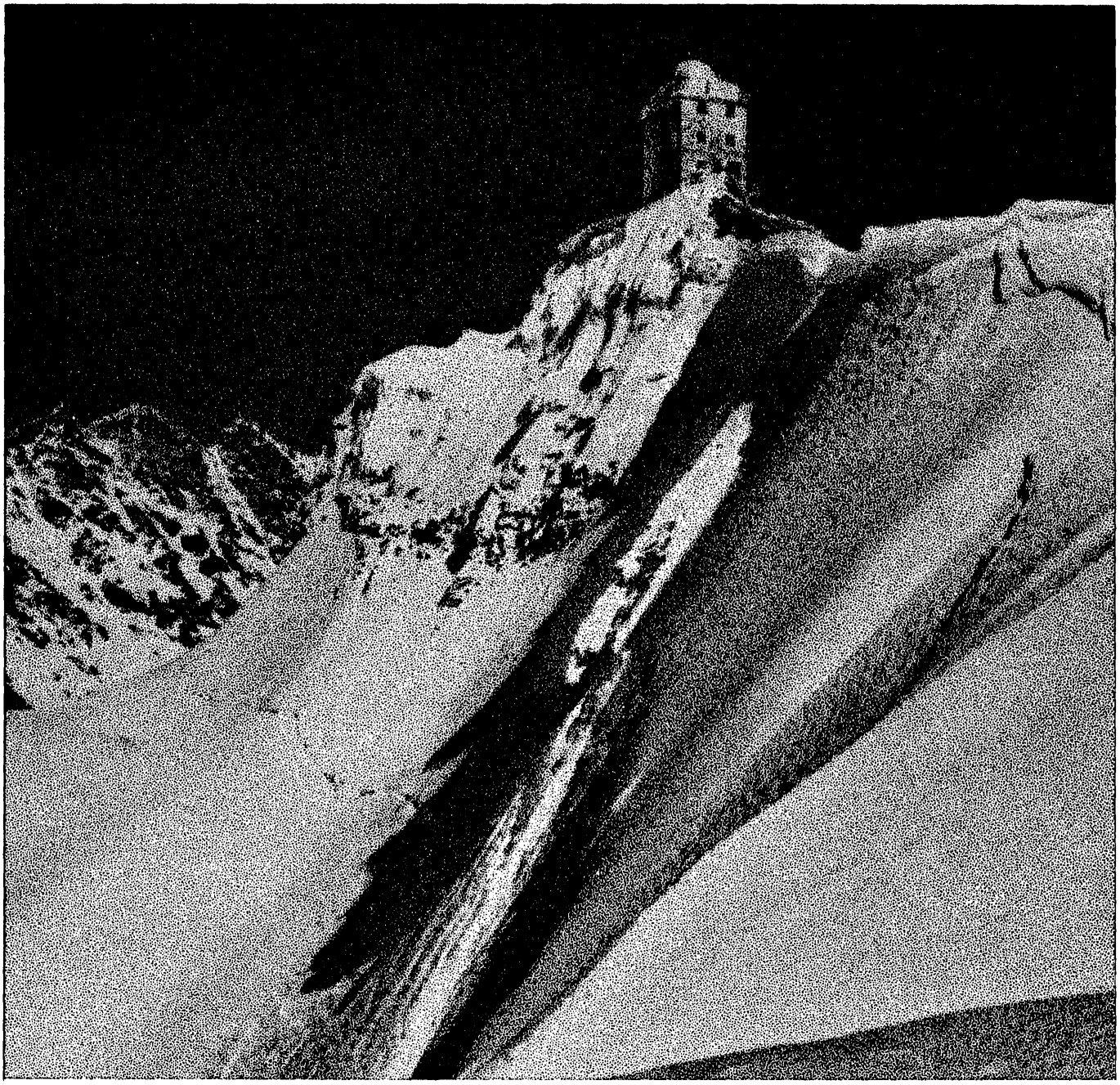
Nor is Audev K-68 prone to skew-produced, time-displacement errors. Precision slitting, together with the scientifically designed Audev reel—and the low moment-of-inertia of the tape/reel combination—provide smooth tape motion on any transport.

Test a sample reel on your transport. For a change, try a balance, not a compromise.



Audio Devices, Inc.
235 E.42 St., NYC 10017

CIRCLE 24 ON READER CARD



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DIGITAL DEVELOPMENT CORPORATION

CIRCLE 25 ON READER CARD

A POTENTIAL SAVINGS YARDSTICK

by V. W. RUSKIN

Many articles on edp stress the importance of thorough and detailed analysis of information system design, computer hardware performance and cost, software, staffing, cost of stationery, forms, installation, conversion and operation, prior to issuing computer equipment specifications.

However, no one, to the best of the writer's knowledge, has ever isolated and quantified the relative importance of these factors to company profit (or expenses).

A fortunate coincidence recently enabled the writer to quantify these factors precisely in the case of two medium-sized companies of comparable size in the same industry. It is hoped that the comparisons presented in this article will provide company executives and edp managers with a yardstick on the relative system analysis and design effort that is justified in terms of potential savings.

The writer was recently asked to review, and advise on, the edp systems of two companies in the same industry, both having about 200,000 customers, sales of $30 to $50 million annually, and about 1,000 employees, but located in different parts of the country. In both companies, customer accounting and billing was the largest edp task, representing about two-thirds of the system workload. The balance consisted of present and future programs for management information reports, general accounting, payroll, plant accounting, inventory, shareholders' records, sales, purchases, engineering, operations and dispatching.

The companies adopted quite different approaches and selected two different systems, two different manufacturers, different machine and peripheral equipment configurations, and widely differing levels of staffing, to do essentially identical jobs.

Fig. 1 shows the total edp expenditures of Company A were 62% greater than those of Company B. To show the relative size of the various cost components, all costs are expressed per dollar of the more economical hardware selected by Company B.

The first question that comes to mind is "how much of this difference in total edp costs is due to selection of a different hardware manufacturer?"

Company B had previously obtained a quotation for its specified equipment configuration from the same manufacturer that Company A placed its order with. If we used this manufacturer's quotation to eliminate any variation due to different manufacturers, we then arrive at the comparison shown in Fig. 2. This shows that the total edp expenditures of Company A would still be 55% greater than those of Company B, even if management policy were to stick to one manufacturer, and not to go to competitive bids from others. Thus, the difference in edp costs between the companies was only slightly affected by choice of manufacturer, and must largely be influenced by other differences, which will be discussed below.

difference in systems

The next question is, "Was there a difference in approach that might cause the large difference in total edp costs even if the same manufacturer were used?" (See Fig. 2).

Company B undertook a time-consuming and detailed system design *before* issuing a tender specification to various manufacturers for equipment.

Company A initially satisfied itself that a new (third generation) basic machine would be more versatile and less expensive than the aggregate costs of the two smaller (second generation) computers it would replace. Company A then ordered the new basic machine. Subsequently they then finalized and made what changes in the order for peripherals were thought to be necessary as they pro-

Dr. Ruskin is a partner of P. S. Ross & Partners, president of V. W. Ruskin & Associates Engineering Ltd., and a special lecturer at the Univ. of British Columbia, department of mechanical engineering. He has a master's degree in business administration and a PhD in engineering.

ceeded with system planning and design. It was considered unfortunate but unavoidable that by the time the order was finalized, the rental cost of machine and peripherals had climbed above the estimate on which the original decision was based.

Company A's billing system design was based on their present method of billing. Their 200,000 customers were divided into 20 billing cycles per month, each on a separate tape reel. For safety reasons, accounts were to be copied on "father" and "grandfather" files which were to be updated, so that 60 billing files have to be continually

ITEM		COMPANY A		COMPANY B
Hardware Rental				
Computers, peripherals and tab equipment		$1.69 per year		$1.00 per year (Base)*
Stationery, Forms		0.41 per year		0.26 per year
Amortization of start-up and Facilities Cost**		0.05 per year		0.03 per year
Staff				
Analysts and Programmers	$0.36		$0.29	
Operators	0.53		0.29	
Keypunch	0.59		0.34	
Managers and Chiefs	0.22		0.16	
Subtotal Staff		$1.70 per year		$1.08 per year
TOTAL—EDP COSTS		$3.85 per year		$2.37 per year
PERCENT		162%		100%

Notes: *All costs are compared per dollar of the more economical hardwa re selected by Company B.

**Five-year amortization of costs of additional air conditioning, elevated flooring, power supply, initial stock of tapes and discs, staff training, parallel running during conversion.

Fig. 1. Comparison of Annual EDP Costs to Perform Essentially the Same Job

ITEM		COMPANY A		COMPANY B
Hardware Rental				
Computers, peripherals and tab equipment		$1.69 per year		$1.12 per year
Stationery, Forms		0.41 per year		0.26 per year
Amortization of start-up and Facilities Cost		0.05 per year		0.03 per year
Staff				
Analysts and Programmers	$0.36		$0.29	
Operators	0.53		0.29	
Keypunchers	0.59		0.34	
Managers and Chiefs	0.22		0.16	
Subtotal Staff		$1.70 per year		$1.08 per year
TOTAL—EDP COSTS		$3.85 per year		$2.49 per year
PERCENT		155%		100%

Notes: *All costs are computed on same basis as for Fig. 1.

Fig. 2. Comparison of Annual EDP Costs if Hardware Supplied by Same Manufacturers*

managed. Theoretically, information on the accounts of all customers in the same cycle should arrive on the same day, so one cycle can be processed each working day. In practice, information from customers in different areas and cycles arrives several days early or late. Files from several cycles have therefore to be processed each day since it would be undesirable, from the point of view of working capital and the interest thereon, to wait until the same cycle comes up next month before processing and sending out bills.

Although Company B had previously also used cycle billing, their analysis showed the advantages of a new "cycle-free" billing system design, under which bills are sent out to each customer the same day that information about his monthly account comes in, regardless of what cycle he is in. Analysis showed this system would speed bill turnaround, would need only one quarter of the tape files of a separate cycle billing system, and would require fewer update runs on the computer. The faster bill turnaround with Company B's system resulted in an important side benefit of reduced working capital and interest charges, amounting to over $100,000 a year, for which no credit is included in Figs. 1 and 2.

Careful system analysis by Company B also enabled savings by obviating the need for a disc "scratchpad", by printing bills two at a time on serial bill forms using a less expensive printer, by eliminating the need for an optical reader, and by various other improvements.

In short, Company A planned to use an improved version of their existing cycle billing system; Company B planned to use a completely new "cycle-free" billing system, which would lead to savings.

The degree of effort spent on system design also resulted in the difference of stationery and form costs, shown in Figs. 1 and 2. The difference is partly due to the use of prenumbered serial bill forms printed two-up by Company B, and partly due to more keypunch cards and numerous multiple detailed reports or breakdowns routinely produced by Company A's system.

Conversion costs are defined here as the cost of additional air conditioning, special flooring, power supply, initial stock of tapes and discs, staff training and parallel running rental for equipment during conversion. (It does not include existing program conversion, which is included under programming staff costs.) If amortized over five years, the difference in conversion costs between the two

companies was not significant compared to the total edp cost involved.

staffing

It is interesting to note from Figs. 1 and 2 that annual staffing costs in each case are just slightly larger than annual equipment rental costs. The staffing costs in this article represent bare salaries without fringe benefits or overheads.

Most managements would dearly love to know whether their edp staffing costs are reasonable. In theory, management could compare edp staffing costs with another company of similar size in the same industry, which performs similar data processing tasks. In practice, it is seldom possible to find, and obtain actual costs from, a truly comparable company (or competitor). In the particular case investigated, where the companies did happen to be comparable, it was found that the number and cost of staffing for Company A was 57% greater than for Company B.

The cost of staffing is dependent on company policy, organization and personnel, as well as information systems design.

It is difficult to determine how much of the 57% difference in staffing costs between Companies A and B was due to information system design, and how much to other factors. However, there is no doubt that the difference in information system design was a significant factor. Company B designed their information system from the point of view of minimizing the labor of data capture and keypunching, use of mark-sensed cards and the like. They also tried to minimize routine output reports by printing summaries and "management by exception" reports.

Company A's system produced many more voluminous routine reports with very detailed breakdowns, which required much more keypunching of classifications and subclassifications, more card and more printed output handling. Company A also experienced second shift and overtime costs due to uneven work scheduling and rigid month-end deadlines.

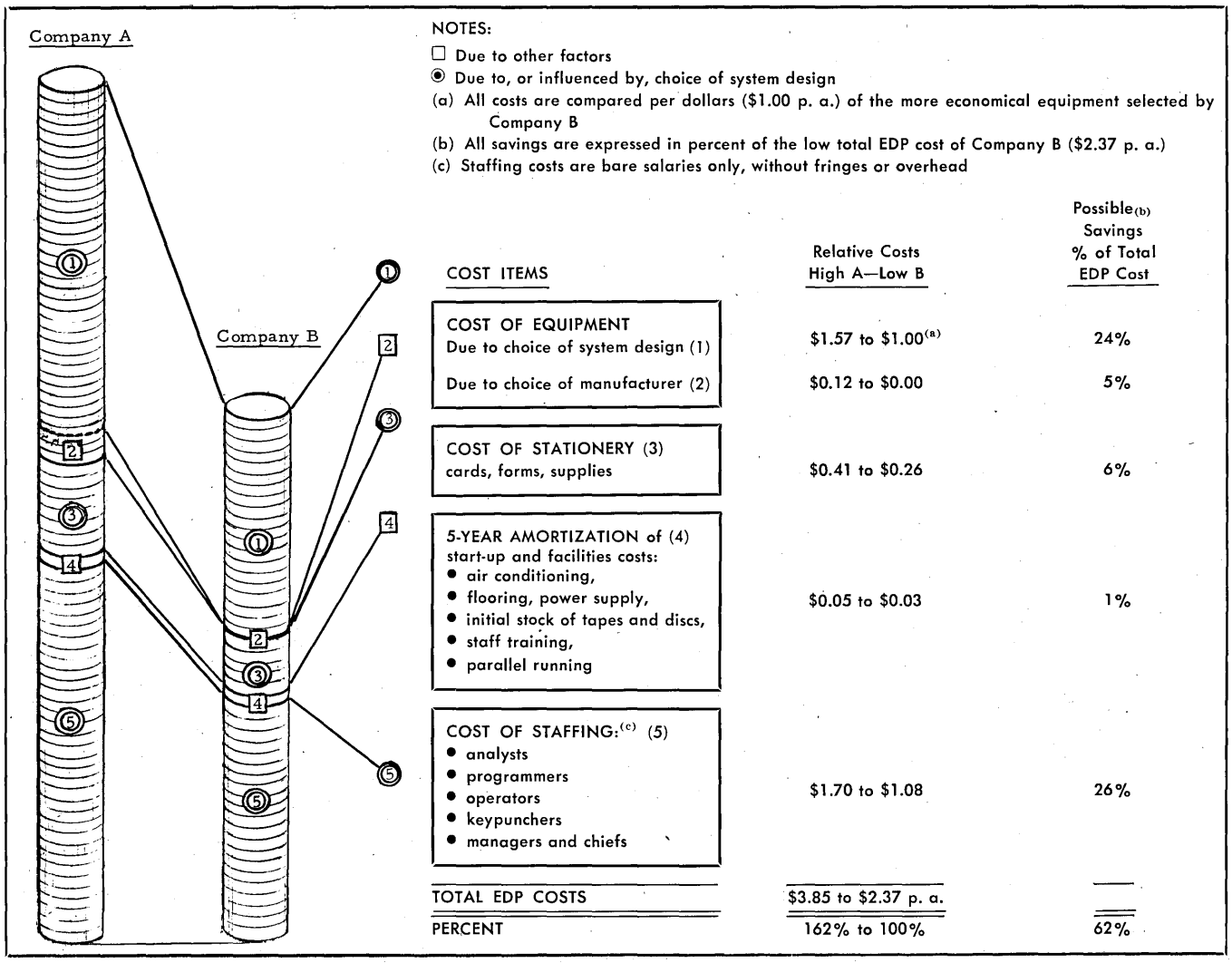

Fig. 3. Potential Savings Yardstick

potential savings yardstick

Before casting any stones, readers should reflect that the approach taken by Company A was neither uncommon nor necessarily bad at the time. While numerous earlier articles may have argued the merits of a thorough, and necessarily time-consuming, information systems analysis prior to specifying basic and peripheral computer equipment, no one had previously quantified the magnitude of possible savings.

These potential savings turn out to be surprisingly large, having regard to Company A's total edp costs being 62% higher than Company B's, as shown in Fig. 3. From this

figure, it appears that the difference in equipment rental accounted for a total of 29%, of which 24% was attributable to the choice of information system design, but only 5% to the difference in prices between equipment manufacturers.

The difference in stationery, forms and supplies accounts for 6%, most of which was attributable to the choice of system design.

The difference in amortization of start-up and facilities costs is less than 1%, and is not significant.

The difference in the cost of staffing accounted for 26%, a significant portion of which was attributable to information system design.

Since the computer rental and staffing costs in many medium-sized companies aggregate about a quarter of a million dollars or more per year, savings such as the figure of 62% found in this example can be very significant in the company's profit. In large companies the magnitude of potential savings might be even greater.

conclusions

A quantitative analysis of the difference in total edp costs, and in the approach used, by two comparable medium-sized companies in the same industry leads to the following conclusions:

1. Top management should insist on a thorough, competent and detailed information systems analysis and design, *prior* to issuing equipment specifications for computers, because potential savings might be over 60%.
2. Choice of manufacturer may account for only a 5% saving in total edp costs and may be offset by other considerations, such as service, expandibility, familiarity with manufacturer, etc. Choice of information system design through careful analysis could thus be over ten times as important (and profitable) as obtaining competitive bids from various manufacturers.
3. It follows that, even if management decides to purchase equipment only from one specific manufacturer, a thorough and competent system analysis and design *prior* to issuing equipment specifications is still extremely desirable because it might cut total edp costs by 55%.

* * * *

postscript

After the foregoing analysis, it struck the author that there exists practically no basic information about computer user costs. In general, management cannot determine just what similar organizations about the same size are spending on edp to do the same things. The author consequently initiated a survey to uncover the costs of equipment and staff by industry, size of company, type of application, hours of use, etc., as an industrial engineering project at the University of British Columbia.

As reported in the December, 1967, DATAMATION News Briefs, p. 67, survey questionnaires have been printed and have been sent to a cross-section of computer users in Canada and the United States. The questionnaires do not ask company names and the survey results will thus be anonymous. The author would urge companies to complete and return any UBC questionnaires they receive. Those who did not receive a questionnaire, but wish to provide information, should write to: "Computer Survey," Department of Mechanical Engineering, University of British Columbia, Vancouver 8, B.C. Canada. ■

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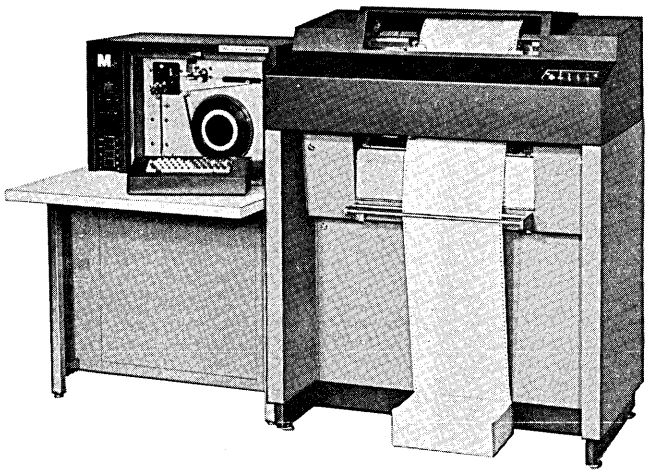

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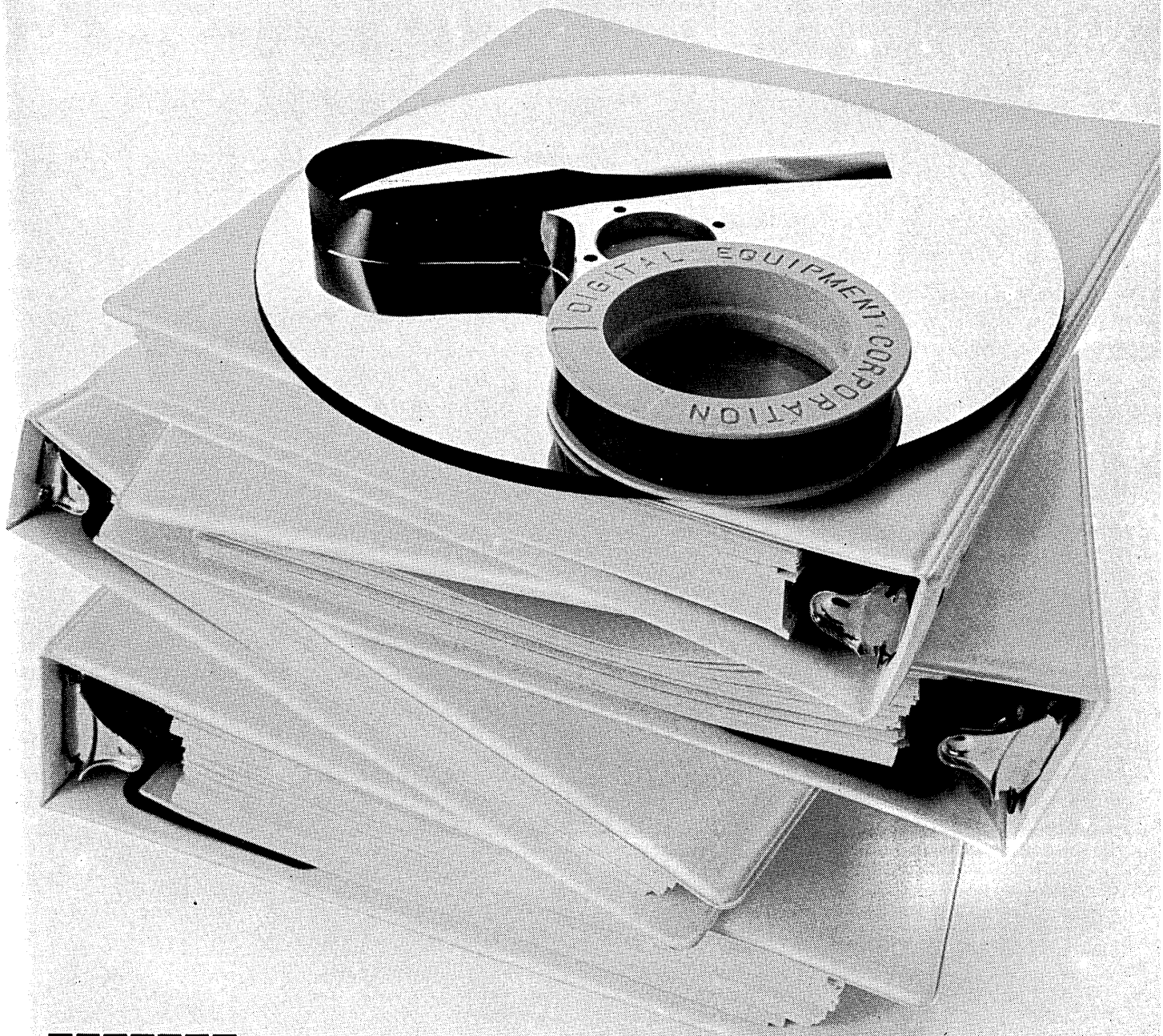

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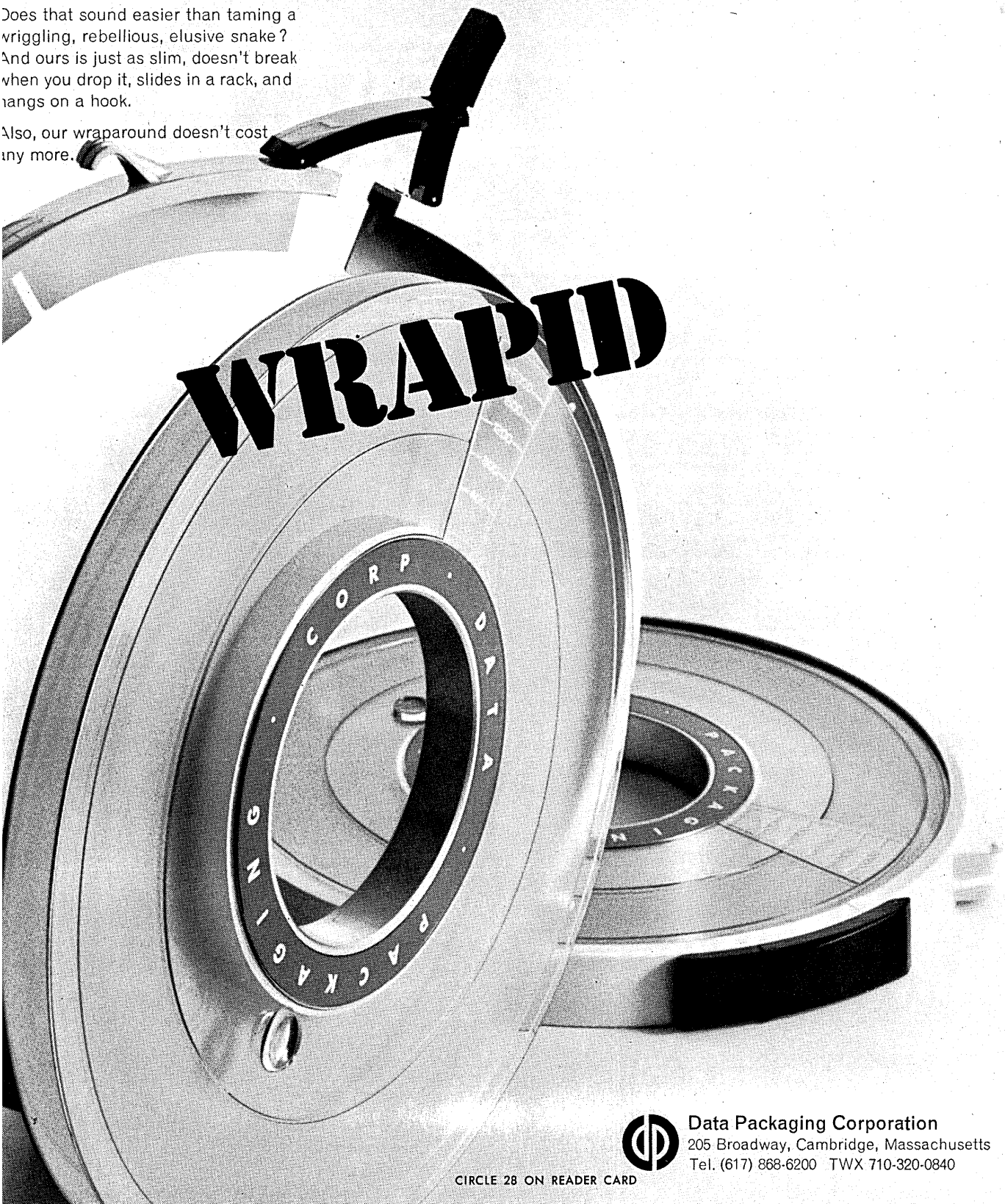

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HEXAPAWN: A LEARNING DEMONSTRATION

by J. L. HUGHES and K. J. ENGVOLD

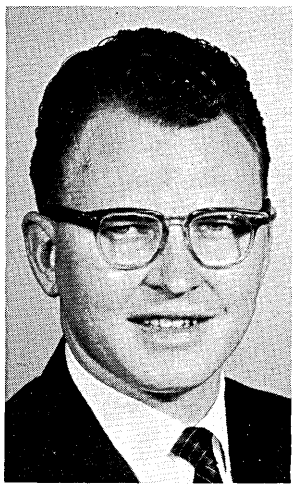
There is some evidence that the basic problem-solving function of computers is generally understood, although at varying levels, by the American public. A 1963 survey[1] indicates that people sense the enormous computational power that computers can bring to bear in solving modern business and scientific problems. For this reason, they regard the computer's contribution as useful and beneficial. Accompanying this positive attitude toward computers, however, is an underlying sense of anxiety. This arises from the belief that the computer is a serious threat to man because it possesses an intelligence that dwarfs man's. Many people do not realize the contribution that programmers make to computer performance. Instead, they ascribe the performance to some inherent, mystical ability of the computer. This naturally results in their regarding the computer with considerable awe.

The computer mystique is particularly strong in the area of artificial intelligence. While many people may be aware that computers can learn to play chess or checkers, they do not really understand the process by which a computer does this. Since most technical articles in the field are written at a fairly abstruse mathematical level[2] and most popular articles are of the science-fiction variety, it is difficult for the public to gain any insight into this area. Thus, the aura of mystery continues.

There is therefore a need to communicate to the public the basic principles underlying computer artificial intelligence in order to dissipate some of the mystery surrounding computers. One means of meeting this need would be a brief, clear-cut demonstration of the way a computer "learns." The game of Hexapawn, developed by Gardner[3], answers this requirement nicely. It is played between man and computer on a 3 × 3-square board with six pieces which move like chess pawns, *i.e.*, they can move straight ahead one square if it is vacant, or they can capture an opponent's pawn in a diagonal square and occupy it. In order to win the game, one side must either reach the third row, capture all the opponent's pawns, or make it impossible for the opponent to move. All computer moves are selected by a random number generator. When the computer loses a game, the move leading to the loss is eliminated so that eventually only winning moves remain to be chosen at random. Thus, the computer soon "learns" to be invincible.

At present, this game is played in executive computer concepts courses by simulating the role of the computer, as described in Gardner. The results have been very

Dr. Hughes directs research on computer display educational systems for IBM's DP Education Research Department. He has also been active in programmed instruction projects and in the development and evaluation of computer training courses. He has a PhD in psychology from Columbia Univ. and is a Fellow of the American Psychological Association.



Mr. Engvold is a member of the research group for computer display educational systems at IBM's DP Education Research Department. He has also been an instructor for the Air Force SAGE system and the 7040 computer, developing course packages for remote transmission and display equipment.

1. Lee, R. S., "The Computer's Public Image," *Datamation*, December, 1966, pp. 33-38.
2. Feigenbaum, E. A., & Feldman, J. (Eds.), *Computers and Thought*, New York, McGraw-Hill, Inc., 1963.
3. Gardner, M., "How to Build a Game-Learning Machine and Then Teach it to Play and to Win," *Scientific American*, March, 1962, pp. 138-153.

successful, but some participants still have reservations about the concept of artificial intelligence because they have not actually seen the game played on a computer. In order to drive the concept home more firmly, therefore, it was decided to program the Hexapawn game on the computer as a demonstration suitable for presentation to small groups.

Fortunately, by means of cathode ray tube display terminals, it is possible to improve the interaction between opponents which occurs during a game. The Hexapawn board and pawns can be displayed on a screen and all moves can be made merely by applying a light pen to appropriate locations on the screen. This ease of interaction speeds up the playing of the game and makes it an

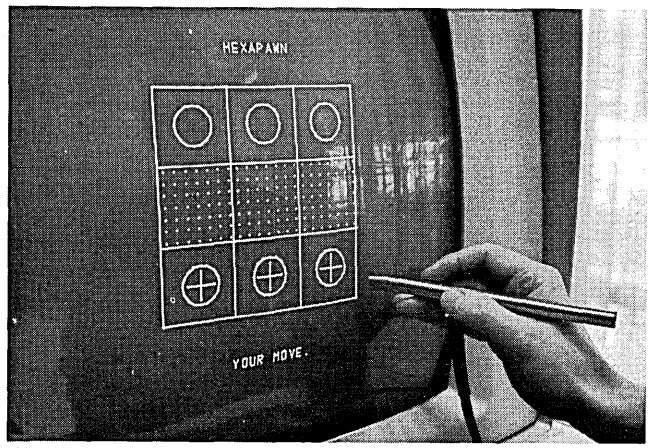


Fig. 1 Hexapawn Starting Board Configuration.

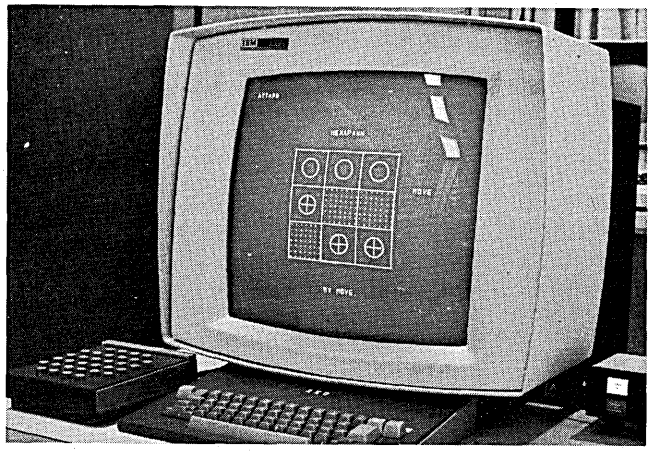


Fig. 2 Board configuration after first move by player.

experience comparable to the real thing. In order to explore the advantages of displays for this and similar man-machine interaction applications, therefore, an IBM 2250 Display Unit was used as the input/output unit for the Hexapawn demonstration. The Hexapawn program to control the display unit was written in FORTRAN IV (Level D) and run on the System/360 Model 40.

how hexapawn is played

After pressing a function key at the display terminal, the player sees a 3 × 3-square playing board measuring six inches on a side and containing three computer pawns and three player pawns in the upper and lower rows, respectively (Fig. 1). Below the board, the screen reads "YOUR MOVE," indicating that it is the player's turn to move. The game is played as follows:

1. The player selects a move by touching a light pen to the screen over a player pawn, which then disappears.

2. To complete his move, he light-pens the square where the pawn is to move, and the pawn is displayed in the new location. The message "MY MOVE" then appears below the board, a signal that the computer is ready to make its move (Fig. 2).

3. The player initiates the computer move by light-penning an area labeled "MOVE" at the right of the board. By means of a random number generator, the computer selects its move and the new board configuration is displayed (Fig. 3).

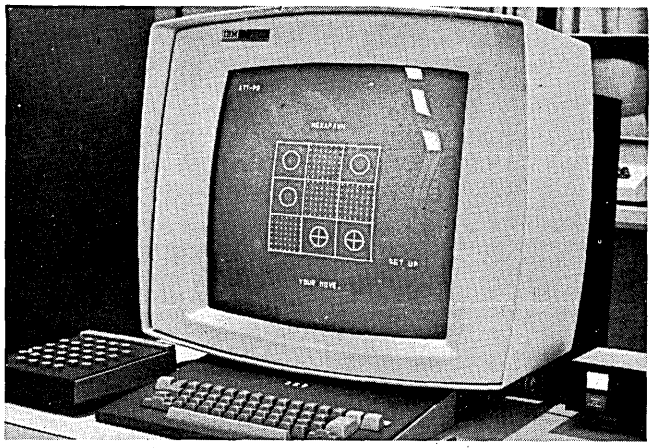


Fig. 3 Board configuration after first move by computer.

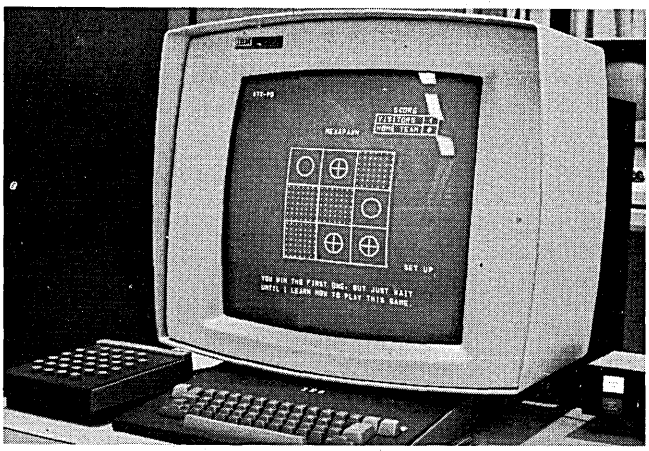
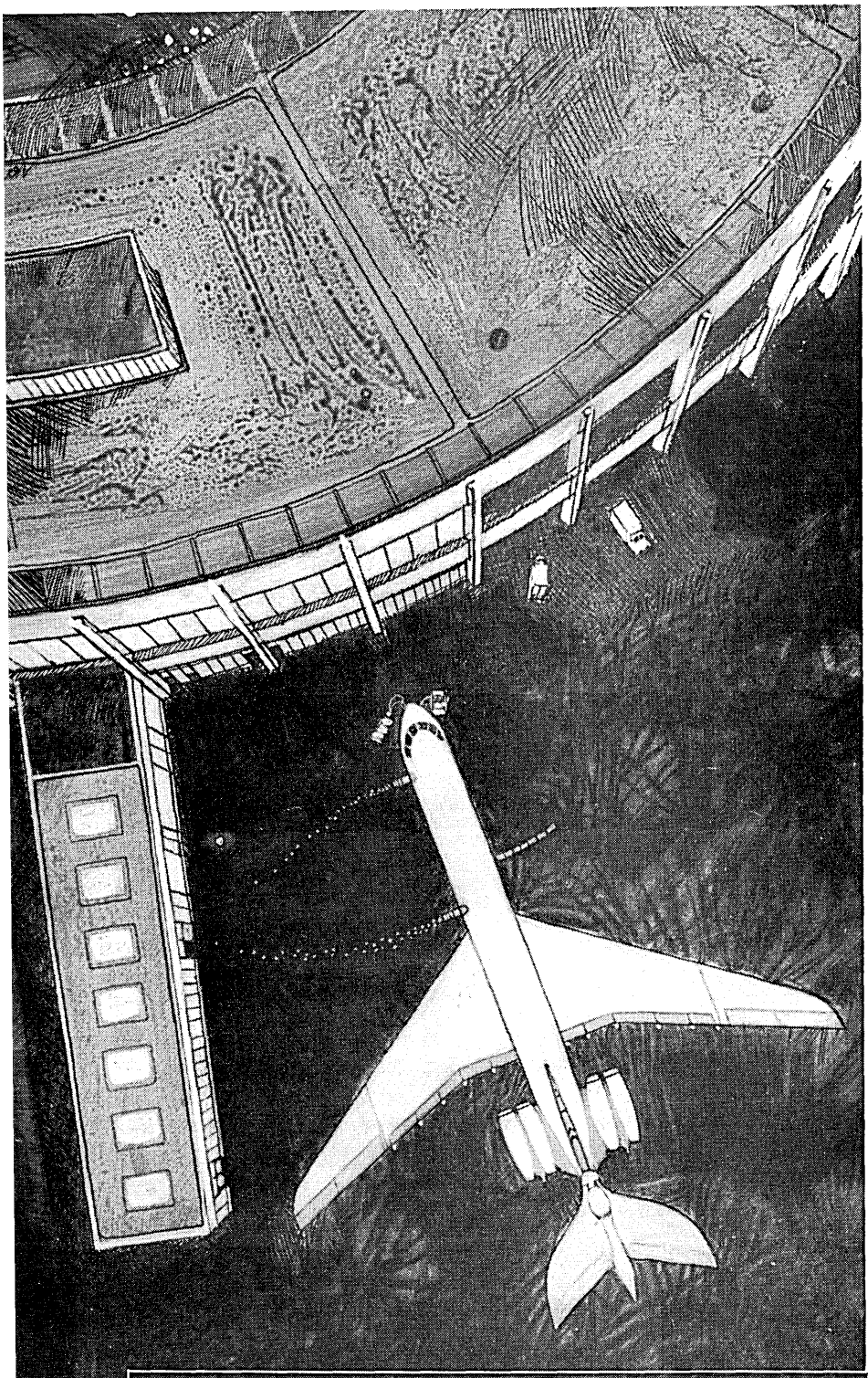


Fig. 4 Display of Message and Scoreboard after player wins the first game.

4. The screen also displays "YOUR MOVE" again and waits for the player to make his next move.

This sequence continues until either the player or the computer wins the game. In order to begin a new game, the player light-pens an area labeled "SETUP" at the right of the board. When a win occurs, a scoreboard containing the number of wins for each side appears in the upper right of the screen. A message which varies with the score also appears below the board (Fig. 4). The purpose of changing the messages is to remind the audience of the dynamic learning process that the computer is undergoing



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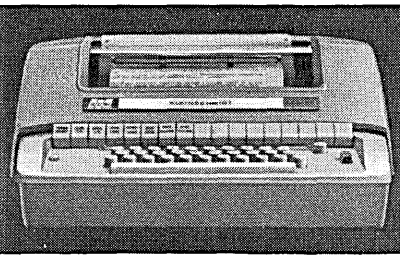

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and, hopefully, to add some humor to the demonstration. For example, if the player scores the first win, the message reads "YOU WIN THE FIRST GAME, BUT JUST WAIT UNTIL I LEARN HOW TO PLAY THIS GAME." Or, if the computer wins repeatedly, the message might be "YOU LOST AGAIN. I GUESS THIS ISN'T YOUR DAY." Twenty-two different messages appropriate for different stages of the game series were set up in a data table. This number appears to be adequate for the usual demonstration, but additional messages could easily be added.

Other features of the display include the appearance of "RETRACT" on the right of the screen after the player has made the first half of his move, *i.e.*, indicated the piece he wants to move but not where he wants to move it (Fig. 5). If he wants to change his mind at this point, he light-pens "RETRACT" and the piece will be restored to the board. He cannot retract his move after it has been completed on the grounds that completing a move is really equivalent to taking his hand off the piece moved, an action that confirms the move in a "real" game.

However, if the player wishes to halt the game after a move has been completed, he can do this by light-pen-

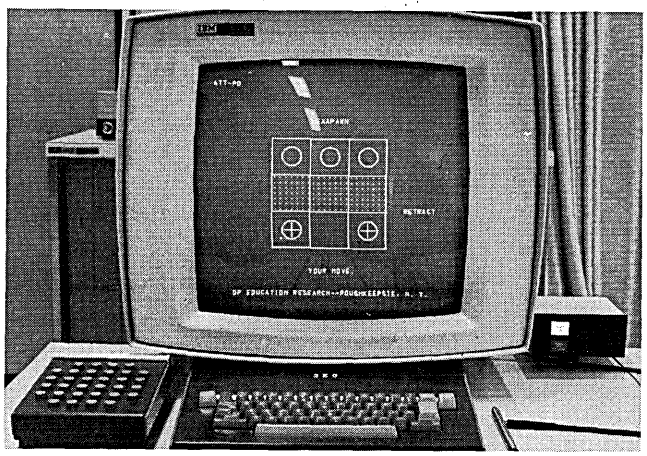


Fig. 5 Display of RETRACT after first half of move by player.

ning "SETUP," which appears at the right of the board after all moves following the first one (Fig. 6). This action has no effect on the score, but resets the board for a new game. Thus, a player who sees from the board position that the computer is beating him can take advantage of the computer by upsetting the board, so to speak, and rearranging the pieces for another game. In the interests of preserving amity between opponents, the computer was not programmed to respond to this display of bad sportsmanship.

The scoreboard accumulates the number of wins for each side. At any time, if the player hits a function key, the scoreboard can be wiped clean and the computer's experience in learning to play Hexapawn cleared from storage. A new sequence of games and a different set of learning experiences for the computer can then be initiated. The computer also accepts this new indignity, the equivalent of a massive frontal lobectomy, without protest.

how the computer learns

The heart of the Hexapawn program is the algorithm by which the computer learns to play the game. Although a number of possibilities suggest themselves, the original method proposed by Gardner was adopted because its simplicity makes it easy to explain to demonstration groups how a computer learns. The algorithm provides that every time the computer loses a game, the *last* move preceding the loss is removed from its behavioral repertoire. Thus, eventually, the computer can only make moves that result in wins. Let us examine more closely how the program accomplishes the selection and elimination of computer moves.

Each time the computer has to move, the program searches a two-dimensional table to see if the current board configuration has been encountered before. If not, it is packed into a word and stored into the table. The program then determines all possible moves from the current board configuration and stores the resulting configurations into a row of words alongside the current board configuration. Thus, the table, originally empty, is filled as the computer encounters different board situations during the game.

A random number generator then selects one of the moves associated with the current board configuration. Since the maximum number of possible moves from any board configuration is four, the random number generator was programmed to produce numbers ranging from one to four. If the indicated slot in the table is empty, it generates another number until a move is found. When a move is located, the resulting new board configuration is displayed on the screen.

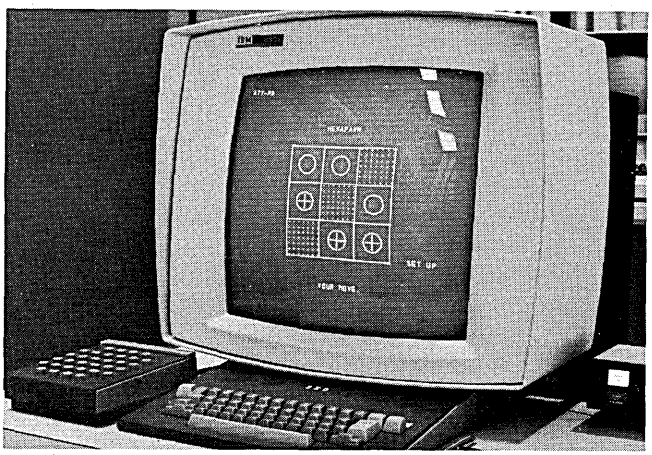


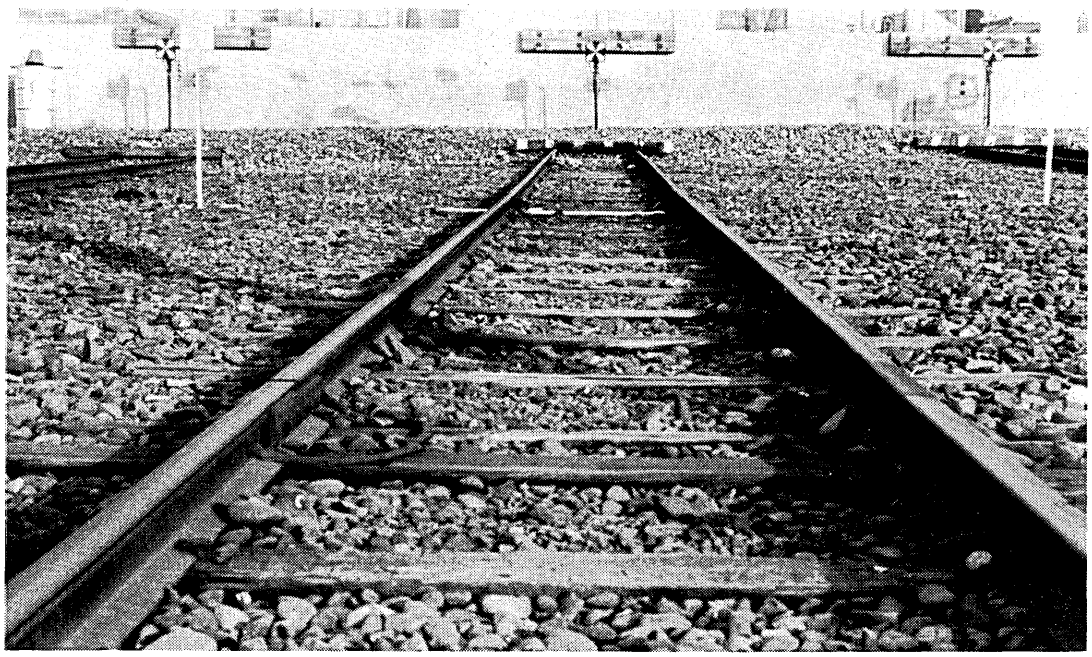
Fig. 6 Display of SETUP after completion of move by player.

After a move, the program determines whether the computer has won the game. It must therefore test whether a computer pawn has reached the bottom row, whether the player pawns are blocked from moving, or whether all player pawns have been eliminated. If any of these conditions is met, the computer wins. (Conversely, the same tests are made after a player move to determine if he has won.)

When the computer loses a game, the learning algorithm requires the elimination of the last computer move that led to the loss. The program accomplishes this by inserting zeroes into the word in the board table corresponding to the board position resulting from the last move. This move can therefore no longer be selected from the table by the random number generator, and the computer cannot lose a game by making this move again.

It should be noted that the computer must lose in order to learn. Eventually, after the computer has experienced a number of losses, all the moves resulting in these losses will have been eliminated, and only winning moves will remain. At this point (after 13 losses), the computer will be unbeatable. Incidentally, and perhaps ironically, the computer learns faster against better players, because it gets beaten more often in the beginning and drops out its losing moves sooner. Psychologists might note that here is an instance where early traumatic experiences, at least in

The end of the line



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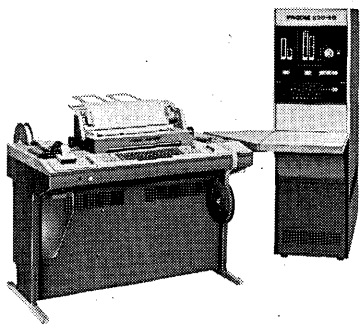

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computer development, have a beneficial rather than a harmful effect on later performance.

lessons from the demonstration

Let us examine what can be learned about artificial intelligence from the foregoing. In behavioral terms, we have an initially naive computer acting purely at random that can be readily beaten by a player who understands the principles of the game. As a result of its experiences, *i.e.*, losing games, the computer modifies its behavior by dropping losing moves from its response repertoire. When all of these have been eliminated, the computer becomes unbeatable at playing the game.

Since learning can be defined as the modification of behavior resulting from experience, the computer can be shown to have met this criterion in playing Hexapawn under the control of a program that modifies itself after each game. The response contingency adopted, *i.e.*, eliminating losing moves, although simple in principle, is nevertheless quite effective in making a significant change in the computer's behavior over a short period of time. The learning algorithm adopted makes it relatively easy to explain to demonstration groups how the program does this. Once having grasped this principle, they are then ready to understand the role of heuristics in limiting the computer's search for alternatives in more complex situations. The computerized Hexapawn game should therefore prove useful for teaching the basic principles underlying computer artificial intelligence.

By approaching the concept in this way, less resistance to its acceptance should also be encountered because the mechanistic—and therefore less-threatening—nature of the computer's learning process can be more readily appreciated. If increased understanding of this important computer area can be achieved, perhaps a start can also be made toward the reduction of the unconscious negative aspects of people's attitude toward computers noted in the survey[1].

Another aspect of artificial intelligence that should be stressed is the role of the programmer in designing the program. It should be emphasized to demonstration groups that it is he who selects the method by which the computer will learn and prepares the appropriate program to accomplish this. Examples of how the programmer could have varied the computer's learning algorithm, *e.g.* by weighting winning moves, by eliminating moves on a probability basis from the board table, etc., could be discussed briefly to illustrate how the computer's learning ability is under the programmer's control.

Other characteristics of the Hexapawn program also demonstrate how the programmer (and player) can retain control over the computer's behavior. If the player changes his mind while making a move, he can light-pen "RETRACT" and his pawn will be restored to its original position (Fig. 5). The "SETUP" feature (Fig. 6) permits the player to call off a game at any time if the computer appears to be on its way to winning. A more drastic means of control also exists if the computer has learned to play the game too well to suit the player. The latter can hit a function key and completely blot out the computer's previous experience so that it is reduced once again to making many losing moves at random. While these are rather trivial controls in the present situation, they do serve to illustrate to demonstration groups how man, by means of programming, can exercise appropriate safeguards to assure that he remains master of the computer. Since fear concerning the latter is apparently shared by many, pointing out the existence of these possible programming safeguards should help to allay anxiety stemming from this source.

The Hexapawn program[4] was written in FORTRAN IV (Level D) to run under the FORTRAN Console Programming System[5]. It also uses subroutines of the Graphic FORTRAN System. The Console Programming System or CPS requires one systems tape and three scratch tapes. The object program specifies the type and scope of the image and data manipulations at the IBM 2250 Display Unit by calling appropriate CPS subroutines stored on the systems tape. Since a similar program, written in FORTRAN IV except for the display processing, had already been prepared by the senior author for the 7044 Graphic System, it was possible to use most of the logical FORTRAN subroutines with minor modifications. The major changes occurred in programming the 2250 Display Unit in FORTRAN and adding new features to the other programs.

FIGURE 7
GENERAL FLOWCHART OF HEXAPAWN GAME

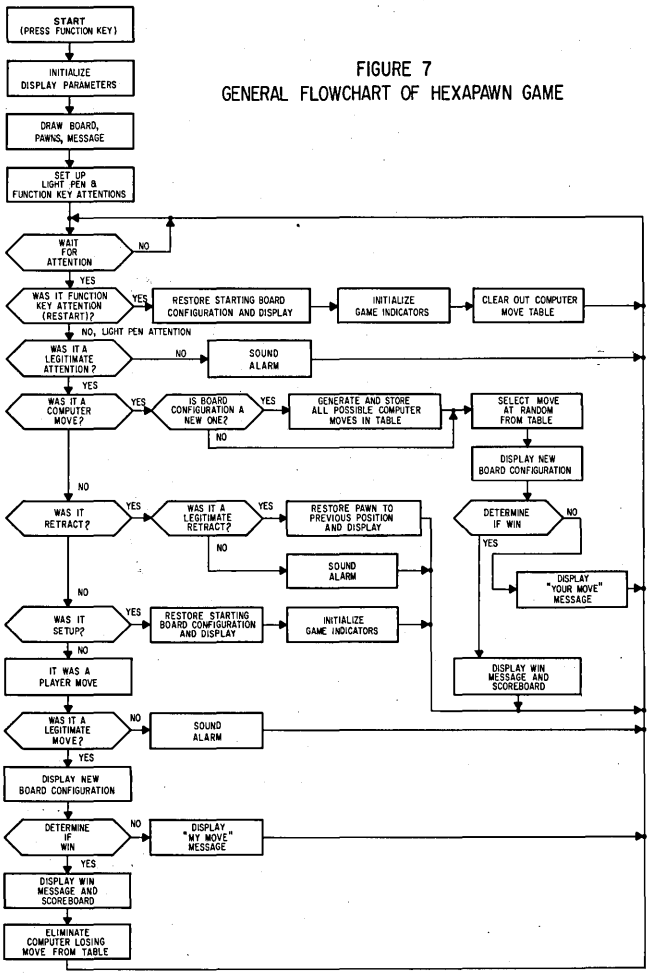

Fig. 7 General Flowchart of Hexapawn Game.

A general flowchart of the Hexapawn program appears in Fig. 7. It consists of a main program and 14 subroutines which, together with the CPS and GFS subroutines, occupy 188,560 bytes of storage. All of the display processing is done in the first subroutine, so that conversion to another graphic programming system that uses FORTRAN, such as GPAK[6], would be mainly a method of rewriting this subroutine. ■

4. Copies of this program may be obtained by sending a tape to the authors. The address is: IBM Education Center Dept. 914, South Road, Poughkeepsie, N.Y. 12602.
5. *The FORTRAN Console Programming System (CPS)*, New York, IBM New York Scientific Center, February, 1966.
6. *GPAK, Version II*, Hawthorne, New York, Program Information Department, September, 1966.

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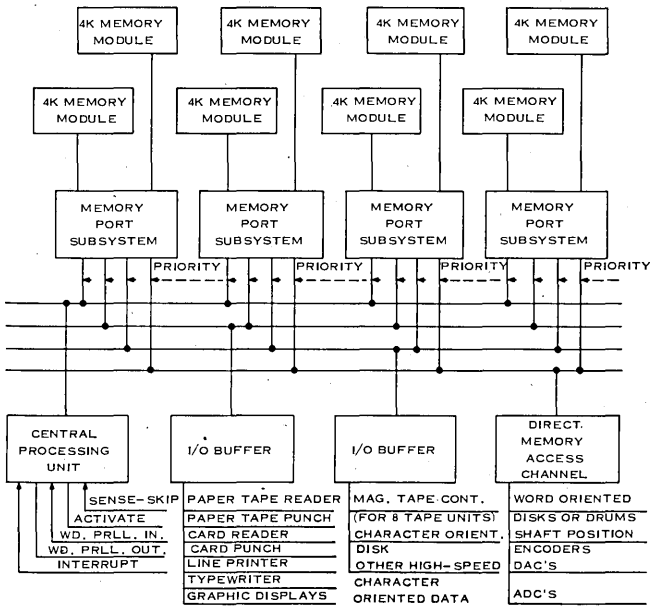

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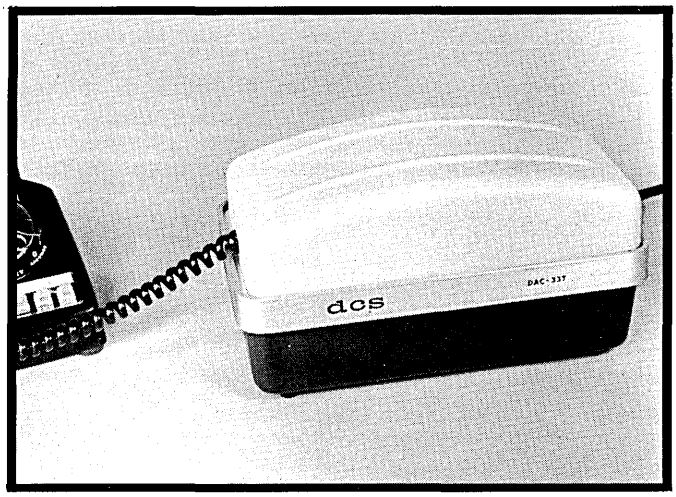

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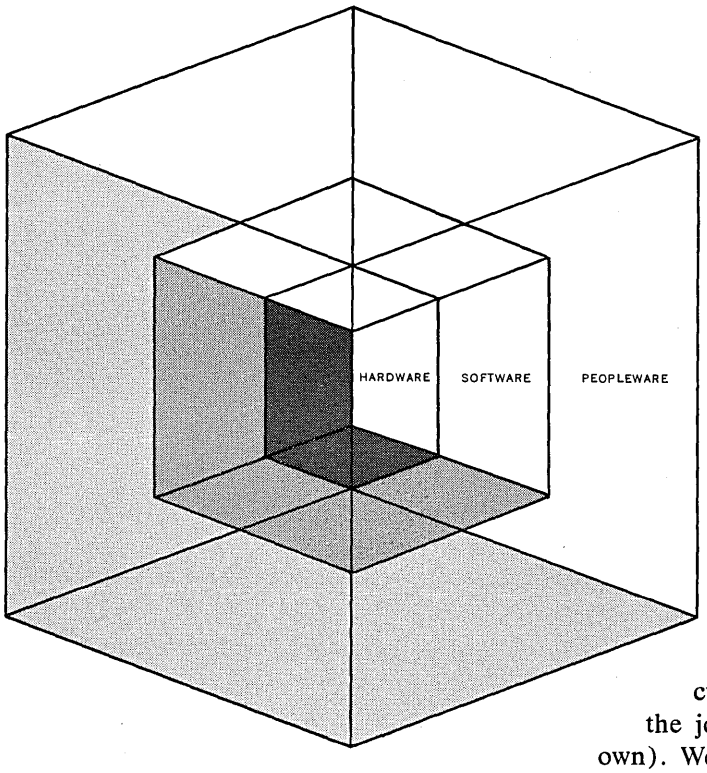

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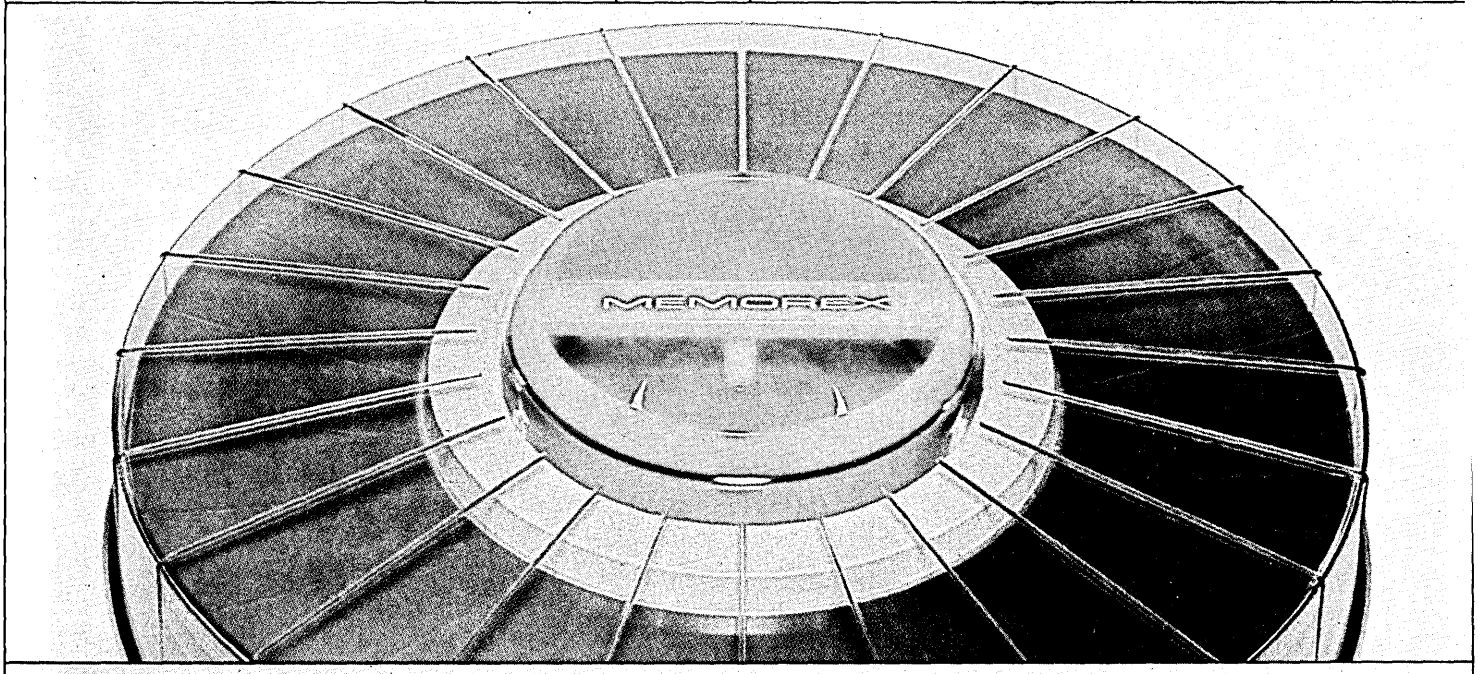

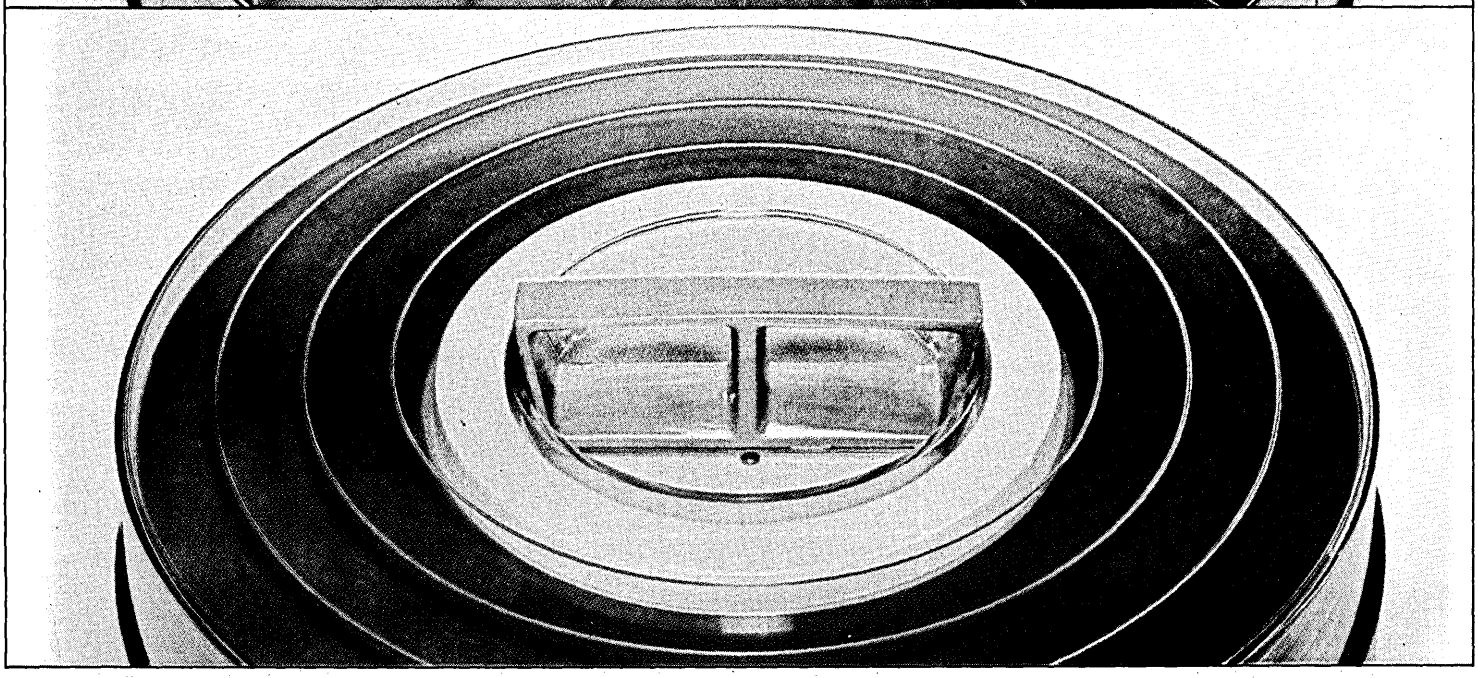

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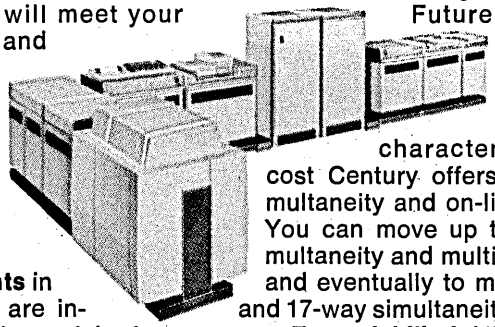

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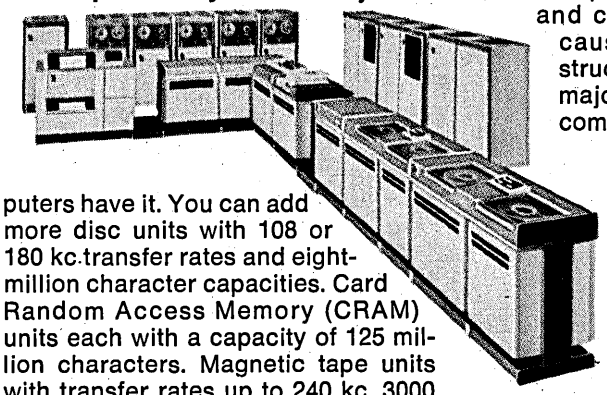

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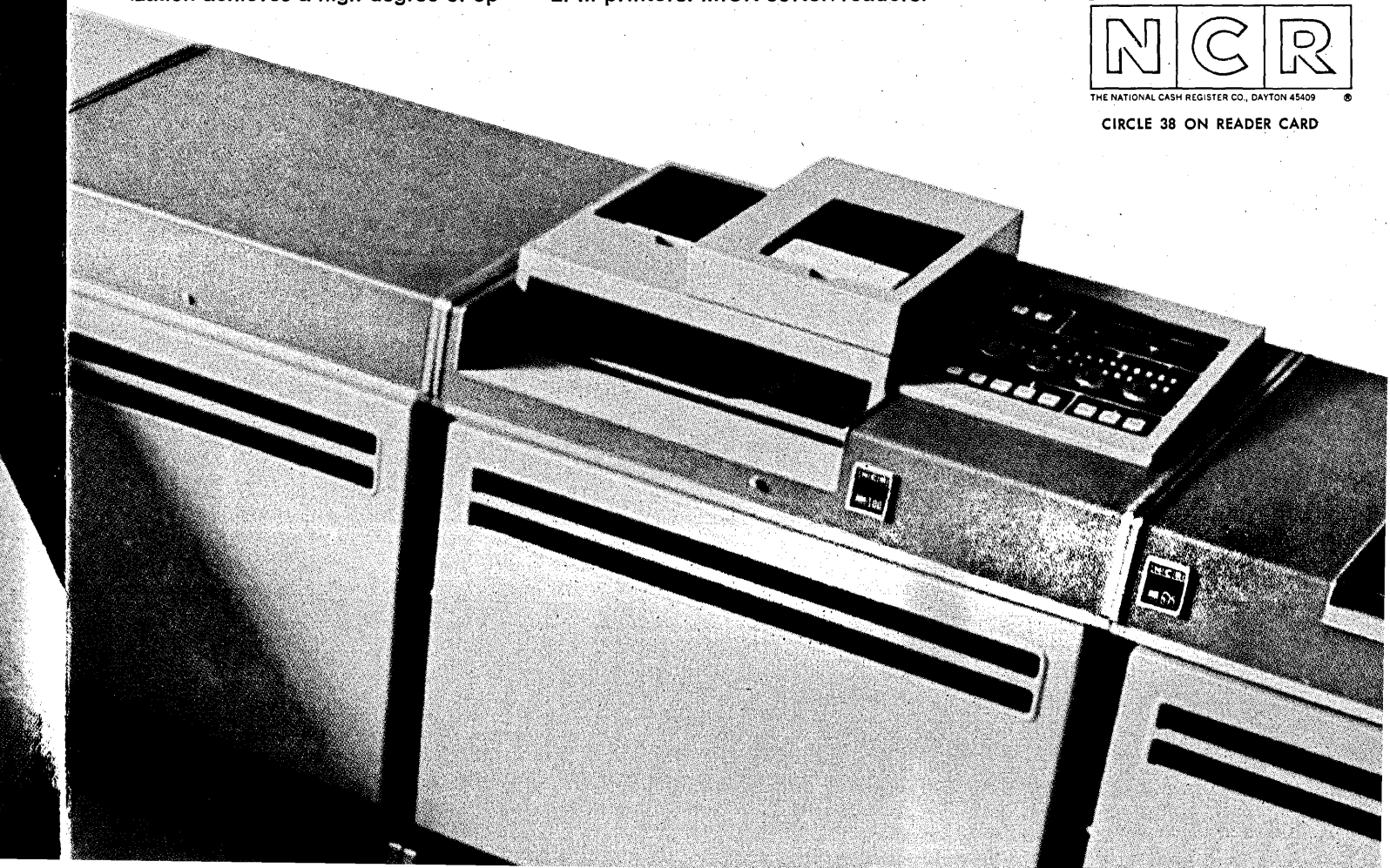

DATA PROCESSING ON THE FARM

a million prospects

by NORMAN B. ANDERSON

The world's oldest and newest technologies—agriculture and data processing—are meeting along an expanding frontier. In the few years since the first exploratory encounter between farmer and computer, a fruitful area of joint enterprise has developed.

Data processing services available to farmers today range from simple accounting aids to highly sophisticated methods using linear programming for least cost rations and farm planning, better known as resource allocation. The type of service needed in each individual case depends, of course, on the size and diversity of the farm and the specific goals of the enterprise. Ideally, the computer should help the farmer optimize usage of all available resources—land, labor, livestock, capital, and equipment.

Computer applications for farmers are still in their beginnings, and potential benefits have not yet been fully realized. But the magnitude of the promise is already apparent.

At present, approximately 15,000 farm enterprises in the United States rely on automatic data processing in some phase of their operations. But it is estimated that more than a million farms may eventually benefit. This prediction rests on the premise that any farmer with more than $10,000 annual gross is a potential candidate for dp services. Today, this premise is being widely substantiated.

Until quite recently, it was widely assumed in the data processing industry that only large, diversified farming operations might reasonably employ computer services, and it is true that the more sophisticated methods of data analysis are mainly suited to large farming enterprises. Linear programming, which will be discussed later, is a case in point. But within the last year or so, it has become evident that very simple data processing routines can be of considerable help, especially to small farmers.

Typically, the small farmer lacks both time and inclination for paperwork. As a result, his bookkeeping may be inadequate. Lacking essential figures about his own business, he generally relies on intuition rather than facts in running his business—a technique likely to leave him behind in today's competitive world.

To help the small farmer overcome this handicap, a growing number of local banks in farm areas (encouraged by the American Bankers Association) now offer accounting procedures known variously as *Rec-Chek* or PAM (Personal Accounting Management).

In these systems, the farmer puts a three-digit code on every check he writes. This code identifies the purpose for which the check was written—fertilizer, fuel, seed, labor, etc. Deposit slips are similarly coded to show the source of the earned money. When the farmer gets his monthly bank statement, every debit and credit is clearly identified on a nine-column form which constitutes a complete income-and-expense account with up to 98 separate categories. Income or expenses can be allocated to separate enterprises such as specific crops, dairy, poultry or beef operations and to specific sub-categories such as labor, seed, fertilizer, harvesting, etc. In addition, the bank provides quarterly and yearly summaries.

The charge for this service is quite moderate. For example, the Bank of Kremlin in the tiny farming town of Kremlin, Okla. (population 150), charges 10¢ per item processed. Even at this modest fee, the bank earned more

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than enough to offset the rental of the punched card equipment after the first six months of operation.

The farmers find the new service even more profitable. By the time the plan was put in operation, in January, 1966, 95 area farmers had signed up, reported V. W. Mendenhall, the bank's president.

"Many were astounded to see how much they had been spending in certain categories," says Mendenhall. Some were surprised that certain sideline crops were more profitable than they had supposed. This proved that previously they had no clear picture of their own operations. Now, for the first time, these farmers have a rational basis for production planning, credit planning, and—best of all—for claiming tax exemptions they might otherwise have overlooked."

The Bank of Kremlin performs these accounting services on punched-card equipment as an adjunct to its normal processing of debit and credit entries for demand deposits. Encouraged by the enthusiastic acceptance of this service, the bank has ordered an IBM System/360 Model 20 and expects to move into more sophisticated methods of data processing as part of a farm advisory service.

The more advanced computer-based accounting programs include:

Enterprise Accounting. Computers analyze basic farm records to pinpoint cost and profit performance of various crops. Inventory control based on projections of market conditions is a key part of these programs. Programs are also available to analyze crop yields on the basis of selected varieties, and to evaluate such factors as special fertilizers, chemical weed control, planting methods (between-row and within-row plant spacing) and even moisture conditions.

Tax Accounting. Keeping track of such complex tax factors as various depreciation rates and write-off for buildings, machinery, etc.

linear programming for management

Aside from providing accounting aid, computers now offer a wholly new management approach for larger farms, based on the principles of linear programming. The computer is fed all obtainable data on a given farming operation. It then evaluates possible management alternatives and figures the potential dollar returns for each. As in industrial applications, the computer is able to put forth the management plan with the greatest profit potential by analyzing and comparing a great many interrelated but variable factors.

One linear program, for example, analyzes feed formulas to take advantage of changing prices in the various feed components while keeping livestock adequately fed at all times. Moreover, the program determines the cheapest nutritionally adequate feed mix, and shows how to minimize the cost per pound of beef sold. A program of this type considers such factors as cattle prices, feed ingredient prices, length of feeding period, nutritional requirements, and the price quoted on the appropriate futures market. It indicates the optimum size of feeder cattle to buy and the most profitable rate of gain.

To obtain the necessary input data for this program, participant livestock farms and feedlots have installed devices to measure the various ingredients of a feed formula by the pound or by the bushel. Accumulating such data, in addition to paying for computer time, may be costly but one west coast cattle feedlot estimates they are saving 50¢ to $1 per ton of feed used.

In the poultry industry, estimates have ranged to $2-$4 per ton cost reduction over previous manual methods of calculation. A recent issue of *Broiler Industry* magazine carries an article on Bayshore Foods, Inc., Easton, Md., which notes that computer utilization has (1) cut feed costs on 150,000 tons yearly by 2-4%, which means the computer is paying for itself; (2) broiler breeder egg production can be forecast and kept uniform up to 1½ years ahead; (3) feed formulas can be changed and in the hands of the feed mixer within 30 minutes.

Linear programming of this type is based on a mathematical model of a particular type of farming operation, and such models are now being widely developed in the agriculture departments of various large universities in farming states such as Pennsylvania State University and Arizona State University. At Arizona State Dr. R. J. Becker, professor of agricultural economics, is teaching a course using mathematical simulations. Typically, farmers supply data for the computer on total farm acreage, soil fertility levels, expected crop prices, local weather conditions, capital and labor at hand, anticipated production and related costs. The computer thereupon suggests: what crops to plant, amounts and ratios of fertilizer for each crop, insecticides and herbicides to use, how to distribute labor, how much capital to apply against each rotation, and the minimum tillage required for good seed beds.

The first farmer-controlled and university-guided dp center has been established in Madison, Wis., under the direction of Dr. John R. Schmidt, chairman of the department of agricultural economics. Named the Agricultural Records Cooperative (ARC), the center is constantly expanding and improving computer applications to farm problems.

In soil analysis, for example, ARC linear programs can consider some 300 possible fertilizer applications for some 40 specialty crops before printing out a recommendation. Dr. Leo Walsh, soil specialist of the University of Wisconsin, enumerates some of the factors involved: "We consider yield potential, subsoil fertility and moisture, cropping sequence, probable precipitation, and even the level of managerial ability before a recommendation is made. It is only through the use of the computer that we are able to go into this much detail for each farmer. We feel that we are more accurate because we are able to base our recommendations on more than just soil samples and soil test results."

improving the breed

Herd improvement is another program in ARC's computer-assisted farm service. "We're ready to go with our sheep and beef-cow program right now," says Dr. Vern Felts, a Wisconsin professor in charge of progeny records. "Our sheep records will help us construct an index based on the weight of the lamb, fleece weight and twinning ability. In the beef-cow program we will have available carcass data on slaughtered calves, weaning and yearling weights and weaning and yearling scores. So we should have some pretty sound data for herd selection." Similar programs have been developed for poultry genetics.

Extensive analysis through linear programming naturally requires detailed input data. In fact, the amount and accuracy of information furnished to the computer is the key to successful decisions. Large farming enterprises already using extensive record-keeping systems are therefore the prime prospects for computerized planning. "The time taken by our tax records," says one farm manager, "is roughly 90% of the time needed to furnish enough data for farm management purposes. So the extra effort and time needed to fill out the additional blanks may pay enormous dividends."

In the example of resource allocation for farm planning costs, receipts and cash returns would have to be deter-

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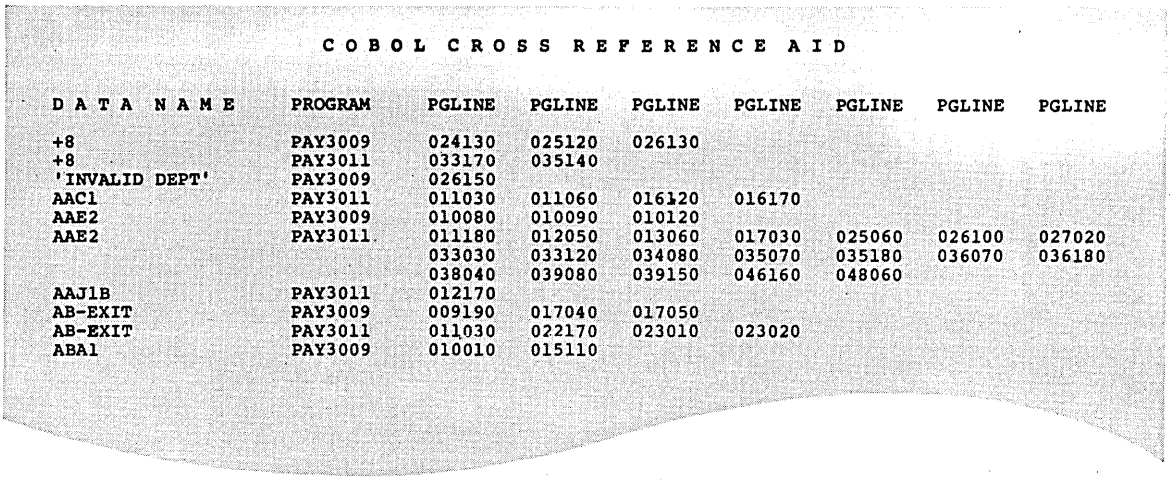

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AAC1	PAY3011	011030	011060	016120	016170			
AAE2	PAY3009	010080	010090	010120				
AAE2	PAY3011	011180	012050	013060	017030	025060	026100	027020
		033030	033120	034080	035070	035180	036070	036180
		038040	039080	039150	046160	048060		
AAJ1B	PAY3011	012170						
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mined for each crop possibility. Depending on the degree of past record-keeping information, input data may be easily developed from a combination of available records on operating experience. "We have found this effort has increased profits substantially and has assisted administrators to make better management decisions, worth many times the cost of the computer"—so states the agricultural economist at one large farming operation in California.

To an increasing extent, farm cooperative groups, associations, banks and private concerns are becoming interested in setting up data processing service centers. In Provo, Utah, the Dairy Herd Improvement Computing Service—one of 12 such centers in the country—uses a System/360 Model 30 to analyze production and breeding records of 120,000 cows on 1,400 affiliated farms of the Dairy Herd Improvement Association.

The computer, working from data supplied by the dairymen on special forms, prints out a complete record of each cow's current production, along with its historical production figures. Another report shows the individual cow's standing in relation to the rest of the herd. By comparing production records with breeding, the dairyman knows which sires and dams to breed, which to provide additional feed, and which to cull from the herd.

dp education efforts

Essential to the success of data processing services for farms is a preliminary educational campaign, instructing farmers as to the best methods of record-keeping and data acquisition. Clients should also be aware that computer readouts should always be interpreted against the palpable realities of farming, rather than being followed blindly on a purely theoretical basis.

"In many cases," reports a dp service manager, "farmers expect too much from linear programming. The computer can offer guidance in management decisions, but it can't do the farmer's basic thinking for him."

As an example, the rancher-grower must develop the specific feed formulation that will satisfy his requirements, then the computer can determine the least-cost ration from the analysis of his available inventory and could then tell him the specific items that could lower his cost.

Farm advisory services with data-processing facilities are already available in many states, either through state universities, state farm bureaus, banks and lending institutions, or—increasingly—through farm cooperatives and private consulting firms. Costs are still far from standardized. Universities, for example, often develop their programs under research grants and make them available to farmers either free or at nominal cost—the farmer thus being indirectly subsidized by tax money.

But universities are often more interested in developing new programs than in providing a general farm service. Consequently, they may only accept cases that will further their research projects. The need thus persists for more cooperative or privately owned farm data processing centers operated on a fee or contract basis.

Seen in broad perspective, the conjunction of farming and data processing fits quite logically into the pattern of historic change that has transformed farming in our century. It is in line with the current transition from labor to capital as the major farm input. It characterizes a new era in farming in which sophisticated planning and management is as vital to the farmer as the ability to raise crops or livestock. ■

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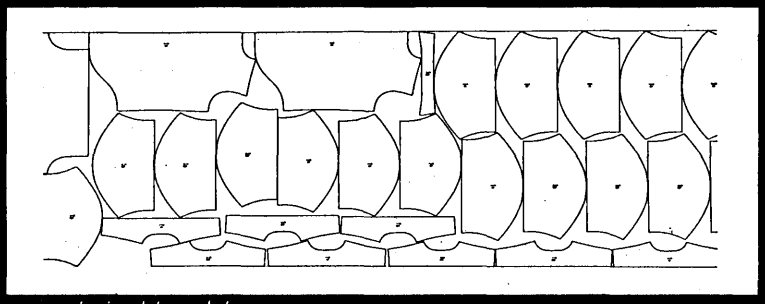

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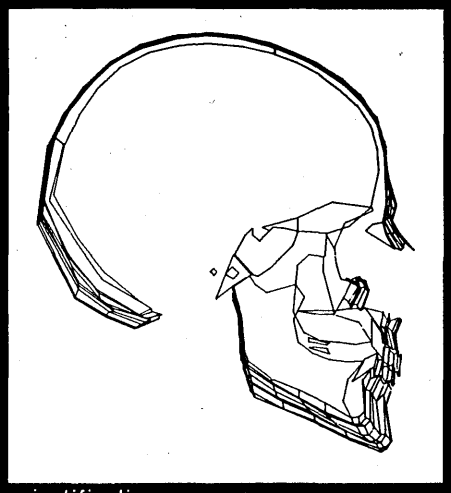

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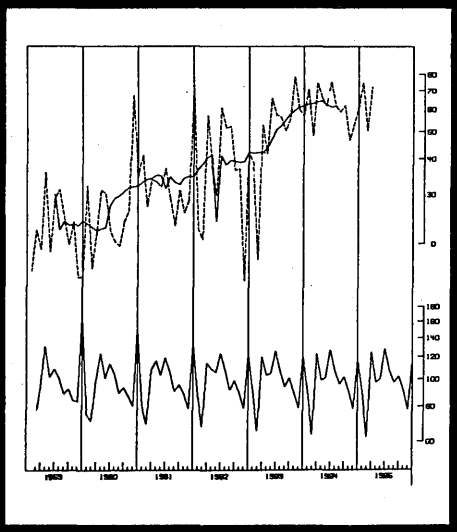

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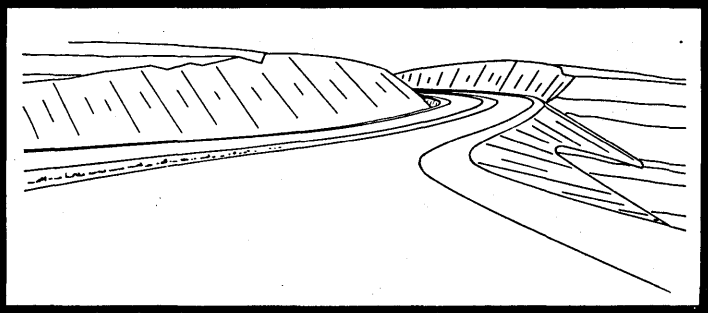

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COMPUTING IN LATIN AMERICA

by SERGIO F. BELTRAN

The last three years have witnessed an important increase in the number and size of computer installations in several Latin American countries. For example, in Mexico, the rate of growth in the number of installations has been approximately 30% per year (1965: 90 computers; 1966: 110; 1967: 150); in Colombia, in spite of severe financial difficulties, the number of installations is expected to double during 1968; Venezuela and Chile will probably see a doubling of installations during the next two years; and Brazil's 200th machine should begin operation during this year. In Argentina, where a large-scale GE 625 has been installed, the rate of growth is also gaining momentum.

This rate of growth in these countries makes more evident the unevenness of computer science development among them. It also dramatizes how critical the shortage of properly trained personnel has become, and to what extent the "take-off" in many countries will depend on adequate training of pioneering groups of skilled specialists.

At the same time, the complex problems faced by the majority of installations impose the necessity of closer collaboration and a more active and constructive sharing of costs and responsibilities between users and manufacturers. With a relatively small number of each computer model installed in these countries, the manufacturers face understandable difficulties in providing software and maintenance support to the extent that it is provided in countries where the amount of machines makes possible substantial investments in these aspects.

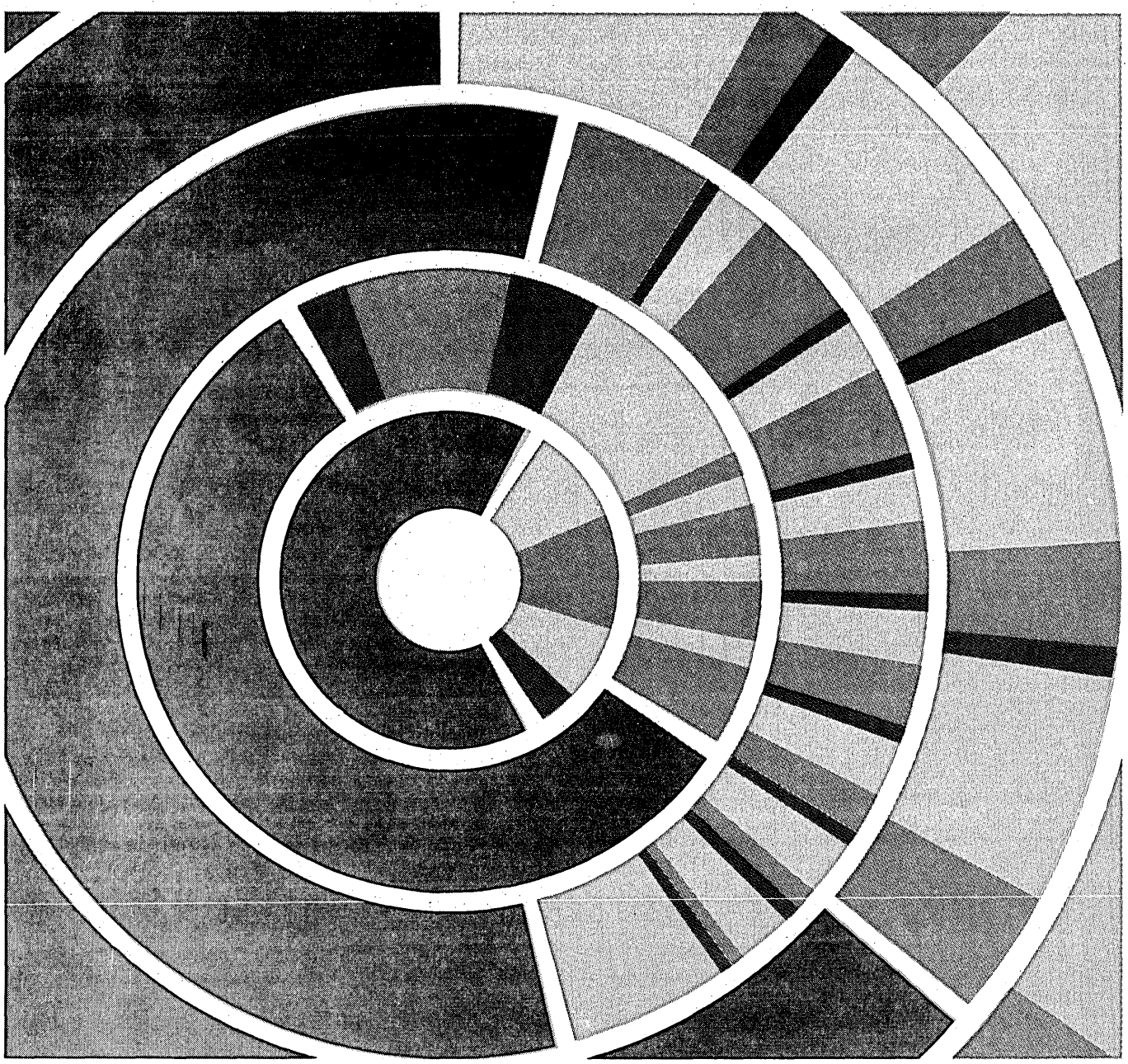
The establishment of the Latin American Institute for Information and Computer Sciences (LAIICS) has provided one way to overcome these difficulties through its program to coordinate cooperation of the computing centers from this region among themselves and with other international institutions. LAIICS was founded last September in Chile by representatives of 47 computing centers from 15 Latin American countries. The membership includes organizations and institutions who are interested in information science, and who may or may not have computers. The objectives are to coordinate the planning, promotion and support of academic and R&D activities of the membership in the computer sciences. LAIICS hopes to create centers of dp instruction in the Latin American countries where these do not already exist, and to help extend the activities and improve the teaching in the existing centers. The organization also hopes to alleviate some of the manufacturers' responsibilities by establishing program libraries and a documentation center on computer sciences.

expansion or development?

Some years ago, in reference to economic structures, the late mathematician and economist, Schumpeter, described the possibility of having "expansion" without necessarily having "development." Taking a close look at the type of growth in information processing in Latin American countries (including many of the most important centers), it is easy to detect the possibility of this danger. From a qualitative point of view, probably the most important aspect in the near future will be to insure a real "development" along with this expansion. The increasing need for computing power, the intensive sales efforts of the manufacturers, and the influence of the pioneering research projects organized in the U.S., Western Europe and Canada, favor the expansion of Latin America's computing facilities and their research projects. Naturally, this desire for expansion makes it imperative to organize the short- and long-range educational programs to insure the availability of highly trained personnel, and to most profitably use the computing facilities' sophisticated equipment.

An acute lack of properly trained programmers and systems analysts now exists (or will, in the near future) in Mexico, Colombia, Venezuela, Brazil, Peru, Chile and Argentina. In every one of these countries, manufacturers' schools and private training centers are mushrooming. And

Mr. Beltran is director of the Latin American Institute for Information and Computing Sciences, an IFIP-affiliated professional organization. As professor of math at the National University of Mexico, he founded the electronic computation center there. He is also a past president of the Mexican Assn. of Computing, and holds a BS in civil engineering, and a BS and MS in math.



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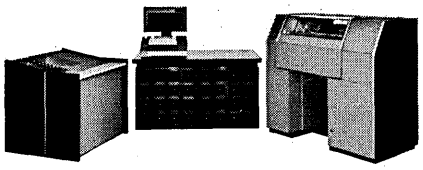

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several universities' departments and schools have included computer science courses in their curricula. But as time passes, it is evident that these two main sources of education will not be sufficient to solve a problem that is already forcing many potential users to consider the installation of an electronic computer as too risky a venture.

In the U.S., Canada, and Western Europe, professional mobility is customary and accepted by most undergraduate students in all areas. For students majoring in physics, biology, or social sciences to shift during their last term to computer programming is quite natural. In Latin American universities, however, inclusion of programming courses in the last years of engineering, science or economics school has not had a similar effect. Practically no students have shifted to computer sciences as a professional activity, nor have they gone into the few graduate programs that have been organized from time to time. It is now generally accepted that Latin American universities will have to adapt themselves to the demands of these emerging professional activities, and organize undergraduate departments leading to a bachelor's degree in computer sciences. In order to assist in this urgent task, LAIICS has submitted a plan for an eight-semester undergraduate curriculum to a number of computing centers and universities, which will hopefully serve as a starting standard program.

The University of Buenos Aires was the first university to establish an undergraduate school in computer programming. During 1968, the Universities of Concepcion (Chile), Oriental (Uruguay), Sao Paulo (Brazil), Central de Caracas (Venezuela), and the School of Municipal Engineering of Mexico will try to start their own undergraduate schools for degrees in computer science.

manufacturers' help

The efforts of some of the manufacturers have also contributed to the educational field, although this usually means an intensive, non-credit course. Leading the way, IBM has established an Institute for Systems Analysis in Mexico to serve Central America and the Caribbean region, and another one in Brazil, to serve the South American countries. These institutes have been giving groups of selected persons 6-9 months intensive training courses in programming and systems analysis techniques.

Following this line, Control Data is reported to be considering the establishment of a similar educational venture in Mexico, joining the capabilities of their local computer sales office, and the Mexican branch of their recent acquisition, CEIR.

Burroughs, the second most important dp company in Brazil, and very active in Chile, Venezuela and Mexico, is also thinking of setting up a coordinated educational effort. Bull-GE and NCR will undoubtedly follow the trend.

But even with these attempts, the immediate problems remain, and many installations are operating at a dangerous level of sub-utilization.

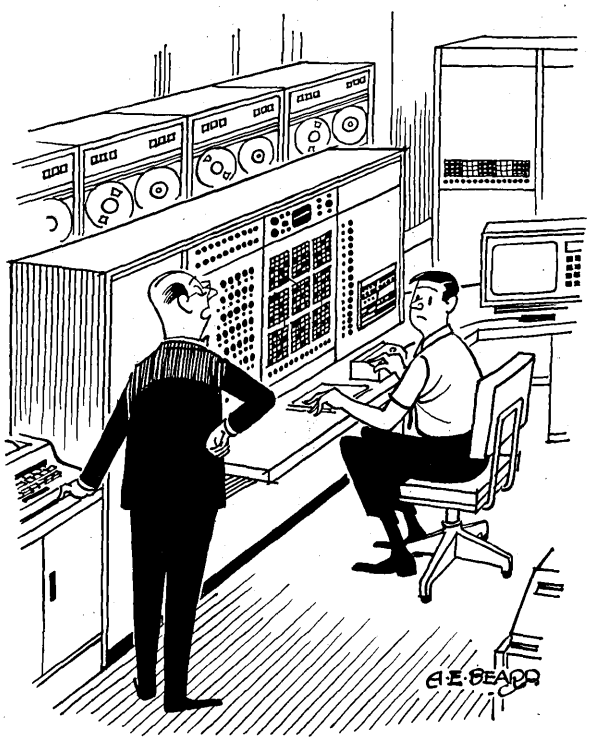
Another problem frequently encountered is the "hard software" problem. As mentioned earlier, the manufacturers are not finding it easy—or financially advisable—to set up the costly structures on which software support has to be based. As a result of users' groups not being formally organized, every new customer receives a deck of cards, a magnetic tape reel or a disc pack, and some operating instructions, which hopefully will make the executive monitor, the compiler's translators, or the statistical routines run in a proper way.

Without information about the architecture of the system, without proper and intelligible documentation about the software, and with no possibility of securing any really experienced and knowledgeable advice from the manufacturer's personnel, 90% of the installations decide on abandoning such hard software, and fall to assembly or machine language programming. The situation is even worse when the needs of a user call for a modification or an enlargement of any of those "black boxes"—as no access whatsoever is possible to the inner structure of the machine.

Another problem, that of "soft hardware," has several different aspects; one of the most important is the growing need for customers to be able to interface different makes and models of second generation machines. Up to now, the local branches of the manufacturers sneer and scowl whenever problems of this nature are posed to them. But their attitude is most likely due more to a lack of personnel capable of undertaking these responsibilities, than to a narrow-minded sales attitude.

As is evident, computer science development poses problems of a more acute nature in the Latin American countries than in more industrialized nations. In order to make a reasonable transference of fast-changing equipment and techniques into a professional and business media that does not have a corresponding degree of absorption capability (mainly because of a lack of skilled, flexible personnel), it is necessary to organize a massive short- and long-range educational program in which manufacturers and users can merge their resources and efforts for the benefit of the whole computing community.

It is a good symptom that IBM and Bull-GE have joined LAIICS, and that the rest of the manufacturers have expressed interest in joining, too. It is also very promising that the Union of Latin American Universities has expressed its support of the LAIICS' curricula program, and has shown its interest in contributing to the solution of a problem that many of its associates are directly experiencing. ■



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lots of projects

CALIFORNIA STATE EDP

Sixteen governmental information systems were described to the State of California Intergovernmental Board on Automatic Data Processing in Newport Beach, Jan. 31. The general theme of the one-day session was "Intergovernmental Information Systems Programs." The board was provided with a narrative overview of the 16 projects which covered, in order, five areas: education, cities, counties, regions, and state. This order of presentation either intentionally or inadvertently supported the currently popular bottom-up or "building block" approach to government dp.

The primary goal of the meeting was to inform the board and, of equal significance, the participants from the various projects of the current status, present problems, and anticipated future development of each information system.

First, a general description of the organization and objectives of the State of California Intergovernmental Board on Automatic Data Processing is needed. The board, under Supervisor Paul J. Anderson of Riverside County, is one of three organizational components designed to coordinate and guide the conceptualization and construction of dp systems within the state of California. The impetus for its creation was jointly derived from the legislative and executive branches of California state government. The board's basic responsibility is to suggest policy for the present and future use of dp by the state. This policy is expected to include an awareness of dp efforts at other levels of government; hence, the intergovernmental title. In essence, the board is in the process of deciding the broad goals for an integrated network of dp systems ranging from local to state levels of government. The 11 members are drawn from the city, county (three from each level), state (four members), and education (one member). Their primary interest in achieving a coordinated approach to the acquisition and utilization of computer-based information systems provides a common bond for mutual interaction and resultant policy decisions.

The board has established two advisory committees (technical and legislation) in order to draw upon requisite expertise from various professions and disciplines. Tug Tamaru, general manager, Data Service Bureau, City of Los Angeles, is the chairman of the technical advisory committee. This committee is comprised of 15 people from the city, county, schools, and state. Unlike the board, this committee has a single purpose—accomplishing pertinent research involving dp hardware and software. Currently, the committee is focusing on the development of statewide dp standards.

The other two organizational components playing a major role in state adp decisions are the Office of Management Services (OMS) and the Department of General Services (DGS). Of the three organizational entities cited DGS has had, by far, the longest involvement in government adp. Recent policy decisions regarding DGS have circumscribed its formerly broad adp interests in favor of an immediate concern for implementation. The missing link between policy (board) and implementation (DGS) was provided with the newly created OMS and its first director, Charles P. Smith. Basically, OMS has been assigned the planning function for adp within the state governement. As one might expect, OMS has already become actively engaged in matters that include intergovernmental adp.

the systems

Obviously, space does not permit anything but a succinct review of the 16 information systems described to the board. Further and more detailed information can be obtained by contacting the described project. Taking them in order of presentation, we will first look at an educational computer-based information system termed the California Total Educational Information System (CTEIS).

CTEIS has evolved out of a recognized need for a better method of applying dp to our educational institutions. It assists regional areas to establish centralized computer facilities for use by contiguous school districts. Their major goal is to insure that all such facilities are sufficiently compatible to comprise a total educational information system for the state. Some of the present applications are: stores accounting, accounts payable, payroll, textbook accounting, budget simulator, management reporting, student scheduling, student test scoring and reporting, attendance accounting, and guidance records.

Next on the agenda were municipal government information systems. First to be explained was the San Gabriel Valley Project (SGVIS). Based on the findings of an adp design and cost study, the 21 cities in the San Gabriel Valley that expressed original interest have been reduced to 10. These 10 cities are in the process of investigating the possibilities of creating a centralized adp facility for sharing by all participants. A single major problem now confronts the involved cities—money. Tentative plans, unless larger sums of money are made available, are to implement certain "bread and butter" dp applications such as water utility billing, land use, and police statistics. It was interesting to note that the speaker, Donald Rinaldi, city councilman, Covina, felt that the real significance of SGVIS was not in the dp accomplishments but in the ability of a number of cities to formally agree on participating in a joint project effort.

The second city-oriented project presented was SOGAMMIS. It differs from all other projects in that it is university based (School of Public Administration, University of Southern California). Its research findings have been elicited from a detailed systems analysis of two medium-sized cities, SOGAMMIS views the municipal organization as a total system comprised of a number of functions or "subsystems," each of which receives and generates information not only of interest to itself, but to other subsystems and central management as well. In accepting this approach, many medium-sized cities are realizing that they can afford their own adp system.

The last of the three municipal information systems explained was the most technologically advanced. It is the Los Angeles Municipal Information System (LAMIS). Considerable detail about LAMIS hardware and software was provided to the audience. LAMIS is now in the second step of phase three which emphasizes the expansion of its fiscal, personnel, library, public works, police, management, and overall dp capabilities.

As the jurisdictional area grew, the information systems discussed became more specialized in terms of the user clientele. Only one of the three county information systems reviewed was depicted in terms of countywide government use. This generalized system was the Local Government Information Control System (LOGIC) of Santa Clara County. LOGIC is similar to LAMIS in its intent and desired achievements. Next to be described was the Uniform Welfare Information System (UWIS). UWIS is basically a study of county welfare information needs. The study is investigating the data needs of public welfare agencies.

Last, the Police Information Network (PIN) of Alameda County adp operations were explained. PIN is a computer-based warrant and want system now used by numerous police agencies in the San Francisco-Oakland area. Its successs has provided impetus for the development of similar systems in southern California. While initially conceived as a county information system, it has been expanded into a police-oriented regional data base.

Both of the regional information systems previewed were in their embryonic stages. The older of the two, the Association of Bay Area Governments (ABAG), hopes to establish a "comprehensive full-scale regional information system." Most of their activities are yet in the early stages of conceptualization. However, other ABAG projects in the area of regional transportation and federal census-taking are providing concrete experience for the anticipated system design study. The Southern California Association of Governments (SCAG) is similar to its northern counterpart in both goals and accomplishments. SCAG is surveying potential user agencies in order to ascertain their requirements for a future systems study.

The majority of the seven state information systems were devoted to the field of criminal justice. These were: Department of Motor Vehicles, Automated Management Information System (AMIS), California Highway Patrol, Automated State Auto Theft Information System (AUTOSTATIS), Department of Justice, Criminal Justice Information System (CJIS), Department of Justice, California Law Enforcement Telecommunications System (CLETS), and Department of Corrections, Correctional Decisions Information Program (CDIP). AMIS has completed its conceptualization phase and is in the process of creating an adp systems design for subsequent implementation. Motor vehicle registration and operators' licenses will be its major focus. AUTOSTATIS is presently operating in an on-line, real-time mode. It contains information on stolen and wanted motor vehicles within California and some parts of Oregon and Nevada. CJIS is now completing its design phase. Eventually, it will contain a variety of criminal information for use by criminal justice agencies.

While pertinent to the board, CLETS is not an information system. It is a planned communications system linking all levels of California law enforcement bodies with one another as well as appropriate national government systems. CDIP is an ongoing systems analysis of the existing correctional information network and its decision centers. Perhaps the most salient observation gained from these five projects was that they were more than merely interrelated. They were, in fact, overlapping a great deal into one another's activities.

In conclusion, the Statewide Federated Information System (SFIS), and the California Regional Land Use Information System (CRLUIS) were explained. Both are statewide in nature. And both are waiting for monies in order to continue with necessary design and analysis. SFIS and CRLUIS are follow-on project activities stimulated by the 1965 aerospace studies.

general observations

All 16 information systems described to the board reflected a major interest in people: their general welfare, their protection against anti-social behavior, their property, and their hopes for more efficient government. Those information systems now operating stressed fiscal matters and/or law enforcement. General welfare and property appeared to be next in line for computerization.

What relevance does this conference have for those in the dp field? Or, for that matter, what relevance does this conference have for those in government? The response from both groups should be "Tell us your problems and hopes and we'll tell you ours." We are able to discern from those in government a great need for dp standards (technological), supportive action (legislation), and public funds. Thus far, sufficient sagacity has prevailed among those directly concerned with government adp for the omnipresent problems to be perceived as opportunities.

The final comment offered deals with the board—its composition and relationships. The board's reality-orientation is reasonably assured by its close cooperation with the Office of Management Services (planning responsibilities) and the Department of General Services (implementation responsibilities). It is useful to note that almost one-half of the individuals recently appearing before the board serve it in some other capacity. Furthermore, most of those present serve in an advisory capacity to one another's project. It is suggested that this form of linking memberships provides the main hope for continued intergovernmental coordination relative to developments and, more importantly, the creation of an intergovernmental information system that is ultimately recognized as a success.

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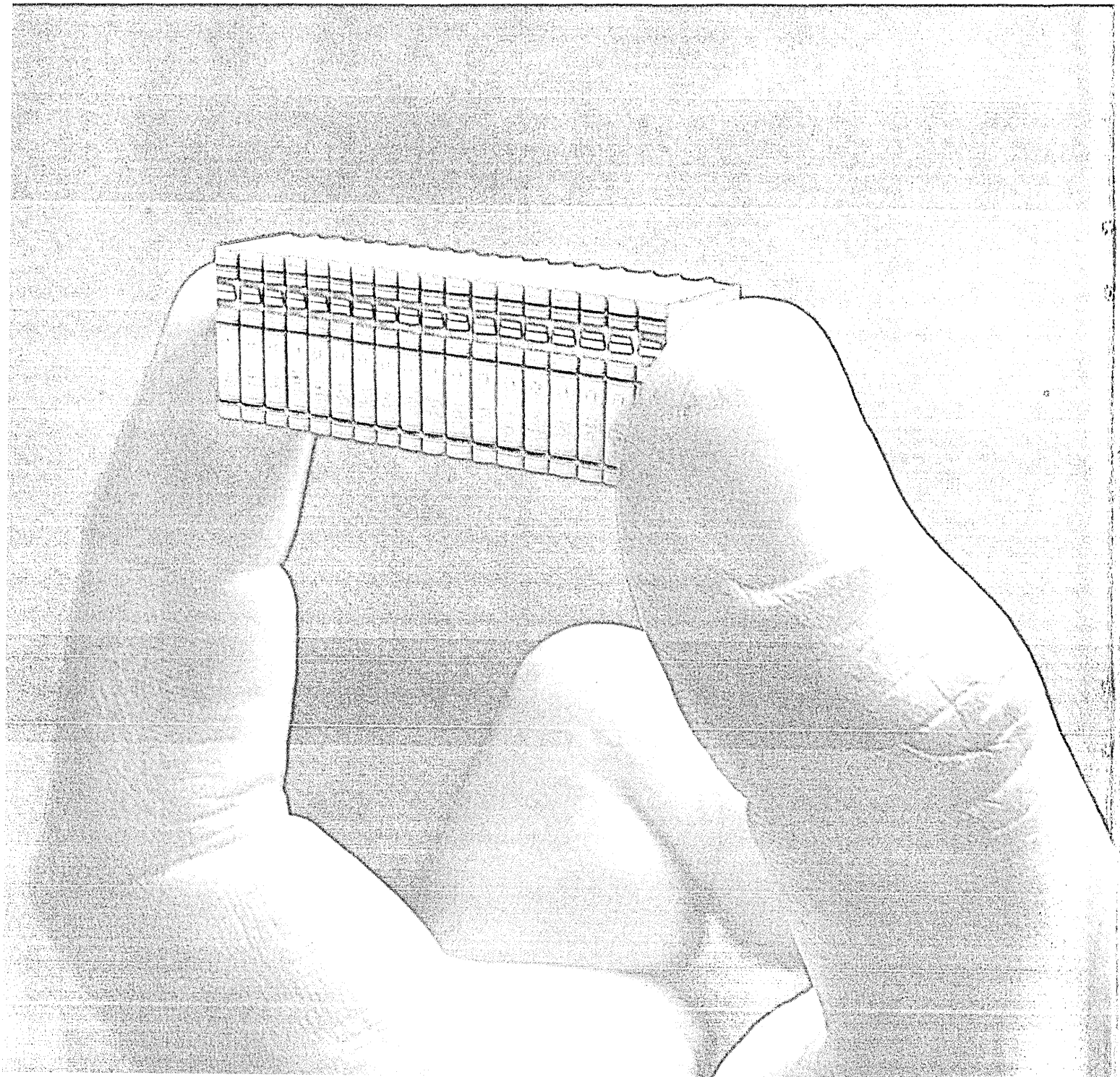

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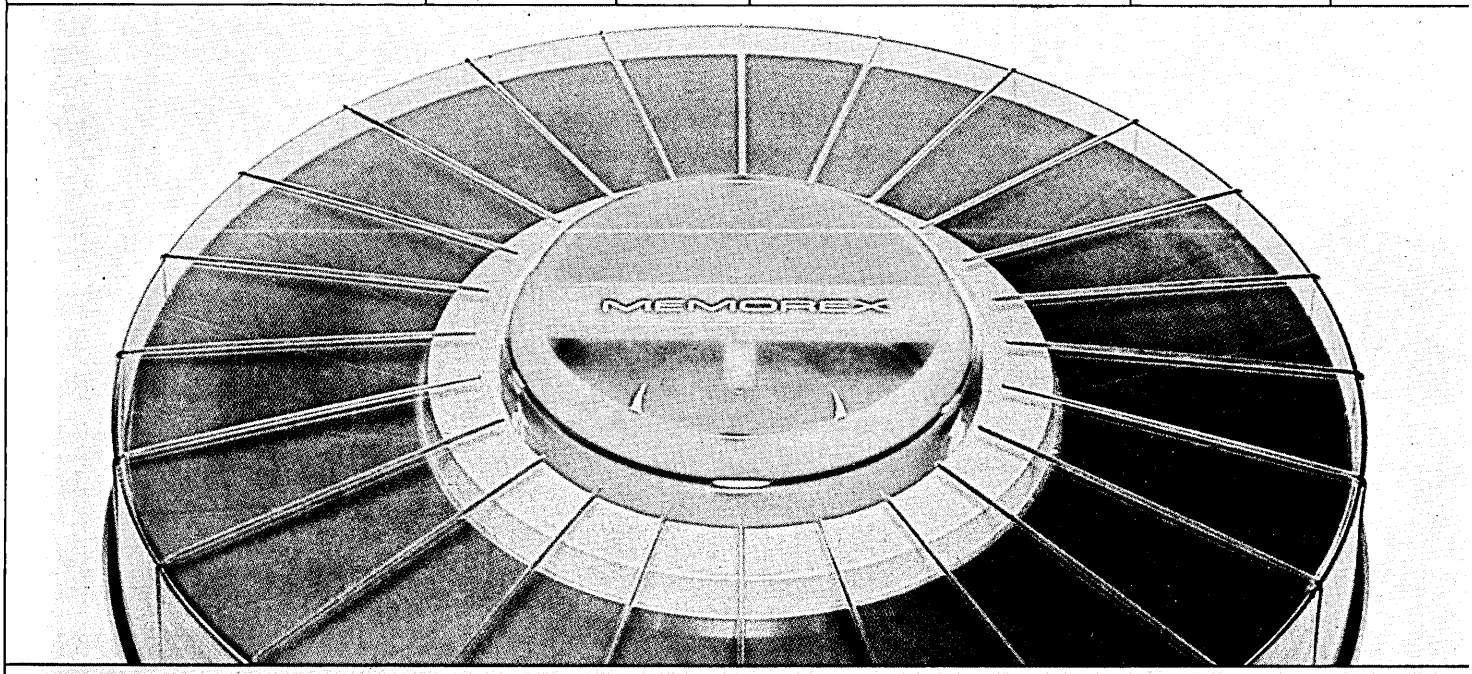

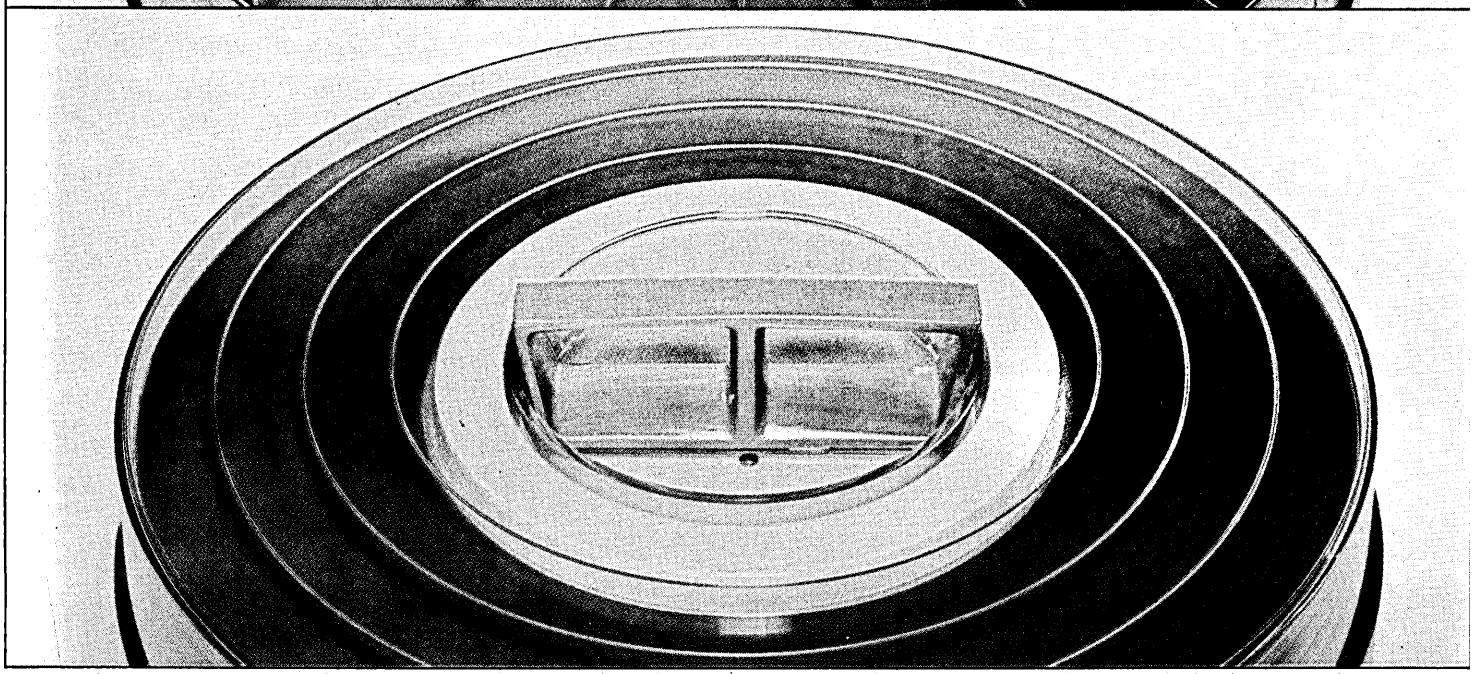

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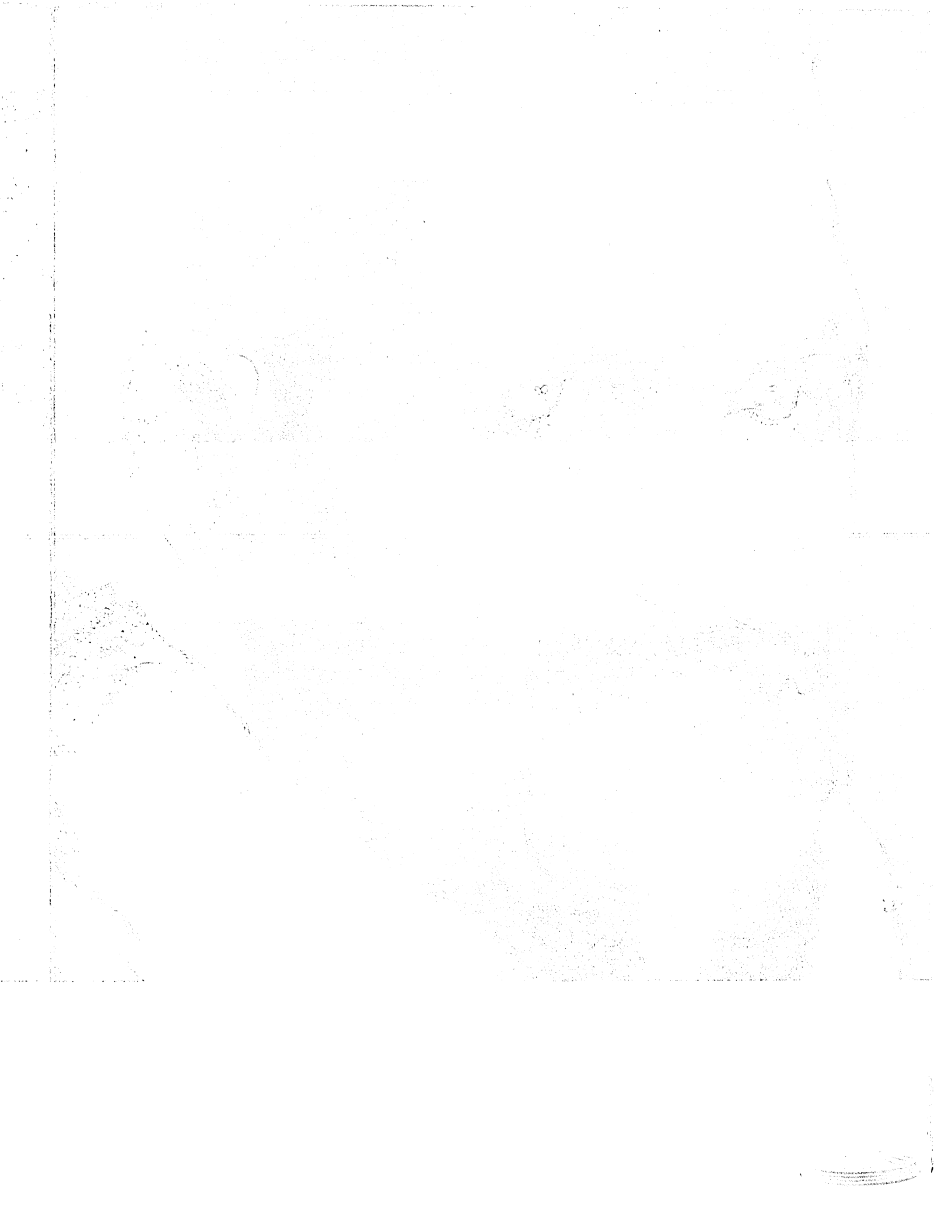
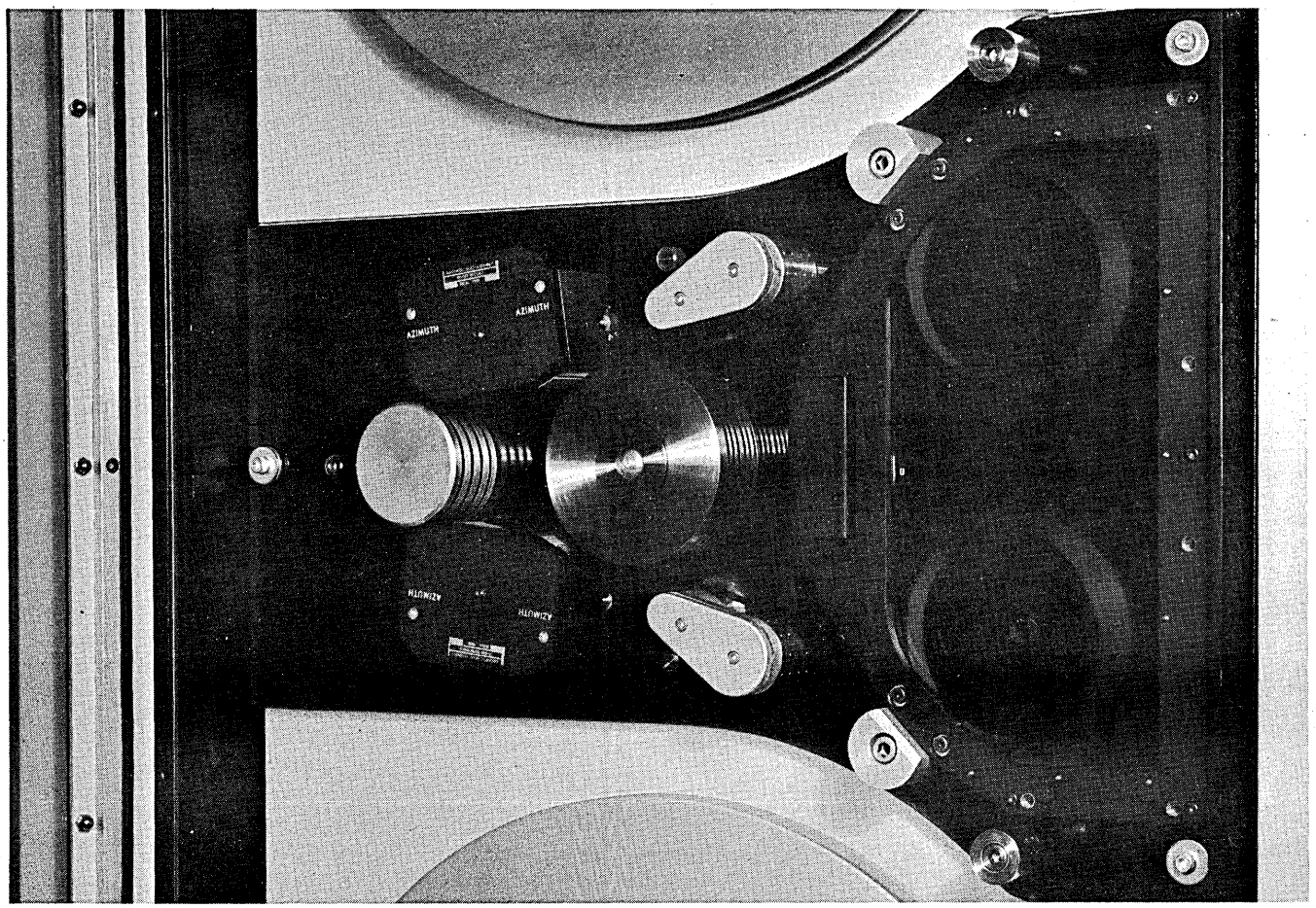
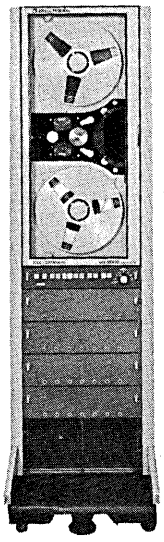




DUAL INERTIA DRIVE, INERTIA DISENGAGED

CEC announces the most important recording advance in years... a time base error of ±400 nanoseconds maximum



The recorder is CEC's new 2.0 MHz VR 5000. Because of its improvements in time base error, the ultimate in real-time restoration of data is now possible. Tapes made on conventional data acquisition recorders under severe environmental conditions can be successfully reduced with correct time base restored.

To some, however, there is another achievement of the VR 5000 which may be even more significant. It has a flutter correction capability *five times more effective* than that of our nearest competitor.

Reason: the VR 5000 is the only recorder that offers Dual Inertia* drive, translating the ideal system concept into a working reality—*high mass recording and low mass reproduce.*

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types and patent applications (on a stylus assembly and facsimile transmission system) to A. D. Little Co. GSI then bought these assets for $500,000, and is presently developing production prototypes. Arrangements have been made with five firms to field test these machines. GSI proposes to lease this model in anticipation of more advanced devices it plans to develop.

The 20-pound transceiver sends and receives documents over phone lines (six minutes for 8½" x 11" copy) merely by placing a telephone receiver in the cradle of the unit and pushing a button. By means of indexes on the unit, the operator can control the amount of material—line, paragraph, signature—sent, saving on transmission costs.

The GSI Leasing Corp., which started operation in December, will restrict itself to IBM System/360's. As of Jan. 1, one system costing $418,000 had been leased. Finances for this subsidiary include a $3 million loan and about $7 million of the debenture offering.

Under information services, GSI will provide systems analysis and design, programming, management and other related software services. This 12-man operation will also provide software and systems support to prospective customers of the leasing subsidiary. A 360/50 has been ordered for these activities, to go in during third-quarter 1968.

In addition to sales offices in New York and Rochester, GSI will open them in Boston, Philadelphia, Montclair, N.J., and 10 other cities before the end of this year. At least 25 more programmers and analysts, 25 production personnel, and five leasing salesmen will be hired this year.

WESTERN UNION TANGLES WITH LAW RESEARCH SERVICE

Western Union has run into more obstacles in its much-publicized attempt to establish a nationwide computer utility.

Law Research Service, Inc., which provides a legal citation service through WU teleprinter and computer facilities, is suing the carrier for $37 million, alleging non-performance of contract. Shortly before, WU sold back its one-third interest in Information Sciences, Inc., which operates PICS, a computerized employment service. Corn Products Co. subsequently purchased a 25% share of ISI.

According to Dale H. Learn, president of Information Sciences, Western Union bowed out because it needed capital. He added that PICS has grown four-fold in the past year. The data file now contains information on 28,800 job applicants; 320 employers are using the system regularly to lo-

GODDARD STARTS UP MODEL 91 (Continued from p. 99)

February arrival, while the other is due this month at Greenbelt.

The 91's execution cycle time ranges from a minimum of 60 nsec for fixed point addition to 2.2 usec for fixed point division. By comparison, the CDC 6600 ranges from 300 nsec to 2.9 usec, the Burroughs 8500 from 500 nsec to 4.1 usec, and the 1108-II from 750 nsec to 10.13 usec. The range for the 360/85 is 80 nsec to approximately 2 usec. (These and following comparisons ignore variations in data length and system logic which can appreciably change the figures quoted in certain cases).

Figures supplied by IBM indicate that the 91 does some operations significantly faster than the 90, which was withdrawn last year. For example, the 90 does a floating point addition in 180 nsec and a floating point multiplication in 270 nsec. The figures for the 91 are 120 and 180 nsec respectively.

The 91's memory cycle time is 780 nsec, but interleaving allows a different cycle to start every 60 nsec. The 6600 has a 1 usec cycle time and a 100 nsec cycle-start interval. For the 1108-II, the figures are 750 nsec and 375 nsec. The 8500 permits simultaneous access of each memory module every 500 nsec. This system is expandable to 64 modules, each containing 16.4K 52-bit words.

The 91's relatively faster cpu cycle stems partly from the use of ASLT (Advanced Solid Logic Technology) and higher component density. The result is a switching speed of 1.8 nsec—three times faster than the SLT circuits in earlier 360's.

GSFC's 360/91 was delivered at the end of last October, and went into two shift/day operation Dec. 1. In February, a third shift was added, and the weekend schedule —which had been varying between 8 and 16 hours—was fixed at two shifts.

Goddard is using Option 4 of OS/360, Release 13. This is the second one in the series to include MVT (Multiprogramming with a Variable number of Tasks). Reportedly, this software works well on the 91—"with 90% reliability," as one source puts it— but considerably less well on Goddard's 360/75 equipment.

Greenbelt is making extensive use of MVT. During the day, five programs are in core simultaneously; at night, eight. Reportedly, this arrangement produces a five-fold decrease in job turnaround time and doubles throughput, compared to an otherwise identical operation without MVT.

Up to 50 megabits of core storage are available in the 91. This is less than the maximums for the 6600 and 8500 (120 and 54 megabits, respectively), but more than the 360/85 and 1108-II offer. The maximum core that can be accommodated by the 85 is 33.6 megabits. For the 1108-II, it's 9.5 megabits.

Disc packs accommodating 233.4 million characters per unit comprise the 91's primary peripheral storage. Average access time is 75 msec. Fast-access (8.6 msec) storage is provided by Model 2301 drums, each holding 4.09 megacharacters.

The 91's cpu is segregated into five "highly autonomous execution units" which reduce execution time "significantly," says IBM's press release.

For example, according to the release, the 91 can process two additions and a multiplication in three machine cycles. These operations, it is claimed, would take seven cycles in a "conventionally-organized machine."

The 91, however, is apparently more conventional in this respect than the statement indicates. A CDC source points out that the 6600 can do the same calculation in 1.1 cycles. He admits that the elapsed time is greater, but that's because of the 6600's longer machine cycle rather than less-sophisticated cpu architecture.

According to a NASA source, the main distinction of the 91's cpu is that it reduces programming somewhat. In sequential arithmetic computations, he explains, the system will store intermediate answers in a register without explicit instructions; with other systems, instructions are necessary.

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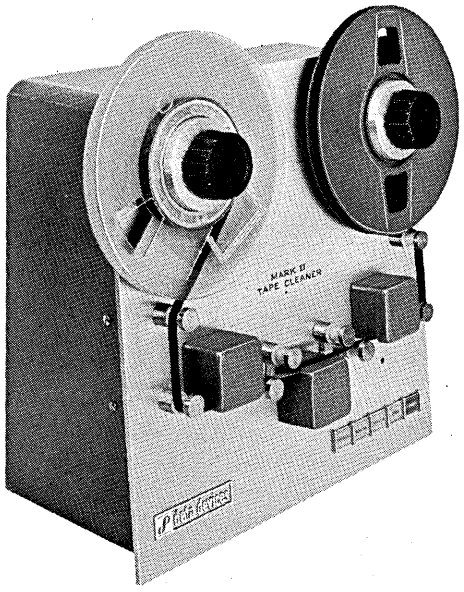

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cate potential employees.

Access to PICS is provided by telegraph, TWX, TELEX, and telephone lines. Until the divorce, a Honeywell 200 and a Univac 418 owned by Western Union processed PICS queries. Now, ISI uses a service bureau, but expects to have its own 360/30 shortly.

Learn reported that the New York State Employment Service has accused ISI of operating an employment service without a license. His position, basically, is that PICS does not place job applicants, only provides a marketplace where employers can meet potential employees, and therefore is not an employment agency. The case is pending before the New York State Supreme Court; no trial date has been set.

E. C. Hoppenfeld, president of Law Research, says he's suing WU because it promised to provide communication links with LRS franchisees in 37 states, together with several million characters of data storage, but actually has provided communications to only seven states and about half the promised storage. LRS has collected $3 million in advances from the franchisees, who are reportedly getting restive.

A spokesman for Western Union says the Law Research suit contains "erroneous" and "extravagant" claims, and that WU's liability, if any, is minimal.

At press time, the trial was just getting started.

BANKS SETTLE ON STANDARD ID NUMBER

Learn your social security number. The use of this number as the nationwide standard for personal identification in the banking industry is now officially supported by the American Bankers Assn. ABA considers this its most significant move in planning for the new automated payment systems of the future.

The decision comes after two years of study by the Personal Identification Project committee of the ABA. According to the association, it meets all requirements: acceptable to the American public, unique, permanent, and suitable for use by other major segments of the economy. Almost half the states now request this number in motor vehicle and driver registration; Medicare, universities, insurance companies, and others also request it.

In explaining the need for an identification number, PIP chairman Gilbert Lawrence, vice president of Manufacturers Hanover Trust in New York, said that a uniform identification number serving as a name's adjunct would reduce and eventually eliminate the ambiguity inherent in the use of names only as identification. But further protection for the individual is needed, and a PIP subcommittee has been studying various verification methods, such as the secret code number, known only to the individual, and fingerprint and signature recognition techniques.

Implementation of the number by banks involves numerous questions. Most banks are likely to adopt the number as standard identification. In fact, many banks have this number on many customers because the Internal Revenue Service requires that a bank supply it along with data on interest and dividend payments paid a customer. But it will be up to the bank to decide whether it uses the standard number as a central account number for a customer or as the entry number to the computer system, which will cross-reference it with the various account numbers a person may have at the bank. The major disadvantage of using the S.S. number as the account number, besides the conversion problem, is the number of digits needed. A one or two-digit identifier would be needed to indicate the kind of account, as well as a check digit.

To assist the banking community in implementing the standard, PIP has prepared a guide on recommended procedures, including those for obtaining the number, methods of recording it, and check digit standards.

PRIVACY HEARING WITNESSES OFFER CONFLICTING VIEWS

AFIPS vice-president Paul Armer told a Senate judiciary subcommittee last month that separating an individual's name from his computerized data file would provide little protection against invasion of privacy. Anyone free to browse through the data file, said Armer, could locate an individual's record, given a few easily obtainable clues, such as the individual's age, street address, and occupation.

Armer, who is also associate head of the computer sciences department at RAND Corp., criticized this means of protecting privacy because the subcommittee's preceding witness, Wiley Branton, executive director of The United Planning Organization, a Washington, D.C., anti-poverty agency, had contended that technique was effective.

Branton explained that UPO is now building a computerized "social data file" containing information on several thousand disadvantaged residents of the city; their privacy will be assured, he explained, by physically separating each name from the related data.

Branton also disclosed that UPO will not provide any data on individuals, only aggregate statistics, and that management of its data file will be put in the hands of trustees. The latter move will give individuals a clear right to go into court if they feel their privacy has been violated.

Although it wasn't mentioned at this hearing, the Census Bureau releases only aggregate statistics, yet several Congressmen have complained that this practice does not give the individual adequate protection. They have introduced bills that would severely limit the questions each individual would have to answer on census questionnaires.

"It is my opinion that, with care and concern, it is possible to develop a comprehensive and integrated record system that will provide the information required for proper programming without unduly jeopardizing the privacy of individuals," Branton told the Senate subcommittee. But a basic question throughout the hearing was whether this care and concern would develop naturally. The first witness, Prof. Alan Westin, of Columbia Univ., thought government action would be necessary.

Prof. Westin, whose recently published book, "Privacy and Freedom," has made him the pre-eminent authority on privacy problems, strongly recommended federal legislation "to provide regulatory standards and supervision for interstate credit company activities." He also called for "a full-scale Congressional inquiry . . . into the specific safeguards for privacy that are being developed . . . [in] public and private systems."

Besides legislation, one goal of future action, added Prof. Westin, should be to establish the individual's legal rights "to determine those to whom he will reveal personal information about himself, how much he will reveal, and at what time." Present law, he indicated, does not usually constrain the collector of dossier-type information from distributing it to others. It is "essential" for every computerized data bank to distinguish among information that can be circulated freely without the individual's consent, confidential data meant for only limited circulation, and "top-sensitive" data that would include derogatory information and which would not circulate at all, said Prof. Westin.

After the hearing, he indicated that the individual, as part of his legal right to control his recorded image, should be able not only to access his

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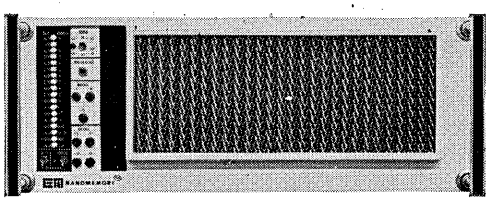

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CIRCLE 55 ON READER CARD

data bank file, but also to rebut information he felt was erroneous. If a credit bureau record, for example, left the wrong impression, the individual should have the right to prepare a "200-word rebuttal" and get it cranked into the system, Prof. Westin explained.

Credit bureaus are almost certain to oppose this idea violently, since they already are on record against providing individuals with printouts of their data files.

"The forces of the marketplace are apt to have little impact in the near future on improving the state of privacy in our society," said Armer at the end of his statement. ". . . The market mechanism works very imperfectly in such areas and needs prodding . . . privacy lacks an organized constituency."

Without the constituency, added an observer, "how much prodding can you expect?"

NEW FROM HONEYWELL: COMPUTER, INPUT DEVICE

A new line of data preparation equipment, the Keytape data input units, and a small-scale computer, the model 110 (low-level member of the 200 series family), were announced recently by Honeywell, Inc. According to C. W. Spangle, vice president of Honeywell's EDP Div., the Keytape unit is aimed at the data preparation market now dominated by keypunch machines; the Model 110 is a beginner's system for first-time users and those with small competitive systems: a market said to yield 20,000 prospects

—equal to the entire market potential for the rest of the 200 series. Honeywell considers the 110, available in tape, card and disc configurations, a suitable step up for 5,000 current manual users, 6,500 unit record installations, 3,000 Univac 1004's, 4,500 IBM 360/20 card systems, and more than 2,000 of the 6,500 1130's being used.

Basic features are a memory capacity of 4-16K, 4 usec cycle time, 2 usec access time, and one read/write channel (one optional). Major competitive selling points are the price and an 8K COBOL compiler—the only COBOL offered on such a small machine, says Honeywell. A typical 8K card system with one read/write channel, line printer and card reader rents at $1,815, versus, say, a similar 360/20 at $2,150. An 8K system with three tapes rents at $2,400, vs. a mod 20 tape system at about $3,200. A 12K 110 disc system with 9.2 million characters of disc storage rents at $3,320.

Three peripheral devices have been added to the line for the H-110. The Model 204B-17 tape unit with control unit (and an -18 secondary tape unit) has a 8,890 cps transfer rate, 200 or 556 bpi packing density, and IBM compatibility option. A disc pack drive (258B) and control provide a 144,000 cps transfer rate and maximum capacity of 9.2 million characters. A new line printer is the 300 lpm 122-I.

Other software includes the CPS control program, EASYTAB, EASYCODER, and application packages for general ledger, accounts receivable, accounts payable, payroll and inventory reporting.

Deliveries begin in August for tape systems, November for disc configurations.

Also announced were the Keytape data input devices.

The most significant assault on the 500,000-unit keypunch market started in 1965, when the Mohawk Data Sciences Data Recorder for direct source data-to-mag tape conversion was introduced. Now Honeywell has come up with a similar system, the Keytape. (IBM, it is rumored, also has such a unit in the works.) Two series of four models each are available: the 700 for seven-channel tapes and the 900 for nine-channel.

Each unit operates in five modes: program entry and verify, data entry and verify, and search. Data entered through the console's 64-character keyboard is stored in a core memory; during each 80-character-record entry the operator can backspace to any location in core, determine the character, and correct if necessary. A display panel on the console indicates current position in memory, data there, and contents of the program in memory which formats the data. An internal checking system validates the data written on tape by comparing it with core immediately after each record is written; on an error, a buzz and flashing red light draw the operator's attention to the display panel which signals the nature of the correction.

The 700 series devices write 80-character records on 556 bpi tapes (120-character record, 800 bpi tape unit optional). The 900 series writes 80 characters (90, 100, 110, 120 optional) at 800 bpi. Both series have a tape forward speed of 24 inches/second and handle 200-2400 foot reels.

The console, core and tape unit make up the basic unit under each series. The 710 and 910 also include communication control for transmission of data on tape from one unit to another over voice-grade lines. The 711 and 911 are basic units with a punched card reader for card-to-tape conversion. And the 712 and 912 have a pooler to effect off-line consolidation of several tapes into one master tape. July and October are first delivery dates of the 700 and 900 series, respectively. For information:

CIRCLE 168 ON READER CARD

PATENT GIVEN GUNN EFFECT SEMICONDUCTOR DISCOVERER

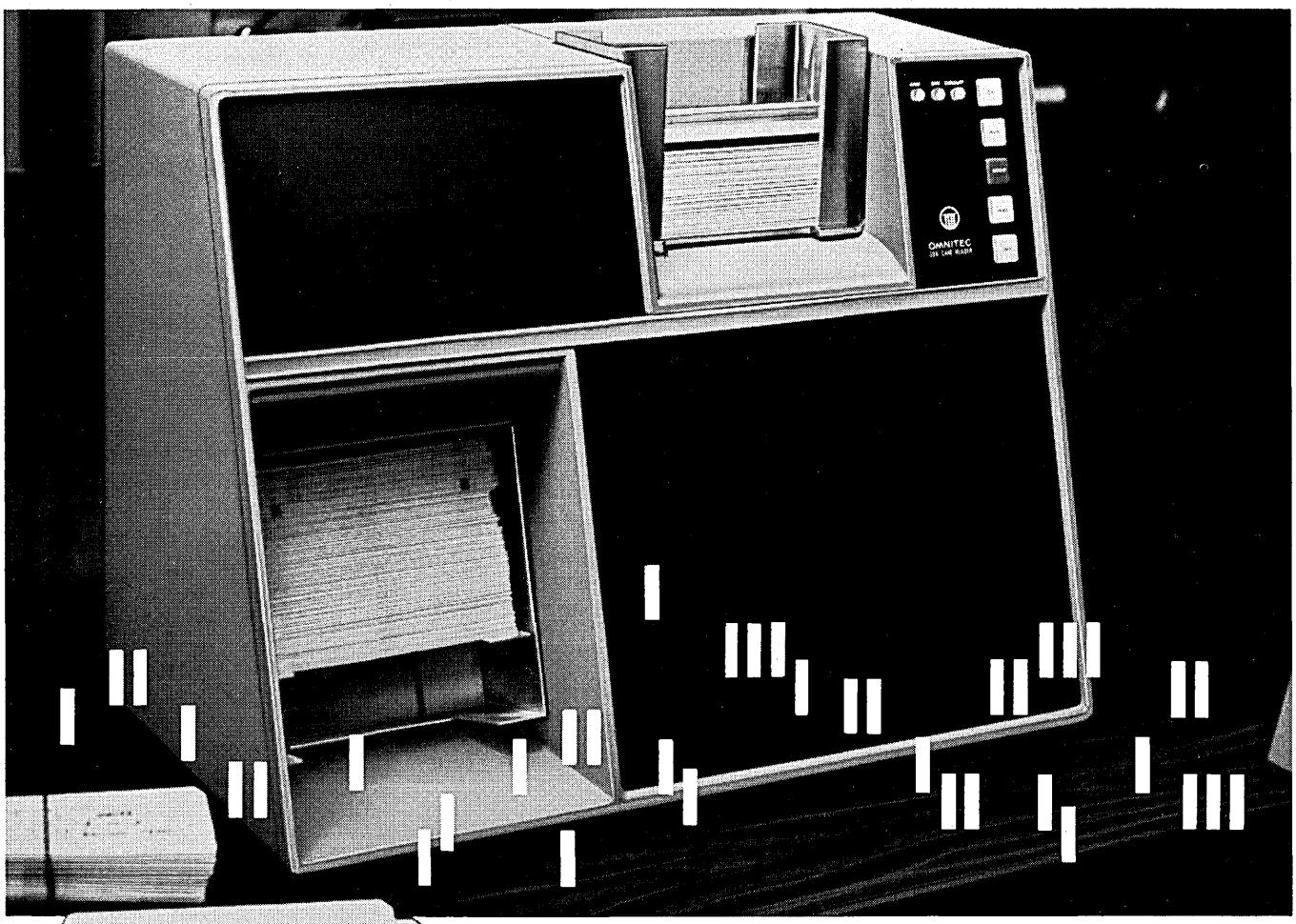
J. B. Gunn of IBM has been issued a patent for developing a semiconducting material in which spontaneous variations of the internal electric field —and of the material's electrical conductance—occur when the applied voltage exceeds certain minimum values. This variation of conductance is used to generate microwaves and is known as the Gunn effect.

This process may be used in applications to portable radars and electronically steerable radars for antimissile systems. Additional applications now being researched include the basic mechanism in devices that perform digital logic, coding and decoding, and I/O functions.

The discovery of the Gunn effect has also stimulated research in other "bulk effects" in semiconductors—effects which occur because of inherent properties of the material, rather than as a result of the introduction of junctions, as in transistors.

LONG SUBCOMMITTEE REVEALS PERSONAL CONTENT OF FILES

The Senate Subcommittee of Administrative Practice and Procedure, under the chairmanship of Senator Edward V. Long (D-Mo.), has compiled a 605-page summary showing how much information the federal government maintains on individual American citizens. The book is entitled "Government Dossier, Survey of Information Contained in Government



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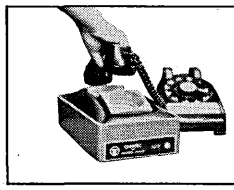
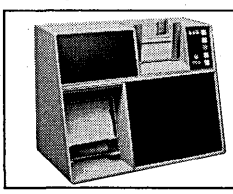
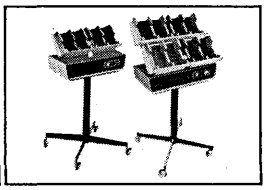


CARD READER



DOCUMENT JOGGERS



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CIRCLE 56 ON READER CARD

Files," and discloses that, for example, citizens' names appear three billion times in government records; ages, two billion times; marital status, 1.5 billion times; and income, 1.25 billion times.

Viewing the published results, Senator Long commented, "Hearings before my subcommittee have convinced me that whatever privacy remains for the American citizen, remains because the federal government is presently too inefficient to pull all its personal information files together . . . it is extremely time-consuming and expensive to put your finger on any one individual. . . . But the proposed . . federal data bank will make it easier and cheaper to put your whole life history no further than the push of a button away . . . what good will this [technical] progress be if we fail to preserve our privacy. . . ." A copy of this report is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price: $1.75.

RCA LOSES LIGHTNING BOLT, STEPS UP EDP ACTIVITIES

RCA is busy adding new dimensions to its edp activities, beefing up old ones, and modernizing its image for "things to come."

First there was an announcement of an agreement with Commercial Credit Co. of Baltimore to form a separate corporation to establish and operate time-sharing computer centers in at least 11 cities. This is the first entry for RCA into service bureau business nationally. Using Spectra 70/46's, the yet un-named firm will start sometime in 1968 with a center in Baltimore, where the headquarters will be. CCC, a major financial management firm, will be the majority stockholder in the new venture; personnel will be taken from both firms as well as hired outside.

While full details of the operation, such as locations and pricing, are not yet available, services will include time-sharing—initially for scientific applications—aiming at engineering firms, universities, and technically-based businesses. Up to 48 terminals, including Teletypes and the 70/752 video terminal, will be handled simultaneously on each 46. Conversational FORTRAN and COBOL are available. Batch processing for business applications will be run in background mode; FORTRAN IV, COBOL, RPG, and other software are offered for batch.

RCA's only service bureau activity for the last few years has been its Systems Center on Wall Street. By the end of February, five new systems were added to bring the total to 14 computers processing the burgeoning paperwork of brokerage firms. These include a 70/45, 70/15, four 501's, and eight 301's. Eventually RCA will link the customers' main and branch offices directly to the center via teleprinters and remote display terminals for transmission of statements, reports, and other data.

RCA also moved to change its edp image last month by renaming its EDP Division the Information Systems Division. James R. Bradburn, in January, was named the executive vice president of Information Systems (group title) under which are now the Information Systems Division (headed by Bradburn) and the Graphic Systems Division (headed by Stanley Cochran). The name change for edp is primarily to encompass activities in the management information systems areas.

A final command decision replaced the hoary company logo with RCA in science-fiction lettering.

DIGITEK PLANS TO ACQUIRE MEASUREMENT ANALYSIS CORP.

Digitek Corp. has announced reaching an agreement in principle to acquire Measurement Analysis Corp. for 196,000 shares of Digitek stock. At the latest quote for the stock when this was written, the price would come to about $2.7 million.

Digitek, founded in 1961 by James R. Dunlap, Donald R. Ryan, and Donald D. Peckham—who has since left—is a Los Angeles software house doing programming systems and noted for its compilers in FORTRAN, PL/I, SIMSCRIPT and JOVIAL.

It's also noted for its financial ups and downs. The company reached its peak sales and profits in fiscal 1966, ending in May of that year, hitting revenue of $1.2 million and a net of $113K. The next fiscal year brought a loss of $710K—larger than the company's sales of $517K.

This period led to some changes, including a move to the low-rent district. And a turnaround appeared in the following quarter, with a $1900 profit on sales of $187K. The quarter following that was both good and bad, with net up to $18K but sales off to $143K.

During this time, the number of employees and the price of the stock showed equally wide fluctuations. Peak employment in '66 was over 50 people; it dropped to 30 by May, '67. The stock, which came out at 6 in early 1966 has seen a low of 2, was around 10 at the end of last year, 20 on Jan. 10, and 14 on Feb. 8.

What Digitek would get in Measurement Analysis Corp. is a company that about matched it in sales for fiscal '67 of a little over $500K and has 25 employees. MAC also has a proprietary program package called MAC/RAN, used in random data analysis. The company, however, has recently described itself as a "research, engineering and consulting organization specializing in the theory of random processes and application to engineering problems"—thus not mainly a software house. It also has a data processing center for data reduction and interpretation using special-purpose analog and hybrid equipment. And it supplies research in vibration, acoustics, structural dynamics and other areas, as well as offering an instrumentation system evaluation service. MAC has been in business about five years.

Digitek brings to the proposed marriage a dowry of around a half million dollars, in the form of a tax loss carryforward. MAC would be operated as a wholly owned subsidiary under president Dr. Julius S. Bendat. The next step is execution of a definitive agreement. This must be followed by approval of MAC's shareholders and issuance of a permit by California's Commissioner of Corporations.

CELESTRON MOVES AHEAD WITH NEW MERGER MONEY

As a result of a merger agreement, the finances and commercial contacts of Inland Credit Corp. will pump new life into Celestron Assoc., a 12-man firm which has specialized in software and scientific engineering programs.

To operate as a wholly owned subsidiary, Celestron, Thornwood, N.Y., will increase its commercial programming activity, branch out into equipment leasing with software under turnkey contracts and further develop program translators.

Initially, Inland, which finances inventory and receivables, will help Celestron bolster its marketing staff and provide a base $10 million for equipment leasing. (In fiscal '67, the 15-man Inland had $18.3 million out in financing, reporting a $2.2 million gross.) Celestron will establish New York offices first, followed by sales offices in Philadelphia and Washington, D. C. In addition to MIS and other commercial programming developments, the firm will offer special packages for the equipment it will lease; the make, except that it won't be an IBM 360, is not yet disclosed. Proprietary packages for such areas as

banking are planned.

Celestron, headed by Henry Oswald, has long been developing translators, the first being XACT (Oct. '65, p. 105). It is also planning translators for conversion of programs from IBM 1400 series, 7074/74, and 7000 series computers to System/360's. The firm will not sell these packages, but translate customer programs either at Celestron or at the customer's site. With Inland backing, Celestron will guarantee this service. FORTRAN IV to FORTRAN H translators are also planned.

CALIFORNIA STARTS THIRD PARTY LEASING, ADOPTS MODEL COMPUTER CONTRACT

California's Department of General Services has signed its first third-party leasing deal, covering punched-card equipment, and intends to push for similar agreements in future acquisition of computer systems. At the same time, the department announced adoption of a model contract with standard requirements agreed to by the major vendors of data processing equipment.

The card machine lease is through the LMC Corp. Selected by competitive bidding, they came up with an 18% discount from the $245K/year the state has been paying.

Terms of the model contract cover equipment performance, delivery of hardware, and completion of software on schedule. The state will agree to pay liquidated damages for failure to accept delivery on schedule; the supplier will do likewise for late delivery or failure to perform as specified. Suppliers were notified a year ago of the proposed provisions and conferences have been held with them leading to the present agreement. Other state, local and foreign governments are expected to adopt the new contract.

BURROUGHS NET UP BUT COMPUTERS STILL IN RED

Burroughs reported record earnings for 1967 despite red ink for computers (which is supposed to turn into black ink in 1968). World wide operating earnings were $34.8 million, up 16% over 1966's $29.9 million (not including a non-recurring $1,035,000 from land sale). Worldwide revenues were up 12%. Fourth-quarter earnings were $15.6 million despite a five-week strike at Detroit area plants, up from $13.9 million for the '66 last quarter. Computer system orders were up 75% (mostly 200 and 300 series, though the 500 series is starting to show).

Burroughs has just announced a $7.3 million contract from the Post Office for production and installation of 59 letter sorters to go into 46 cities. This brings the 10-year-old letter sorter business into its fourth contract, totaling 178 units installed or on order. These sorters are semi-automatic, operating by manned reading and pushbutton rather than optical reading.

Burroughs also opened a new plant this month in Hollywood, Fla., to manufacture small electronic products. The plant will employ 200-300 people.

UNITED AIR LINES GETS TO INSTALLATION STAGE

Unimatic System, United Air Lines' ambitious $67 million real-time information system, billed as the world's largest, took a giant step toward fall completion with the installation of three Univac 1108-IIs at UAL's executive center in Elk Grove, Ill. The system will link 116 cities, have 3,000 agent sets at 500 locations and 700 Pagewriters for automatic ticket or

airbill printing. (The Pagewriter is a 25 char./sec. printer developed by Univac and modified to meet UAL's needs.)

Initial uses of the system will be for passenger reservations, flight schedules, passenger name records and fare display. Later applications include ticket handling and cargo airbill issuance, tariffs and computed fares for passengers and cargo, hotel and car rental reservations, required aircraft parts and equipment routing, flight planning, flight progress reports, crew status and schedules, and aircraft weight and balance. The system will also handle all UAL's internal daily message switching (115,000 output/105,000 input).

Unimatic is designed to handle the current 140,000 transactions per hour, requiring transmission of 35 million characters, with an average response time of one second per transaction and is expandable to meet expected traffic volumes through 1975.

McCALL SEEKS FULFILLMENT THROUGH DP UTILITY

The origins of firms aspiring to become national computer utilities are many and varied. Common carriers, computer manufacturers, aerospace firms, countless small new groups are gearing up to get a slice of the mammoth business promised—come FCC or anti-trust.

McCall Corp. has used its subscription fulfillment department as the base from which to jump into the game. In January 1967 this department was turned into McCall Information Services Co., which under James Gallagher not only improved the subscription business, but added a 200-man computer services operation that has hauled in two major center management contracts and $1.5 million of the $6 million gross for the year.

The overall goal of the 900-man firm, which expects to gross $10 million in '68, is nationwide regional centers, with an emphasis on time-sharing, and a well developed capability in software and systems consulting. By mid-year McCall Corp. should have decided whether to spin off MISCO into a separate corporation. If that happens the firm will go public to further build its finances and, ultimately, will tie in with a computer manufacturer, not IBM, to gain more programming and engineering strength for its time-sharing network.

The areas of activity break down into subscription fulfillment (which should be only 50 or 60% of business in '68), edp services for industry, and educational systems.

The firm now has nine computers. Two 360/50's, a 40, and two 30's are being used in Dayton, O., where MISCO has a 25-year contract with the 11 colleges of the Dayton-Miami Valley Consortium to provide both the edp equipment and services needed. McCall Corp., NCR, Meade Corp., and GM-Frigidaire are helping to finance the consortium. In industry, MISCO has a similar contract with Hunt Foods in Fullerton, Calif. Three model 30's are used in a MISCO center there to do all edp for Hunt, as well as provide block time for other firms. The Hunt contract is a long-term one worth a "few million dollars." Another model 30 is used by MISCO for dp services in Hayward, Calif. More computing power, much via time-sharing systems, will be added to all these centers. The next office will be in Washington, D.C., where a model 30 will be in and operational by April 1.

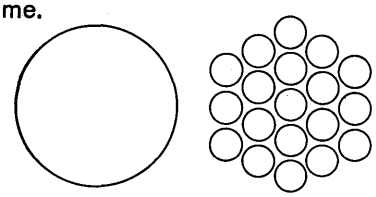
Another contract in the works—one of many such arrangements, MISCO hopes—is the operation of a time-sharing center, systems programming, and consulting for an Ohio university.

MISCO recently formed its Educa-

What every executive should know about time-sharing

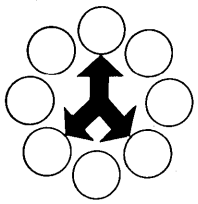
Computers process data and solve problems. And they do it fast. So fast that most production jobs are generally fed into a computer in large batches.

That takes care of the large demands on computer time. But what about the programmer who needs the computer frequently for short periods to check the programs he is writing? And what about engineers, financial analysts, market researchers, or other personnel, whose time can be so important to you and to themselves? They usually wait. Sometimes hours. Sometimes days. Just to get an answer to a problem that may take less than a minute of computer time.



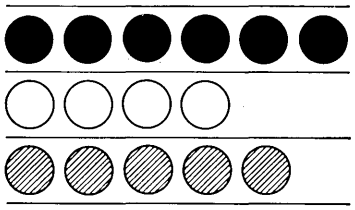
Time-Sharing systems are designed to change that situation. They let many individuals with small or occasional problems use the computer without waiting. Thus, they help an organization attain the full potential of its creative human resources. Ideally, such systems also permit "bread-and-butter" production jobs to be performed concurrently.

How time-sharing works. To the dozens of users of a time-sharing system the computer is always available for work. They call up the computer from their remote terminals, give it a problem and in a few seconds or minutes they have their answer.



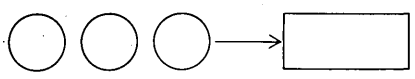
Actually, during that short time the computer works on many jobs. It does a fraction of a second's work on job A, then on job B, and so on until every active terminal has been serviced. It repeats that cycle over and over until all jobs are complete. Meanwhile, the flow of production work continues unabated.

Because third-generation computers can do millions of operations in seconds, jobs are performed so quickly that no user has any impression of waiting. In fact, from his point of view, the full computer power is at his disposal.



Time-sharing computers have some extras. One is a hardware and software operating system designed for multiprogramming—interlacing a mix of jobs to utilize fully the computer's capabilities. This lets the computer switch from one job to another with great efficiency. Another is a special high-speed auxiliary memory system that allows the programs and data of many individual users to be stored outside the computer's main memory, yet be called into the computer quickly just when needed, a small segment at a time.

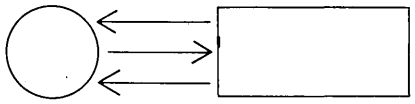
What's so good about time-sharing? In the first place, each user gets immediate and convenient access to the computer whenever he needs it. In fact, he can have an input-output terminal right at his desk. Increasingly popular are the video displays with typewriter keyboards which permit dynamic man/machine dialogue. The user station may be next door to the computer or hundreds of miles away.



In the second place, the user of a time-sharing computer is not restricted to working through professional programmers. He can get a basic grasp of a special language—a kind of shorthand used in talking to the computer—in just a few hours. From then on he can ask the computer questions directly, get answers, and work his way through problems step-by-step. The whole area of defining and solving problems, and storing and retrieving data is greatly simplified.

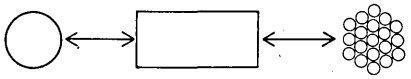
Not only does this rapid turnaround on small jobs save time and increase productivity, the very act of working directly with a computer helps men think more logically and creatively.

What about time-sharing and professional programmers? Time-sharing is a great timesaver for programmers.

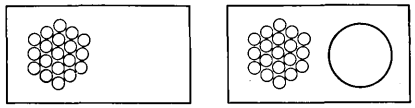


Instead of waiting for computer time, the programmer can check each step at his convenience. And he can quickly check alternative program designs, to see which works out best in practice.

What happens to production work in a time-sharing system? That depends. In some computers called "time-sharing," the system is completely dedicated to either batch processing or time-sharing. But both activities can't go on at the same time.



The best kind of time-sharing system is one that permits processing of production jobs to go on as usual, concurrent with conversational problem solving, thereby enabling full utilization of both equipment and human resources.



Two ways to get time-sharing for your company. One way is to go to a service center that offers time-sharing. This gives the user *only* time-sharing capability, and is frequently very expensive when added to existing data-processing costs.

A better way is to buy or lease a time-sharing system that will also handle your present batch processing requirements.

news briefs

tional Systems Division, headed by Dr. Robert Gregory, formerly head of an American consulting firm in England. This group, to be based in the new computer building at the Univ. of Dayton, will provide consulting and software development for administrative and computer-assisted instruction systems.

LA SOFTWARE FIRM OPENS "SOPHISTICATED" DATA CENTER

Jacobi Systems Corp., a fledgling Los Angeles software firm which last December reached an agreement in principle to become a subsidiary of Consolidated Leasing Corp. of America, has now announced its own subsidiary.

It's the Jacobi Computation Center, which last month unveiled a $50K/month 1108. The 65K core system includes six 432 drums (4 msec access, 1.5 million cps transfer rate), eight tapes, an off-line 1104 (card reader, printer and plotter) and three communications lines . . . one broadband and two dial-up.

President of the new firm is Jerry Hanna, SDC veteran who says the data center will aim at sophisticated, large scientific users with emphasis on FORTRAN. Avoiding technically naive customers who require hand holding will hopefully allow JCC to run more economically and to pass the savings along to the customer. Orders for time on the 1108, scheduled to fire up in late February, have almost reached the break-even point, he said.

Eventually JCC hopes to offer services based upon proprietary packages, although none have yet been designated for development. Jacobi Systems Corp.'s sole venture into proprietary packages so far is a cooperative venture with Honig Time Sharing in developing a compartmentalized time-sharing system under OS on the 360/50 and larger machines of that family. Honig will market the package and pay royalties to JSC.

Incorporated last May with an initial capitalization of nearly $500K, Jacobi Systems Corp. remains essentially the skeleton of a software firm with about 15 employees, five of them at the new computation center. The company's only major contract was for a GE 265 compiler for an aircraft firm. An original plan to offer programming services has been shelved.

The Consolidated Leasing deal will call for an exchange of stock which sees Consolidated acquire a 51% interest in Jacobi with an option to pick up the rest over a two-year period. The deal could represent a maximum $5 million investment for the Chicago firm, which specializes in automotive equipment. The 1108 is on a five-year lease from Univac; Consolidated is evidently staying out of the computer leasing business.

FROM TELEPHONE LINE TO MAG TAPE TO COMPUTER

Everyone wants to hang something on a 360. Tally Corporation's Dartex, Santa Ana, Calif., has come up with a hardware/software package that permits receipt of data over phone lines for tape recording, then feeds it directly from tape to the computer.

The Model 1027A plugs into the 360 multiplex channel (standard on 30's and above, optional for the 20) and, together with a program package that fits into DOS, makes the Dartex data terminal look like an IBM 2400 tape drive to the 360.

Another model will be available for the 1620 and still others are in the development stage. For information:

CIRCLE 165 ON READER CARD

CDC IN NEW ACQUISITIONS AS EARNINGS HEAD HIGHER

Control Data Corp. is purchasing the Data Processing Systems Division from SCM Corp., expanding their product line as they did by acquiring small computers some years ago from Bendix. This move will give them the SCM Typetronic line, ranging in price from $10,000-$30,000. The accompanying personnel addition is even more vital in this day of personnel shortages—the deal gives CDC about 350 people skilled in sales, programming and customer engineering.

While getting small business machines in this acquisition, CDC is pushing heavily on the supercomputer end also. In its last-half report for '67, CDC says that the 6000's are being used for new applications on their traditionally scientific side while the market has broadened with orders from industry and government. The number of customers with at least two 6000 series has increased to 15. With the Extended Core Storage available, several multiple users plan to link two or three supercomputers together for memory sharing of up to one million words. The six-month report also shows increasing profits: net earnings (1967) $8,563,386, or $1.01 per share as opposed to $1,769,410 or 16 cents per share for the same 1966 period.

CDC also has reached definitive

agreement with Electronic Accounting Card Corp. for the acquisition of that company, terms to be subject to approval of at least two-thirds of EACC's stockholders at a meeting tentatively scheduled for May 1.

ROMNES KEYNOTES BOARDWALK SJCC

In honor of the "great debate"—the FCC inquiry into the interdependence of computers and communications—the Spring Joint Computer Conference this year will lead off with a keynote address by H. I. Romnes, AT&T chairman of the board. To be held in Atlantic City again, April 30-May 1, the AFIPS-sponsored meeting will also feature 21 technical sessions, more than 125 exhibitors, and an election-year special by ABC, "Election Forecasting Seminar."

A. S. Hoagland of IBM chairs this conference, which will be centered at Convention Hall, the Chalfonte-Haddon Hall serving as the official SJCC hotel. The technical program, headed by Prof. Ted Baskow of Columbia, boasts only three sessions in parallel at any time and has a mix of seven panel discussions and 14 paper sessions. The paper sessions have the oft-seen topics of time-sharing, hybrid systems, LSI, man-machine interface, computer-aided design, memories and mass storage, and languages. Interesting debate is indicated by such panels as "Separate Pricing for Hardware and Software," "What's Wrong with the Computer Industry?" and "Commercial Time-Sharing: The Second Generation."

The conference banquet will feature an address by Dr. George H. Brown, RCA executive vice president of research and engineering, who holds 79 patents in electronic communications and television development. Seymour R. Cray, vice president of CDC's Chippewa Laboratories, will receive the annual W. W. McDowell award for his contributions to the computer field.

Advance registration will be Monday, April 29, at the Holiday Inn, 4-10 p.m. On Tuesday-Thursday, it will be at the Convention Hall from 8:30-5:00. Registration fees for the sessions and a copy of the proceedings will be $20 for members ($10 for one day), $30 for non-members ($15 for one day), and $3 for students. Exhibit hours will be from 11-6 on Tuesday, 11-9 on Wednesday, and 10-5 on Thursday. For further information write the SJCC Public Relations Chairman, John M. Kinn, IEEE, 345 East 47th Street, New York, New York.

CREDIT CARDS CRISS-CROSS COUNTRY

Intrabanking competition for consumer credit continues to stiffen.

In a move to strengthen their national credit card coverage, seven banking credit card systems representing 286 banks in seven states have joined hands to create Interbank Card, Inc. Primarily aimed at Bankamericard, offered under license to 21 banks in 19 states, the new cooperative venture will represent the cards of Seattle First National Bank; Valley National Bank of Arizona, Phoenix; First Wisconsin National Bank, Milwaukee; Marine Midland Corp., Buffalo; the Mellon National Bank and Pittsburgh National Bank, both of Pittsburgh; and Master Charge Card, sponsored by 81 California and four Nevada banks, members of the California Bankcard Assn.

Holders of these cards will see them honored at some 132,000 merchants covered by the seven cards combining

to set up Interbank Card, Inc.

Bankamericard, which got a head start in the credit card business in 1959, now has over six million card carrying members, who rang up $355.8 million in sales at 155,000 stores and shops in 1967. In the Interbank group, Master Charge Card alone accounts for over three million holders and more than $100 million in sales since its inception in July 1967. The new cooperative venture took effect Mar. 1.

Meanwhile another association is forming—the Intermountain Bankcard Assn., which will begin operation in mid-1968 and will cooperate with the California Bankcard Assn., and hence, probably with Interbank. This is a group formed initially by three Salt Lake City banks and expects to have about 70-100,000 card holders. It, too, will use the Master Charge name. Arthur S. Kranzley and Co. has been contracted to help the association set up the system, including programming, analysis and management consulting.

TRAFFIC LOGGER SENSES VEHICLES 1,000 FEET AWAY

ADACS (Automobile Data Acquisition System) is a traffic data acquisition system with a portable portion consisting of an ordinary tape recorder and two photocells. It is the result of a PhD project of Georgia Tech engineer Jacque Williams. The photocells detect vehicles from up to 1,000 feet and the output of the cells is a pulse which is recorded by the tape recorder (positive pulse for vehicle arrival, negative pulse on departure).

When data recording is completed, the tape is taken to the lab for data extraction and played into a gating unit which triggers a scaler giving times in milliseconds between pulses on the tape. The tape is played once to extract time of vehicle presence and again to determine uncovered time. Data displayed by the scaler is converted from parallel to serial form, then punched into paper tape for computer input.

Williams finds photocell data collection accurate and economical; it provides information on velocity, volume, headways, acceleration, space mean speeds, and length of vehicle and is usable in any weather at any time.

Future data will be transmitted to a control room for continuous analysis; this will eliminate recording/playback and allow data collection from several detectors simultaneously.

The purpose of the project is to

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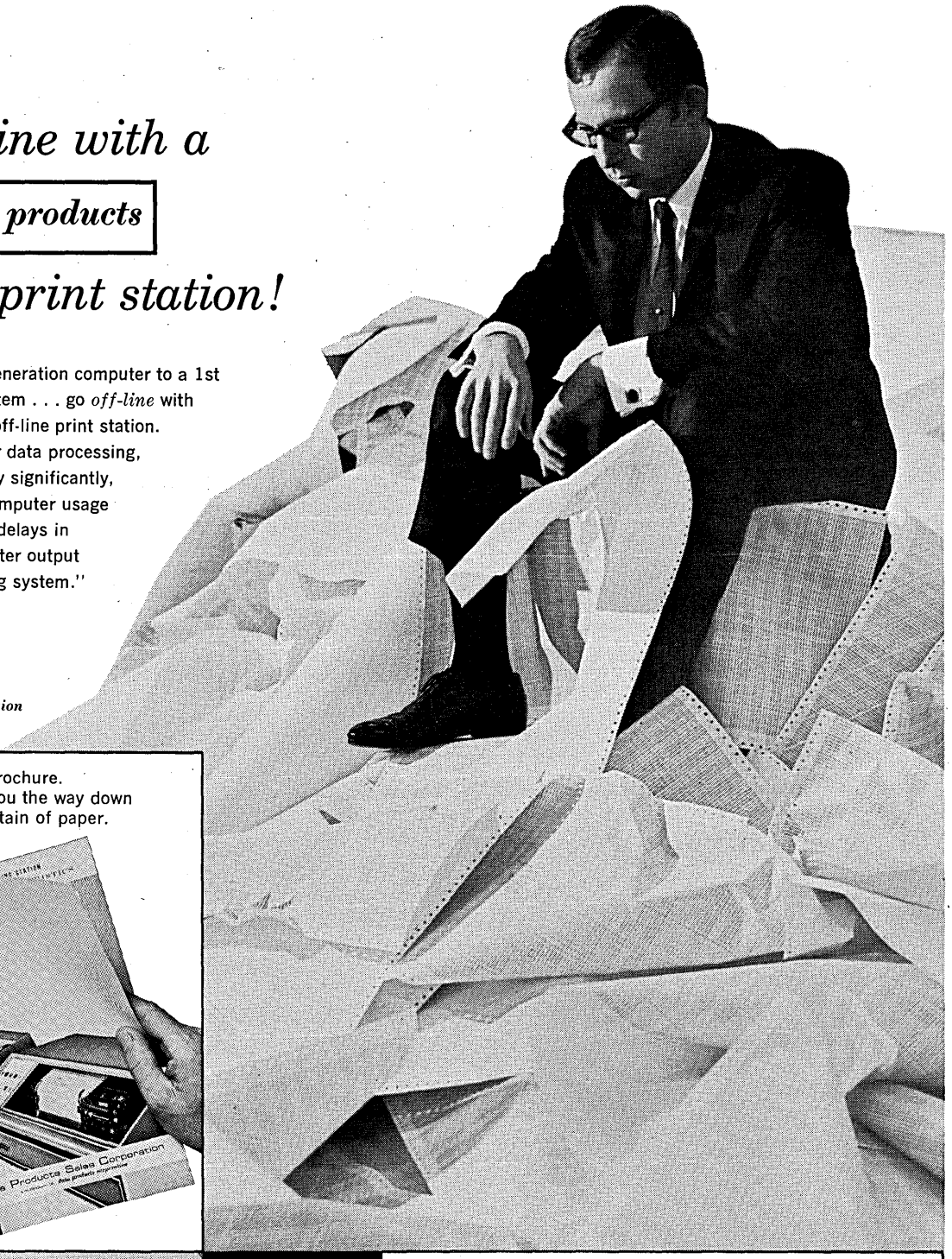

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ACM SEMINARS GROPE FOR PERSONNEL POLICIES

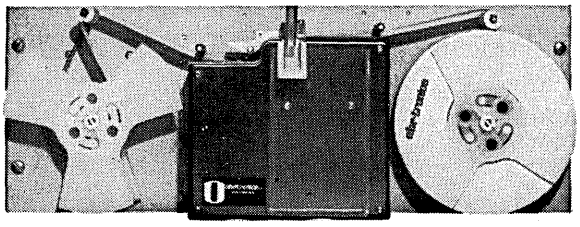
The Selection and Evaluation of Computer Personnel was the subject of ACM-sponsored seminars held in five cities in January—a title much firmer than the facts available on the subject. One came away from the Detroit meeting feeling that the subject is like a globe of mercury—trying to touch it fractures the globe into dozens of tiny globules rolling in all directions.

The presentation was smoothly handled by David B. Mayer (technical staff manager, computer sciences, IBM Research) and Ashford W. Stalnaker (assistant professor of management science, Georgia Tech), both members of the ACM SIG/CPR (Special Interest Group/Computer Personnel Research).

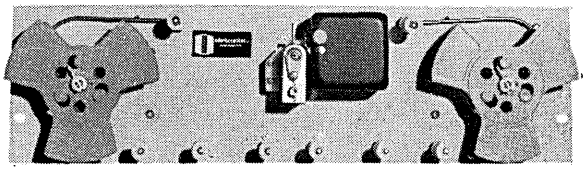
The half-day sessions covered: history of computer personnel research from 1962 (the inception of the Computer Research Group; it joined ACM in November 1966); use of psychological measuring and selection techniques; evaluation and proficiency testing; personality of programmers; creativity; and current unresolved personnel problems.

The two seminar leaders described some of the tests and a survey made by the group, the results of most of these being more negative than positive. Apparently there is little agreement on any basis of judging whether or not an individual will do well in training or in job performance. One problem is that indicators which may have some value for good trainee performance do not carry over to indicate good programmer performance. Such factors as intelligence, college entrance test scores and school grades, personality traits, logic, and interests were considered. Logic, intelligence, and possibly interest showed some correlation to future performance but the other factors didn't.

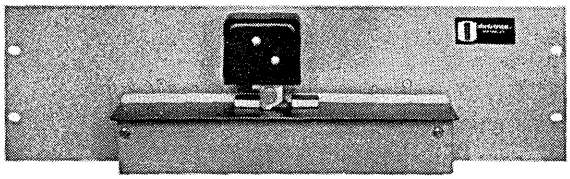
Scores on the IBM PAT (Programmer Aptitude Test), as analyzed in the 1966 CPRG survey of 483 U.S. and 98 Canadian firms, seemed irrelevant to performance. Stalnaker thought that the SVIB (Strong Vocational Interest Blank) might have some merit, although it is seldom used and needs testing in more situations. The survey showed that most firms responding required better than high school background for systems analysts and at least high school for programmers. Where companies used more testing the educational require-



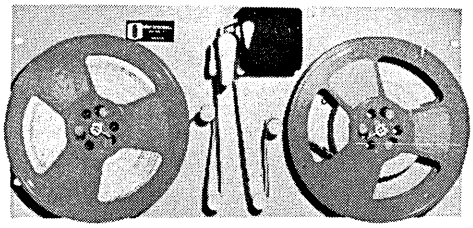
Model 110, Paper Tape Punch . . . punches standard 5 to 8 channel paper tape asynchronously at speeds up to 30 CPS. Powered by continuously running induction motor. Error detection achieved by parity checking switches. Tape can be back-spaced. 7″x 19″ panel, 24 or 48 VDC. **Price: $599.00**



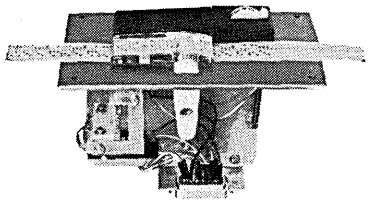
Model 119R, Paper Tape Reader . . . reads up to 8 channel punched paper tape with spooling mechanism for bi-directional tape supply and take-up. A switch out-put for tight tape and end-of-tape is provided. Panel is 3½″ x 19″ with optional 24, 48 or 90 VDC. **Price: $578.00**



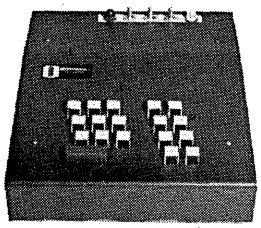
Model 131, Edge-punched Card Reader . . . bi-directional capability to read single, hand-fed edge-punched cards that have standard 8 channel paper tape codes punched along edges. Same mechanism as Model 119R. **Price: $457.00**



Model 121, Paper Tape Reader . . . 60 CPS with inclusive solid-state Drive-Pak at lowest cost! Advanced reader head features full 180° tape surface. 750′ reel supply or take-up. Tape Lever indicates non-reading or broken tape. Panel is 8¾″ x 19″ with 24, 48 or 90 VDC. **Price: $605.00**



Model 153-60, Flatbed Reader . . . new, speedier reader at 60 CPS. Unidirectional starwheel sensing device permits mounting on horizontal surface. Panel 4½″ x 5¾″. Same mechanism as Model 121. **Price: $413.00**



Model 117, Encoding Keyboard . . . 18 key . . . converts key depressions into coded (8 level) arrays of switch closures designed to interface with tape punches, printers, plotters, computers or other automatic machinery. Any code configuration can be supplied. Keys can be mechanically or electrically interlocked. **Price: $435.00**

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ment was less and vice versa. Respondents using testing favored aptitude tests with IBM's PAT leading the field; some gave IQ tests, with the Wonderlic Personnel Test predominant; very few gave personality tests.

Most of the research by group members has been at a single large installation and it was conceded that much more research needs to be done. Conclusions by the two speakers were that it is safest to bet on intelligence at this point, plus some indefinable quality which a gifted interviewer may feel intuitively.

The speakers also believe that an effective evaluation procedure must be developed before further research can be useful; it's necessary to be able to measure the stratifications in programming; new observational techniques are needed to supplement the current ones of testing and interviewing; and the relation of creativity to programming must be determined.

U OF CHICAGO BEGINS INFORMATION SCIENCES YEAR

An Information Sciences Year began in January at the Univ. of Chicago, funded by a grant celebrating the 200th year of the Encyclopedia Britannica. During this period, outstanding leaders in information sciences will be designated Britannica Scholars; they will be at the university at various times for discussions with faculty members and other scholars. Discussion of the social implications of information sciences and computer use will include the faculty of the Committee on Information Sciences (11 of the 12 members of the committee hold joint appointments with varied disciplines of the university), and their colleagues in law, medicine, business, social sciences, and the humanities.

The committee (chaired by Prof. Victor Yngve) conducts research and offers a broad academic program concerned with computers and the scientific nature of information. The year-long effort will culminate in a conference evaluating the research program results.

BAY AREA ACM SCHEDULES APRIL TECHNICAL SYMPOSIUM

Will there be an ALGOL 68? Shall we design machines to fit languages? Do we really have to read all the manuals about all the languages before we start to program? These are some of the questions you might get answers to at the Bay Area Chapter ACM Technical Symposium April 19 at the Jack Tar Hotel, San Francisco.

In fact, to the last question I can give an answer right now: NO. You can get away with reading only Professor Peter Wegner's book. To quote from the preface: "This book covers machine languages, machine organization, multiprogramming systems, assemblers, macros, LISP, ALGOL, PL/I, simulation languages and many other topics in programming. It treats these topics as part of a single *unified discipline*, using a unifying framework developed in the text. The author feels strongly that the subject of programming should be treated as a coherent discipline rather than as a loose collection of techniques. Such an approach allows practical problems arising in programming to be analyzed more clearly, and therefore yields practical as well as aesthetic dividends."

How? If you really want to find out, come to the symposium. Professor Wegner is our first speaker. He comes from the department of computer science of Cornell University.

Mark Halpern of IBM, San Jose, who made a good case for natural language programming at the FJCC in 1966, will talk about "Task Structures and Programming Techniques." His talk will be liberally illustrated with down-to-earth problems in programming.

Prof. John J. Donovan from MIT, of Project MAC fame, will head the afternoon speakers. His topic is "Compiler Techniques," and one could hardly find anyone more authoritative on the subject. At the FJCC in 1967 he presented a paper entitled "A Formal System for the Specification of the Syntax and Translation of a Computer Language." This and his many other contributions suggest that his talk will be an up-to-date summary of new trends in compiler writing.

Prof. William McKeeman of Stanford will talk about "Software-Hardware Interaction," and I surmise that his answer to my second question in the lead paragraph might be affirmative.

This gets us to the last question, about ALGOL 68. Yes, Virginia, there still is an ALGOL Working Group. They met at Zandvoort, The Netherlands, May 16-20, 1967. Prof. John Peck of The University, Calgary, Alberta, was present at the proposal on ALGOL X, prepared by the Amsterdam group (Van Wijngaarden, Mailloux, Peck). It is expected that his talk on "Trends and Extensions" of programming languages will present a strong case for

news briefs

ALGOL and thus will serve as an apt introduction to the panel discussion, which promises to be a lively one.

For more information and pre-registration blanks, write to: Registration Chairman, Bay Area ACM Chapter Technical Symposium, P.O. Box 2447, Menlo Park, Calif. 94025.

—STEVE TOROK

HOLIDEX CONFIRMS MOTEL RESERVATION FOR 20 CENTS

The Holidex system is Holiday Inn's $10 million computer network, consisting of two System 360/40's connected by over 200,000 miles of communication lines to 1,000 special IBM 1971 reservation terminals (at 900 inns) and 200 IBM 2970 terminals in sales locations. This is all managed by General Data Corp., a Holiday Inn subsidiary. One 40 controls the Holidex system with the other serving as backup and handling the company's other dp tasks—such as site feasibility forecasting, inventory control for the individual inns, etc.

Site forecasting is an important item; HI has grown to over 900 inns with 118,000 rooms in 700 cities and is adding a new inn every 67 hours. Locations are in all states, except Alaska, plus Canada, Puerto Rico and the Bahamas. Reservations costs have been lowered from pre-Holidex 87 cents to 20 cents, for each confirmed reservation, and take 15 seconds or less.

GT&E WILL SET UP REGIONAL SERVICE BUREAUS

More competition for commercial dp service bureaus appeared recently when General Telephone & Electronics announced plans to set up seven regional dp service bureaus throughout the country.

Much of their workload will come from GT&E operating companies, but an apparently substantial percentage of available computer time will be sold to banks, credit unions, and other "financial institutions," according to a company announcement, which added that "business, industry, government, and educational institutions" represent other likely markets. Reportedly, the bureaus will provide both local and on-line dp services.

The regional centers will be established at Tampa, Fla.; Ft. Wayne, Ind.; Santa Monica, Cal.; Erie, Pa.; San Angelo, Tex.; Everett, Wash., and Vancouver, B.C. A GT&E operating company now has a dp facility at each

news briefs

SOLITRON FIGHTS BR-AMPHENOL MERGER

Bunker-Ramo and Amphenol Corp. have announced agreement to merge, but Solitron Devices, Inc., is waging a battle through the stock market to thwart that merger. Since the stockholders' meetings to vote on the merger won't take place until late March, Solitron advertised an offer to swap one of its shares for five Amphenol in an effort to gain stock control (over 50%) of Amphenol, and vote down the agreement.

The earnings and products of the companies bring to light the reasons for the struggle. Amphenol, manufacturer of electronic components and assemblies, instruments, knitted deep pile fabrics and other products, grossed over $152 million in 1966; net was $5.8 million, or $1.98 a share (NYSE). Bunker-Ramo, maker of crt systems, special computers, communications systems and machine control devices, grossed $54 million, netted $1.1 million, for $.13 share (AMEX). BR also brings on the benefits from a $15 million tax loss carryover from '64 and '65. Solitron, also a component maker (transistors, microcircuits, capacitors, diodes), grossed $15 million in '66, for a $2.5 million net, and $3.31 share earnings (AMEX).

Amphenol, obviously wanting the BR merger, has also advertised a notice to its stockholders, warning them of the disadvantages of taking the Solitron offer, such as all gains to the trader will be taxable, and the Solitron offer is for a number of Amphenol shares in excess of "the number likely to be tendered." The Solitron offer was good until Feb. 26, unless extended.

If the merger goes through, the parent firm will be called Bunker-Ramo, under which will be the Bunker-Ramo and Amphenol divisions. John Parker, BR chairman, would be chairman and Matthew Devine, Amphenol chairman, would be president and chief executive officer. Milton Mohr, BR president, would be corporate vice president and BR Division president. William H. Rous, Amphenol president, would be Mohr's Amphenol Division counterpart. Martin Marietta, holder of 51½% of BR common stock, would own 40% of the shares of the new corporation. Amphenol stockholders will receive 3¼ shares of the corporation for each Amphenol share owned; it would be one-for-one for BR holders.

GRAPHIC SCIENCES RAISES MORE FUNDS

Graphic Sciences, a firm formed in March, 1967, in Rochester by ex-Xerox executives, has moved its headquarters and production facilities to Danbury, Conn. For the second time, GSI is in SEC registration, now for convertible subordinated debentures to raise over $14 million for its computer leasing subsidiary, development of graphic communications systems and services, and providing computer information services.

Headed by Dr. Sullivan Campbell, board chairman; Robert Dombrowski, president; and vice president Gul Hira, the firm created a stir on its initial market offering with the news that it would produce a small acoustically-coupled facsimile transceiver directly competing with the Xerox/Magnavox Telecopier.

According to its prospectus, as yet GSI is uncertain whether it can mass produce the Graphic Transceiver and sell it profitably, although other devices will be developed. It was invented by H. M. Morgan Co., Cambridge, Mass., which then sold the right of sale of the two existent proto-

GODDARD STARTS UP THE FIRST MODEL 91

The first 360/91, which IBM bills as "the fastest, most powerful computer" in service, recently became fully operational at Goddard Space Flight Center.

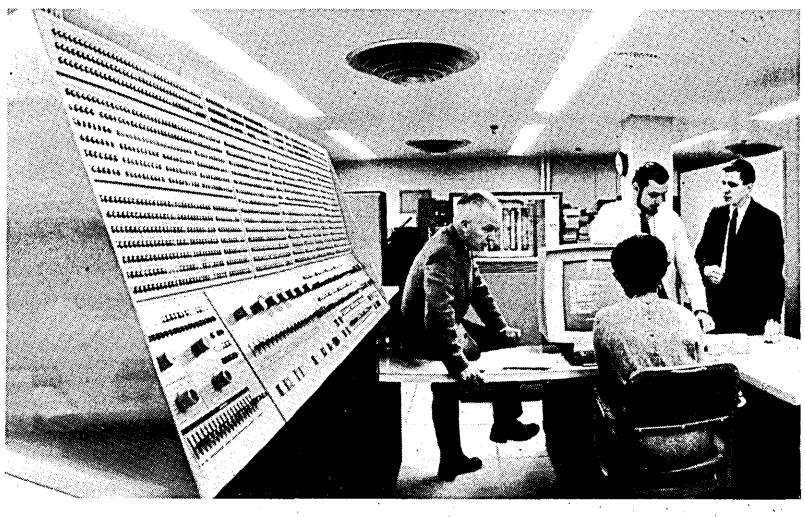
NASA reportedly purchased the central system—at discounts off list of up to 50%—and rented the peripherals; these include 19 Model 1050 terminals capable of being expanded to 31, which are being used by GSFC staff mainly to do esoteric computations. The 91's K-size core (2 megabytes) cost the taxpayers an estimated 1.5 megabucks, and the cpu $1.9 million. According to one source, these two units were discounted an average of 25%.

"IBM no longer is accepting new orders, having met the initial objectives of the Model 91 program," says a company announcement. All remaining orders for the 90 series will be delivered "within 17 months."

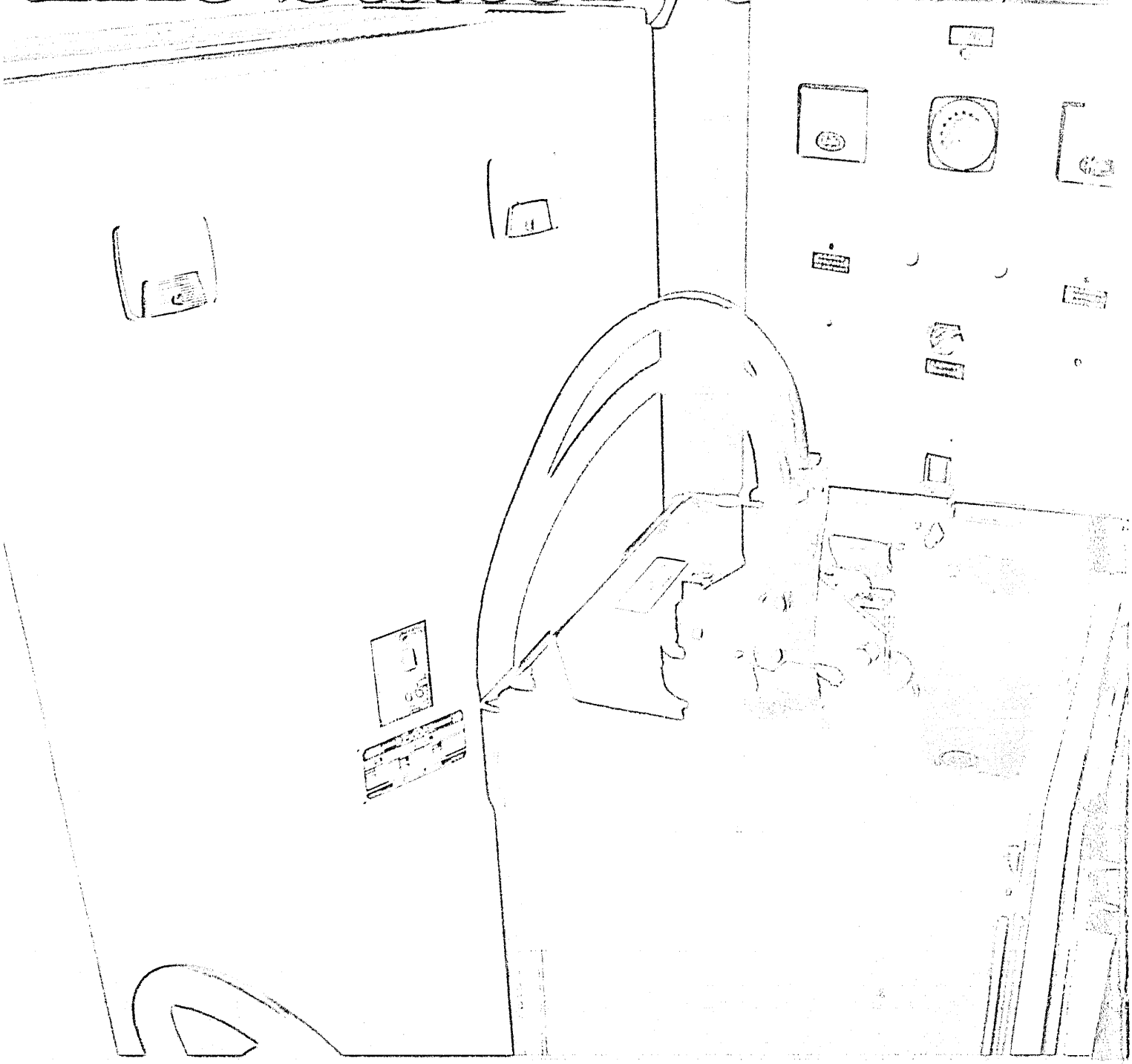
Reportedly, these will be 95's rather than 91's. The Model 95's memory cycle time is said to be 120 nsec; the 91's is 780 nsec.

The customers allegedly awaiting delivery are: the Johns Hopkins applied physics lab; AEC/Oak Ridge; Princeton University; Columbia University; Lockheed; North American Aviation; Westinghouse/Pittsburgh; Mobil Oil; Avco Corp., Boston; MIT; the French atomic energy commission, and the Max Planck Institute in Munich, Germany. UCLA reportedly is acquiring two 95's. NASA is also getting two; one, to be installed at the Institute for Space Studies, was scheduled for mid-

(Continued on p. 101)



The battery and the



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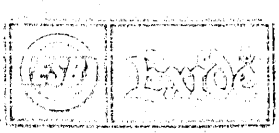

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of these locations. Typically, the hardware consists of a 360/30 or 40. GT&E plans to replace these units with 65's over the next 18 months.

The regional centers will buy communication services from GT&E operating companies at the same tariffed rates charged other users, reports John B. Renwick, president of GT&E Data Services Corp., a subsidiary set up to run the new operation. Besides marketing edp services to outsiders, the subsidiary will become a central dp manager for all GT&E operating companies. Their hardware, now rented, will be bought by the service corporation and leased back at lower rates.

A central design and programming center is to be set up in the Tampa, Fla., headquarters of the subsidiary; it will be devoted exclusively to telephone company applications. The center will be staffed initially by personnel drawn from the operating companies.

Up to 40 additional designers and programmers will be hired this year, Renwick said. Some will be assigned to Tampa; the others will fill vacancies in the operating companies and presumably will spend at least part of their time designing and programming systems for the regional centers' outside customers.

PATENT OFFICE CHANGES STAND ON PROGRAM BAN

A ban on patents for computer programs now written into proposed legislation "may be premature," says Patent Commissioner Edward J. Brenner. He has recommended that the prohibition be removed.

Brenner's statement, which represents an about-face from last year's position of the Patent Office, was made at the latest round of hearings on the Administration's new patent bill, S1042. The hearings were conducted by a Senate Judiciary subcommittee, with Sen. John McClellan, chairman of the full committee, presiding. The group also discussed a bill introduced by Wisconsin's Gaylord Nelson, S1377, which would provide people outside Washington with direct access to patent records. S1377 authorizes establishment of "patent search centers" at strategic locations, where microfilm copies of the main patent file would be stored.

Possibly Brenner's new attitude was inspired by objections from the U.S. Chamber of Commerce and the Electronic Industries Association. Representatives of both groups appeared at the hearing.

The Chamber's position was spelled out by George Metcalf, vp of Martin-Marietta's aerospace group. He said

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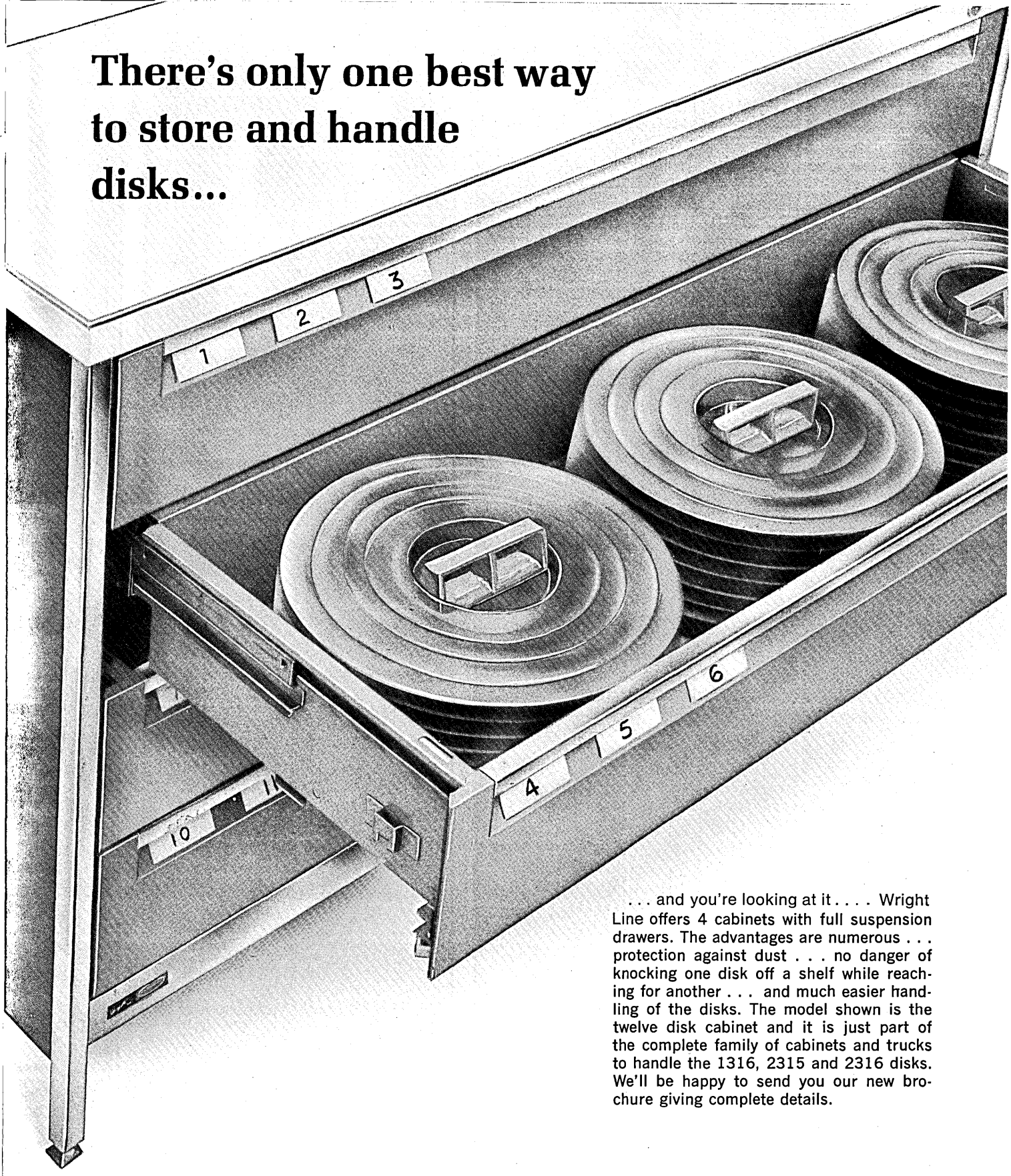

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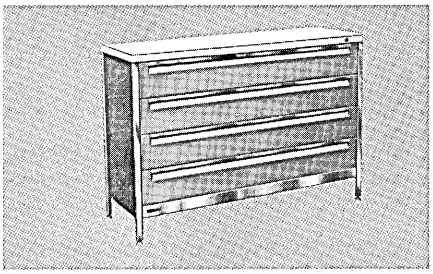

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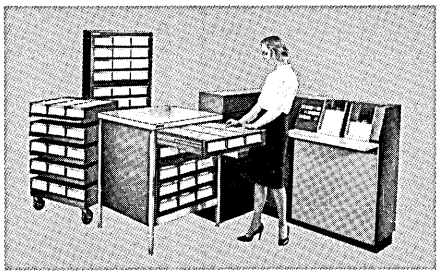

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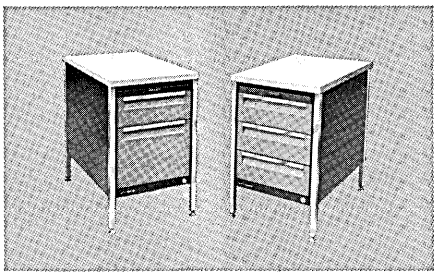

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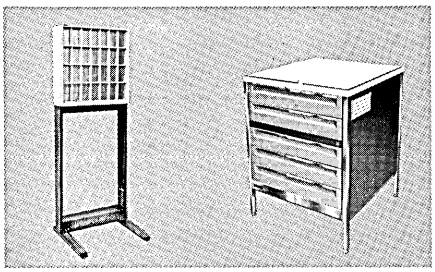

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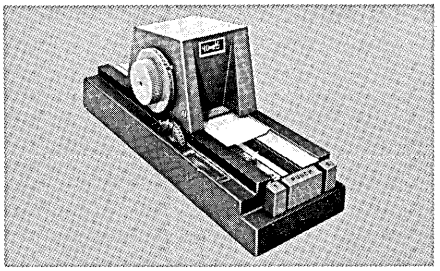

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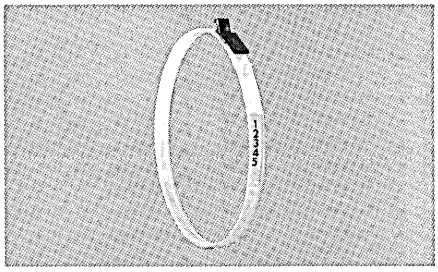

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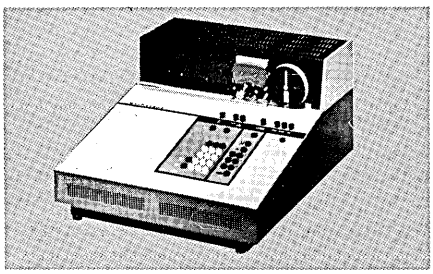

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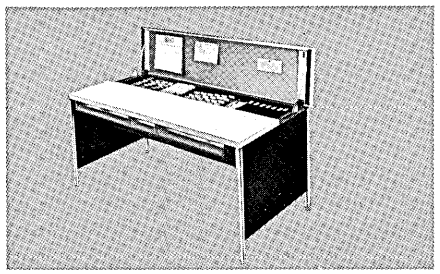

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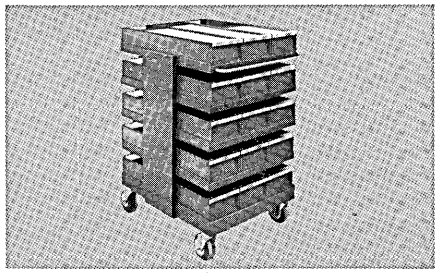

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the proposed bill's categorical ban on computer program patents is "too drastic," and advocated "alternative solutions for determining what is and what is not patentable in the field of computer software."

Last year, a Presidential study commission, in advocating a ban on computer program patents, cited difficulties in classifying and comparing the related applications. Metcalf admitted that problems exist but argued that they shouldn't be sidestepped. "The more appropriate solution is to generate the needed files and experience within the (Patent) Office . . . Industry is learning to cope with programs and related subject matter—so can the Patent Office . . . The best way for the doubts and uncertainties noted by the commission to be resolved is . . . in the courts."

In a written statement filed with the subcommittee, Richard C. Jones, president of Applied Data Research, Inc., Princeton, N.J., pointed out that the British, in November, 1965, held that a computer program could be patented. He contended that the present system in this country, under which programs are not patentable, favors the computer maker. It perpetuates "a lucrative tie-in business (and extends) the economic advantages of his hardware into the systems programming business. The 'value added' contribution of 'tie-in' software enables the computer manufacturer to mask the price of hardware in the sale of a total system in the hope that he can realize a larger than normal profit. If patent protection were possible for qualified software inventions, many software companies would be encouraged to develop competitive systems without fear of the manufacturer or others taking their inventive concepts and using them with impunity."

DATA PRODUCTS PLANS TO ADD FAIRCHILD UNIT

Data Products continues to spread its wings. The L.A. manufacturer of printers, large disc systems, and punched card gear—and which owns 66% of Informatics and an Irish core maker—may acquire another core memory facility.

DPC and Fairchild Camera and Instrument Corp. have agreed in principle on the acquisition by Data Products of Fairchild's Memory Products Section. Fairchild's facility in northern California makes core planes and stacks and memory systems, employing 150 people.

The cash agreement is subject to approval of the boards of directors of both firms.

In December, Data Products acquired an interest in Data Devices, Inc., a Santa Monica maker of mag tape cleaning equipment which will soon enter the tape handling field. Grossing a little over $13 million in FY '67, Data Products declared a net income of $655K. Current backlog is reported to be around $15 million.

UNIV. OF COLORADO SETS SOCIAL SCIENCE INSTITUTE

A month-long institute, under a $47,500 NSF grant, will be held June 17-July 19 at the University of Colorado, Boulder, to acquaint faculty members with basic principles of computer science applicable to social and behavioral science.

The six courses planned are: Introduction to Computing in Social and Behavioral Science Research, Artificial Intelligence and Problem Solving Computer Models, Computer Models of Personality and Social Phenomena, Simulation in Sociology, Political Science and Social Psychology; Computer Models in Regional Economics

and Urban Planning, and Computer Programming and Applications in the Social and Behavioral Sciences.

Programming workshops will be held daily under the institute faculty and personnel of the CU computation center.

Deadline for applications is April 15. Prerequisites are at least a master's degree in social, behavioral or computing science, and a teaching position in sociology, psychology, economics, anthropology or a related department. Applications are available from Dr. Daniel E. Bailey, Institute for Computing Science, Ketchum 8, U. of Col., Boulder, Colo. 80302.

BANKERS CENTRALIZE PLANNING FOR COMPUTERS

The current projects and progress of the "RAND" of the banking industry were outlined by Bernard Ellis, assistant director of the American Bankers Assn., at a recent Louisiana Bankers Assn. meeting in Baton Rouge.

The banking industry is not listed among top industries in research and development effort, Ellis said, and because of the need for automation it should be. One step toward increasing R&D is the Automation Planning and Technology research group, formed last May by ABA to investigate developments in automation, prepare long-range plans for the banking industry, and do research in hardware, software, MIS, communications, automated customer services, operations research, internal operations and standards. Thus far, said Ellis, 800 banks have become members of the APT effort, contributing almost $400,000 in dues ($100-$3000 each depending on the bank size). ABA partially subsidizes APT as well.

Eight specialists in the computer areas outlined above are now in the group, along with four statistical researchers. Among the . 10 projects completed or now under way is a guide for management to help determine whether a bank is ready for automation. Another report is a bibliography of articles and books on automated customer services. A third is a plan for banks to follow, including small computer system descriptions, when the decision to automate is made. And "A Bank Manager's Guide to Management Science" will explain the use of operations research and modeling in simulating bank operations.

Other activities include assisting the general counsel of ABA in preparing a position on the ADAPSO litigation in St. Paul (a service bureau attempt to prohibit banks from selling dp services to customers). And the group is studying the forthcoming FCC inquiry on computer/communications interdependence.

VARIAN OFFERS COMPUTER CONTROL OF INSTRUMENTS

Five new modular systems, Spectro-Plan, to computerize the data processing and the operation of analytical instruments, have been announced by the Analytical Instrument Div. of Varian Assoc., Palo Alto, Calif. Spectro-Plan is based on a 4,096 (16-bit) 620-/I digital computer with a 1.8 usec cycle time. Also included in the standard package is a control console, instrument interfacing, Teletype for readout, and software. The on-line control and data reduction system for nuclear magnetic resonance spectrometers automates spectrometer setup and operation.

The 200 package can handle up to 10 instruments of the same type (such as chromatographs). For larger laboratories, the 400 system is designed to mate any number or array of instruments with such computers as the

IBM 1800.

At the lower end of the line is the SpectroData system—a spectrum digitizer coupled to an interface at the instrument. Data is stored on mag or paper tape or punched cards; it can then be batch-processed or sent to a service bureau. Just slightly more sophisticated is SpectroShare, a time-sharing program; with the SpectroData apparatus providing signal conditioning, the digitized output is transmitted via a Dataphone or Teletype to a computer center. Manual data entry is also possible.

The SpectroPlan systems may be purchased or leased. Deliveries of the entire line will begin this summer. For information:

CIRCLE 166 ON READER CARD

● Pillsbury Management Systems is a new subsidiary of Pillsbury Co. which will operate with a national sales force and have administrative offices in Minneapolis and Phoenix. PMS will specialize in developing information systems and communications, and real-time and time-sharing software. The parent company's systems and computer people, plus new personnel, will be involved. Call-A-Computer, time-sharing company of which Pillsbury is the major stockholder, and the new PMS will be independent of each other.

● A patent has been granted to Alvin A. Snaper of Chatsworth, Calif., for an electro-optical computer and data processing system. The inventor says the concept can be adapted to complex installations but that it also can lead to desk top computers selling in the same price range as electric typewriters. The design is based on the use of discrete areas of optical polarization for high density storage and series or parallel input, computation, and readout. For information:

CIRCLE 167 ON READER CARD

● Lehigh University's Computing Center will have five new graduate assistantships, four in July and one in September. Candidates will be selected from universities and colleges throughout the country. Graduate assistants will become involved in computer program design, development and installation and will be consultants to users of the center. These half-time positions pay $2,500 the first year and $2,750 the second.

shortlines . . .

Digital Logic Corp. has been contracted by Hughes Aircraft to expand the memory of the PDP-9 computer with a DLC mod 700 disc memory system including a controller and interface. The mod 700 accommodates from one to four discs each with a capacity of 335K words, for a total storage capacity of 1.34 million (18-bit) words . . . Metronex, the foreign trade corporation of Poland, has purchased a £345,000 System 4-50 computer system from English Electric Computers. The computer will be delivered to Centrostal, a steel ordering organization . . . University Computing and Gulf Insurance have reached an agreement in principle by which UCC would issue 350,000 shares of common stock to purchase 700,000 shares of Gulf common. Agreement is subject to approval by stockholders this month . . . Adage, Inc., whose stock has climbed 90 points since announcement of its hybrid computer-controlled graphics terminals now reports two AGT systems in and two on order. Latest order is from MIT, which will use a $160K AGT 30 in such projects as simulation of auto safety devices under GM contracts . . . Univac has announced two orders from Italy: the Fiat Co. will purchase a 65K 1108; and a 490 real-time system has been delivered to giant steelmaking firm, Italsider S.p.A. . . .

great late data date

Listen here! To paper tape talk. It's Telespeed equipment. A tape-to-tape system that can transmit a whole day's data demand in a matter of minutes. Feed a computer ten, fifteen, up to twenty times faster than copy can be manually typed. Move large volumes of data unattended during the night when line costs are lowest. Another answer from Teletype R&D for moving data at high-speed.

* * * *

Imagine moving an entire inventory list of over 7,000 items from warehouse to home office in a few minutes. A list that if manually typed in tabular form would take many hours and a hundred feet of paper to reproduce. This is but one of many capabilities that Teletype has designed into its line of Telespeed tape-to-tape terminals.

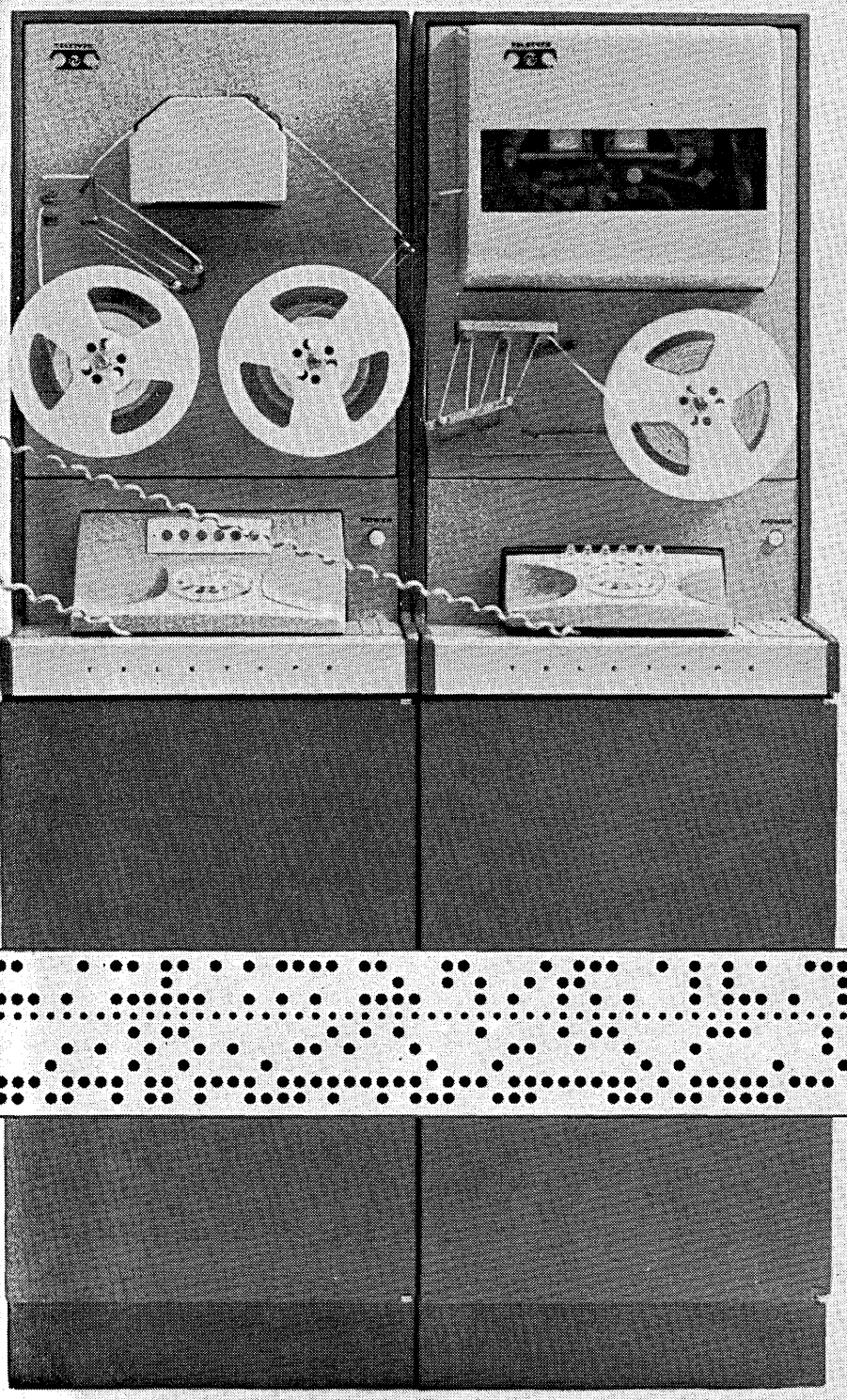
Telespeed equipment is being used to exchange data with central on-line computers. In point-to-point data exchange for both distributing and collecting data in any number of remote locations. It communicates in 5, 6, 7, or 8-level code including the U.S.A. Standard Code for Information Interchange (ASCII). And, ASCII is perfectly compatible for use with most computers and other business machines.

Detects and corrects transmission errors

Telespeed 1200 EDC terminals provide automatic detection and correction of transmission errors. An extremely important capability in computer use and high-speed numeric business data transmission. This Telespeed equipment delivers up to 120 characters per second. And it is compatible for use with Telespeed 1050 equipment that operates at 105 characters per second. The Telespeed 750 terminals shown at right are extremely economical high-speed tape-to-tape equipment that provide data handling capability of 75 characters per second.

machines that make data move

TELETYPE®



Unattended operation

All Telespeed sending sets can be equipped for unattended transmission to a receiving unit allowing you to accumulate data on punched tape throughout the day and transmit it during the night when line costs are lower. Day or night—data transmission by paper tape offers greater economy and speed all around. And the paper tape converts easily to printed copy.

Telespeed equipment is one of many exciting moves being made by Teletype R&D *in moving data at very little cost.* That's all we're really concerned with. Providing economical, versatile, incomparably reliable data moving equipment. If you would like to know more about Telespeed tape-to-tape equipment and all of its unique capabilities, write Teletype Corporation, Dept. 81C, 5555 Touhy Avenue, Skokie, Illinois 60076.

CIRCLE 73 ON READER CARD

Having trouble communicating with the modern generation?

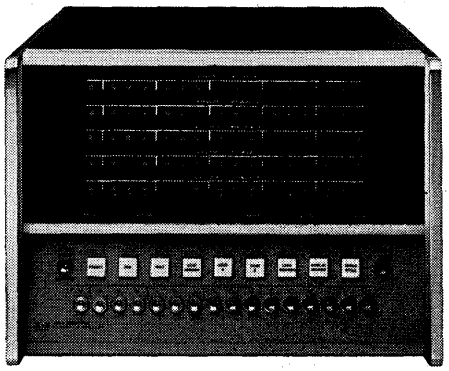
HP software makes it easy.

Not only do Hewlett-Packard computers speak many common languages, but they also let you change your mind, your program and your equipment configuration —with minimum effort.

HP computers speak three higher level languages: FORTRAN, ALGOL and Conversational BASIC ...and in these languages you can perform scientific calculations or converse with the most elaborate instrumentation system.

The compilers are only part of the package. A Basic Control System (BCS) simplifies programming and execution of all I/O operations—permitting device-independent programming. Assemblers (and compilers) generate relocatable code. Communication is easy on the hardware end, too—using standard plug-in cards.

The two computers—the HP 2115A and the 2116A—offer a choice of memory and I/O capacity, and they're completely software compatible. Make it easy on yourself. Call your local HP field engineer for all the details. Or write Hewlett-Packard, Palo Alto, California 94304; Europe: 54 Route des Acacias, Geneva.



The 2115A Computer has 16-bit words, 2 μsec cycle time, 4K memory. Price, including Teleprinter, $16,500. Additional memory and options available.

HEWLETT hp PACKARD

DIGITAL COMPUTERS

06723

CIRCLE 74 ON READER CARD

world report

BRITISH COMPUTER CORP. PLAN PROMPTS INFIGHTING

The Spring offensive in the U.K. opened early this year. And by March most of the main frame houses were battling to make their impact on the shaping of the industry. Disclosure of NCR's plans to make some of the Century Series in Scotland completed a tumult of industry activity to which ICT, English Electric, IBM, Honeywell, Burroughs and others have all been party--whether they liked it or not.

Because of its effect on the morale of the native computer talent, the most memorable event of the past month will be the brawl that flared between ICT and English Electric in the midst of their merger negotiations to form the British Computer Corporation. With English Electric holding out for a higher price for its dp holdings and pushing its normally reticent managers into the limelight, the two groups embarked on a technological wrangle that is unprecedented in Europe. English Electric claimed superiority for its System 4 range (a U.K.-licensed version of Spectra 70) over the six-bit-character, 24-bit-word machines of ICT. With only 20 System 4's shipped so far, English Electric is fighting hard for recognition so that its product line is not dropped.

... EE ACTIVE BUT ICT HAS THE ORDERS

However, another move will come from English Electric. Always aware that its merger negotiations could break down and leave considerable difficulties, a model 40 and 60 were secretly designed to slot between the 30 and 70 in the System 4 series. This will give the company its first broad market coverage.

ICT's order book logged 1000 sales by the year's end. More than half are delivered and the successor to the series was brought out last month with the microcircuit version 1900A series.

Matters are made worse because the makers have opted for different ic techniques (and, therefore, production methods) in their micromin machines. Hinting that they were the more capable unit in marrying the diverging technologies, ICT made it known that their advanced research lab had completed a working model of a Basic Language Machine--the code word machine proposed by John Iliffe. Since a report in Datamation 18 months ago that ICT was working on such a design with a Ministry of Technology grant, the company has kept the project closely guarded. Still insisting that this is no preproduction prototype, a programme of software experiments and system efficiency measurements has been laid on.

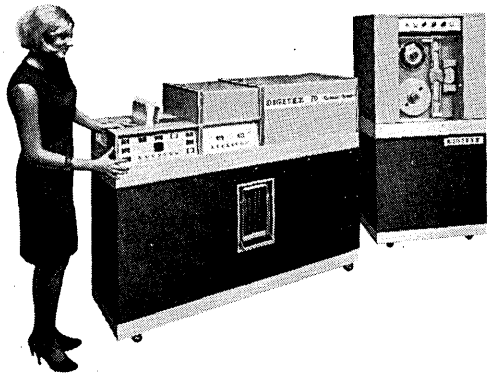
... AND MORE ACTIVE PROJECTS

Pundits are forecasting that the basic language machine will be hooked up to ICT's new photo-optical memory, which should provide a cheap fixed store for surrounding a system with as many emulators as needed.

On top of all this, ICT has been gaining support in the university and scientific market for Project 51, a $7 million system to stave off further encroachment from CDC and IBM. Project 51 configurations come in as many guises as there are customers. But it is

(Continued on page 129)

Have you heard the one about the computer that was held up by a band of keypunchers?



We don't think it's funny either. That's why we've cut keypunching off at the pass with a better, faster, more accurate and economical way to feed your computer: the Digitek 70 optical scanning system.

This versatile system reads pencil-marked (original) documents at the rate of 2500 per hour and transfers information directly to magnetic tape. The Digitek 70 not only saves labor, time and space, it also reduces errors, speeds the movement of data and raises the efficiency of the computer.

Keypunching can account for as much as 35% of the total cost of your computer operation and up to 90% of time delays. While you're sitting there thinking about this kind of money, smile. We'll round up our posse and tell you how the Digitek 70 can work for you.

Write today for information on this and other Optical Scanning systems that read a variety of hand- or machine-printed source documents.

OPTICAL SCANNING CORPORATION

Newtown, Pennsylvania 18940 Phone (215) 968-4611

CIRCLE 75 ON READER CARD

essentially a multiprocessor system centered around the larger cpu's of the 1900 series--the 1906/07. With block transfer from core to core, the design resembles a cross between Univac back-to-back techniques with 1107's and 08's and the B 8500 ideas on processors that are allocated definite job responsibility.

... AS U.S. MAKERS ADD TO THE ACTION

In the meantime, IBM is pitching hard at Manchester University (another potential Project 51) with a 360/91 plus a model 67 as scheduler. In a bid to clinch a $10 million deal, IBM has put a time limit on the decision awaited from the university. Big boy argues that this is the last of the line on 91's and there are plenty of other eager customers to satisfy.

To counteract the effects of the fluctuations in prices by all the other competitive moves, Honeywell has cooked up a pay-as-you-use method of financing.

THE BRITISH BANK HASSLE CONTINUES

In two weeks of revolution early in February the banking business was transformed dramatically with Barclays, Lloyds and Martins going together to become second only to California's Bank of America. The new grouping encompasses 5,545 branches and about $16 billion deposits. Two of the other giants, National Provincial and Westminster, linked to top $8 billion in deposits, thus leaving the Midland bank with 2,677 branches and over $6.5 billion in third place.

This concentration has turned up in a period of massive re-equipment in which the banks have planned to bring all branches on-line to a central system. The score before mergers was firmly in Burroughs' favour. In the winter it lopped off Barclays and National Provincial with B 8500's and topped the lot with a handsome order from Midland for some of those TC 500 terminals, which have attracted British banking men to Burroughs like bees to a honeypot. Much of this ordering was to the detriment of existing IBM and NCR equipment. But IBM has been regrouping for an onslaught now that it has both the model 85 on board and Lord Cromer, former Governor of the Bank of England, at the helm of U.K. operations.

The first sufferer of the merger is English Electric, which had System 4-70's signed up for Midland. These were to link up with the Burroughs terminals spread through the 2,677 branches. English Electric suffered some slippage on System 4, which probably sealed the fate of the Midland order.

BITS & PIECES

Burroughs seems to have chosen this year to make a decisive entrance in Latin America. A 32K B 5500 able to handle up to 24 teleprocessing stations will go to the Latin Amercan Institute for Information and Computing Sciences in Mexico City. The Universidad de Sao Paulo will get a 150K B 3500...Proceedings of the first Colombian Congress on Computer Sciences are now off the press. Attendance was over 400, a Colombian Computing Association was formed, and negotiations for membership in IFIP have been started...The first word is in that IBM has felt some pain from devaluation. At least two $450,000 orders fell from their grasp because of the price difference between a 360 quote and that offered by competing English Electric...Univac won another order in Italy--an 1108 with 65K core, a companion 1004, and a variety of remote terminals, for the Institute of Technology in Milan.

washington report

MOTHER BELL COMES THROUGH

AT&T has proposed a wideband dataphone service, to go into trial operation April 1, that seems to meet at least some of the dp industry's demands. Known as "Data 50," the service would permit users to transmit sequential signals at a rate of up to 50K bits per second. Existing dataphone service handles 2,500 bps maximum. Initially, the new service would operate between Chicago, L.A., New York City, and Washington. The rates would range from 50¢ to $3.25 per minute, depending on distance. The minimum monthly charge would be $250 per installation. Each user would also pay a $125 terminal installation charge.

ARMY TRYING NEW EVALUATION SIMULATOR

A new simulator program--S_3, developed by Leo Cohen Associates, Trenton, N.J.--is being tested by the Army Computer Systems Evaluation Command. Acceptance is targeted for mid-April, after which S_3 is expected to be used extensively to evaluate bidders' computer system offerings. Reportedly, the Navy and Air Force are also interested in S_3. It is said to offer more sophisticated analyses of multiprocessing and multiprogramming capabilities than older simulators. The Army is currently running S_3 on a 360/50, hopes to do likewise later on an 1108. ACSEC has encountered "numerous minor problems but no major ones" in testing the simulator so far. Among the improvements needed are better OS simulation capability and a simple assembly language to input job cards.

HOPE DAWNS FOR CODE STANDARD

NCR's ASCII-compatible Century Series, announced this month, is regarded here as an important step toward industry-wide code standardization. "The basic idea," explains a knowledgeable source, "is to create a base for standardization which will be expanded voluntarily." He believes that once ASCII becomes a government-wide information interchange code, the series will have a competitive advantage over EBCDIC-oriented systems sufficient to persuade other manufacturers to follow.

Another goad in the same direction is being considered by NBS, where officials plan to recommend testing ASCII as a record storage code in an existing system. A "relatively inexpensive" I/O converter would reformat data from internal machine code to ASCII and vice versa.

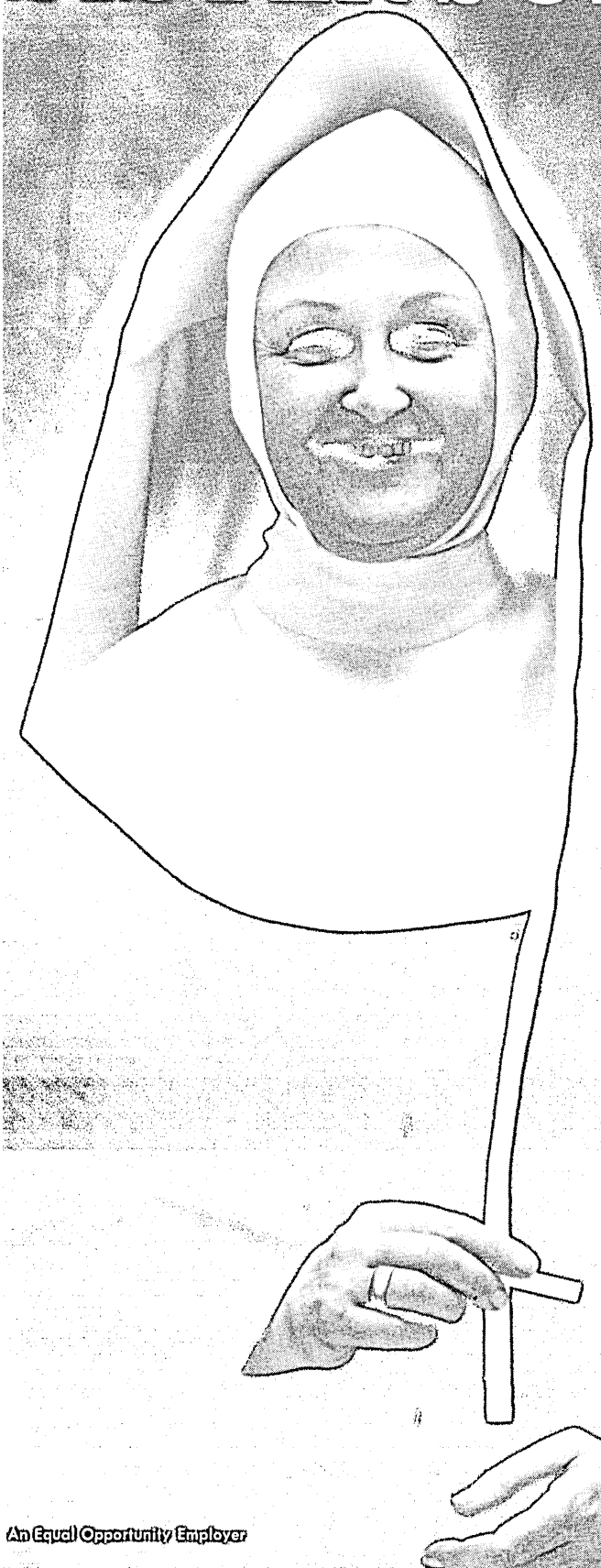
THE BUDGET VISE TIGHTENS

NBS has closed down its Management Applications Division because of the budget squeeze. Six systems analysts have been riffed in the process. Lack of money has also forced the Bureau of Information Processing Systems Division to dispense with three electronics engineers (GS 11-13's); they've been transferred to other NBS offices. Meanwhile, NASA, because of budget constraints, has leased only one 360/75 instead of two as originally planned.

CAPITOL BRIEFS

Erv Voltin, manager of the NBS service bureau, has resigned after running afoul of his boss, Herb Grosch. Voltin reportedly has been hired by the National Science Foundation...John Eberhard, piqued over the second-class citizenship accorded the Institute for Applied Technology by NBS' front office, plans to leave in May; the new institute director will be Eberhard's deputy, Larry Kushner...University of Maryland implemented the latest release of Exec 8 last month for a "significant" improvement in system performance.

WE JUST CREATED A LITTLE MIRACLE FOR SISTER JUDE.



Multiplication

8 10 9 12

8 2 6

We have taken her out of the records keeping loop. Now she has more time for the job she was trained for—teaching. Through systems programming Sister Jude and her counterparts have overcome the common plight of educators who must handle detailed administration at the expense of curriculum preparation.

We've done our homework in other application areas too. We have been involved in over 600 projects that span the spectrum from space exploration to supermarket product movement. As an important part of the information industry, we constantly seek new techniques and approaches in software.

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new products

large-scale system

The 360/85, through increased use of memory hierarchies, becomes the fastest generally available System 360, operating at three times the model 75 speed on typical instruction mixes. And, says IBM, in some jobs it achieves the same speed as the larger limited-production model 91, which is optimized to floating point.

Basically, the 85 is program-compatible with the smaller 360's, aims at large-scale commercial and scientific users, and is offered with most of the same peripheral devices and communications facilities as model 65 and up. Unique to it is a 16K buffer memory using monolithic i.c.'s to achieve an 80 nsec cycle time, equal to cpu speed (the interval between successive clocks). The arithmetic and logic units also use these circuits, another 360 first. (The 75 uses hybrid circuits for all these units; other models have registers primarily in read-only storage.)

Memory capacity is 512K to four million bytes, four times that of the 65 and 75, twice that of the 67. Because of the buffer, however, the 8 million bytes of bulk core available on the other large systems cannot be implemented on the 85.

Main memory cycle time is nominally 1 usec per 16 bytes, including error correction and detection. But with each request, using look-ahead techniques, the 64-byte blocks are automatically streamed, through four-way interleaving, into the buffer in 1.28 usec. Thus the 80-nsec buffer meets the cpu's data needs 95% of the time. (The 75, without buffer, has a 750 nsec cycle time per eight bytes, speeded up through four-way interleaving; the 65 has the same time and two-way interleaving; the 91, with the same effective cycle time, has 16-way interleaving.) The error detection coding in main memory of the 85, noted above, is another unique 360 feature, providing detection of one- and two-bit errors, correction of all one-bit errors.

The 85 has all the instructions of the 65 and 75 plus a new extended precision instruction "ø" for 128-bit floating point numbers for scientific applications involving very large numbers. Another special, optional, feature for scientific users is high-speed multiply which provides three times the speed of the standard 85 multiply and up to 10 times that on the 65. (Example of option's speed: a two 17-digit number multiply is under 600 nsec, floating point; under 450 nsec, fixed point).

It should be noted here that the 85 is much like the 65 in being balanced in handling fixed and floating point and decimal numbers. The 75 and 91 are more optimized to floating point, although the high-speed multiply option on the 85 increases its capabilities here. IBM has run some tests on these four systems, using a 2-million byte 91, the rest having one-million-byte storage. (The 85 time was provided by an instruction trace and timing program run on another 360.) The following internal performance, using the 65 as the base of 1, was indicated:

	FORTRAN IV Compile	Assembler	Floating Point Code	
			Eigen Value Code	Heat Transfer
75	1.3 (times the 65)	1.3	1.7	1.5
85	3.2	3.6	3.6	3.9
85 (with multiply option)	3.2	3.6	4.6	4.1
91	3.6	3.5	9.1	4.1

Other optional features on the 85 include expansion of the buffer memory to 24K or 32K bytes. Emulators, achieved through the writeable control store and software (as on the new model 25), are available for the 709, 7040, 7044, 7090, 94, and 94 II. IBM notes, for example, that some 94 II programs will run at twice the internal performance speed on the 85. The 65 runs them at .85 the 94 II time.

The 85 comes with all IBM-supported software (type 1 and 2), including OS/360 with MVT (Multiprogramming with a Variable Number of Tasks), which permits handling 15 jobs simultaneously, and COBOL, FORTRAN, PL/I, etc. As on models 65 and up, communications channel facilities include a selector channel supporting up to eight control units and 248 I/O devices (1.3 megabyte/second transfer rate), and a multiplexor channel with 192 subchannels, also supporting eight control units (110K-670K transfer rate).

A new console on the system has two microfiche viewers for maintenance and machine status display and a crt display with keyboard. One microfiche viewer projects reference documents stored on microfilm at the console and the other uses indicator labels, also stored on microfilm, and indicator lamps, which show the status of the control logic at any point. The crt is used for diagnostics and as an operator console.

Competitively, the 85 will do battle with the Burroughs 8500 and the Control Data 6600 and, in the future, most directly with the CDC 7600, not yet publically announced. Price range for the 85 is $96K-220K a month, or

—PRODUCT OF THE MONTH—

A program checkout package which operates under OS on the 360/40 and up, consists of three programs: Dataset Generator, Printer and Stripper. The programs are also available individually. The Generator uses punched card input to create test records of any size or format on sequential or random access files. Numeric data fields can be converted to hexadecimal or packed binary. Data fields can be tabulated selectively.

The Printer program allows selective snapshots of the file whether 200, 556 or 800 bpi, and in any record length and format.

The Stripper allows selection of live data on the basis of "and/or" and "greater than, equal to and less than" statements, and can be used to create new files for preparation by the Printer routine.

The company claims that the package cuts program checkout time in half, allows more accurate and complete generation of test data, and permits standard test procedures for program documentation to be used for future modifications and conversions. TIME SHARING SERVICE, INC., Beverly Hills, Calif. For information:

CIRCLE 140 ON READER CARD

new products

$4.5-10 million, purchase. A 2-megabyte system rents for $175/month, selling for $7.5 million. Delivery begins third quarter 1969. IBM DP Div., White Plains, N.Y. For information:

CIRCLE 141 ON READER CARD

disc drive

The 2500 disc drive, compatible with the IBM 2311, will compete with similar drives produced by Control Data and Memorex. It has a 70 msec maximum access time; average random access time is 50 msec. Capacity is 58 x 10^6 bits. The 2500 also has a binary hydraulic adder head positioner, and read/write amplifier shaping circuits mounted on the head carriage. The design, because of the shorter distances for the signals to travel, reportedly reduces error rate and requires less maintenance. Deliveries of the drive begin in June. MARSHALL LABORATORIES, Torrance, Calif. For information:

CIRCLE 142 ON READER CARD

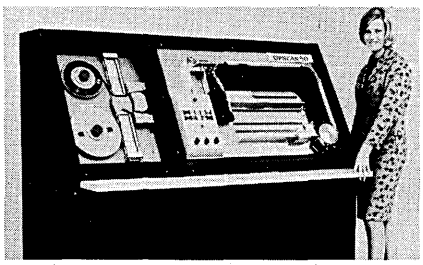
cobol reference aid

A COBOL cross-reference aid for System/360 programs, COBOL-AID, may be used with individual or multiple programs which process common data files. Three COBOL source programs and two IBM DOS sort programs with job control make up the package, which analyzes the Procedure Division of COBOL source programs. Every data name, literal, and library name is cross-referenced to the page and line number where it is used on the source program listing. With some modifications, the package could be used by any COBOL installation. COMPUTER RESULTS CORP., West Springfield, Mass. For information:

CIRCLE 143 ON READER CARD

optical mark sensing system

The OpScan 50, an optical mark sensing system, scans forms (such as unit control tickets in retail stores, and the 22-column stub cards used in credit payment applications) and transfers the data to mag tape for computer processing. The system reads a variety of forms as small as 1″ x 3″ from computer-printed, machine-printed, hand-marked, punched, or bar-coded forms, and can read data on 1″ x 3″ forms at a speed of 24,000 an hour. The OpScan 50 can read BCD or positional codes, such as pencil marks and punched codes, and has a basic tape speed of 24″/second. The integral tape deck adapts to 200, 556 and 800 characters an inch. A special blocking form allows five forms per tape record. OPTICAL SCANNING CORP., Newton, Pa. For information:



CIRCLE 144 ON READER CARD

data acquisition

A Badge Reader for information input has been added to the Source Record Punch model 1730, a data acquisition system for industrial and library applications. Hollerith-code-punched information on the plastic badge is transferred to up to 10 pre-selected columns of a Zip Card source document. The information is then printed simultaneously along the top of the card with all other entries made through the other three sources of input to the punch. The badge is available in two dimensions, 3¼″ x 2⅛″ and 3⅜″ x 2 5/16″, with thicknesses from .010″ to .030″. THE STANDARD REGISTER CO., Dayton, Ohio. For information:

CIRCLE 145 ON READER CARD

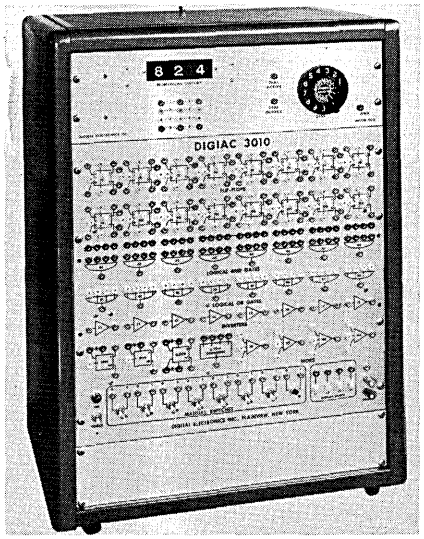
test-scoring machine

The Automata 450 test-scoring machine scores both teacher-made and standardized, objective tests at a rate of 7.5 tests a minute. The machine, which uses I/O, memory, logic and control circuitry, can score 100 test cards in one loading. Students mark answers on test cards which can handle up to 100 questions; no special pencil is required. The machine compares these answers with a master card, which has been placed on a revolving drum inside the instrument. During scoring, a Data-Dot Edge Marker notes every wrong answer on a student's test card. The machine also prints the number of right and wrong answers on the top of each card, and records the class totals of right and wrong answers. AUTOMATA CORP., Richland, Wash. For information:

CIRCLE 146 ON READER CARD

logic trainer

The Digiac 3010DD is a trainer designed for the teaching of digital computer logic. Some 60 separate basic computer circuits are screened on the front panel, and correspond to the logic diagram in the accompanying student manual. A telephone dial and numerical display panel serve as I/O



devices which simulate data from a computer. A removable rear panel allows access to all components for instruction in computer maintenance and servicing. DIGIAC DIV., DIGITAL ELECTRONICS, INC., Plainview, N.Y. For information:

CIRCLE 147 ON READER CARD

tape transport

The model FT-153 tape transport for geophysical field data recording reads and/or writes data in IBM-compatible 7- and 9-channel formats at selectable speeds from 15-150 ips with packing densities to 800 bpi, NRZI; transfer rate is up to 120 kc. The unit is equipped with standard 8½" reels, and accommodates ½" tape. Operated from a 12-volt battery source, the recorder has a start time of 50 ms, and stop time of 100 ms. POTTER INSTRUMENT CO., Plainview, N.Y. For information:

CIRCLE 148 ON READER CARD

printed circuit design program

The Autologic System for the design of printed circuit boards uses schematic or logic diagram information, and is capable of manipulating either discrete or multi-pin i.c. devices. A "footnote" program assigns part numbers to the components and selects the proper outlines and mounting dimensions from a master file tape. The system then prints a bill of materials, and a mag tape to be used as input to the automatic production control and inventory systems, and a mag tape is produced to operate an off-line plotter. Paper tapes are included in the output for control of NC drills and component insertion equipment. AUTOLOGIC, INC., San Francisco, Calif. For information:

CIRCLE 149 ON READER CARD

cobol flowcharting

Computer-drawn flowcharts are produced from COBOL program decks, are written for any computer, and are priced at 5¢/card; charts will be printed and mailed back within one week of receipt of order. The program is also available on lease. NATIONAL COMPUTER ANALYSTS, INC., Princeton, N.J. For information:

CIRCLE 150 ON READER CARD

aerospace computer

The RAC-230 general-purpose digital aerospace computer is a parallel two-address machine with a 2-usec main memory cycle time, a 4,096-word NRDO-program memory, and a 2,048-word scratch-pad core memory. The RAC-230 has 63 instructions and a library of mathematical subroutines. Word length is 22 bits plus parity and sign for single precision use, and 44 bits for double precision. Less than a half-cubic-foot in volume, the unit weighs 20 pounds. RAYTHEON CO., Sudbury, Mass. For information:

CIRCLE 151 ON READER CARD

disc pack

The CM VI (six-high) magnetic disc pack is guaranteed to function with the IBM 1311, 2311 and compatible

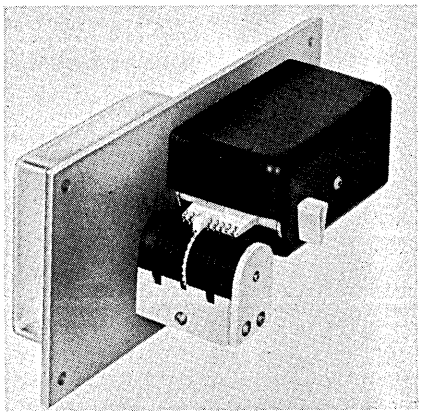
new products

equipment. The unit has 10 coated surfaces with 203 tracks of information, and is capable of storing up to 14.5 million bits. Access time is 75-85 msec; the pack rotates at either 1500 or 2400 rpm. Delivery is immediate. CAELUS MEMORIES, INC., San Jose, Calif. For information:

CIRCLE 152 ON READER CARD

tape reader

The model 18 perforated tape reader uses starwheels to sense the holes; output is presented in the form of contact closures. The unit reads 5-, 6-, 7- or 8-channel tape unidirectionally at a



rate of 30 cps. An electromagnet is used to advance the tape. Model 18 does not used complex circuitry or timing; cost is $180.00 fob New Jersey. IDEA ASSOCIATES INC., So. Hackensack, N.J. For information:

CIRCLE 153 ON READER CARD

message composer

The DATACALL DC80 Message Composer can store up to 80K alphanumeric characters in its indexed, magnetic tape cartridge. Specific data can be located by means of readable descriptors on the front of the tape, and the pre-recorded message is transmitted over teletypewriter lines or into computers in one transaction. For selective or non-selective communications systems. DASA CORP., Andover, Mass. For information:

CIRCLE 154 ON READER CARD

data logger

The Digital Data Logger scans, digitizes and records analog data; it can measure and record any combination of physical parameters that are convertible by transducers to voltage, current or resistance (temperatures, pressures, velocities, weights, etc.). Suitable for field use (20" x 26" x 15"; 75#), it can also record digital data from keyboards, shaft encoders, counters and digital transducers, and gener-

ates time and identification information. Availability is 60 days after receipt of order. CONTROL EQUIPMENT CORP., Needham Heights, Mass. For information:

CIRCLE 155 ON READER CARD

pert/cpm kit

A PERT/CPM Kit for project managers includes a PERT-O-GRAPH (a circular "slide rule" which performs all necessary computations), a copy of the *Project Manager's* PERT/CPM *Handbook*, a guide to use of the kit, and a vinyl binder. HALCOMB ASSOC., Sunnyvale, Calif. For information:

CIRCLE 156 ON READER CARD

a/d converter

A series of analog to digital converters are based on a 5-bit parallel comparison (PC) card increment which allows cards to be added to produce three units: 9-, 12-, and 15-bit converters. Conversion time for the 5-bit instrument is 400 nsec; a 15-bit unit operates at 3.5 usec with analog accuracies of ± 0.1%. The units also feature reconstructed analog output which monitors the digital output and reconverts the output to an analog form. This enables the user to visually check the performance of the converter by using a standard oscilloscope. CANOGA ELECTRONICS CORP., Chatsworth, Calif. For information:

CIRCLE 157 ON READER CARD

disc pack cabinet

The four-drawer Storaway cabinet holds a dozen 2316 or 1315 disc packs. Each drawer is fitted with

three plastic cones to position the packs securely. Cabinet is available in full range of computer colors. TAB PRODUCTS, CO., San Francisco, Calif. For information:

CIRCLE 158 ON READER CARD

plug-in interface

Logic-Pak is a plug-in interface between the IBM 735 Selectric typewriter (for I/O) and the Digital Equipment PDP-8, giving what the manufacturer considers the same advantage as the System/360 user gets. The setup does away with teletype and becomes a standard means of I/O for DEC computers.

Logic-Pak converts IBM code to ASCII and vice versa and includes documentation and code conversion tapes, overlay program tapes for operating DDT and other DEC routines. Also included is a pushbutton keyset (alt mode, rubout, CTRL/form, etc.), decoder and encoder cards which recognize and produce functional codes such as tab, space, carriage return, back space, index, ribbon shift and upper/lower case, and the logic and circuitry necessary to properly gate and condition selection magnets.

Logic-Pak uses the following DEC modules: (4) W510 positive input converters; (3) W603 positive level amplifiers; (6) W021C coaxial cable connectors; there are also 11 solid state double sided circuit cards of the company's design. Delivery time is 45 days. LOGIC, INC., Detroit, Mich. For information:

CIRCLE 159 ON READER CARD

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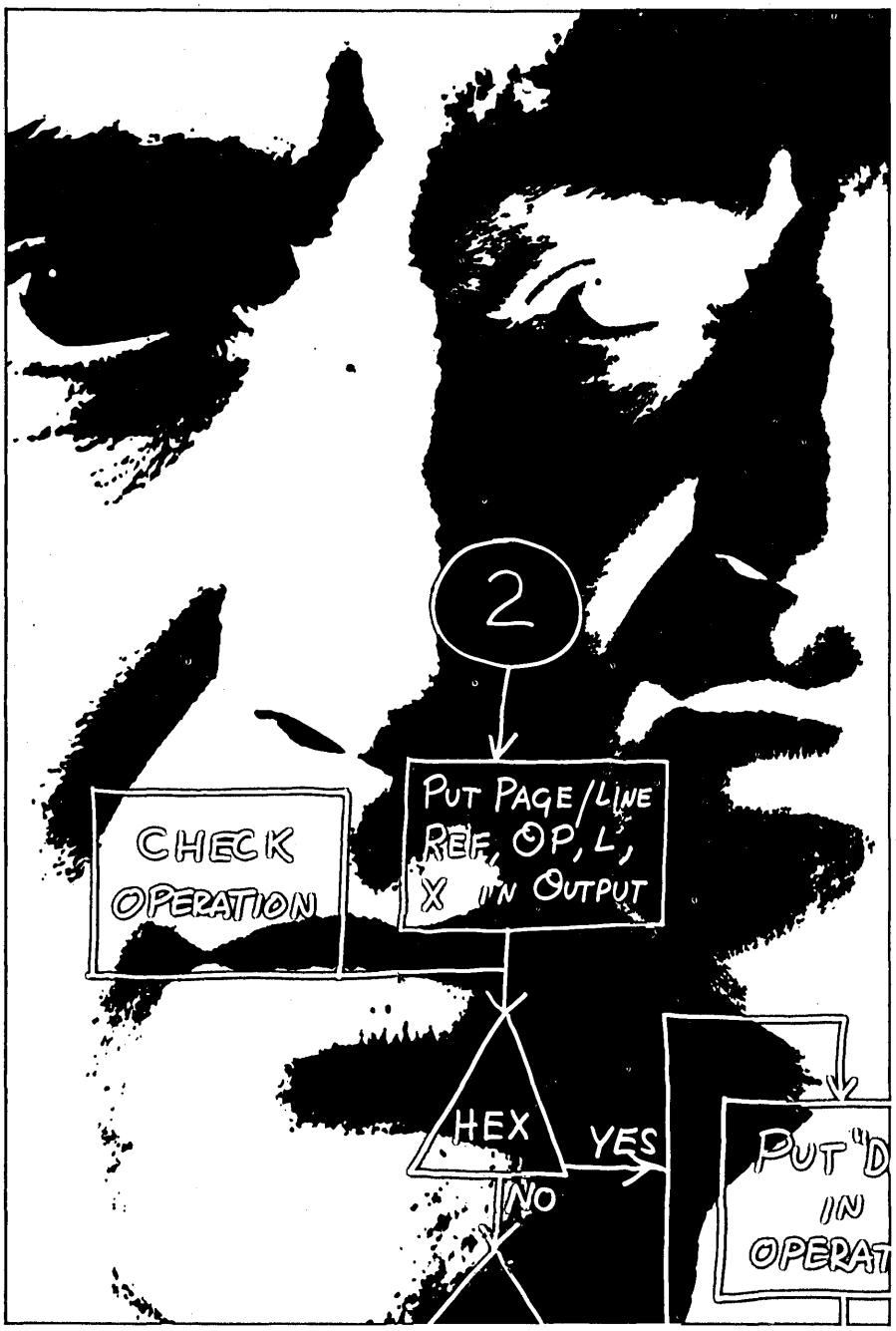

If you can't see ahead to fourth-generation software from where you sit, there's a generation gap in your career. At NCR Electronics Division, the third generation of computer technology has matured and the fourth is being born. Current work includes system programming based on completely new concepts, high-speed thin-film memories, ultra-high-density disc storage, integrated circuits, and peripherals with unprecedented capabilities. ☐ NCR Electronics Division is the largest commercial computer manufacturing facility in Southern California and one of the most advanced in the world. Its plant and laboratories in Los Angeles have recently been doubled, and a new manufacturing facility is now being opened in San Diego. You can enjoy stable, non-defense activity in an outstandingly professional environment. Your job and your future: the creation of advanced business automation for established NCR markets in 121 countries. ☐ Challenge, opportunity and Southern California are waiting for you. Why let another generation go by?

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Software Systems Design

Develop operating and executive systems and compilers for third- and fourth-generation advanced systems.

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Write programs to debug function specifications and/or programs to verify hardware capability; write test outlines; code, debug and document programs. Requires familiarity with both hardware and software.

Business Applications

Write programs to implement systems within the division, such as payroll, accounts payable, inventory control, etc. Prefer BS in related area plus 1 to 3 years' experience in one or more of the areas mentioned. Should be familiar with concepts of medium- to large-scale general purpose systems employing time sharing, multiprogramming, multiprocessing.

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new literature

COMMUNICATIONS EQUIPMENT: 16-page catalog lists international communications equipment for use on ITT circuits for telegram, telex, high-speed data and private leased channels. ITT WORLD COMMUNICATIONS, INC., New York, N. Y. For copy:
CIRCLE 124 ON READER CARD

THESAURUS: Three-volume preliminary edition of NASA thesaurus contains approximately 15,000 indexing terms, together with scope notes, subject categories, and cross-reference for each term. It is designed to assist users of the NASA technical information system in the retrieval of documents and journal articles in all fields of aerospace science and technology. The vocabulary was based on the indexing terms developed by NASA during 1962-66. NASA SP-7030. Cost: $8.50. SUPERINTENDENT OF DOCUMENTS, U .S . Government Printing Office, Washington, D.C. 20402.

QUESTIONNAIRE ANALYSIS: Brochure describes software system designed to analyze survey questionnaires. Capable of handling up to 20 80-column cards per respondent, QUESTAIRE constructs tables of data, performs calculations on them, and lists results in whatever format requested by the user. CONTROL DATA CORP., Minneapolis, Minn. For copy:
CIRCLE 125 ON READER CARD

LOGIC FLOW TABLE: Pamphlet describes technique of using a logic flow table rather than conventional flow charts and diagrams for preparing or documenting assembly language programs. The technique reportedly reduces the amount of time required for logic definition, coding and de-bugging by from 20-50%. SUDBURY E.D.P. SERVICE CO., Sudbury, Mass. For copy:
CIRCLE 126 ON READER CARD

LOGICAL DESIGN: 103-page report describes methods for designing digital circuits that have a minimum number of active elements. The design methods employ the mathematics of logic. AD-662 878. Cost: $3; microfiche, $.65 CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

I/O EQUIPMENT: Six-page short form catalog describes the company's line of tape punches, readers, and handlers; photoelectric keyboards; I/O typewriters, printers, and systems. INVAC CORP., Waltham, Mass. For copy:
CIRCLE 127 ON READER CARD

INTEGRATED CIRCUITS: Booklet describes integrated circuit data book issued each spring and fall and available on a subscription basis. The latest edition lists 6,549 circuits available from 88 companies. The data book is indexed in type-number order and cross referenced to electrical characteristics. The devices are classified as follows: amplifier, flip-flop, clock or multivibrator, counters, decoders, gates, shift register, and time delay. D.A.T.A., INC., Orange, N.J. For copy:
CIRCLE 128 ON READER CARD

AUTOFORCE: Twelve-page brochure explains the AUTOFORCE system for control of data processing manpower by management. The system provides management with tools for automatic standards enforcement and programmer evaluation. Manuals and proprietary support software have been developed for all existing computer equipment. AUTOMATION SCIENCES, INC., Jersey City, N.J. For copy:
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INVENTORY BOOK: 36-page hard cover book is for in-plant or service use in recording monthly consumption of data processing forms. Can be used for up to 30 different forms covering a two-year span. Pages are arranged for detailing form numbers, descriptions, vendor names, delivery time and prices. Space is provided for quantities ordered and received plus month-end inventory, month usage and

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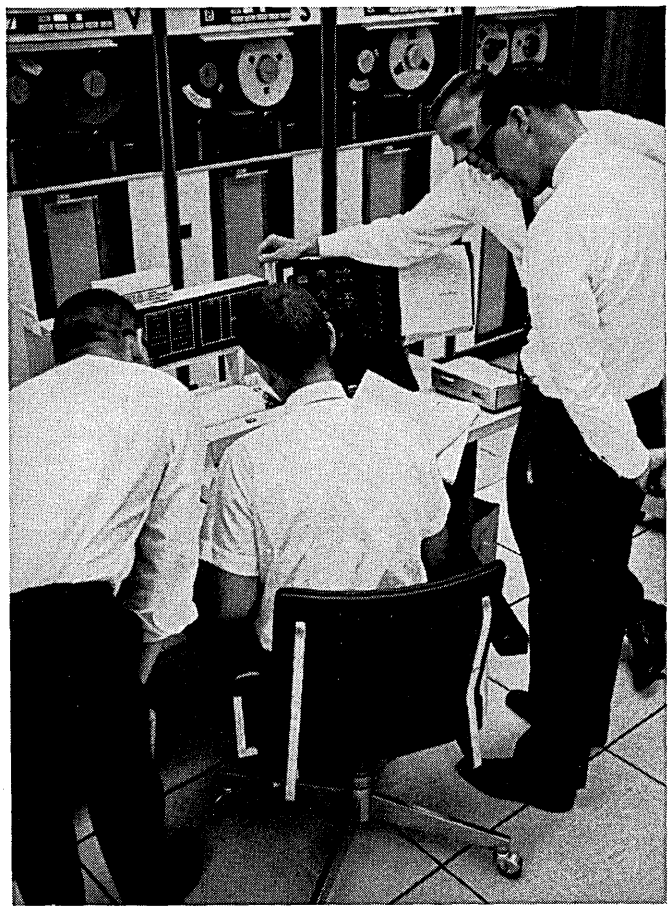

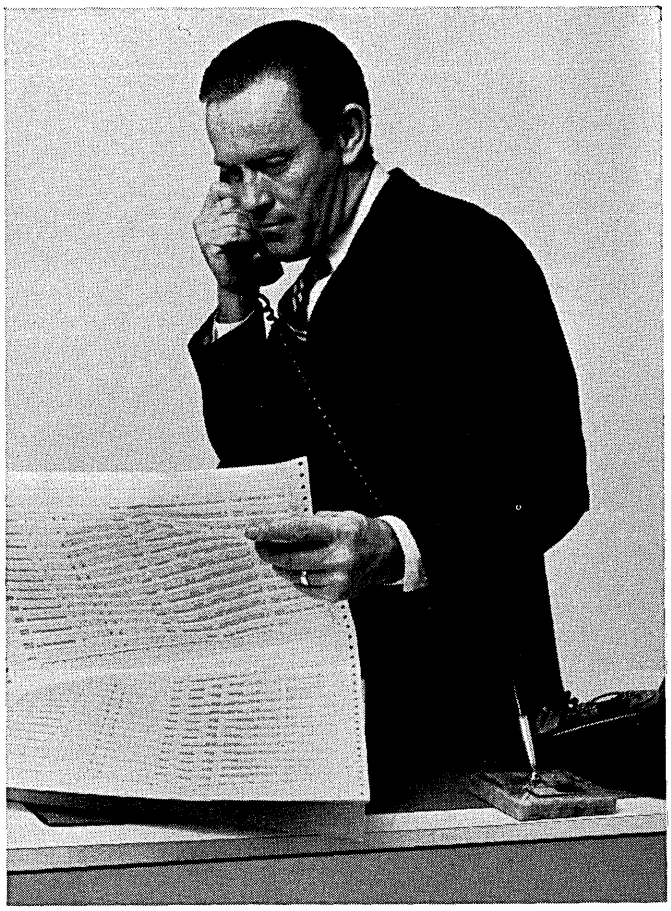

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year-end totals. SHELBY BUSINESS FORMS, Shelby, Ohio. For copy:
CIRCLE 130 ON READER CARD

USER PROBLEMS: Many computer users are not realizing anticipated advantages of third-generation machines because they are unable to effectively manage and support their rapidly growing dp activities. Discussing the major problems hampering such users, a 16-page report also includes recommendations on corrective measures for improving operating efficiency. SOFTWARE SCIENCES CORP., New York, N.Y. For copy:
CIRCLE 131 ON READER CARD

TAPE REHABILITATION: Eight-page illustrated brochure covers six basic areas relating to the use and maintenance of magnetic tape: causes for failure, rehabilitation concepts, cost concepts, testing and maintenance techniques, equipment, and establishing a rehabilitation program. CYBETRONICS, INC., Waltham, Mass. For copy:
CIRCLE 132 ON READER CARD

NATURAL LANGUAGE INPUT: Eleven-page report describes the effect of natural language input on an interviewing computer program using the term "good" as an example. The program utilizes syntactic and semantic information to general relevant plausible inferences from which statements for a goal-directed man-machine dialogue can be constructed. PB-176 771. Cost: $3; microfiche, $.65. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

PROGRAMMED IMAGE ANALYSIS: Six-page brochure describes general purpose visual image processor which reads from or records on film, differentiating between wanted and unwanted data. Also described are various subunits of the complete system, including film handling optical/mechanical unit, signal processing and logic unit, programmable light source (point-plotting CRT), scan control monitor unit and CRT graphic terminal with light pen. A general introduction to the field of automatic image analysis is given. INFORMATION INTERNATIONAL, Los Angeles, Calif. For copy:
CIRCLE 133 ON READER CARD

DRUM MEMORIES: Three-part brochure contains two product booklets, as well as information on the company's design and manufacturing capabilities and other products. One product booklet covers drum reliability; mechanical, magnetic and electronic design factors; standard logic modules used; and specifications of five standard drum models with capacities from 2,624,000 to 64,307,200 bits. The second booklet discusses standard VRC drum memory systems for use with small computers and describes three different system configurations, basic I/O instructions and programming data. VERMONT RESEARCH CORP., North Springfield, Vt. For copy:
CIRCLE 134 ON READER CARD

MULTIPLEXING: Eight-page brochure outlines the role of multiplexing in edp communication systems and describes the company's line of multiplexing equipment. Typical system layouts are illustrated. RIXON ELECTRONICS, Silver Spring, Md. For copy:
CIRCLE 135 ON READER CARD

COMPUTERIZED TYPESETTING: 64-page publication, "The Realities of Computerized Typesetting," is a collection of 15 papers presented at the Research & Engineering Council sponsored conference in October, 1967. The papers presented are practical in nature, emphasizing the economics of computer use in typographic application. Cost: $8.50. COMPOSITION INFORMATION SERVICES, 1605 N. Cahuenga Blvd., Los Angeles, Calif. 90028.

GRAPHICS TERMINAL: Twelve-page brochure describes general-purpose CRT display system which makes possible 3-D displays which move with full six degrees of motion. Included are system highlights, system concept, standard models, and standard options and software. ADAGE, INC., Boston, Mass. For copy:
CIRCLE 136 ON READER CARD

ASSOCIATIVE MEMORIES IN MULTIPROCESSORS: 147-page report describes development of a "multiprocessor with associative control" for purposes of evaluating and studying the use of associative memories for executive control functions in multiprocessors. Presents preliminary results in terms of system efficiency and requirements on the associative memories. AD-662 361. Cost: $3; microfiche, $.65. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

books

***Data Processing Managers*, R. J. Harper, Lyon Grant and Green, London, 1967. 21 shillings.**

As the title of his book implies, Mr. Harper's study focuses on the work and qualifications of data processing managers in the U.K. In the course of his analysis, Mr. Harper provides many insights into the management of 30 representative U. K. data processing installations, and the reader is tempted into sweeping general comparisons with the U.S., comparisons which may or may not be true.

The corporations he surveyed are substantial in size—the median number of total employees is around 8,000—yet in June, 1966, the median time since the installation of the first computer was less than three years. U.S. corporations of similar size probably have more experience; they might also be spending more money and using more staff in the data processing department, since typical annual computer department expenditures in the U.K. are around $350,000 and typical staffs around 55, according to Mr. Harper's figures.

Despite the longer computer experience of U.S. corporations, the problems of the U.K. data processing managers will be distinctly familiar to their U.S. counterparts; but some progress has been made in the U.S. to solve them.

Overwhelmingly, the previous work experience of the U.K. data processing managers has been in punched card installations, organization and methods work, or accounting, and their computers are clearly being used largely for accounting tasks. It seems likely that a survey in the U.S. would show computer applications to be more varied and the experience of data processing managers wider, but the main cause for satisfaction is that the opportunities in the U.S. for self-education to overcome any limitations of a restricted work experience are widening. Colleges and universities now offer evening courses; the graduate business schools have excellent seminars and short residential courses; and professional conferences grow in size and popularity every year. The training of U.K. data processing managers is, in contrast, minimal, and the chance to learn is difficult to come by.

One of the big difficulties in the U.K. is the lack of a professional body to develop standards of training and education. With the number of computer installations scheduled to double and the need for computer professionals expected to triple or quadruple, by 1974, the need for formal education courses and professional standards is clearly great. In the U.S. the DPMA has made at least a first move to meet this need.

It would be interesting to have a comparative study of data processing managers in the U.S. and the U.K. The differences between the two countries are considerable; but despite the longer experience of the U.S., many problems recognized in the U.K. are still to be solved here. The reporting relationship of the data processing manager is still awkward; the role of operating departments in the development of computer systems is still undefined; and the tendency of computer professionals to affiliate with the machine rather than with their corporate employer shows that satisfactory career paths have still not been planned.

The book makes interesting reading

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and can serve to provoke a useful progress review in any U.S. data processing department. It will, however, be of the greatest interest to U.S. companies and to the many U.S. corporations trying to integrate their U.K. subsidiaries into the corporate-wide data processing system.

—RIDLEY RHIND

book briefs

(For further information on the books listed below, please write directly to the publishing company.)

***Linear Vibration and Control System Theory with Computer Applications*, by James B. Vernon. John Wiley & Sons, Inc., New York, N.Y. 1967. 281 pp. $14.95**

This book relates topics in control system theory to the material usually associated with the study of mechanical vibration, and explains the use of digital and analog computers in the utilization of numerical methods. Transparent overlays for frequency response analysis and FORTRAN programs for the solution of common problems are furnished in appendices.

***Digital Computer User's Handbook*, by Melvin Klerer and Granino A. Korn. McGraw-Hill Book Co., New York, N.Y. 904 pp. $27.50.**

Compiled for the convenience of the user who is not trained in programming, the articles, written by distinguished dp professionals, fall into four general categories: topics in programming numerical techniques, statistical methods and computer applications. Tables of computer characteristics and discussions on compiler design and simulation languages are also included.

***Developing a Computer-Based Information System*, by Perry E. Rosove. John Wiley & Sons, Inc., New York, N.Y. 1967. 384 pp. $14.95.**

Written for the layman, under the auspices of System Development Corp., this book describes the process and problems associated with the creation of large-scale systems for business, governmental and military institutions. Aided by four contributors, Mr. Rosove includes chapters on system design and programming; the primary orientation of the book, however, is social sciences: emphasis is on the training program, management problems in the development stage,

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personnel design, etc. A bibliography is included.

***A National System for Storage and Retrieval of Geological Data in Canada*, A Report by the *Ad Hoc* Committee on Storage and Retrieval of Geological Data in Canada, The Geological Survey of Canada, Toronto, Ontario. 175 pp. $2.00.**

The National System recommended in this report stresses five principles: 1) the system will consist of data files held and controlled by individual organizations in the earth sciences; 2) the user-oriented files will be computer-based; 3) files will be linked by standard methods of reference numbers and coding; 4) the index to the contents and location of the files will be a computer-assisted national index; 5) data files will be recorded according to certain minimum standards, but the standards for an individual file may exceed the minimum depending on the user's needs. As a step toward the national system, the computer-assisted index has already been selected and tested. The report recommends procedures and standards for the reference numbers and coding, and describes pilot studies that have been conducted to evaluate principles and make proposals for standards of observation and measurement.

***Threshold of Planning Information Systems*, American Society of Planning Officials, Chicago, Ill. 1967. $6.00.**

A selection of papers that were presented at adp workshops conducted at the American Society of Planning Officials National Planning Conference in 1967. The papers center on four main topics: general state-of-the-art reports, explorations in municipal systems research, geographic implications of urban systems, and data processing for planning.

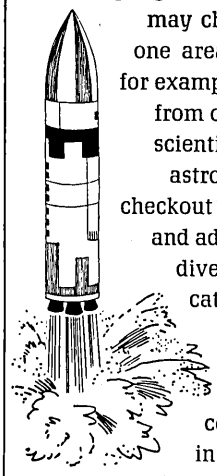
***Modern Communication Principles: With Application to Digital Signaling*, by Seymour Stein and J. Jay Jones. McGraw-Hill Book Co., New York, N.Y. 1967. 382 pp. $15.00.**

This book is intended for use by practicing engineers. A refresher chapter on Fourier transforms is in the beginning of the book to back up the authors' statement that the volume is intended for self-study with no outside references needed. It presents the major principles and theories which form the basis of digital communication system design, with emphasis on special applications.

The imaginative computer.

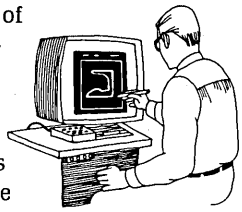
There's no such animal . . . yet. There are, however, imaginative computer programmers. And Lockheed in Sunnyvale is looking for these people.

To lure programmers, Lockheed promises not to cage them in one specific area of programming. Programmers may choose to specialize in one area (reentry problems, for example) or they can move from one area to another—scientific areas as varied as astrodynamics, automatic checkout and graphic systems; and administrative areas as diverse as business applications and government information systems. Lockheed offers the widest range of computer assignments in the country today so programmers will always find a field to stimulate their imaginations.



As a further incentive to programmers, Lockheed's 25-million-dollar computation center includes the most up-to-date digital computers and two of the most sophisticated and powerful hybrid computer systems in the country.

Imaginative computer programming has been, and will continue to be, instrumental in many of Lockheed's aerospace successes. Delivery of the first Polaris missile two years ahead of schedule was due in a large part to the Program Evaluation and Review Technique (PERT) developed by Lockheed programmers in conjunction with the Navy. Now Lockheed programmers are developing configuration data management systems for on-line, real-time computer analysis of manufacturing, financial, and personnel related data.



If you are a computer programmer, whose imagination is trapped by the same programs day after day after day . . . FREE IT! Send your resume, as soon as possible, to Mr. R. C. Birdsall, Professional Placement Manager, Post Office Box 504, Sunnyvale, California 94088. Lockheed is an equal opportunity employer.

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CAI's new marketing manager for NE region. Then Cooper stepped up to executive vp of corporate marketing (and took a three week vacation), bringing in Howard Morrison (from the acquired Computer Concepts Inc.) as regional head, and B. Coudriet as NY office vp. CAI has also reorganized its regions.

The 15-man Bradford firm was formed in NY in February and is headed by two ex-First National City Bank vp's: Don Lourie, board chairman, and Peter Delcol, president. Heavily financed, the consulting, design, and programming house will service business and industry, with initial emphasis on banking and engineering systems.

FROM MIDGET TO MONSTER: NEW DISC FILE READIED

Another group with eyes for the blossoming disc business has appeared in San Diego and seems to have found a market niche not yet claimed by anyone else.

Computer Peripherals Corp., founded a few months ago by well-known marketing rep Joe Costello, is finishing up a prototype of a modular disc file system that starts at a one-disc, 25 megabit size and can be field-expanded in the same increments up to a monstrous 12.8 billion bits through one control unit. The DSU 8100 has a 3 mhz serial bit rate, 16.7 msec average access time, and uses digital decoding. Discs come in a choice of one to four per box, which fits into a relay rack, and a system can use up to 64 boxes.

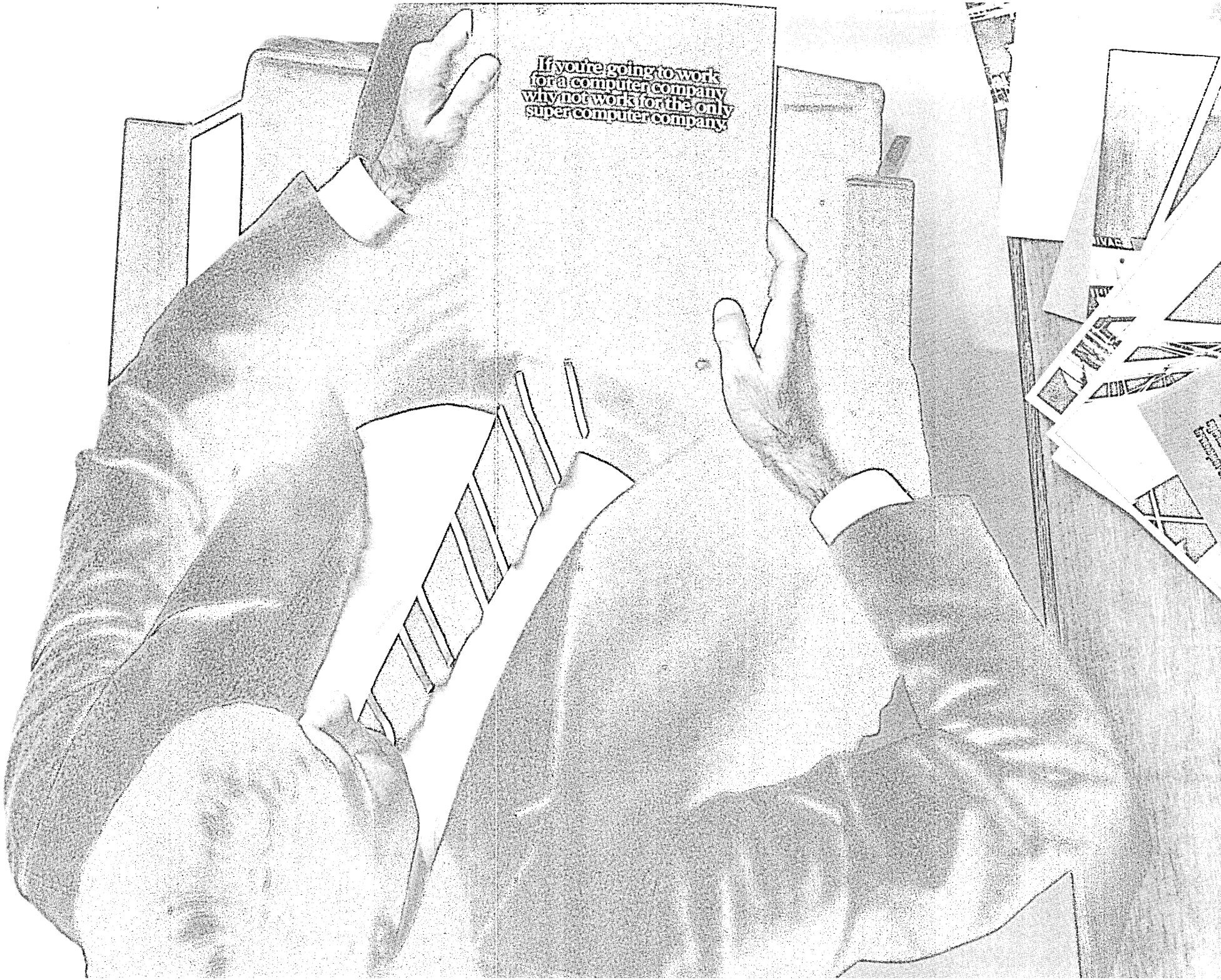
First target: OEM market, emphasizing on-line, time-sharing needs of small computer users. Look for public unveiling at the FJCC. Director of engineering is Wayne King, ex-SDS peripheral engineering head.

P.C. PRICE SLASH CAN MEAN A HIKE

IBM has announced a "double-take" price change for punched cards. A flat rate of 89¢ per thousand looks like a big savings for low volume orders (previously over $3 per thousand for a 10,000-card order). BUT the equalizer is a $35 order charge, plus $10 for each additional location or delivery. Thus it's high-volume buyers that benefit most: a 10,000-card order to one place, one time, is now $43.50 versus $40.90 before; a 200,000-card buy is now $210 versus $222 previously. Reason for the flat rates is that setup and accounting costs per order are the same, regardless of volume.

RUMORS AND RAW RANDOM DATA

Newest success story in the crowded core stack and planes business is Data-Ram Corp. Formed last May by John Dimecki, ex-rep and Ferroxcube executive, the company shipped its first product 90 days after opening shop, looks to break even after the first nine months. Current backlog, thanks primarily to a $500K order from a computer manufacturer for 1.5 usec stacks, is over $600K. Now 30-strong, the Princeton, N.J., firm also makes slower and faster stacks... The proposed merger of CDC and Adams Assoc. (Feb., p. 19) is off; the Boston-based software house is pursuing other avenues of financing...A barnstorming delegation from Nippon Software which took a look at big, big US machines for use in software development, may soon decide on a large-scale system from finalists CDC (6600), IBM (360/75), and a domestic machine...Allen-Babcock, L.A. time-sharing service bureau, will institute a pilot no-minimum cpu-use rate schedule in San Diego this month.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Consider the intriguing and quite exceptional things we are doing about and with software plus the growing impact of our many Data Centers.

There's all this, and there's more. Not the least of it (even if the most obvious) is the advantage to be gained by you through the tremendous momentum of our growth. Less obvious (but no less important) is the advantage that comes your way through our way of operating.

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You might agree with us that working for the only super computer company could be that super opportunity you've been waiting for. If you do, drop us a copy of your resume. Send resumes to: Thomas Linklater, Dept. D-3, Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minn., 55440. An equal opportunity employer.

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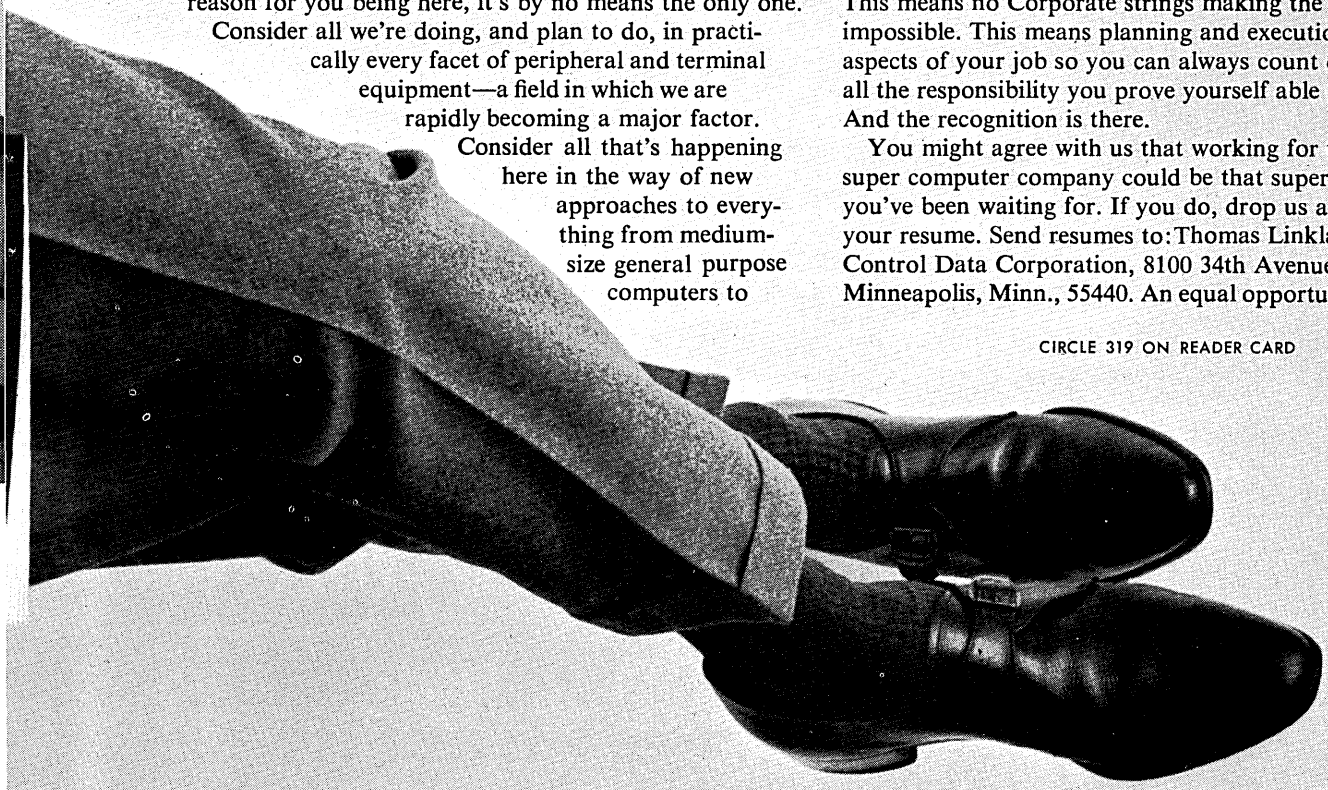

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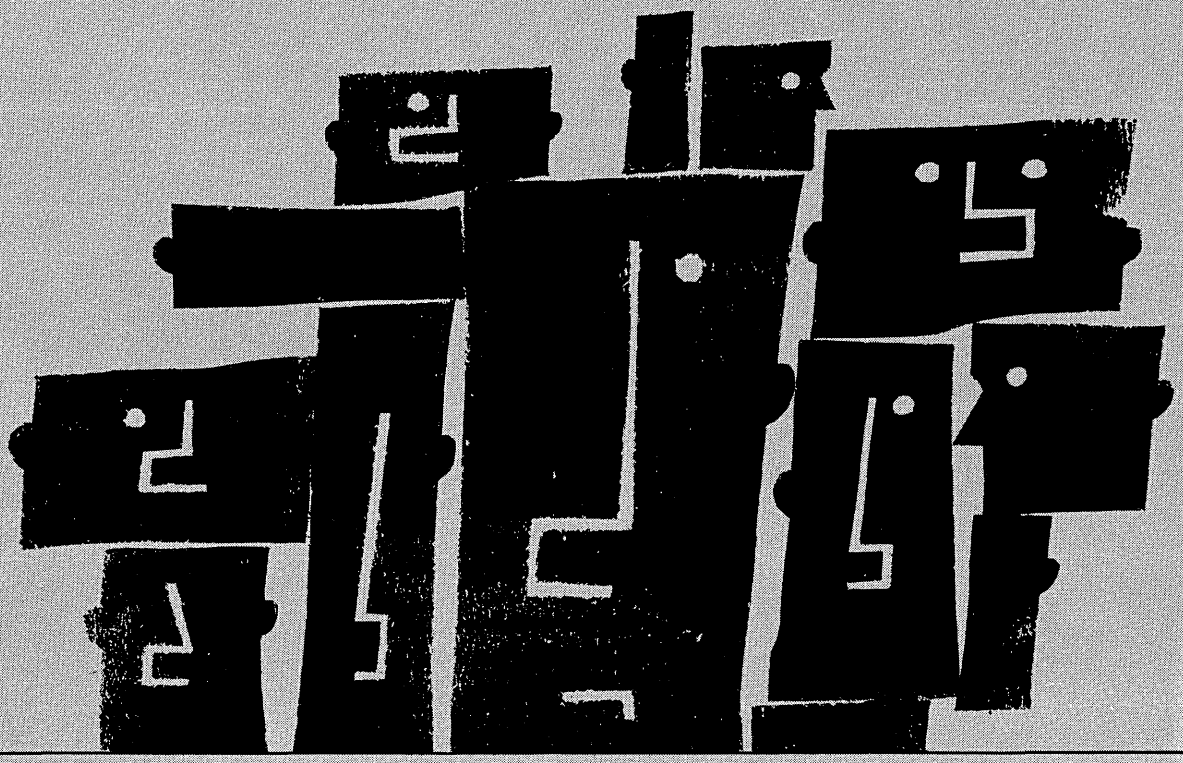

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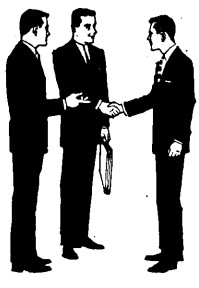

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Studies indicate that, at some time in a planetary mission, the spacecraft may be across the solar system from the earth.

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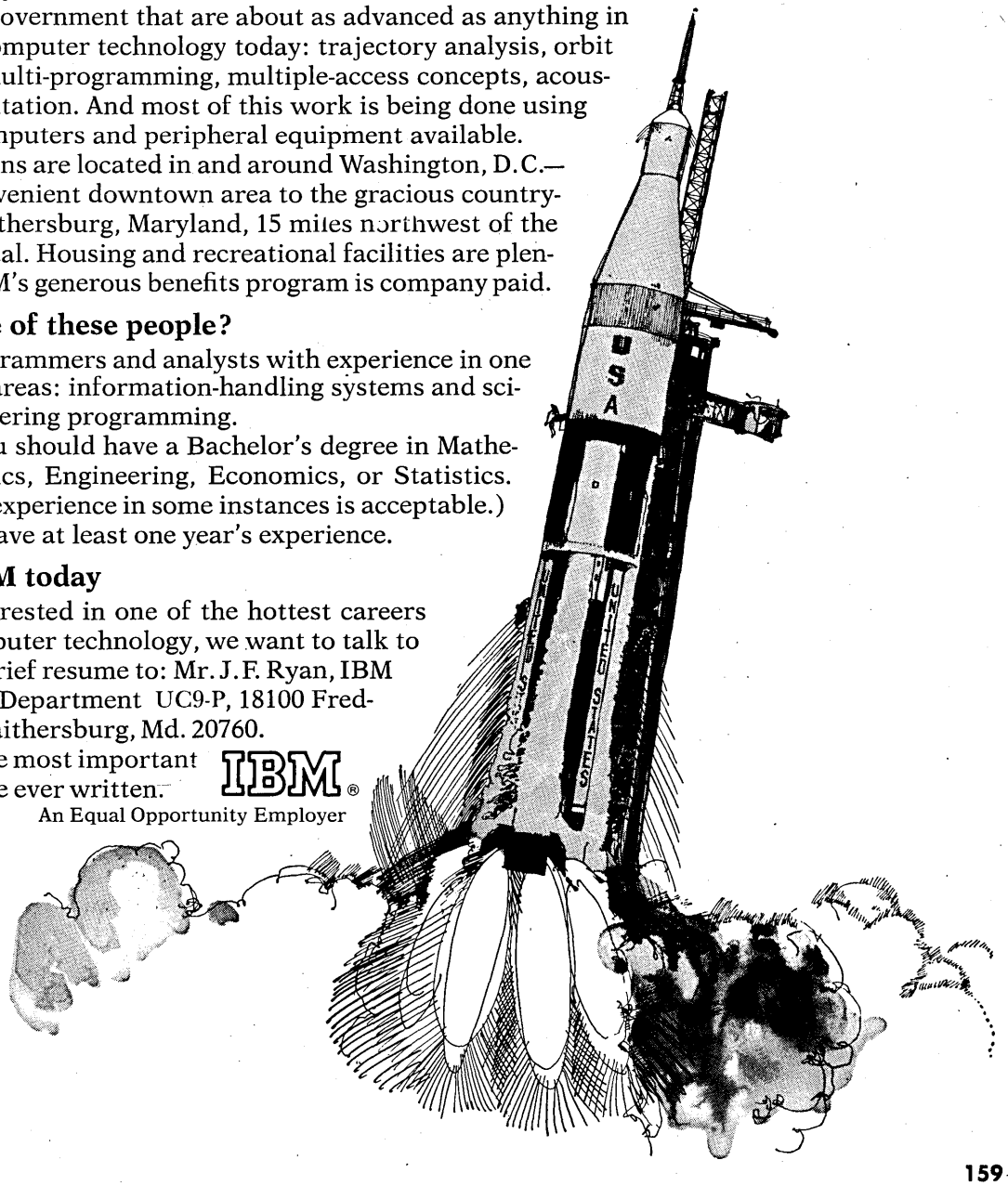

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The classified section is open for the following advertising categories: Used equipment; positions wanted; help wanted, educational institutions; maintenance services; professional cards; hobby products; business opportunities and educational courses. Rates are based on total number of insertions used within each contract year.

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•

GENERATION
VENERATION

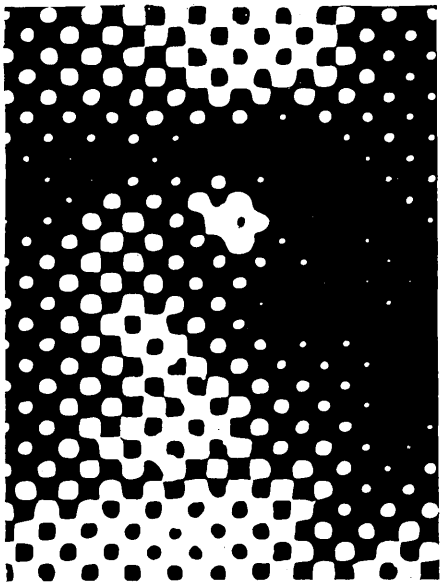
The first
was cursed

So the second
was beckoned.

The third?
Absurd.

Let's go fourth
And so forth . . .

Ed Conti



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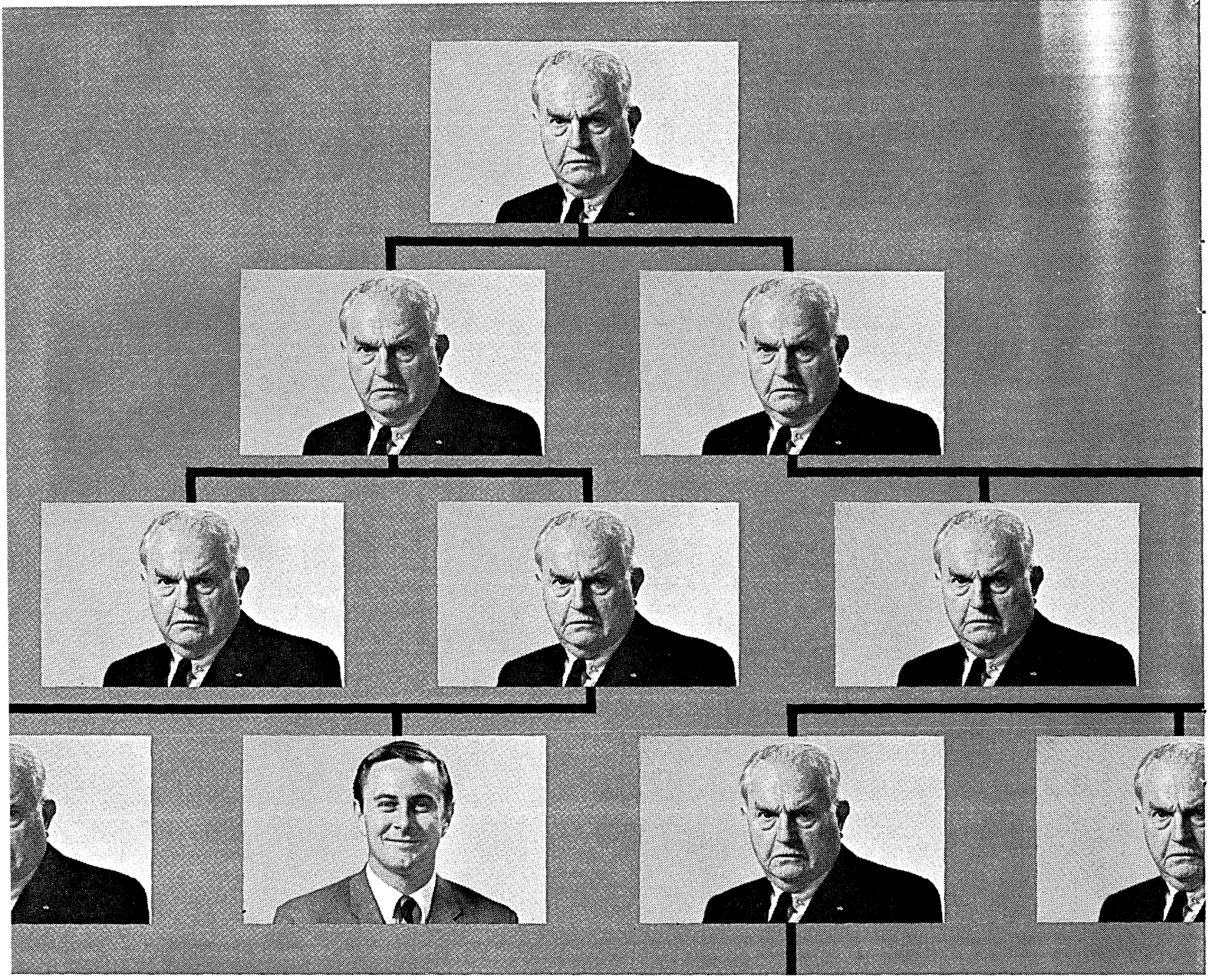

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get out.

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And you're good at it.
But you're not getting anywhere.
It could be the company you're in. If it isn't growing very fast, it probably isn't promoting very fast.

Or maybe you're the kind of guy who has too many new ideas.
Maybe you wear the wrong kind of ties.
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Or just the wrong color.

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Switch.
To us.

You already know about us. We'd like to know about you. A few basic facts will do: who you are, where you've been, what you do. Send them to Bob Wheelan at SDS, 1649 17th Street, Santa Monica, California 90404. He won't discuss this information with anyone.
Except maybe you.

SDS
Scientific Data Systems,
Santa Monica, California

CIRCLE 328 ON READER CARD

people

■ Jack Strong, an early member of the Computer Sciences' staff and most recently an independent consultant in the Los Angeles area, has joined Digitek as executive vp.

■ Jerome L. Dreyer has been appointed executive vp and secretary of the Association of Data Processing Service Organizations (ADAPSO) to succeed retiring chief executive, W.H. Evans, one of the founders of the organization.

■ Dr. Peter C. Patton is now manager of systems design for Univac's data processing div., Roseville, Minn. He had been manager of the Univac 1107 computer center in the aerospace engineering div. of the Technical Univ. of Stuttgart, West Germany.

■ Edward L. Glaser has been appointed director of the Jennings Computing Center at Case Western Reserve Univ., Cleveland. He will also serve as professor of engineering at the university. Glaser comes to Case from MIT and Project MAC.

■ Standard & Poor's Corp. has elected Penelope Kaniclides vp-computer services. Miss Kaniclides will be responsible for all S&P computer operations, including programming and analysis, machine requirements, acquisition and operations.

■ James D. Gallagher has been named president of McCall Information Services Co., div. of McCall Corp. He has been with MISCO since shortly after the company was formed.

■ George H. Crawford has been elected executive vp and a director of DASA Corp., Andover, Mass. He was previously secretary of Standard International Corp., Andover.

■ J. E. Voyles has joined Informatics Inc. as vp/government plans and programs in the company's Bethesda, Md., office.

■ Sir Humphrey Trevelyan has been appointed international executive director of English Electric, London. He has been a director of the company since January, 1966.

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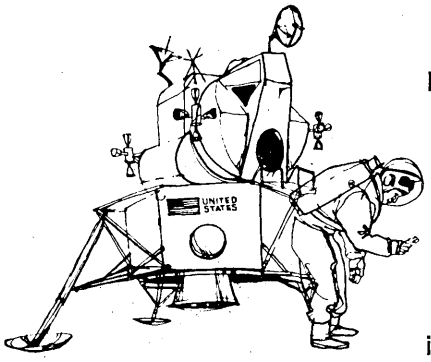

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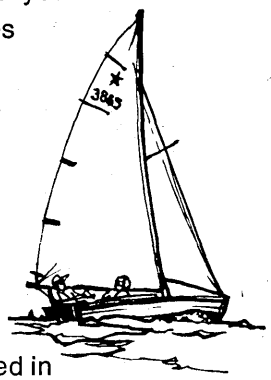

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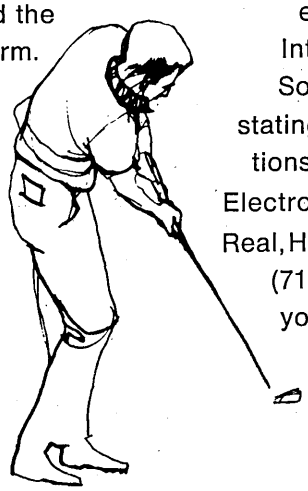

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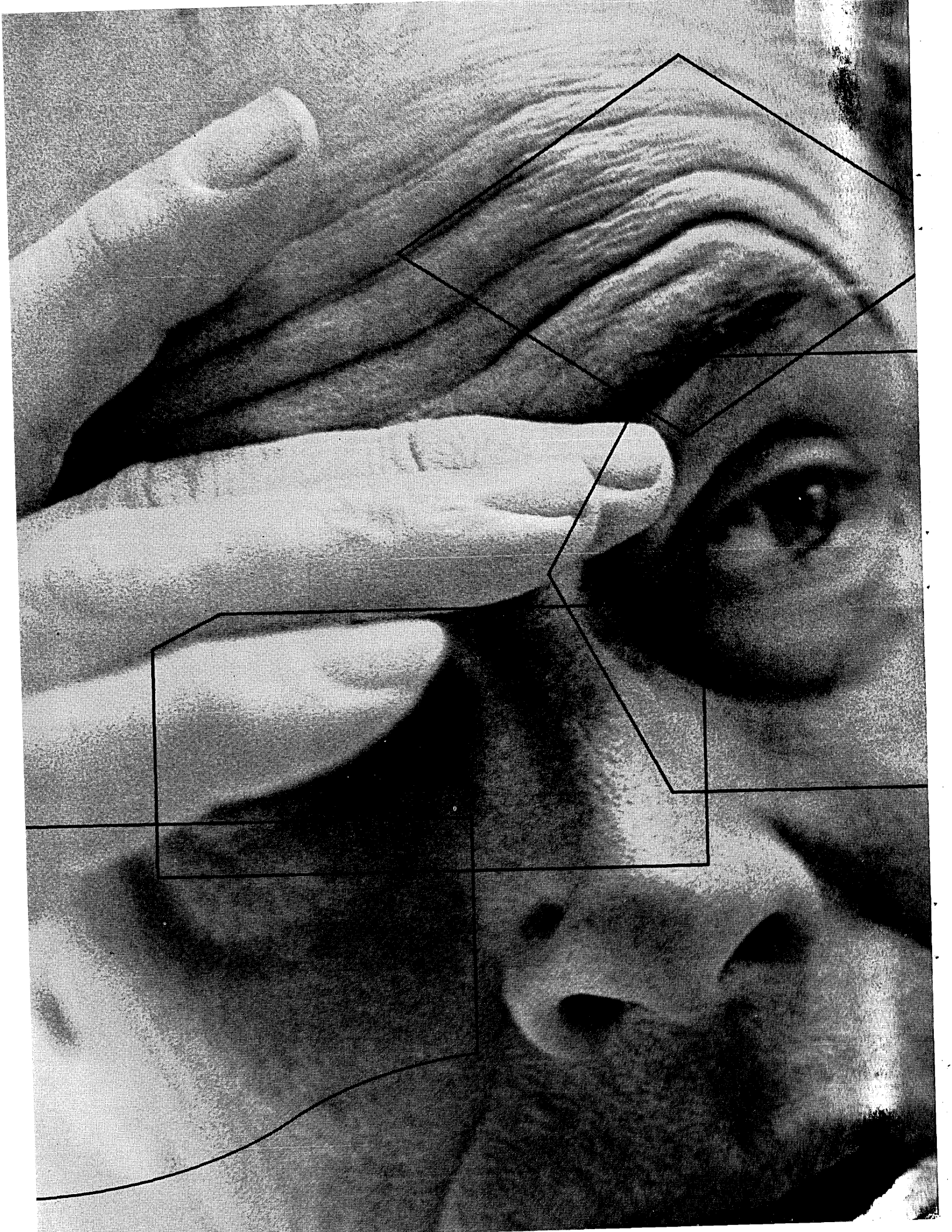

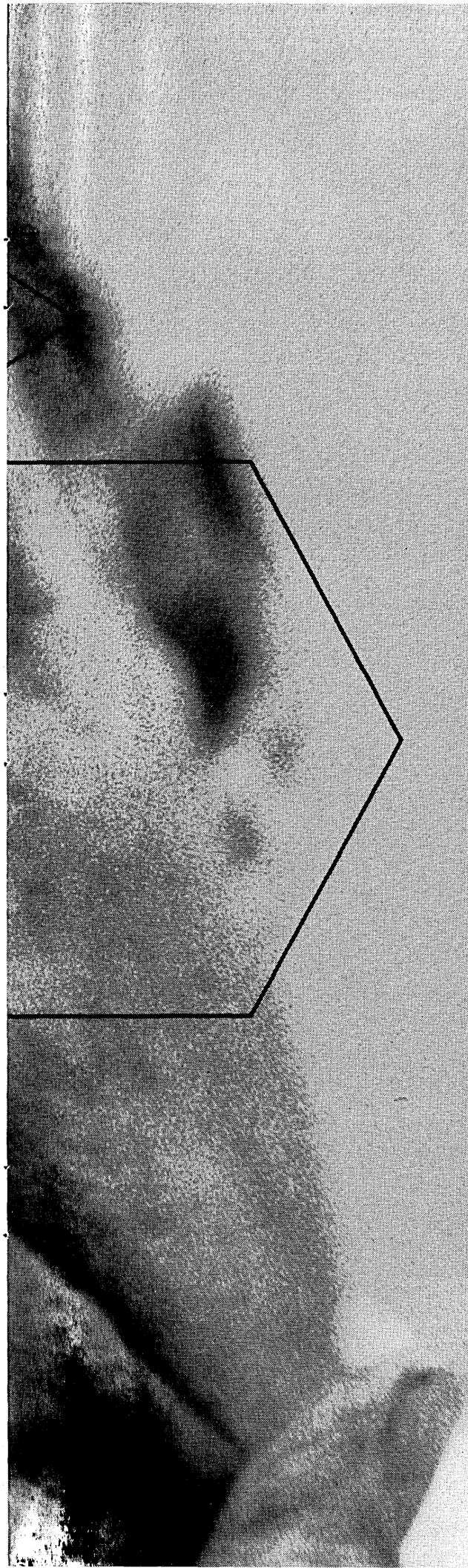

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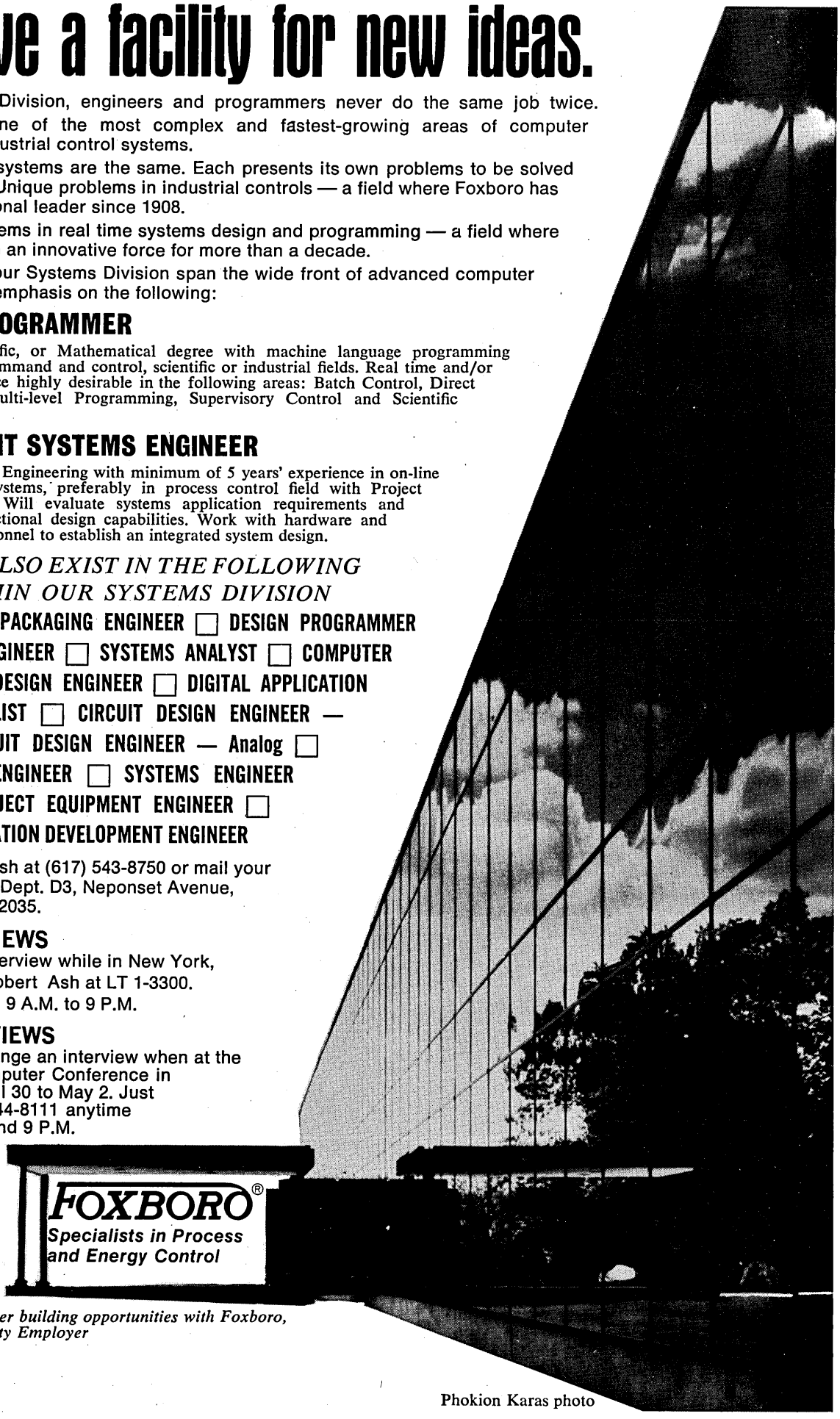

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the forum

The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

DECISION, NOT IMPRECISION

M. A. Jackson's Forum article in the February issue deals with a topic that is of interest and importance to the data processing community. In addition, it is sufficiently controversial to crystallize groups for and against his viewpoint. I would like to comment on his article.

I agree with his thesis that "the case for finding a better, non-procedural technique is well-founded." I disagree strongly with his contention that the use of decision tables, a non-procedural technique, is a rigorous methodology that imposes irksome and often unacceptable constraints. I will discuss the three specific constraints to which Mr. Jackson objects: 1) the requirement for complete and accurate statement of the problem logic, 2) the table must not contain contradictions, and 3) the table must be checked for redundancies.

With regard to completeness, it was never the intention of those who advocate the use of decision to require the system analyst to explicitly state all the decision rules of a decision table. An ELSE-Rule in each decision table is available to the system analyst to take care of those sets of conditions for which he has not yet determined the series of actions to be taken. As a temporary measure, the ELSE-Rule can refer any transactions of this type to a particular person to look at and make ad-hoc decisions. When specific actions are decided upon, these can form the basis for additional explicit rules in that decision table.

As for contradictory rules, I don't see how computers or people can decide which one of the two or more contradictory rules should be followed when a transaction acted upon by those rules occurs. If the intent is to have a certain percentage of the transactions acted

upon by one of the contradictory rules, another percentage of the transactions by the second contradictory rule, and so forth, then state this as one of the decision rules in the program. Then, both man and the computer can live with the apparent—but not real—contradictions. However, where such a rule is not available to resolve the contradiction, the system analyst must be unambiguous in the statements of his decision rules.

As for redundancy, it is true that redundancy per se is not bad. Engineers take advantage of logic redundancies to produce more efficient circuits and psychologists endorse redundancy to reinforce learning and to improve the chances of getting tasks done—for example, by sending two men with the same message to increase the chance of the intended receiver's getting the message. Then, why check for redundancy in decision tables? One reason for the redundancy checks is to help the system analyst streamline his program logic. Some redundant decision rules can be combined to form less decision rules or one of the redundant decision rules can be eliminated when it is already imbedded in another decision rule. Another reason for this redundancy check is that it may indicate an error in the program logic. The system analyst will probably appreciate having his attention called to such possible sources of error.

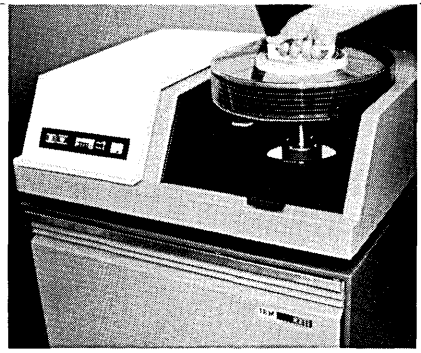
In those cases where computers convert decision tables to computer programs, the preprocessor should be designed to do the following in each of the three cases:

When the decision table is incomplete, i.e., all the rules are not specified either explicitly or by an ELSE-Rule, the preprocessor should set up automatically, for those branches that have no actions specified for them, a routine that will notify the analyst/programmer that he has not provided actions for a given set of conditions.

When the decision table contains contradictory rules, that decision table cannot be converted to computer code, and the analyst/programmer should be so notified.

When the decision table contains redundant rules, conversion of the decision table to computer program will take place, but the analyst/programmer should be notified of the redundancy.

SOLOMON L. POLLACK



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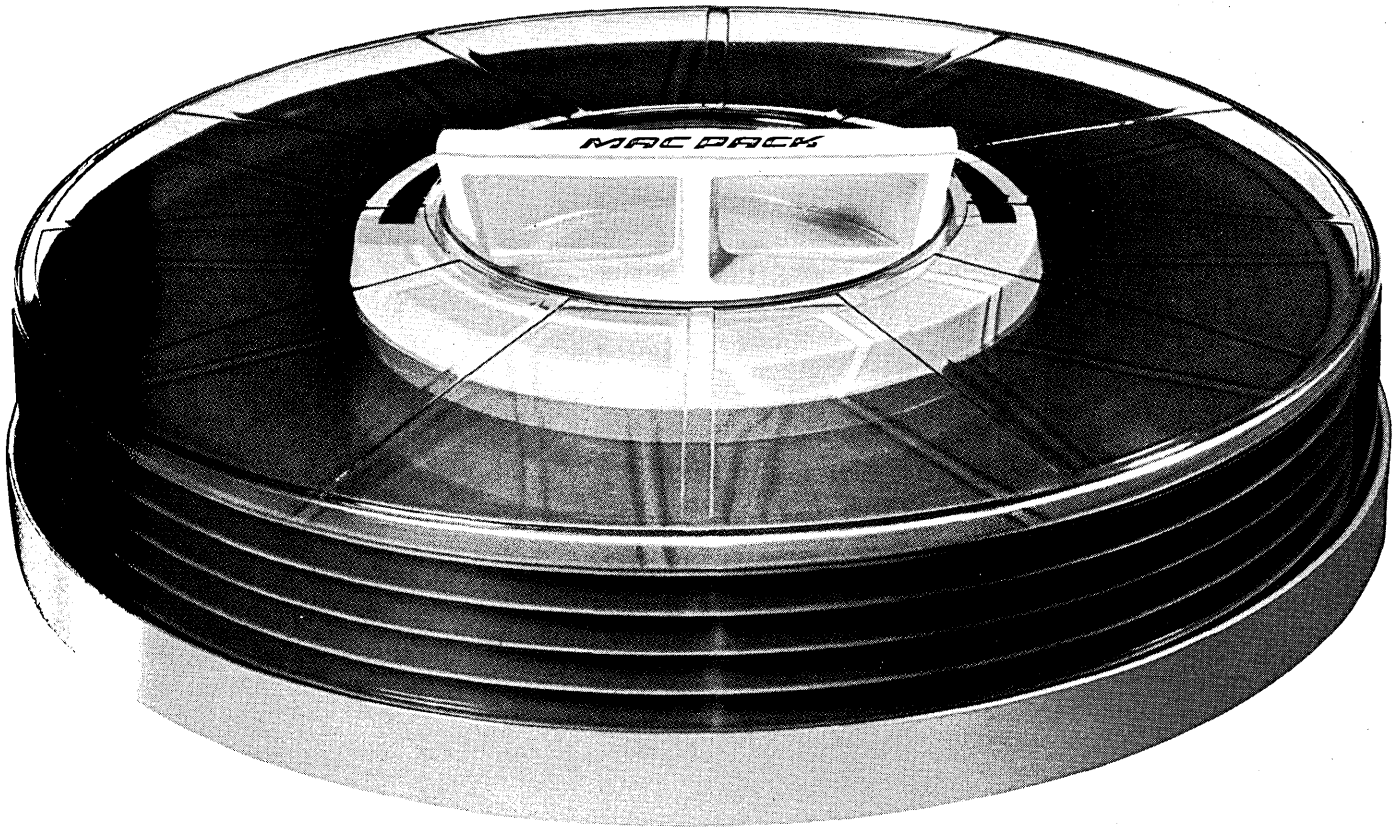

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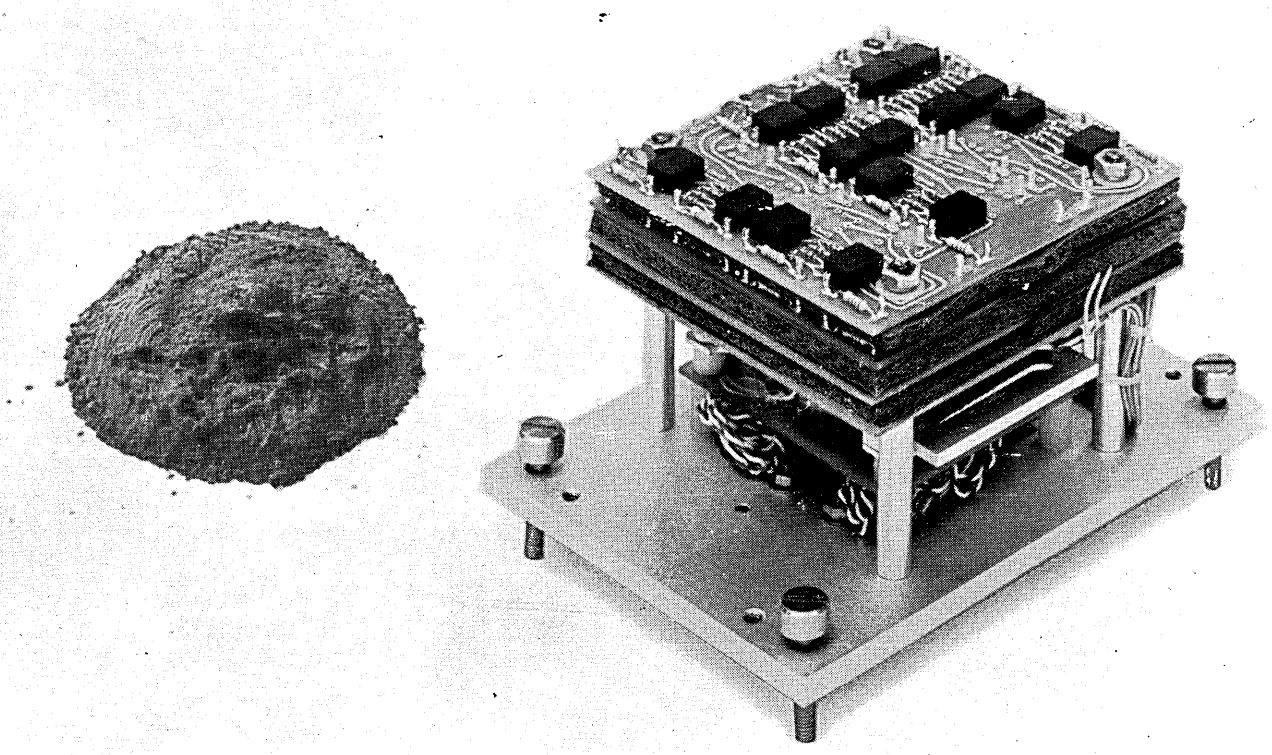

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