DATAMATION® 67

April

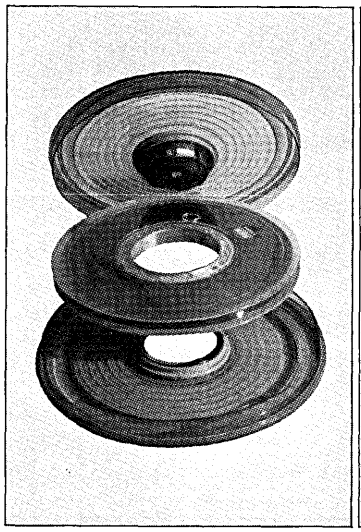
SJCC

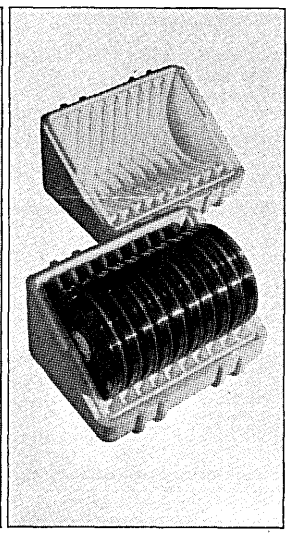
ATLANTIC CITY 1967

april 18-20

Ampex makes computer tape

come clean and comfortable.





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CIRCLE 1 ON READER CARD

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or two

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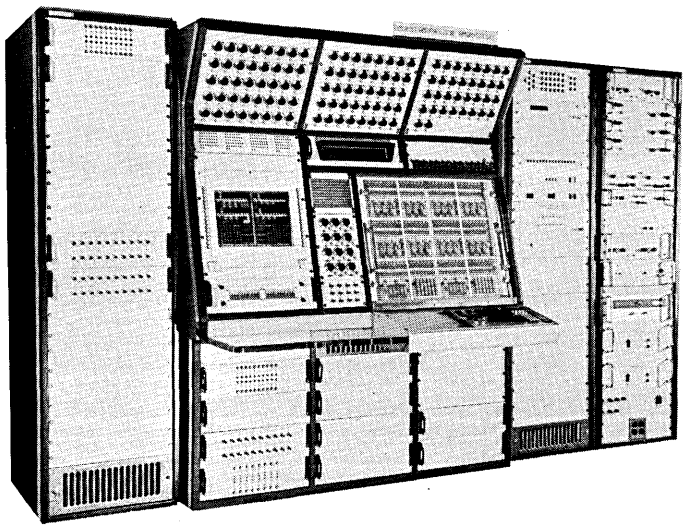

GEO SPACE
COMPUTER DIVISION

april
1967

volume 13 number 4

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This issue 74,750 copies

to data communications users who are about to feel the pinch of increased monthly transmission rates:

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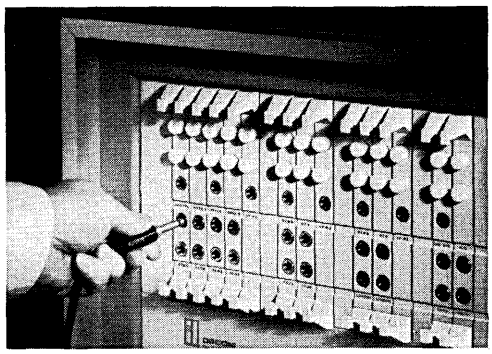

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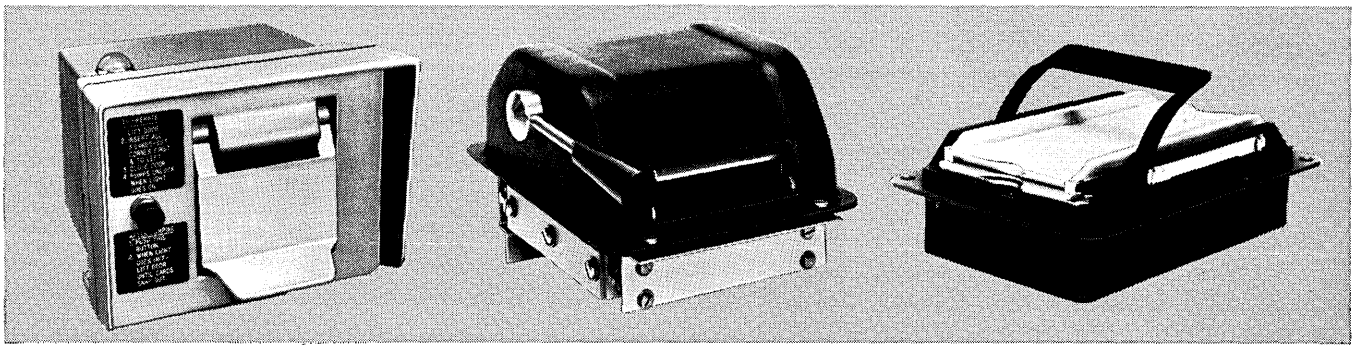
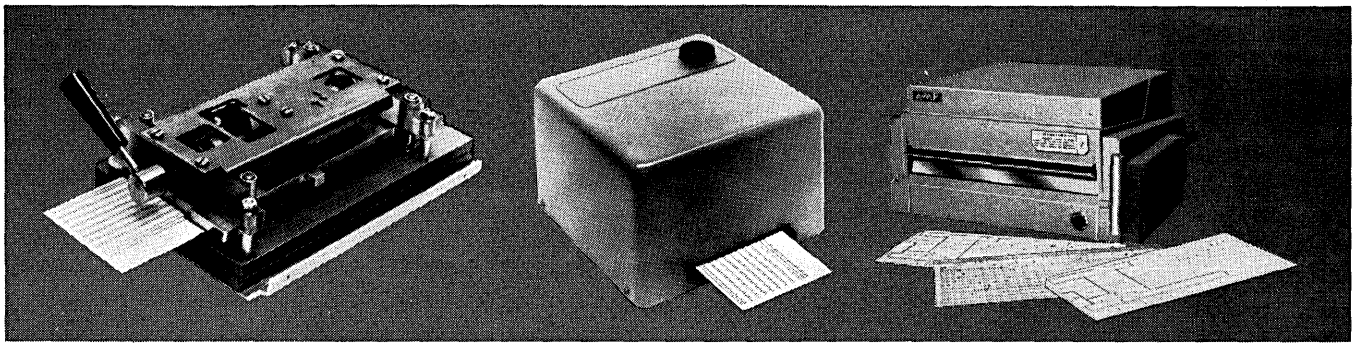
CIRCLE 7 ON READER CARD



Are we handing you a line?



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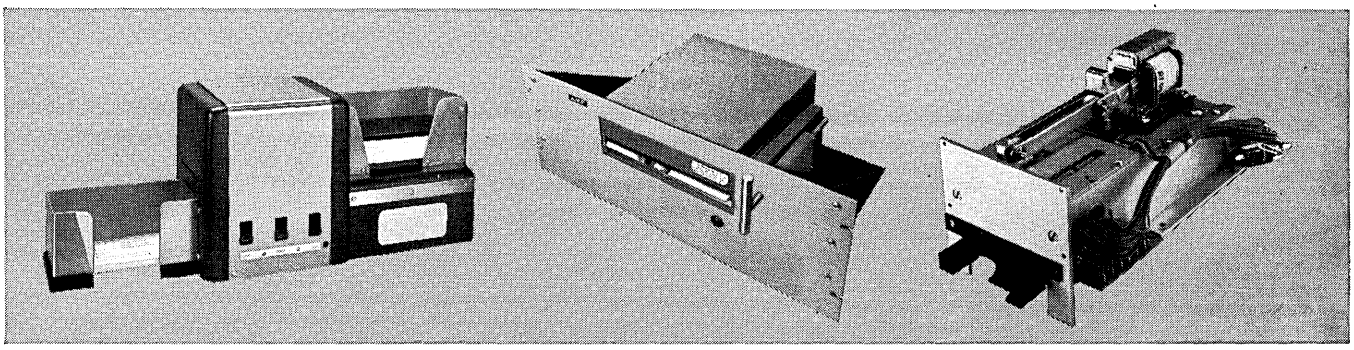

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CIRCLE 8 ON READER CARD

DATAMATION 67 ®

april
1967

volume 13 number 4

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2. Automatic tape loading

3. Oxide contact with only the head

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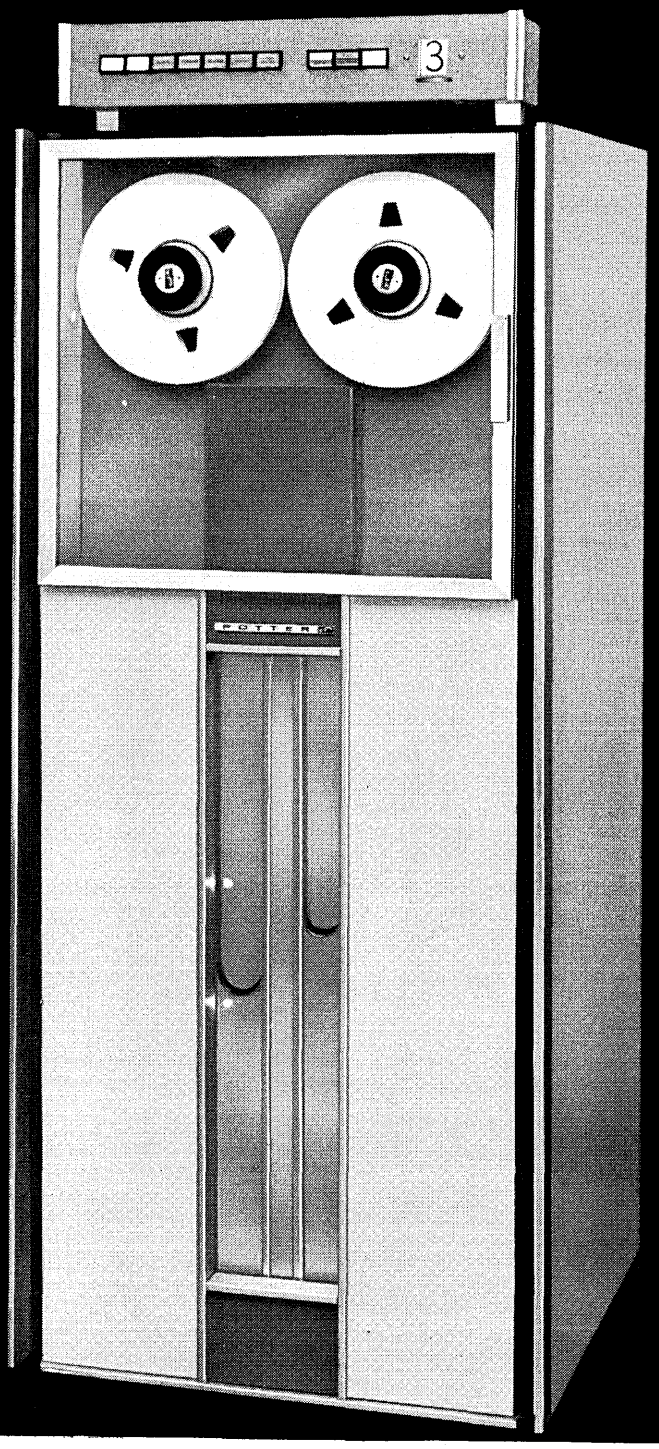

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CIRCLE 9 ON READER CARD

calendar

DATE	TITLE	LOCATION	SPONSOR/ CONTACT
April 17	JUG Workshop	SJCC Headquarters Atlantic City, N.J.	Joint User Group of the ACM
April 17-28	Course: Advances in Digital Systems Design. $300.	Univ. of California Los Angeles, Calif.	——
April 18-20	Spring Joint Computer Conference	Chalfonte-Haddon Hall Atlantic City, N.J.	AFIPS
April 24-26	Conference: Machine Records	Sheraton Western Skies Albuquerque , N.M.	U. of New Mexico
April 27-28	Conference: Tools of Management	Hotel Muehlebach Kansas City, Mo.	Systems & Procedures Assn.
April 27-28	Conference on Management	Radisson Hotel Minneapolis, Minn.	DPMA
April 28	Seminar: Computer in Local Government Accounting & Management	McGregor Center Wayne State Univ. Detroit, Mich.	Governmental Accountants & Analysts Assn.
May 3-4	Colloquium on Information Retrieval	Philadelphia, Pa.	ACM SIGIR, IEEE Computer Group, ADI, Moore School of Elec. Engr., U.S. Army Frankford Arsnl.
May 7-10	Conference on Data Processing	Americana Hotel New York, N.Y.	American Bankers' Assn.
May 8-10	Symposium: Information Retrieval in the Office	Washington Hilton Washington, D.C.	National Archives & Records Service
May 15-17	Conference: Power Industry Computer Applications	Pittsburgh Hilton Pittsburgh, Pa.	Lloyd W. Coombe Detroit Edison 2000 2nd Ave. Detroit 48226
May 18	Technical symposium	Century Plaza Hotel Los Angeles, Calif.	L.A. Chapter ACM
May 23-26	Users meeting	Americana Hotel New York, N.Y.	GUIDE Intl. (IBM users)
May 31- June 2	Meeting: Operations Research Society	New York Hilton New York, N.Y.	ORSA
June 1-2	Colloquium: Computers in the Earth Sciences	Univ. of Kansas Lawrence, Kansas	Kansas Geological Survey
June 5-16	Course: Communication Theory. $275.	Purdue Univ. Lafayette, Indiana	————

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letters

i.c.t. and nicely too

Sir:

You recently mentioned (Jan., p. 103) that ICT has taken one order from a British subsidiary of an American firm where the parent company is an IBM user. There are in fact 18 of these subsidiary companies who have ordered 1900 series computers, including, for example: Woolworths, Helena Rubenstein, United Glass, and H. J. Green (Pillsbury Flour).

G. R. BUNTING
ICT Ltd.
London, England

beware

Sir:

We found the contents of the January issue to be very informative and interesting, especially those articles which speculate about the fourth generation computer system. Particularly interesting was Ascher Opler's article, "Fourth Generation Software," in which he proposes the introduction of a new word into the vocabulary of the computer world ("firmware") to designate the microprograms resident in the control memory of a computer. We agree on the importance of microprogramming and share the opinion that the utilization of microprograms will increase tremendously. However, we are not yet convinced that "firmware" is a good word to introduce into our vocabulary. "Hardware" and "software" have long been accepted as words to designate, respectively, the inner body or machine and the outermost garments, (what the user really sees). Therefore, a more natural choice for a word to designate the microprograms, which really lie just below the software (and not really visible to the user), and just above the hardware would be (God help us!)—"underware."

If underware were introduced into the vocabulary of data processing, there would probably be a tendency for some secretaries to consistently misspell the word (many secretaries very diligently—and rightfully so—discreetly correct all spelling errors). Imagine the impact of such sentences as "You can improve your system by changing the underwear," or "We began to clean up the system by eliminating the remaining bugs in the underwear!"

Finally, as Mr. Opler is a member of a notable programming *firm*, one could apply, as proper nomenclature, that the output of his organization is indeed "firmware."

It need not be pointed out that some companies are strictly "no-ware," of course.

E. J. GALLI
D. B. MAYLER
Yorktown Heights, New York

cai: what's ahead?

Sir:

Robert M. Gordon, "Computer-Assisted Instruction: The Numbers Game," (Feb., p. 124) is right. It will take a lot of consoles for large-scale CAI. Is it conceivable that every student can have a CRT console?

Loony proposals have long been with us. In the 1920's, it was proposed that visual display consoles could be created for the dissemination of news and entertainment in real-time.

The hardware R&D to support that vision took 20 years. But lead times have gotten shorter. If we go full speed ahead in developing CAI techniques, and new console media and creativity support systems, we will barely be ready when the terminals have become cheap as dirt. That is, as cheap as TV sets are now.

THEODOR H. NELSON
New York, New York

square feat

Sir:

I would like to make one correction in your otherwise fine story on Standard Computers IC 6000 series (Feb., p. 77). The 6000-19 requires *300* square feet of floor space, not *3000*, as you stated.

ROGER HUGHES
Standard Computer Corp.
Santa Ana, California

a bit more

Sir:

The letter of P. Wirth of Munich, Germany, (Feb., p. 13) did not remove all confusion. Information is measured in bits, the rate in bits/second. The term "cycle rate of information," is misleading, as the letter shows.

Transmission of information requires a channel with a certain frequency bandwidth, measured not in

letters

cycles, but in cycles/second (cps) or Hertz (Hz), a unit long in use in Europe and now accepted in the U.S.

So, it seems that a 1 Hertz channel could handle an information rate of 1 bit/second—what your Editor probably meant to say.

ROBERT G. TANTZEN
Mountain Park, New Mexico

what XACTly?

Sir:

Re: Henry Oswald's article "Translation by XACT," (Jan., p. 37):

Nowhere in the article is more than a cursory description of the XACT algorithm given. For instance, the so-called "analysis" phase is described as the one which "elicits the gross operations that the source program performs by a process of contextual analysis in the environment of the source machine logic structure." Perhaps Dr. Oswald would clarify this in the environment of bits and bytes that is more familar to most of us.

The capabilities of the 7090/1604 translator are never explicitly stated, nor is it clear as to the number and types of programs that have been successfully run through the translator. Can Dr. Oswald supply data on source program size and type, translation times and target program size to justify his claim of "very efficient target programs" and fourth generation automatic program translation software packages? I am curious what portion of the SHARE library, for example, Celestron is prepared to translate? Personally, I would have grave doubts about using an automatic translation program in preference to hand recoding, knowing that a 100-instruction source program may become a 600-instruction target program after consuming one-half-hour of machine time.

The lack of treatment of I/O is an all too egregious omission. It is not clear whether the XACT algorithm has any application in this area, but it is clear that I/O must be a major consideration of any but the most severely limited translator. Ignoring the problem will not cause its resolution.

The dismissal of "software" as being inapplicable to the automatic translation process because of "the intrinsic ties to the source machine" is too catholic a statement to be ignored. True, a translated compiler will continue to generate source machine code, but are compilers the only systems software? What about sort/merge or even an operating system (e.g., IBSYS) for the target machine? What is implicit in this dismissal is that such system software presents problems and complexities beyond the scope of current translators, rather than stating that though their utility is doubtful, translated systems programs are an operational reality. Further, the line between "application programs" and "software" is difficult to define—if it exists at all. Dr. Oswald's own definition is certainly needed in order to understand this apparent limitation of the XACT translator.

My general impression is that a great deal more clarification is necessary before an intelligible idea of the scope of this work may be obtained. Perhaps a most germane question is: judging by the absence of explicit qualifications or limitations on the XACT algorithm in the paper, how was Celestron able to obtain significant, general results while the rest of the computer world has resigned itself to a long and arduous climb toward achieving anything but trivial results in this area?

RAYMOND EISENSTARK
New York, New York

The author replies: Let me first correct a printing error in the article: my title is *Mr.*, not *Dr.*

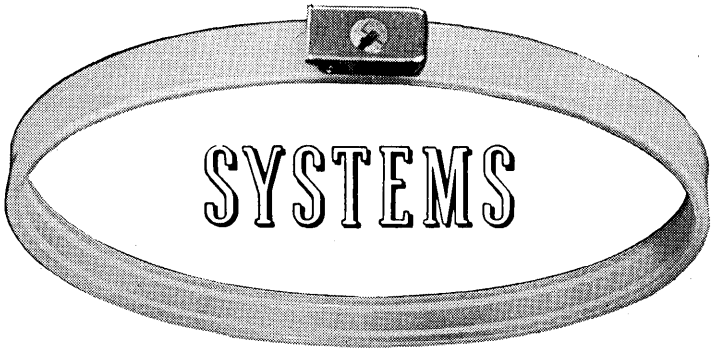
Questions of the kind raised here have occurred before, and we have responded in detail with potential customers. I feel the significant fact is that as a result of the Rome Air Development Center support, there now exists a program that has translated 7090 programs into equivalent 1604 programs automatically. Program translation is applicable to all kinds of throughput programs. Our approach to translation is to form an overview or gestalt of the source program operating in its environment: the logical structure of the source machine.

Celestron has been able to achieve results in this area because of a fresh view of the problem. We have gone beyond the classical line-at-a-time approach to data processing and implemented what might be thought of as a pattern forming mechanism.

Additionally, not being Number One, we try harder.

CORRECTION

With publication of "Computers in the High School," by William S. Dorn (Feb., p. 34), we inadvertently failed to mention that the article is based on material from the forthcoming book, "Mathematics and Computing: with FORTRAN Programming," by Mr. Dorn and Herbert J. Greenberg; John Wiley and Sons Inc., New York, N.Y.



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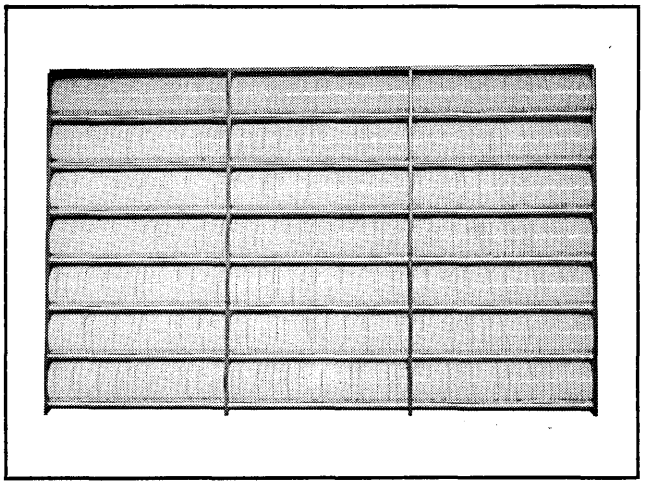

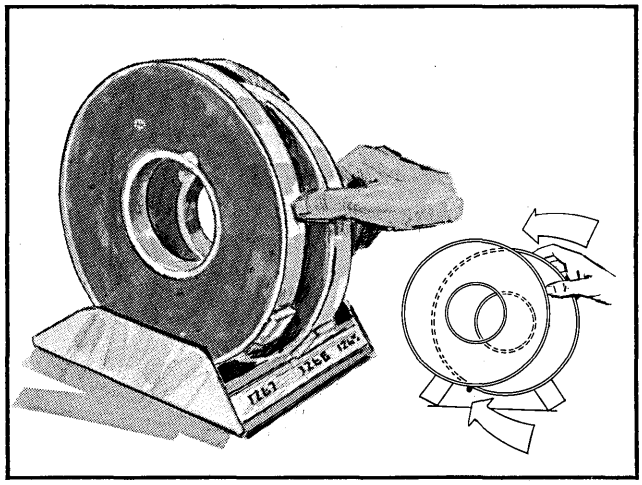

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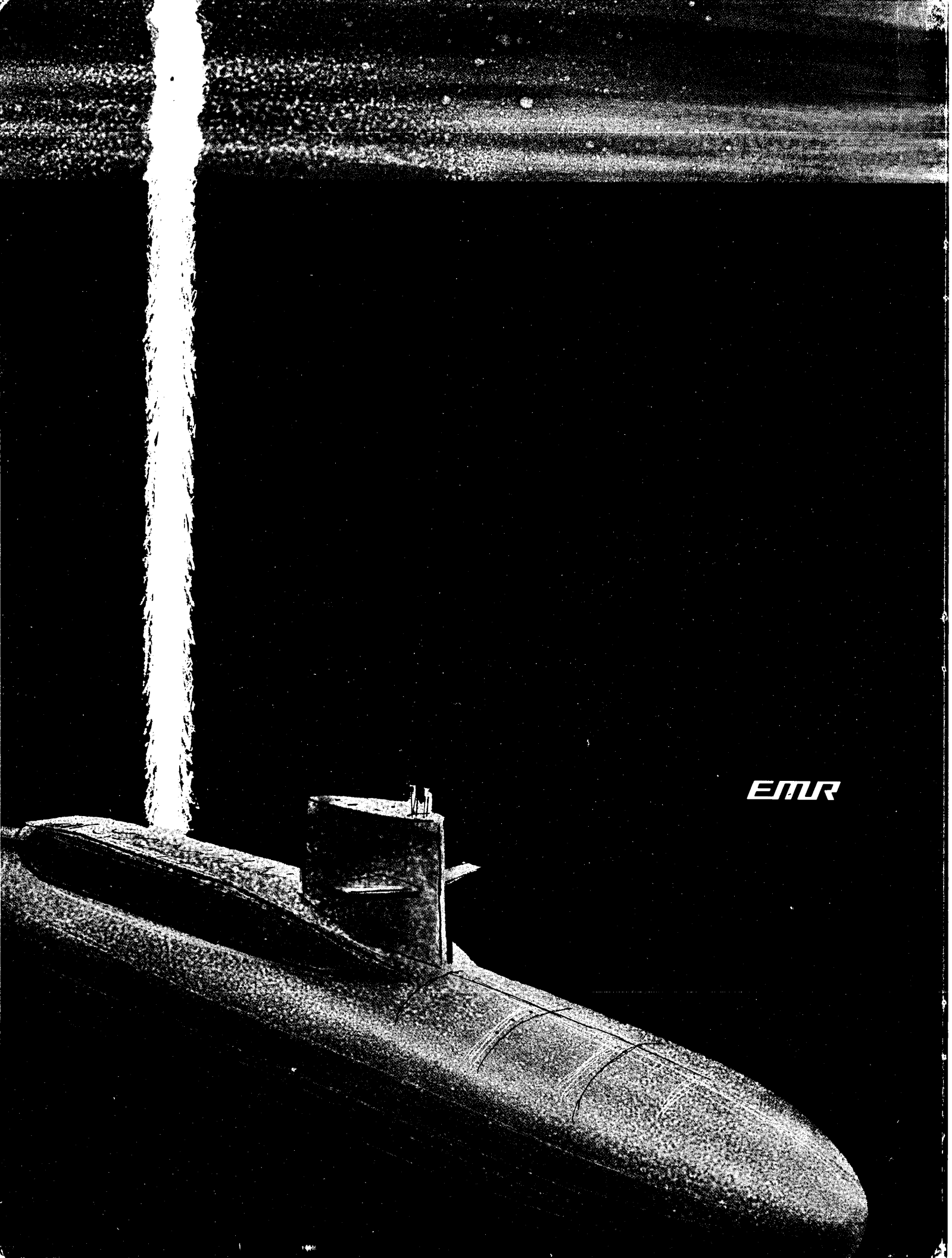
EMR

look ahead

ADPAC ADVOCATES CHALLENGE COBOL

"We're gonna take Cobol and bury it," says Pete Harris, head of Applied Data Systems, San Francisco. His Adpac programming system has made converts on the west coast, now spreads nationally with sales to be handled by Statistical Tab Corp. Stat Tab has bought Adpac for its 10 nationwide dp centers, cites its compile times as 25% of Cobol's, and one job that took 14 hours to write in Cobol took three hours with Adpac. Another user, a former Autocoder shop, wrote one job in 2-3 hours that took 1-2 weeks originally. And the object code, they say, is better.

THANKS FOR THE MEMORY: BULK CORE COSTS DIPPING

Fabri-Tek is actively marketing its large-scale, 2-wire, 2½D core memory systems now that the first unit, at Project Mac, is in the third and final stage of acceptance tests. The development system, 256K (40-bit) words, is being used as an extension of main memory for the 16K PDP-6 in an artificial intelligence project directed by Dr. Marvin Minsky.

Cost per bit of the production system will be about 2.2¢ per bit for a 20-megabit, 4-usec cycle time system; about 3¢/bit for a 10-megabit, 3-usec unit; and a 5-5.5¢/bit for the smallest economically feasible unit, a 65K (20-bit) word, 2-usec model. Word sizes range from 18-80 bits.

The Fabri-Tek units are said to be highly competitive with IBM's Large Core Storage systems for the 360. The 256K (36- and 72-bit) systems have 8-usec cycle times (4-usec effective sequential access with two-way interleaving); the larger totals 18.9 megabits, costing about 2.7¢/bit; the smaller is under 10 megabits, costing about 3.3¢/bit.

In thin film systems, Fabri-Tek expects to deliver its first large-scale unit this summer, a 500K bit system, and reportedly has a contract for a 256K (50-bit) word system with a major computer maker. We also hear IBM will be announcing a 125-nsec thin film system of 2K (288-bit) words.

WEAVERS FASHION SMALL, FAST BRAIDED MEMORIES

In the area of read-only memories, much noise is being made about Memory Technology Inc., of Waltham, Mass. The 8-man firm, formed last August, says it has made economic and speed breakthroughs with braided transformer memories, and will be announcing the BTM units this month. Up to now, only very large capacity BTM's have been economically feasible, but MTI has developed both the production machine and the technique to make the memories in modules of up to 512 (128-bit) words each. The modules can be combined into a system with from 50K bits to five megabits, the systems cost-per-bit ranging from 8¢ to 2¢. And the customer can determine the system design. MTI president John Marino says the firm is also the first to produce off-shelf BTM's with cycle times of 250 nsec and less.

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The loom-like production machine, the first of which was completed last month, can weave one bit of each 256 wires, or words, in 15 seconds.

MTI is now exploring the OEM market for the memory, although, later, end users may be offered packages for such uses as dictionaries for machine translation. BTM applications include microprogram control, function generators in gp computers, subroutine instruction memory, numerical control, hyphenation memory for typesetting, compiler program storage in time-sharing systems, and program storage for airborne computers.

NEW YORKERS TO START ON-LINE SCALPING

Under development and reportedly ready for a trial run from May to September is Ticket Reservations Systems, an on-line reservations and ducat issuance system for sports and entertainment events. We hear that 12 Control Data terminals in New York City and suburbs are to be linked to a modified CDC 3300, with 50-100 remotes placed there eventually.

Plans call for implementing the service in three regional areas, one area might include NYC, Boston, Philly, Washington) this year ... 10-12 next year. With terminals placed in hotels, dept. stores, airline terminals, a San Franciscan could make instant reservations for and get tickets to a New York show.

Public opinion polls in cities and suburbs are said to show a favorable attitude toward this service. And CDC, which supplies all the hardware, is also favorably inclined. Software is by Computer Applications Inc. The system's storage requirement is reportedly greater than airline systems, storing 60,000 seats for Madison Square Garden for six months in advance of each event ... opera and theatre seats for two months.

CALIFORNIA BANKS PREPARE CREDIT CARD OPERATIONS

What started out as four banks in search of a credit card system has ended up with California Bank Card Assn., now composed of 60 banks in California with combined assets of $16 billion. This is just shy of the Bank of America, which has its own Bank Americard, but the BofA doesn't have the 1,000 branch offices represented by the CBCA.

The Master Charge card system is due to go on the air in early July, following distribution of cards late in June. A 360/30 in San Francisco will handle the central clearing and cardholder accounting, with credit clearing by Credit Data Corp. Software was by Western Operations, a San Francisco firm. There will be over 30,000 merchant outlets, some 1.5 million cardholder accounts, and over 2.5 million cards out.

LOWER COST DISPLAYS FROM SANDERS

Look for Sanders to announce a $5-6K keyboard/display with buffer and some editing capabilities -- a smaller, lower cost complement to the 720 line. A multi-megabuck order for the 720's by a major computer maker was announced recently by president Royden Sanders, and that's what NCR had in its booth at the business equipment exposition in Dallas. Sanders also said the firm expects to sell $20-50 million worth of CRT's in the next 3-4 years.

CONTROL DATA 6500: A DUAL-PROCESSOR 6400

Control Data last month gathered 82 people from 45 companies with 360/67's on order, and showed them the new 6500 -- running. This is the 6400 with an extra processor, new operating system, that still retains compatibility within the 6000 series.

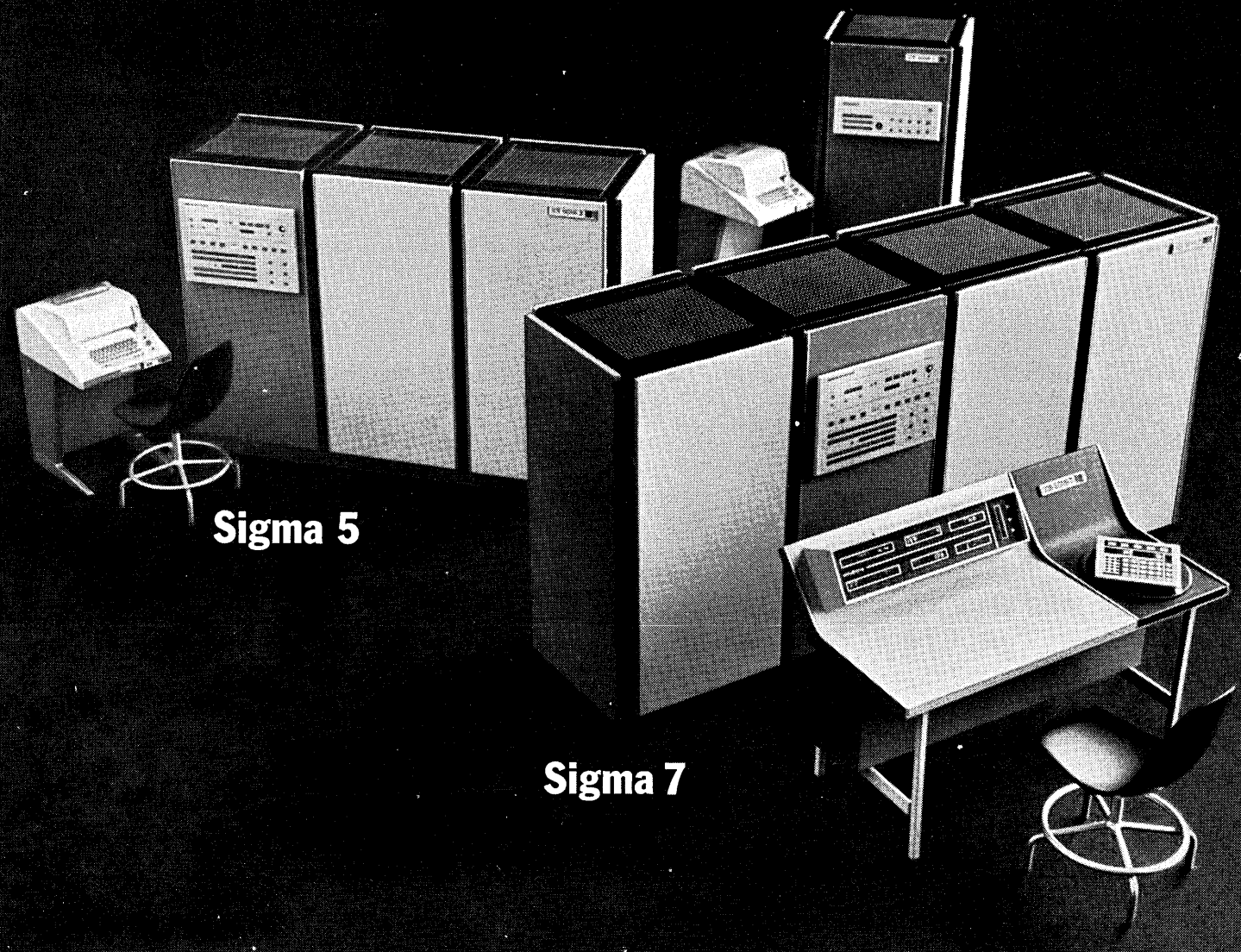
(Continued on page 169)

Sigma is the only family of computer hardware and software designed for multiprogramming.

Sigma systems have the fastest throughput rates in the industry.

Sigma systems cost from $26,000 to $1,000,000. Scientific Data Systems, Santa Monica, California

SDS



editor's read*ut

A VOICE FOR SOFTWARE HOUSES?

Like the statement that crime is bad, the observation that systems software is important hardly calls for debate. Computer manufacturers know how much it costs—more than it ought to—and users know that it causes more headaches than hardware by far.

Now the computer manufacturers would probably like everyone to believe that they are the source of all systems software. But most of the small computer makers turn to software houses for their compilers and assemblers, and many of the major makers' software systems—including the fastest Fortran IV compiler yet—have been designed and developed by independent software firms.

Despite these facts, software houses have no official voice in the development and establishment of software system standards, nor do they offer a united voice in such important goings-on as the FCC or anti-trust investigations, or the patent hearings. You could point out that there is no official voice for the information processing industry in any of these matters, but it's important to note that other elements of the industry—the hardware manufacturers and professional societies, for instance—do offer their advice to the organizations concerned with such activities.

All of this is by way of wandering gently toward the thought that perhaps there is a need for an association of independent software companies. The thought is not a new one: an abortive attempt to form such an association was made three years ago.

In light, however, of the increasing importance of systems software and accelerating federal concern with industry matters, it may be time once more to investigate the advisability of such an association.

Such an investigation should begin with the question of the specific goals of such an organization, followed immediately by answers to the question, "Are there any organizations or structures in existence which could provide alternative means to meeting these goals?" Without a hard, detailed look at these questions, discussion of a new association would probably be meaningless. The industry is fragmented enough as it is. Its people are already over-extended, over-committed to conferences and meetings: the thought of another vaguely dedicated association is not a happy one.

Nevertheless, there is a solid possibility that an association of independent software firms could be useful. An informal poll of the presidents of several leading software firms reveals such possible activities as the establishment of a code of ethics and professional standards; offering an official software industry voice on matters of standards, legislation, the separation of hardware and software prices, etc. It might try to identify the elements of what could become a systems software science, advise universities on computer science curriculum development.

Maybe it's time for another look at the advisability of forming this new association.

DATA COMMUNICATIONS: THE BOILING POT

by WALTER E. SIMONSON

Seemingly, the subject of data communications has overnight captured the fancy of the computing community. The "overnight" aspect of the interest is more apparent than real; experimentation in data communications has a fairly lengthy history but only recently has reached the "take-off" point. Whereas, in the past, the percentage of installations utilizing some form of data communications has been relatively small, this percentage is now rapidly increasing.

Some industry sources estimate that within five years at least 50% of all new computing installations will feature some type of data communication capability. This rapid increase is applied to a computer market which in itself is experiencing a 20% annual rate of growth. The result is an explosion in the demand for new techniques and trained personnel—and also in the incidence of new problems.

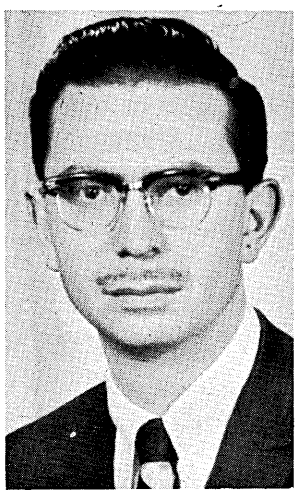
A large number of applications are ideal for the data communications environment. Indeed, initial data communication installations derived from applications which clearly could not be handled in any other way. One set of these applications is found in the military where the parameters of many security situations simply require the speed of data movement which can only be achieved in computerized data transmission. Similarly, the advantages of on-line operations in such applications as airlines reservations systems have been clearly demonstrated. Few now deny that their optimal operation requires a data communication environment.

Related to these "natural" applications are a number of inquiry types of operation. On-line inventory systems are coming into increasing use; optimal inventory control can generally be achieved only with an on-line control over ordering and shipping which is simply not practical without data communications.

As anyone reading today's computer literature can observe, there is a tremendous amount of interest in the development of management information systems. Though MIS systems can be developed without utilizing direct inquiry capability from a remote console, most designers see them as being more satisfactory when such capability is provided. Furthermore, most well-functioning management information systems revolve about some type of central file or data bank. Whether data is communicated from a multitude of points around the country to a central computer where a master file is maintained, or whether the files are maintained in several different computing systems is irrelevant. Some mode of data communication becomes essential if the central computer servicing the management information system is to be provided with the data required for handling inquiries.

a technological lever

It may seem ironic, but most of the major issues confronting the computer world in data communications tend to be economic and/or political rather than technical in nature. As is well known, interstate communications falls under the aegis of the Federal Communications Commission. As a regulatory body, the FCC's operations are delimited by operating procedures established by the Communications Act of 1934, as amended. It is often difficult for the layman to derive accurate insights into many FCC rulings and policies since commission proceedings do not receive nearly the publicity accorded deliberations in Con-



Dr. Simonson is director of management at CEIR in Washington, D.C., where he has designed real-time communication net and display systems and on-line ordering systems. He has a PhD in communications from the Univ. of Minnesota.

gress. Yet, the rulings of the commission have dramatic effects on the computer manager who is operating within a data communication environment.

Consider the AT&T TELPAK service. TELPAK consists of a series of broadband communications capabilities, broadband in that the "bandwidth" provided the purchasers of these communications services is greater than that needed to sustain voice communication. (This terminology can be confusing since Western Union applied the label "broadband communication" to anything larger than their standard service which is a sub-voice grade line. In this article I will utilize the term "broadband service" only to refer to greater-than-voice grade service.)

The TELPAK service provides the purchaser the ability to buy group voice grade channels at a quantity discount price. There are four TELPAK* "packages"—A, B, C & D—with C and D being "super packages." In the case of TELPAK A, a buyer can get twelve voice grade lines for approximately two-thirds of what it would cost him to purchase them separately. The discount-for-quantity price obviously is of interest to any firm which employs a large number of private lines between any two points. To the computer user TELPAK A represents an ability to move data at a rate of 5,000 characters per second compared to 300 characters per second on a conditioned voice grade line. The speed is sufficient to permit a computer to operate at the speed of the fastest card readers and line printers now available.

This is important since in many computer operations, the need to move data requires rates of transmission at least equal to that provided under TELPAK A. This higher transmission rate is certainly basic, especially in those cases in which the motivation is to obtain some centralization of computing facilities.

The price break in dollars per bit moved is just as vital as speed. Consider the difference over a 500 mile distance in paying TELPAK A charges of $15 mile, versus the equivalent rental of voice grade circuits at approximately $24 mile. The difference of $4500/month rental for one line represents a "crossover" in many situations as to whether it is economic to put a remote terminal in a given city communicating to a central computer or whether a large number of decentralized computing installations should be maintained.

legal basis for telpak

In this environment, it becomes interesting to examine the legal base on which the TELPAK tariff rests. Here the prospective purchaser will rapidly realize that the foundation is extremely shaky.

The first point to note is that the TELPAK tariff has not had the approval of the Federal Communications Commission. This leads to the obvious question, "If it hasn't been approved, how could AT&T offer it?" One then enters into the peculiar world of commission proceedings. In general, these are the ground rules under which the common carriers and the commission operate. In the event of a dispute over a proposed rate reduction, the burden of proof that the proposed change is undesirable or discriminatory lies with the commission. The tariff when announced applies in 90 days until the commission establishes a sufficient case to order its withdrawal. The same rule generally applies to most new services.

Accordingly, though TELPAK was not approved, it has been in effect, pending the outcome of litigation. The Federal Communications Commission held that the TELPAK tariff should be withdrawn because they felt that it is inherently discriminatory to provide price discounts which are not based on cost savings thereby allowing larger firms to meet their communication requirements at a lower per-unit cost than can their smaller competitors. The commission feels that the price reduction is not based on any true cost differential as far as TELPAK A and B are concerned. This position has been upheld by the U. S. Court of Appeals in Washington in a unanimous vote of a three-judge panel.

Though AT&T has indicated that it does not intend to appeal, some of the other parties intervening in the case (e.g., Xerox) have filed an appeal. The same set of circumstances followed the district court ruling; hence, one might infer a high likelihood of such an appeal. Looking at past precedent one would also have to predict that the odds would heavily favor the courts continuing to uphold the commission. However, such an appeal would provide additional time for new plans. This decision does not affect the Western Union 48kc offering. The impact of the ruling is to force AT&T to "unify" its pricing between voice grade, TELPAK A, and TELPAK B. TELPAK C & D are currently unaffected, though the commission originally held that they should be unified albeit at rates competitive with private microwave. AT&T has now released the details of its new filing for a broadband data service which will retain the economics of TELPAK A (in fact improve them on long haul usage) while raising the rates for broadband services.

The merits of the arguments pro and con the TELPAK offering are interesting. Without going into their merits, however, the critical point remains that data processing installations all over the country have been conducting feasibility studies and initiating data communications services predicated on a TELPAK offering which might be wiped out at any time. In fact, many installations were literally gambling that the FCC would overrule, a circumstance which by any legal standard would be extremely unlikely.

Furthermore, computer manufacturers have been building terminal equipment and other companies are investing considerable sums of money in data processing systems of all types, structured around TELPAK. If this tariff should be abolished, it would have serious impact on the computer industry, for a principal effect would be an increase in the rate that a user must pay for the 5,000 character-per-second transmission rate. Such an increase in mileage charges, from $15 to $24 mile, could be disastrous for many companies which have calculated to a fine margin their computing operation costs on such service.

the problem of state regulation

Nor is the regulatory problem ended if one arrives at an understanding of the activities of the Federal Communications Commission. Operating in parallel with the FCC are the state regulatory agencies which govern intrastate communication. These agencies are in no way bound to follow the policies established by the FCC, though it is true that they tend to be guided by its decisions. However, they have the right to independent action, and they exercise it frequently. In fact, the computer user will not infrequently face situations in which intrastate regulations will be in conflict with interstate FCC regulations. Certainly most networks of slow speed typewriter-like terminals will be involved in servicing some stations which reside within the same state as the computer. Such service is under state regulation even though the computer may be servicing interstate lines as part of the same application. Furthermore, in many cases, the availability of and rates for terminal equipment will be governed by the rules applying within the state as opposed to those involved in interstate tariffs.

Services such as voice telephone circuits or teletype messages have been around long enough and are well enough standardized that few problems are encountered

*New tariffs filed by AT&T would replace TELPAK A and B with wideband 48KC service. These are scheduled to go into effect May 1, subject to FCC approval.

in going between states. Difficulties encountered by the data communicator are more apt to be found in the newer developments.

In recent consulting work regarding the design of nationwide systems involving typewriter terminals, we encountered substantial variance in available teletype services. For example, the model 35 ACS teletype, which contains a number of features desirable for data communication, was available on an experimental basis or as a non-standard offering from several member companies of the Bell System. However, since the systems requirements of our client included installation of this equipment in a state whose local rulings did not permit such non-standard offerings, serious consideration of its inclusion in the system was precluded.

Thus additional confusion is added to the communications scene by the variety of regulatory commissions. Compounding this problem is the fact that one also is forced to deal with a variety of different operating companies. The Bell System consists of a number of regional companies, each of which has its own management and considerable prerogatives as far as the decisions it makes. The product offerings of AT&T are classified into system standards and non-standard offerings. Systems standards are available, at least nominally, through all the member companies of the Bell System. However, a variety of other interesting products are available only through some of the member companies. This depends upon the attitudes of the local telephone company management. This does not mean that there is a general lack of coordination or that the variances are very substantial, but it is necessary for the would-be communicator to realize that variations between operating companies will occur.

It is not unusual to find situations in which terminal equipment has special features inaccessible to the user because either the software system or the computer manufacturer's interface does not provide a facility for using all the capabilities theoretically available. In some of the situations in which we at C-E-I-R have been involved, we have found it necessary to modify terminal equipment to be able to provide such abilities as enabling the programmer to stop transmission on a device at some point in time without losing data. For instance, it is possible to stop transmission on some teletype devices but the panic stop approach will invariably garble the message being transmitted and would normally be a last resort method. By permitting the computer to disengage the clutch in the teletype it is possible to permit start-stop operation which does not destroy the message in process.

This is only one example of a much broader data communication problem. It is characteristic of the area in which the greatest difficulties lie—namely, the programmer's need to *maintain control over a widely scattered environment.*

new sources of competition

New developments by the common carriers also affect the computer industry. AT&T is developing new terminal equipment and other communication devices which move them into increasing competition with the computer manufacturers. The latest such device to be developed is an edge-punch data collection and transmission system. AT&T has thus far indicated its intention to stay out of the computer business itself, but Western Union has shown strong interest in various aspects of the service bureau business.

For example, Western Union's management information system division is attempting to obtain contracts to do "turnkey" operations with computing systems involving data communication. They are also in the business of installing computers for message switching. This is interesting in the light of an application by ITT with the FCC for commercial message switching. This case gets additionally involved since ITT is an international common carrier but does not hold that status domestically. Nonetheless, they have filed for a tariff for message switching operations by computer.

This request is an interesting move in light of the fact that nothing in current FCC rulings or in the Communications Act itself would suggest that such operations are subject to commission regulation. This poses a question as to whether or not an activity, not explicitly subject to commission regulation, can be voluntarily ceded by a firm as one in which the FCC has a regulatory role. One result of the commission's accepting such a tariff would be that it would remove the right of the common carriers to pass judgment on whether the service offered infringes on common carrier activities. ITT thereby would avoid some of the problems that Bunker-Ramo encountered in trying to obtain lines for their stock brokerage service. That issue was resolved when, after Western Union refused to make lines available, Bunker-Ramo finally succeeded in negotiating for the required lines with AT&T (though some modifications in the services were required by AT&T). Offering a new service, Telequote IV, Bunker-Ramo had planned to offer message switching between brokers. AT&T feared that brokers might "cheat" and use the facility to transact other communications. This issue was resolved by reprogramming to formalize the message structure so that free form messages could not be switched.

This, however, raises the new problem that dealings between domestic common carriers are not subject to FCC regulation and there is no way to force Bell or Western Union to provide lines for such services even though its legal right was established.

In the current message switching debate, Western Union is in a peculiar position. On the one hand they hold that message switching is not sufficiently intrinsic to common carrier activities to require the carriers to submit to federal regulation and file tariffs for that part of their activities. On the other hand, they indicate that they would refuse to provide lines to a service bureau intending to go into the message switching business on the grounds that such activity would infringe on Western Union's rights as a common carrier.

The issue is among the more complex items which will have to be decided by the Federal Communications Commission. Its resolution will have significant effect on the service bureau industry as well as on many other large commercial users. For instance, it will affect banks who provide data processing services for clients and who are interested in utilizing data communications to that end. The question as to whether the relaying of information on a financial transaction between two parties is a banking or a message switching operation may lead to profitable employment for many attorneys, but will probably lead to nothing but frustrations and additional headaches for the data processing manager.

the yawning "service gap"

The purchaser of common carrier services will soon discover that there is a considerable gap in the services available. Consider for a moment the huge difference between a voice grade line costing about $2/mile and carrying (using conventional equipment) about 2,000 bits per second, and the TELPAK A service at $15/mile with a 40,000 bit per second capability. TELPAK A represents more capacity than that which is required to run current card readers and line printers at full speed, while the voice grade line is considerably below the required capacity to

operate even a 600 line-a-minute printer.

The situation also serves to underscore the lack of adequate communication and coordination between the common carriers and the data processing industry, especially in the development of new services. Liaison exists, of course, but joint efforts are needed for real innovation. Classes of service are oriented strictly to standard devices such as teletypes or voice telephone. The class of service represented by TELPAK A is not tailored to a specific requirement for broadband transmission but is simply a logical multiple of voice grade lines. There is an obvious need on the part of the data processing industry for intermediate levels of service.

Some of these problems are compounded by the fact that requirements for such things as dial-up capability further restrict the available levels of service.

The dial-up system, of course, has many advantages to users in which a central computer is communicating to a great many points and in which the traffic load in any one part of the net is relatively light. However, the nature of the dial-up requirement restricts the equipment available to the user since the telephone company has far greater control over equipment attached to lines going through their switching system than lines which are obtained on a private line basis.

Western Union currently offers switched service under the sub-voice grade service for Telex, though they are moving into broadband dial-up capability. In this case, however, the broadband dial-up is in the voice grade range and does not yet extend into the 48 kilocycle bandwidth channels. They indicate their intent to move in that direction but there will be a reasonable lapse of time before they are ready to do so on any scale. AT&T's moves in this area have been slowed by the legal controversy that has surrounded the FCC ruling on TELPAK.

In utilizing dial-up telephone lines through the switched network, the user is restricted to the 2,000 bit per second transmission rate available from AT&T supplied data sets. Furthermore, it is mandatory that the AT&T dataphones be used. On a private line basis it is possible to obtain the lines under a tariff which permits clients to attach their own equipment to the ends of the lines. In this way some companies today are selling data sets which offer a higher transmission rate (4800 bps and even 9600 bps) than those provided by current AT&T offerings. Though AT&T is experimenting with data sets whose transmission rates are the equivalent of those offered by some of the electronics firms, they are not released yet and until they are, such transmission rates will be available only to the private line user.

the need for coordination

This fact, however, should not let the would-be data communicator feel unduly frustrated. The limitation on higher speed modems for voice grade lines is matched by the lack of available terminal equipment to accommodate those transmission rates. There are currently no standard pieces of terminal equipment on the market which are geared to transmit data to a computer at the higher 4800 and 9600 bps transmission speed and only a few that use the readily available 2400 bps rate. By and large these special transmission rates are suitable primarily for computer to computer communication (due to lack of terminal equipment) and would in many cases require a special interface from the computer manufacturer to synchronize with those rates.

We have previously referred to the need for better coordination between computer manufacturer, terminal equipment manufacturer, and common carrier. Merely providing a higher transmission rate does the user no good unless there is equipment able to send data at that rate.

Mechanical limitations are apt to be severe in the traditional card reading and line printing types of equipment. The degree of difficulty which will be experienced by a manufacturer in modifying terminal equipment to operate at higher speeds is largely a function of its original mechanical design. Inasmuch as higher transmission rates are coming, one of the factors that a user may want to analyze in deciding whether or not to purchase, as opposed to lease, a particular piece of terminal equipment is its suitability for modification to operate at a higher rate.

Coordination problems crop up in other ways. Minimally at least one additional firm, the common carrier, is involved in the successful operation of a data communication computer installation (potentially, at least two more if terminal equipment not manufactured by the computer supplier is utilized). Only the most careful coordination can avoid serious problems. It is all too easy for a well-meaning telephone company representative to substitute one modem for another which, as far as he knows, is superior except for the minor problem that the computer happens to utilize some peculiar characteristic of the previous device. As a result the system will not work.

Neither terminal equipment nor an appropriate service tariff will, by themselves, provide better solutions to the problems of various sectors of the computer community. Only a combined effort aimed at the specific applications and problems can yield a package that makes significant progress. This does not suggest that liaison does not occur or that the common carriers do not listen to hardware manufacturers and users or seek to inform them about services. It is in many ways a tribute to the firms involved that the situation is not worse. However, as was mentioned previously, the long delay in the development of a reasonable set of devices to utilize the capacity of voice grade lines and the failure to develop an intermediate service between voice grade and TELPAK service are examples of industry needs that require coordination. It remains a fact, however, that coordinational problems remain and that these problems inhibit developments that might help some users.

user feedback

The troubles in the legal and political environment of data communications stem largely from its recent and complex development. The Federal Communications Commission is really not designed and staffed to solve the problems it encounters. In order for the commission to function more effectively in this area, it desperately needs more input. Computer users involved in or contemplating major applications involving data communications should make their needs and problems known to the commission. The commissioners have a clear interest in making reasonable, equitable decisions, but in the absence of user communication they work in an environment in which the only informants are the common carriers and a handful of other firms with vested interests. The problem of regulation is worse at the level of the state commissions which are even less adequately staffed and funded. As a result, all too often they are forced to rely on the common carriers to provide them with the research and information they need. Obviously, this makes objective regulation difficult, if not impossible.

The current notices of inquiry provided an opportunity for members of the data processing community to speak out on issues that affect them. Subsequent decisions based on these proceedings may profoundly affect the future of the industry. By the same token the problems mentioned in this article should not discourage the reader from undertaking data communication projects; there is a vast technology now available and a host of systems problems to which it can be usefully applied. ■

MNEMONICS

spk up, dnt mmble

by MICHAEL JACKSON

"Mnemonics" is a technique for automatic recognition by computer of abbreviated names. It was conceived during the planning of a large, on-line data-processing and accounting utility to serve stockbrokers in the City of London, and will be part of that system when it goes live later this year. Names of stocks and shares (typically, a company name followed by a description such as "5% Loan Stock") in which bargains have been made occur in abbreviated form in the system input from remote terminal keyboards; the "mnemonics" package uses these abbreviated names to identify the correct stocks from a file of about 11,000.

Our philosophy in the early design stages of the stockbroker system was straightforward: not only must the system offer its users a direct cost advantage; it must also be demonstrably the most attractive way of carrying out their dp functions. If the terminal keyboard operator were required to consult books of codes and account numbers before entering each basic transaction, the system would be to that extent demonstrably worse than the manual methods it sought to replace.

However, granted the desirability of "mnemonics," its feasibility remained to be proved. A pilot study was carried out on a 1401 to test some possible techniques and to gather some statistics on the file of stock names. The results were encouraging, and "mnemonics" was incorporated in a model of the on-line system which was being built at that time. In this model the console typewriter of a 1440 was used to simulate the terminal keyboard, and a 1440 program was written which provided a simplified form of several of the system functions. The model was used over a period of a year for experiment and demonstration, and was the testbed for the first versions of the terminal procedures and the mnemonics package; it has now been discarded, since a working system is now available on the operational hardware.

We shall discuss that part of the mnemonics package which handles the identification of company names, because it is most free of irrelevant complexities which might obscure the generality of the method; the discussion will be based chiefly on the experimental and demonstration version of the system implemented on the 1440.

To enter a company name, the terminal operator keys in any reasonable abbreviation of it. For example, for

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Rank, Hovis, McDougall Limited

she could key in

RANK/HOVIS/MCD
or RNK/HVS/M
or R/H/MCDGL
or RANK/HOV

or any one of a large number of alternatives. The range of possible abbreviations is not predetermined or limited, and the aim of the mnemonics package is to recognise correctly all those abbreviations which would be intelligible to a human being.

The advantages of such a facility are obvious. Code books, with their attendant maintenance problems, are eliminated; input to the computer system is "raw" information (surely the only valid method for an on-line system); the content of each input message is directly intelligible to anyone inspecting it; the system can tolerate a higher level of inaccuracy in its input information.

the technique

Input abbreviations are not matched against the full company name stored on the stock file. Instead, they are compared with an index file of "perfect" abbreviations, and a "match factor" calculated; the first index entry which yields a satisfactory "match factor" is recognised as pointing to the required company name.

The "perfect" abbreviations or "templates" are formed according to precise rules derived partly from the designers' insight, partly from experiment. As a very broad guide to operators in training, the rules may be summarised as:

1. Abbreviate every significant word in the name, up to a maximum of three words.
2. Initial letters must always be present.
3. Consonants are more important than vowels.
4. The beginning of a word is more important than the end.
5. Abbreviate to between six and fifteen letters in all.

The algorithm for matching the input against the templates is a letter-by-letter scan and comparison; counts are kept of the number of letters which match, the number of unmatched vowels in the input, the number of unmatched characters in the template. The "match factor" is calculated from these counts and from the number of characters in the input.

the rules

The rules for forming "perfect" abbreviations are these:

1. The words "company," "limited," "of," "the," "A," "and" and "&" are ignored.
2. Hyphenated words are treated as separate words.
3. The words to be abbreviated are taken in sequence up to a maximum of three.
4. Grouped initials count as one word and are not abbreviated.
5. One-word names are abbreviated (if necessary) to 11 characters, two-word names to 5 characters each word, three-word names to 4 characters each word.
6. Within a word the abbreviation is formed by deleting vowels successively from the right-hand end of the word, until either all vowels have been deleted (except the initial letter of the word, if that is a vowel) or the word is reduced to the required size. If all vowels have been deleted and the word is still too large, the procedure is repeated, deleting consonants, until the required length is obtained.

Examples of "perfect" abbreviations are:

British Motor Corporation	BRTS MOTR CRPR.
Aiton Limited	AITON
Aerated Bread Co.	AERTD BREAD
A. C. Cars Ltd.	AC CARS
Barrow, Hepburn & Gale Ltd.	BRRW HPBR GALE
Rio Tinto Zinc Ltd.	RIO TINT ZINC

the algorithm

The input abbreviation is compared with the template in a letter-by-letter scan from left to right, until either the template or the input is exhausted. During the scan the following conditions may occur:

1. The two characters are equal, COUNT 1 is incremented by one, and both pointers are advanced.
2. The two characters are unequal, and the input character is a vowel, COUNT 2 is incremented by one, and the input pointer is advanced.
3. The two characters are unequal, and the input character is not a vowel. COUNT 3 is incremented by one, and the template pointer is advanced.
4. The end of a word is reached which is not the last word of the input. Both pointers are incremented to the start of the next word.

Note that an unmatched consonant in the input cannot be skipped; the input pointer will be halted, while the scan on the template continues until the word is exhausted.

The match factor is a small number calculated from COUNT 1, COUNT 2, COUNT 3 and the number of characters in the input. In the experimental 1440 version it can take only the values "0" and "1". It takes the value "1" (abbreviation matches) whenever:

1. The number of input characters is equal to COUNT 1. (All the input characters occur in the template in the order in which they occur in the input.)
2. The whole template has been scanned, COUNT 3 is less than 2 and COUNT 2 is less than 3. (Not more than one character of the template is "skipped" in the input, and the input contains not more than two "surplus" vowels.)
3. COUNT 3 is less than 2 and COUNT 1 is greater than COUNT 2. (Most of the input characters are matched and not more than one template character is "skipped".)

The simplicity of the algorithm is deceptive. Experiment shows that it works, and we can reasonably draw two conclusions: that the rule for forming "perfect" abbreviations does correspond closely with a practice which terminal operators can easily adopt; and that this rule results, in the case of the file of company names, in a satisfactory discrimination between one item and another.

performance

The performance of the algorithm is measured by the following parameters:

A The proportion of inputs whose identification is ambiguous.

W The proportion of inputs which are wrongly identified.

U The proportion of inputs which cannot be identified.

The performance figures will be affected by several factors, including the lengths of input abbreviations, the "reasonableness" of the abbreviations and the density of the company names file. In experiments with both the 1440 demonstration version and the operational System/360 version, it was found that a minimum length of six characters for input abbreviations (or fewer where the full name has fewer) gave almost perfect results. A very low value (less than one percent) was achieved for parameter U, with zero values for A and W; these results depended on an absence of perverse or stupid input abbrevia-

tions, but did not require any significant amount of operator training.

the operational system

The first operational version of the system is running on a System/360 Model 40, with 256K core and 2311 disc drives; this configuration will be replaced during 1968 with a Model 50 with 2314 disc drives. Terminal sets are 1050's.

The operational version of mnemonics uses a slightly different template and a more complex algorithm, but the principles are those of the 1440 version. The resident mnemonics program requires just under 3,000 bytes of core storage, including the area allocated for permanently held tables and the coding for accessing the index file of templates. With the more complex algorithm, checking one input against a template takes between 100 microseconds (no match) and 8.5 milliseconds (perfect match).

index look-up

There are between 2,500 and 3,000 distinct company names, each having at least one template on the index file. Some names have aliases (e.g. "FAGS" for "ANTOFAGASTA") which require separate index entries if the aliases are to be recognisable.

The primary arrangement of the index file is by number of words in the template; this may be one, two or three. One-word and three-word input abbreviations may only be matched with one-word and three-word templates respectively; two-word inputs may be matched with two-word or three-word templates. The three-word templates are therefore repeated on the file in their truncated two-word form.

Within the primary arrangement, the index is arranged by alphabetical order of initial letters. In the case of one-word templates even this subdivision may be inadequate, and a further subdivision is applied. Each template carries an index letter which is the highest consonant (i.e., nearest to the start of the alphabet) occurring in the body (i.e., not as an initial letter) of the unabbreviated name. Because an input abbreviation cannot validly contain a consonant which does not appear at all in the unabbreviated word, the index letter of the template can be used to determine how far down the list of templates to start looking.

For example, consider the input abbreviation "ACRW." The highest non-initial consonant in this abbreviation is "C"; the input cannot therefore match any template which does not have an index letter of "C" or "B." An index letter of "D" or lower would indicate that the unabbreviated word contains no non-initial "B" or "C," and that "ACRW" therefore contains at least one letter ("C") which does not occur in the unabbreviated form of the template.

With the template index structured in this way, it is always possible to obtain the correct index block from disc in a single access. In most cases the number of templates to be tested within the block is immediately reducible to six or fewer.

range of applicability

The mnemonics package as implemented for the on-line stockbroker system is a special purpose product; the technique, however, on which it is based is more generally valid.

The system need not be on-line. The original conception of mnemonics was based on an on-line real-time environment. We expected that ambiguities would occur fairly frequently, and the only practical way of resolving them would be by dialogue between the terminal operator and the system. From experiment, it now seems possible to reduce the number of ambiguous identifications to a level which would be acceptable in an off-line batch system. Any transaction input carrying an ambiguous identification field would be rejected (with diagnostic) for re-submission.

Random access is not always necessary. On one application we have considered, the file contained the names of about 100,000 consumer products under 300 classifications, with between 100 and 600 products in each. By using a two-stage identification process, where the first abbreviation gives the classification and the second gives the individual product, the mnemonics technique can be applied in a tape-only system.

The density with which names are packed on the file is important. Large files (50,000 and over) of the names of individuals will always contain areas in which there are so many identical or near-identical names that accurate identification is difficult by any method; an attempt to use abbreviations on such a file would simply aggravate the difficulty by reducing the amount of information.

conclusion

The most important fact about the mnemonics package is that it works. Its mechanism is simple, and arguably it does no more than reproduce crudely what a human being does with more sophistication. Nonetheless, the result achieved is a striking improvement over present-day conventional techniques, and that result is incorporated in a working, commercially-oriented system. ■

"Sorry I'm late, Chief, but you've just no idea what the traffic's like this morning."

MACHINE TRANSLATION— FACT OR FANCY?

the reasonable middle ground

by PAUL L. GARVIN

A few years ago, a number of news stories appeared here and there announcing "fundamental breakthroughs" in the development of machine translation from Russian into English and declaring that workable machine translation systems, if not already a reality, were just around the corner. Since then, one or two government agencies have begun to operate automatic translation facilities with which some users were partly satisfied, some not at all, and none completely. More recently, a committee constituted by the National Academy of Sciences, National Research Council—the Automatic Language Processing Advisory Committee (ALPAC)—conducted a two-year study of the field of machine translation and came to the conclusion that "without recourse to human translation or editing . . . none is in immediate prospect."[1]

Where, then, do we stand in machine translation? Were the claims justified that were made in the earlier days, or is ALPAC correct in concluding that there is no prospect for its achievement in the foreseeable future?

In my opinion, both are wrong.

To substantiate my view, let me give a brief survey of the state of machine translation. First, let me make clear that the field of machine translation is (with one glaring exception—the photoscopic disc)[2] not primarily concerned with the design of a special translation machine, but with the design of translation programs to be run on large general-purpose computers. Let me add that the major effort so far in this country has been directed toward the machine translation of Russian into English, although some experimental work has also been done on other languages (such as Chinese and German).

Two extreme approaches have been taken to the field, and one which I consider a reasonable middle ground. I call the two extremes the "brute-force" approach and the "perfectionist" approach. Let me discuss these first, since they are the ones represented in the earlier newspaper claims and in the recent ALPAC opinion.

The "brute-force" approach is based on the assumption that, given a sufficiently large memory, machine translation can be accomplished without a complex algorithm —either with a very large dictionary containing not only words but also phrases, or with a large dictionary and an equally large table of grammar rules taken from conventional Russian grammar. The dictionary approach was implemented on special hardware, the dictionary-plus-conventional-grammar approach on a general-purpose computer. Both versions of the "brute-force" approach have yielded translations on a fairly large scale, but of questionable quality. The trouble is that both systems are fundamentally unimprovable, since they allow only mechanical extensions of the tables which create as many or more new errors as they rectify. The negative opinion of ALPAC regarding the achievements of machine transla-

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[1]Language and Machines, Computers in Translation and Linguistics. A Report by the Automatic Language Processing Advisory Committee, National Academy of Sciences, National Research Council. Publication 1416. National Academy of Sciences, National Research Council. Washington, D. C., 1966. p. 19.

[2]Neil Macdonald, The Photoscopic Language Translator, *Computers and Automation*, Aug. 1960, pp. 6-8.

tion is based largely on a study of these systems, and is of course justified to the extent to which it concerns them.

The "perfectionist" approach represents the other extreme. It is based on the assumption that without a complete theoretical knowledge of the source and target languages (based on a theoretical knowledge of language in general), as well as a perfect understanding of the process of translation, both preferably in the form of mathematical models, the task can not even be begun. Consequently, the "perfectionists" have devoted most of their energies to theoretical studies of language, sometimes using computing equipment in the process, and have deferred the development of actual translation systems into the indefinite future. ALPAC's assessment of the future of the field reflects this view.

Clearly, neither extreme will lead to acceptable machine translation within the foreseeable future (or perhaps ever). But there is that reasonable middle ground—to which, in my opinion, ALPAC has not given sufficient attention. Not surprisingly, it is the position that I represent.

The approach which my associates and I are taking, the "Fulcrum" approach, is essentially an engineering solution to the problem. It avoids not only the naiveté of the "brute-force" approach (which by now has become evident to the professional world thanks to the poor quality of the results that it has produced), but it also avoids the lack of task-orientation of the "perfectionist" approach (which is much less evident to a professional world that stands in awe of theoretical research couched in dazzling quasi-mathematical symbolisms).

Our disagreements with the "perfectionists" deserve some further elaboration.

It is clear that the achievement of acceptable machine translation requires a very detailed and extensive knowledge of the languages concerned. Everybody agrees on this. Where the disagreement lies is in regard to the nature of this knowledge and the approach to be used in acquiring it. In my opinion, the knowledge needed for the design of machine-translation systems is not merely theoretical knowledge, but primarily empirical knowledge, and above all problem-solving engineering know-how. This knowledge cannot be acquired in the abstract, before the design of translation systems is begun. On the contrary, it is only in the process of developing a translation algorithm that it becomes clear what type of knowledge of the language is required. And it is only in the process of experimenting with the algorithm that the correctness of our findings about language can be verified.

Let me now discuss some of the essential features of the "Fulcrum" approach. In the process, I want to point out some further similarities with, and differences from, other approaches.

First, some similarities.

All approaches agree that a machine translation system must contain two basic components: a machine dictionary and an algorithmic portion. All approaches further agree that the dictionary must contain not only the source-language (Russian) words and their target-language (English) equivalents, but also a set of codes by means of which the information contained in the dictionary can be used to activate the algorithmic portion. These codes will be both grammatical and semantic, since in effect the algorithmic portion must perform both automatic parsing and semantic ambiguity resolution on the input text, and therefore needs both types of information. Because of the great burden placed on it, the algorithmic portion is the essential part of the translation system and determines the design of the codes used in the machine dictionary. The system operates by first performing a dictionary lookup on the source text. As a result of it, the dictionary entries (together with their equivalents and codes) corresponding to all the words of the text are brought into the work space—one sentence, or a few sentences, at a time. There the algorithmic portion goes to work on the text and uses the codes to do the processing.

Up to here, most approaches agree. Where the disagreements come in is in regard to both the basic design and the detailed structure of the algorithmic portion of the translation program, and consequently the dictionary codes.

First, the matter of basic design.

Many researchers view the matter of a language-data-processing algorithm in a manner similar to the parsers used for the processing of computer languages and other artificial languages. That is, they consider that the processor and the grammatical and other information required for the processing should be kept separate. The information needed by the processor should be stored in a table in the form of rules, to be called by the processor when needed. The rules are stored in the table in no special order, since each time information is needed the whole table is called and the state in which the processing finds itself will determine which rule will be applied. I call this approach "tripartite," since it favors the use of programs containing three basic portions: a dictionary, a processing algorithm, and a separate table of grammatical (and, to the extent possible, semantic) rules. In theory, the tripartite approach has two great sets of advantages:

1. It separates the labor of the programmer who designs and maintains the processor from that of the linguist who designs and maintains the table of rules. The only thing they have to agree on is the format of the rules that the processor can accept. This minimizes the communication problem between linguist and programmer, since once these matters have been settled, the two portions of the program can be handled separately.

2. The same processor can be used with more than one table of rules. This means first of all that rules can be modified or changed without having to change the processor, provided of course that the format is maintained. This gives the linguist great freedom of experimentation with different types of rules. It also permits the use of the same processor for the parsing of more than one language, by simply substituting one table of rules for another.

This is indeed an impressive array of arguments in favor of the tripartite approach. Unfortunately, the theoretical advantages turn out to be illusory, whenever in practice the use of a realistically extensive grammar, and not just a few basic rules, is attempted. The grammar table then becomes so complex that it can no longer be handled by a simple algorithm. Then either the algorithm has to be adapted to the table, which reduces its generality, or a secondary algorithm has to be written which will show the processor the way around the table. In either case, the principle of the strict separation of grammar and algorithm (or more generally, of information and algorithm) has to be violated.

I might add that the tripartite approach has so far produced only limited experimental results, although, of course, they are considered promising by some of its proponents.

This is why we have chosen a different basic design, one in which the information, grammatical and otherwise, is written into the algorithm rather than being kept separate from it. This means that the over-all system consists of only two portions, a dictionary and an algorithm—hence,

the term "bipartite" has been chosen for it.

The algorithm of a bipartite system is essentially not a "parser" of the type used in tripartite systems. It is instead a linguistic pattern recognition algorithm which, instead of matching portions of sentences against rules stored in a table, directs searches at the different portions of the sentence in order to identify its grammatical pattern. Thus, the essential characteristic of the algorithm is the sequencing of the searches and, in each search subroutine, only as much grammatical information is used as is appropriate to the particular search. The rules of the grammar are in fact applied by the algorithm in a definite order, and a given rule is not even called unless the previous searches have led to a point where its application becomes necessary. This means that the highly complex system of rules that makes up the real grammar of a language is distributed over a correspondingly complex algorithm which applies the rules in terms of the ordering that the structure of the language requires.

A bipartite system thus stands or falls by the manner in which the problem of the sequencing of the searches within the algorithm has been solved. This is the key problem in developing the detailed structure of the algorithm, and we have chosen the "Fulcrum" approach for its solution.

The "Fulcrum" approach is based on two fundamental principles: the concept of the fulcrum and the pass method.

The concept of the fulcrum implies the use of key elements within the sentence (fulcra) as starting points for the searches performed by the algorithm. This means that the algorithm, in searching through a sentence, does not simply progress from word to word, but in fact "skips" from fulcrum to fulcrum. It performs a little search sequence each time it has reached a fulcrum, and goes on to the next fulcrum when this particular search is completed.

The pass method means that not one but several passes are made at every sentence, each pass designed to identify a particular set of grammatical conditions pertinent to the recognition process. Consequently, each pass has its own set of fulcra and its own search sequences. The pass method reflects the orderly progression in which the determination of the structure of the sentence is made: first, the sentence components are identified individually, then the relations between components are established, and finally the structure of the sentence as a whole is established. To each of these intermediate parsing objectives there corresponds, roughly, a pass or series of passes in the algorithm. The correspondence is not exact, because there are many ambiguities and irregularities interfering with the recognition process, and the design of the "Fulcrum" algorithm reflects these added complexities.

Let me give a grossly oversimplified illustration of the operation of the "Fulcrum" algorithm:[3] imagine that the following sentence were Russian and not English.

"These various compounds of copper have been treated in the technical literature on many occasions."

In the earlier passes of the algorithm, first the nominal phrase "these various compounds of copper" and the two prepositional phrases "in the technical literature" and "on many occasions" are identified and labeled as to their potential functions within the sentence (the nominal phrase is a potential subject, the prepositional phrases are potential complements). In a later pass, the verbal phrase "have been treated" (which in Russian consists of a single word) is identified as the potential predicate. These identifications are made on the basis of the fulcrum principle. Thus, in the nominal phrase, the algorithm first identified its fulcrum, the head noun "compounds," and then directs its searches at the modifiers ("These various") and the nominal complement ("of copper"), the structure of which had been previously identified by the algorithm. Finally, in the same late pass in which the potential predicate is identified, the algorithm fits the different sentence components together to arrive at the structure of the sentence as a whole, again using the fulcrum principle. The algorithm "knows" that the fulcrum of a simple sentence is the predicate and therefore seeks out the predicate immediately. It then reads the grammar codes of the predicate to determine which are likely subjects and complements and, armed with this knowledge, can hunt up the remaining sentence components.

Semantic ambiguities are resolved by context searching wherever possible: the conditions in context are sought out which are likely to determine the choice of one rather than another of the equivalents of a given Russian word. Thus, in our sample sentence, the word represented by the English word "compound" really has two English equivalents: "compound" or "association." The algorithm will decide that "compound" is the correct equivalent, because of the complement "of copper" that follows in the immediate context.

Note that the grammatical and other information which the algorithm needs to carry out these decisions is carried in the codes that are contained in the dictionary and are made available to the algorithm by the dictionary lookup.

Obviously, not many Russian sentences are as simply structured, nor are they as similar to their English equivalents, as the one cited here. To allow the processing of all Russian sentences, simple or difficult, similar or dissimilar to English, the "Fulcrum" algorithm consists of a sophisticated interlocking system of passes and searches for fulcra. In addition, it has a capacity for generating English text "from scratch" for those sentence portions in which the differences between the two languages are so great that selection of equivalents for the Russian original is not enough to produce correct English text. Finally, we are building a heuristic capability into the "Fulcrum" algorithm, which will allow it to revise decisions made earlier in the program on the basis of information gathered later in the program. This will give it the capability of recognizing even some of the most involved Russian sentences.

An earlier experimental version of the "Fulcrum" algorithm, called "Fulcrum I," has been in existence for some time now (developed under the sponsorship of the Air Force, RADC, and of the National Science Foundation), and has served as a testbed for developing new concepts and techniques in machine translation. More recently, we have begun designing an advanced version of the "Fulcrum" algorithm, the "Fulcrum II" (under Air Force, RADC, sponsorship), which is ultimately intended to be the basis for a new production machine translation system, to replace the inadequate ones now in existence. The "Fulcrum II" will be characterized by a revised and updated sequence of passes and searches for fulcra, a heuristic capability, new techniques for producing English translated text, as well as efficiency-oriented rather than experiment-oriented programming. The plans and major flowcharts for it are now in essence complete, though not all the details. Given the necessary funding, the "Fulcrum II" can be completed and running within four to six years, depending on the level of effort and availability of staff (which is hard to find). ■

[3]For a more detailed discussion, see *Adaptation of Advanced Fulcrum Techniques to MT Production System (Russian-English)*, Final Report, Contract AF30(602)-3770 (Engineering Change "B"), Nov. 1, 1966, The Bunker-Ramo Corp. Canoga Park, Calif.

THE WEEK THE COMPUTERS STOPPED

the ultimate weapon

by HAROLD WEISS

The head of Wontonia's intelligence organization was addressing a class at his espionage school. "Comrades, you have heard of the tremendous sabotage which has recently occurred in the United States, including the complete shutdown of the leading capitalist country's economy for a significant period of time. This, as you may have guessed, was a triumph of our SUEY (Subversion Unrelenting to Entomb the Yankees) branch. We are privileged to have with us today Agent 2-5 who was in charge of this operation and who, I might add, has just been decorated with the Order of the Main Chow.

"The techniques which 2-5 will be discussing are probably applicable to most highly industrialized societies, so you have much to learn from his experience. A powerful weapon is available which a less developed country such as ours can use against the imperialists. His work has led to the computer training which you have received, so you should have no trouble with the technical aspects of his discussion. Without any more delay, I shall turn the rest of today's session over to our highly esteemed Agent 2-5."

A surprisingly young, intellectual-looking man came up to the front of the room from where he had been standing in the rear. He was obviously not a Wontonian. He wasted no time in formalities.

"Comrades, there is much to cover in only a few hours, but I want to give you a little of the background on my most recent assignment. For security reasons some details will be omitted from my discussion. Several years ago the head of SUEY was given the assignment of seriously sabotaging the United States economy, performing industrial espionage, and acquiring considerable sums of United States dollars which would be useful to Wontonia in a number of ways.

"As a member of his group I had been studying this imperialist economy for some time along with other agents, searching for areas of vulnerability to sabotage. We had explored damage to such obvious essential services as electrical power, water supply, transportation, and the like, and in the process conducted some successful capers, although their over-all impact was not very significant. During this period I became aware of the growing field of information technology in the United States. Research showed the increasing vulnerability of the U.S. economy to a relatively few sophisticated machines. There was a great concentration of values at comparatively few locations. The informational life blood of all the large companies and government agencies flowed through only a thousand or so key computers. As an immature and rapidly growing field, information technology had many deficiencies that it appeared SUEY could exploit profitably. I made a formal proposal to this effect and was placed in charge of the project which I shall be describing to you. As you might guess, I received my current code number at the time of that promotion. My background included considerable scientific as well as business training, which is one of the reasons a project of this scope was given to a fairly young man.

"Our intelligence operations have always benefited from thorough planning and a long-range approach, I am told. This project was no exception. To be effective, not only I but the several agents initially assigned to my project had to be technically competent. There were computer manufacturers' courses available in a number of countries, university and college courses, private school training, and other sources of knowledge about information technology. Each agent received intensive training in computer programming, among other subjects. It was fairly easy to place intelligent, well-trained people in their initial jobs because of the personnel shortage in the computer field. Once they had two years or so of practical experience, their skills became highly salable and they could move from place to place readily. The computer field is characterized by considerable job-jumping, which made our task much easier. An effective agent could therefore be brought to bear against several computer installations in only a few years.

"We felt our way cautiously at first to test the lax security of computer installations and to see what we could get away with. Our people did numerous little things to reduce the efficiency of the computer operations they worked at and thereby harm the large organizations by which they were employed. We filched cards from program or data decks, put cards out of sequence, wiped out key tapes and disc packs, caused subtle equipment malfunctions, and the like. We were able to change program cards or copy magnetic tapes with changes to create program bugs

Mr. Weiss is director of the Automation Training Center, Scottsdale, Ariz., and has been active in edp since 1952. He was head of customer support for the GE computer department and is now ready to reveal his authorship of "The Konscience of a Komputer Konservative," appearing in the October, 1962, issue of Datamation. He is a CPA, a holder of the DPMA certificate, and a member of the DPMA certificate testing committee.

in production programs. The consternation which little things like these caused must be seen to be believed. A false fire alert at an unprepared installation usually leads to someone pressing the panic button, which can take some computers down for days.

"As we gained experience and saw how permissive things were at many computer centers, we got more ambitious. Localized fires turned out to be a very effective technique for computer sabotage. There are often extensive combustible materials present, noxious smoke often results which hampers fire fighting, and often all the major programs and files of the installation are physically close together and not in fire-resistant vaults. One such fire can knock out a highly integrated organization with most of its information system on the computer, or at least cause it to suffer catastrophic consequences. And you should see the Yankee firemen! Just turn them loose with their axes and hoses and you needn't worry about a computer center for a long time. Some places had electrical shorts for months after a fire. It was very pathetic to see the recovery attempts of some computer groups which thought they had good disaster protection. Off premises they typically kept third generation files, some obsolescent programs, inadequate transaction data, and little if any system documentation. By the time their equipment was replaced and they started to try to bring their files up to date, they were swamped with piled-up transactions—that is, where sufficient data to operate at all existed. Some companies failed completely as a result of these fires or suffered huge financial losses.

"Ours can be a grim business, but SUEY's computer project was not without its humor. One of our people heard of a planned visit by a Boy Scout troop to a large military computer installation. Typically, visitors were permitted to walk through the computer room itself during an Open House. With considerable inspiration our agent met the group at the parking lot and passed out toy magnets to the boys. Quite a few programs on magnetic tape were wiped out that day as a result of boys trying to stick their magnets on everything they could, before the problem was detected by the computer staff.

"As another example, you may be aware that many computers are placed at ground floor level or in basements. One of our enterprising agents arranged for a sewer to back up, which took out a large commercial computer installation.

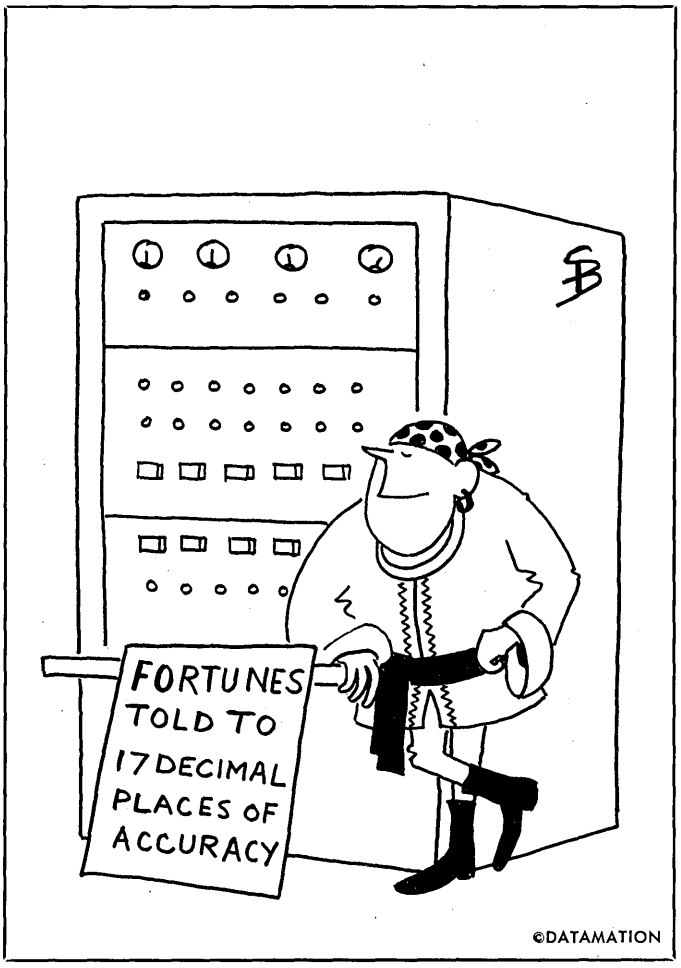
"We use beautiful women in various aspects of intelligence work and their value was proved in our information technology project as well. We trained some carefully selected female agents and placed them in computer groups. Besides the direct sabotage and espionage which they performed, there were beneficial side effects from their distraction to male technical personnel. A very significant rise in program error rate could be correlated to the arrival of each such agent.

"We found that wholesale personnel raids could seriously weaken an information systems organization. Some of our people had worked up to managerial levels after a few years and could carry out such tasks directly. Others in senior positions found willing accomplices in some computer managers. I recall a data processing manager who jocularly offered the advice that one should not steal all the skilled personnel of another computer group. He recommended following conservation practices—one senior man should be left on the victim's staff to train a new set of people to be raided at a later date.

"As you can see, our plans were proving effective. I have not yet mentioned an important aspect of our assignment, which was to secure considerable sums of Yankee dollars. We found it very easy to filch proprietary materials from waste baskets in computer centers, especially during periods of debugging. Some such information could be used directly; other types, such as customer lists, we were able to sell. Even used carbon paper was quite valuable. There tends to be loose control of forms at U.S. computer centers, except for check forms. We were able to acquire invoice and other forms which were very useful in the perpetration of various frauds. I might mention that ample computer service bureau time is available where needed to accomplish certain frauds and at relatively nominal rates. We also stole certain programs and files and held them for ransom. You would be surprised what some computer users or their data processing insurance companies will pay for the three generations of an important master file!

"Early in our project, I personally made it a practice to walk into strange computer rooms to see how far I could go without running into trouble. Initially I did not remove materials or perform acts of sabotage; rather, it was in the nature of research. Usually after wandering around for 20 minutes or so and looking at equipment, files, and documentation as a perfect stranger, a member of the staff would walk up and ask if I needed any help. Later many of our people did perform acts of sabotage or steal materials during such unauthorized visits. I have, for example, wandered about with an Alnico magnet in my hand in a room with 10,000 tapes, tapping any at will. One day I walked out of a large oil company's computer center with a magnetic tape filled with valuable exploration data, copied it at a service bureau, and returned the original without detection. We made a good deal of money out of that particular caper. All you had to do on such raids was to be well dressed, brazen and to know a little about computers. It may seem incredible that things were so lax and permissive with these rich companies, but they were. Can you imagine billion-dollar companies that 'could-not afford' a vault for vital magnetically stored records?

"Well, after three years we had severely damaged several



dozen large companies which had a major role in the U. S. economy and completely destroyed some smaller ones. We had also acquired almost $100,000,000 by various means. By now, however, many organizations were starting to tighten up their computer practices. Some began to treat their computer areas like a bank vault or top military security area. While it was hard to prove who performed some of the sabotage which I have described, several of our agents were being actively sought by the police, although the authorities were not yet aware of SUEY's inspiration and direction. I felt it imperative that we move more rapidly and across a broader aspect of the Yankee economy.

"Finally we recognized the Achilles heel of information technology—personnel—although I have mentioned personnel raids and other minor techniques in this category of sabotage. We had observed that many computer people were poorly motivated, had little loyalty to the organizations employing them, had no path of progress in their companies, etc. Even computer management had little participation in their companies' training and development programs. This was a prime factor in the heavy computer personnel turnover which we had exploited. After a decade or more in computer work the first blush of enthusiasm and pioneering had worn off. Much of the work was becoming more routine and less creative. There existed the specter of technological unemployment from automatic programming developments, the machines operating themselves via sophisticated programs, the machines even diagnosing their own malfunctions. Here was a really prime area for us to concentrate our efforts.

"We planned to organize information technology workers into a strong union. The ultimate weapon would be disabling strikes which could completely shut down organizations with little likelihood that strikebreakers could be brought to bear. We started very modestly, forming a few locals in the larger cities. The Computer Employees Union (CEU) was vertically organized, with operators, coders, programmers, systems people, maintenance men, even some lower level managers joining. With a few token strikes we won some large pay increases and got privileged status for computer people. As you might expect, a SUEY man headed up the national organization of CEU and we had other agents in the leadership of several strategic locals.

"Then we got a fortunate break which accelerated our entire program considerably. A large independent union saw in affiliation of the computer workers an opportunity to reinforce its own goal—the capability of shutting down the national economy to enforce a victory at the bargaining table. We got married to them in almost indecent haste. With the infusion of considerable money and powerful local support from the new parent union, organization of information technology workers proceeded rapidly.

"Finally our big moment came. The parent union called a nationwide strike. We immediately called a simultaneous walkout of the affiliated Computer Employees Union. After a week of the computers being shut down, you can hardly imagine the catastrophic impact on the U. S. economy. Most banks could no longer process checks. The credit system broke down. There were few companies which could bill customers. Plants closed because many essential functions were gone—production scheduling, purchasing, etc. The process industries shut down because our operators and maintenance people walked out. Many areas were blacked out as a result. There were no airline reservations or large magazine mailings. Many newspapers could not publish. Most of the scientific and engineering work in the country was interrupted. The military establishment was severely hurt despite the fact that some of their computer installations were manned by service personnel. You must pardon my apparent lack of modesty when I tell you that this was *total disaster*. It is essential that you grasp the full meaning of our operation.

"In desperation the federal government invoked an injunction with strong punitive features. We felt it too dangerous to our long-term plans to oppose this restraint outwardly, so the CEU people went back to work. Word was informally passed down the line, however, to sabotage computer installations wherever feasible. Operations were slowed down, people made many more errors, there was 'inadvertent' use of wrong generations of files, and so on. Programmers were always '90% done' on their assignments. Systems men messed up system designs and antagonized operating people. A rash of mysterious machine malfunctions occurred which maintenance people were slow to find. After several months of this a number of large employers caved in and CEU and our parent union won the strike. The cost to the Yankee imperialists has been conservatively estimated in the tens of billions of dollars.

"This, comrades, was only a first attempt with very limited resources, but which nevertheless produced impressive results. There is considerable opportunity for ingenuity and creative thinking by new cadres of agents such as yourselves. There is no reason why the basic pattern which I have described today can not be applied to other imperialist nations, although they may lag the Yankees by a few years in terms of their concentration of values in computer centers and thus in their vulnerability to our operations.

"This concludes my formal remarks. After a brief pause for refreshments, I shall be happy to answer any questions you may have on basic ideas or techniques, although I am not permitted to discuss names, places or other details. You have been a most appreciative audience, for which I thank you." ■

THE RELAY COMPUTERS AT BELL LABS

part one
those were the machines

by GEORGE R. STIBITZ as told to MRS. EVELYN LOVEDAY

Sometimes these days when I am at one of the many teletypewriter stations of the sophisticated GE computer at Dartmouth College asking for, or putting in, a program related to my work of applying mathematics to biomedical problems, I feel like the old lady in the nursery rhyme who said, "Lawk a mercy on me, this can't be I!" For I can remember when.

At my somewhat advanced age (or what often feels like it), it seems only yesterday—but it was actually in 1937—that I liberated some relays from a scrap pile at Bell Telephone Laboratories where I then worked, and took them home to start what I thought of as a play project. I had observed the similarity between the circuit paths through relays and the binary notation for numbers and had an idea I wanted to work out.

That weekend I fastened two of the relays to a board, cut strips from a tobacco can and nailed them to the board for input; bought a dry cell and a few flashlight bulbs for output, and wired up a binary adder. I wired the relays to give the binary digits of the sum of two one-digit binary numbers, which were entered into the arithmetic unit by pressing switches made of the metal strips. The two-flashlight-bulb output lighted up to indicate a binary 1 and remained dark for binary 0.

I took my model into the labs to show to some of the boys, and we were all more amused than impressed with some visions of a binary computer industry. I have no head for history. I did not know I was picking up where Charles Babbage in England had to quit over a hundred years before. Nor did it occur to me that my work would turn out to be part of the beginning of what we now know as the computer age. So, unfortunately, there were no fireworks, no champagne.

Being a compulsive generalizer, I wondered what could be done with a large number of such adders. Further evenings at home were spent entertaining myself by sketching circuits for addition, multiplication and even division. The idea occurred to me that decimal digit adders could be set up in binary form, with each decimal digit expressed in binary form by multiple contacts on keys. I actually designed such decimal adders, but soon found that the "carry" circuit was complicated, and that the circuits for converting a number to its complement were rather complicated.

No mathematician can abide lack of symmetry, and so I looked around for a neat way of solving this difficulty. The tidiest kind I could think of was to shift the range of decimal digits to the middle of the list of 4-bit binary numbers. This shift was equivalent to adding 3 to the decimal digit so that decimal 0 was represented by binary 3

Dr. Stibitz is presently a research associate in physiology at Dartmouth Medical School, where he is involved with computer applications in biomedicine. Formerly with Bell Labs (1930-1941), he was later an independent consultant (1946-1964). In 1945, he received the Harry Goode Memorial Award for pioneering in edp; in 1966, he was honored with a D.Sc. from Denison Univ. He has an MS from Union College, and a Ph.D. from Cornell Univ.

Telespeed 750 High-Speed Tape-To-Tape equipment can send and receive entire inventory records in minutes.

KEYED TO CONTROL INVENTORY COSTS

In today's marketplace, consumers demand variety. Most merchandise has to be available in many colors. Many styles. And with many features. And so it goes throughout all industries . . . with spiraling inventory costs causing serious problems.

Yet, many companies have cut inventory costs while keeping a larger selection of stock on hand! They did it through data systems that include Teletype data communications equipment.

This is how it works Teletype equipment is used to send and receive inventory data among warehouses, distribution outlets, and a computer center. The computer analyzes the inventory at each location and considers past stock requirements as well as seasonal demands and, where applicable, possible obsolescence. It determines the stock needs and material requirements of each ware-

house and distribution outlet. Then, Teletype equipment transmits stock replenishment orders quickly and accurately. As a result, management keeps inventories current and costs at a minimum.

Examples of how Teletype equipment can be used in your inventory operations are described below.

Aids decision-making capabilities A major producer of heating units replaced its traditional order handling and inventory replenishment method with a communications network that ties distribution outlets to its computer center via Teletype Model 35 ASR (automatic send-receive) sets. The data system has substantially reduced inventory levels, general administrative and paperwork costs, as well as cut four days off the entire order processing cycle.

Though inventory cost reductions have been significant, the firm's marketing vice president points out that the system also supplies management with more comprehensive and current reports than previously possible. This has improved their decision-making capabilities while permitting greater flexibility in dealing with customer demands.

Cuts inventory needs 45 percent The Wisconsin division of a leading food store chain once depended on an inventory system in which store managers entered stock needs in order books. These notations were translated to mark sense cards, and then converted to punched cards for input to a computer. The printout was used to fill and ship each store's order. The entire routine took three to four days.

To expedite the procedure, Teletype Model 33 ASR sets were installed in each store. Inventory tapes are now prepared on these sets and transmitted immediately to the company's computer center for further processing. Within 24 hours each store's inventory needs are filled. Also, backroom stock needs have been reduced by 45 percent. Consequently, the company plans to cut down this nonproducing storage space in future stores or utilize it for additional "front-line" display.

Eases costs of growing pains One of the midwest's largest distributors of ball and roller bearings faced a major problem resulting from a tremendous growth in business. The company's manual order processing and inventory procedure was taxed to the breaking point. Inventories skyrocketed in an attempt to keep enough stock on hand to assure prompt customer service.

To ease the problem, each of the company's branch offices was equipped with Teletype Model 35 ASR sets. Now orders are prepared on punched paper tape for immediate transmission to company headquarters. Here they are received in both paper tape and page copy form. The tape is converted to punched cards for order processing, and the page copy is used for inventory control. The new system has cut costs and assured management of control over the entire operation.

There are additional capabilities of Teletype equipment for improving all phases of management's business information needs. For instance, Telespeed 750 high-speed tape-to-tape equipment can send or receive an entire inventory of 7,000 items in minutes using only ⅓ of a tape reel. More facts on these capabilities are explained in our new brochure, "HOW TELETYPE EQUIPMENT MOVES DATA FOR YOUR BUSINESS OR INDUSTRY." For your copy, contact: Teletype Corporation, Dept. 81D, 5555 Touhy Avenue, Skokie, Illinois 60076.

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(0011), and so on. With this symmetric arrangement, the 9's complement of any decimal digit was found by changing each binary 1 to a binary 0, and conversely. The interchange was easy with relay (or any binary) circuits. All that was needed was a single two-pole contact leading to all the relays of the number to be inverted.

Unfortunately, when two excess-3 decimals are added, the sum is too large by six units, so it was necessary to think about some translating circuits to remove three units and get back to an excess-3 code. In compensation, there was the happy accident that, in the excess-6 code of the sum of two digits, all numbers greater than decimal 9 are 5-bit binary numbers. Hence, if the 5th binary digit was 1, it meant that a carry was called for and this was easy to accomplish.

Well, as I said, all this thinking was the kind of play project that I still indulge in very frequently in place of golf, or other constructive leisure time pursuits.

fortune and need

Soon, however, it had to become work in earnest, for Dr. T. C. Fry, chief of the mathematics group I was in, told me that the difficulties of handling complex numbers had come to his attention, and he asked whether my little relay calculator could do complex arithmetic. Could it! I had already thought out most of the components for a complex calculator, and so I soon had drawings sufficiently complete to be considered.

These were highly unusual, since I knew nothing of the language of symbols of the well-developed switching art, and my sketches must have amused the switching engineers. But—there was Sam Williams.

Now my calculator had had two pieces of good fortune. One was the coincidence of the binary adder and my circuit diagrams with Fry's expression of complex computing needs. The second was the assignment of Sam Williams to the evaluation of the calculator's feasibility to meet the needs.

Sam had been a switching engineer for many years and was thoroughly familiar with all properties of relays, but not with mathematics or number theory. He had to struggle, not only with my dismally unconventional drafting, but also with the ideas of binary notation and operations, and with my excess-3 coded decimal notation.

All the angels were with us. He not only made a thorough study of the calculator and reported it was feasible, but, from my knowledge, made many useful suggestions about control circuitry. In a few weeks we got the go-ahead signal; Sam was given the job of detail design and we were off to the races.

At this point there were some small complications about correcting 9's complements into 10's complements, but they were not serious. The adders were now designed and multiplication was not difficult. Rather than use multitudes of relays to perform this operation we decided to use some relatively new pieces of telephone equipment called crossbar switches, which were, in effect, compound relays with many contacts.

There were many serious discussions about 10-key vs. bank-type keyboards for input. The bank keyboard would have saved some memory equipment in the computer, but it was soon decided that the simplicity of the 10-key arrangement made it worth the extra cost. Operators' strips of 10 keys were adapted, and a second strip was modified for the operational symbols, $+$, $-$, $\times$, $+i$, $-i$, $\div$ and $=$.

We thought very briefly of using binary notation for input and output, but the prospect of teaching binary notation to a crew of girls was appalling, and so the idea was abandoned pronto.

In complex operations it was handier to put the divisor into the machine first. We had to have a special type symbol in which the slash for division was turned backwards for this purpose. By putting the divisor in first, the arithmetic unit could start squaring the real and imaginary parts as soon as the slash appeared.

Since relays operate at about 10 milliseconds, the squaring operation (which was carried on when the slash appeared) took an average of 40 addition times, or some half-second with no allowance made for sub-normal relays. As I recall, for safety's sake we allowed a couple of seconds for this operation.

The capacity of the machine was to be eight decimal places with two extra digits provided in the arithmetic unit to compensate for excessive round-off errors when accumulating many subtabulations.

The machine was a parallel one, with two units which handled respectively the real and the imaginary parts of the calculations. A standard whimsey of sightseers when shown the imaginary unit was that it *looked* real. Somehow that remark lost its freshness after a score of repetitions. The two units operated in parallel, during multiplication, for example, when the real and imaginary parts of the multiplicand were multiplied by digits of the real part of the multiplier simultaneously.

success

Construction of the machine was completed in 1939, and debugging began, using diagnostic problems devised by Williams. Many of the relay operations were dependent on timing, with slow and fast operate and release relays determining the sequence of circuit openings and closures. When one relay in a register failed to come up to specs in speed of operation the whole calculation came out wrong. Slower relays, to initiate the next step of computation, cured the trouble but slowed the machine. All of this created some troublesome and often profane moments.

Even so, the final successful speed was nearly that contemplated in the original design. As I recall, the addition time was about 0.1 seconds.

In 1938 we had "known" on paper just what the computer should do, and the Bell Labs experience indicated that the relays would do what the paper design said they would, but nevertheless it was a spine-tingling experience when the wiring and design bugs began to give way, and true answers began to flow from the computer, just as we had envisioned they would.

The binary computing elements were so very different

A published poet, Mrs. Loveday is a member of a surfacing group of creative writers who have tiptoed into the computer field. She is now a freelance technical writer for Sperry-Rand patent attorneys, IBM, and the Colleges of Medicine at the Universities of Vermont and Dartmouth.

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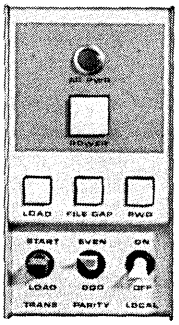

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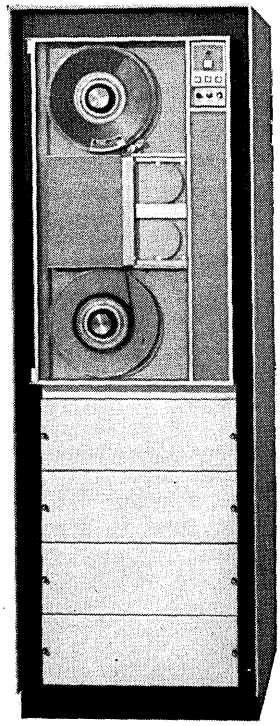

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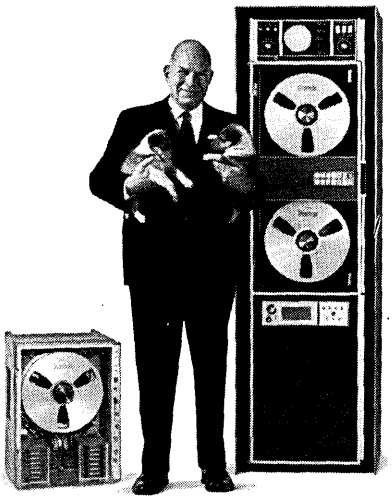

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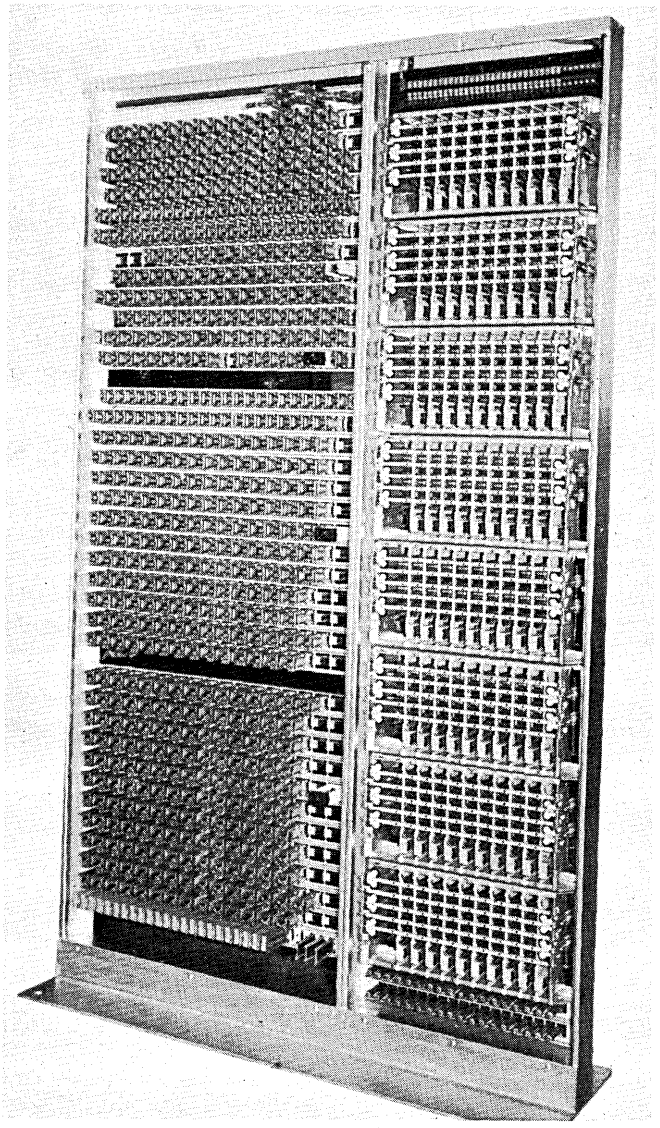
from the rotating gears of the conventional desk calculator, that it had been hard for many to believe they could do a more complex job and do it with incredible speed. Remember, this was in 1939.

It is believed that this relay computer was the first (at least in this country) to employ binary components. Succeeding Bell relay computers were binary also, as, of course, are all modern high-speed computers.

At last, in January of 1940, after some months of debugging and testing, the Complex Calculator (as it was now called) was set up in the Bell Laboratories building at 463 West St., New York City, and turned over to the calculations people in the mathematics department. The girls were entertained when a small new bug cropped up causing the teletype to print out BOO several times. Witchcraft?

Originally it had been thought that only complex multiplication and division were complicated enough to be worthy of the new machine, but it was soon found that complex additions and subtractions were so mingled with the difficult operations that there were many interruptions. A few relays were added, and then we had sub-

Mainframe of the Complex Calculator (Model I)



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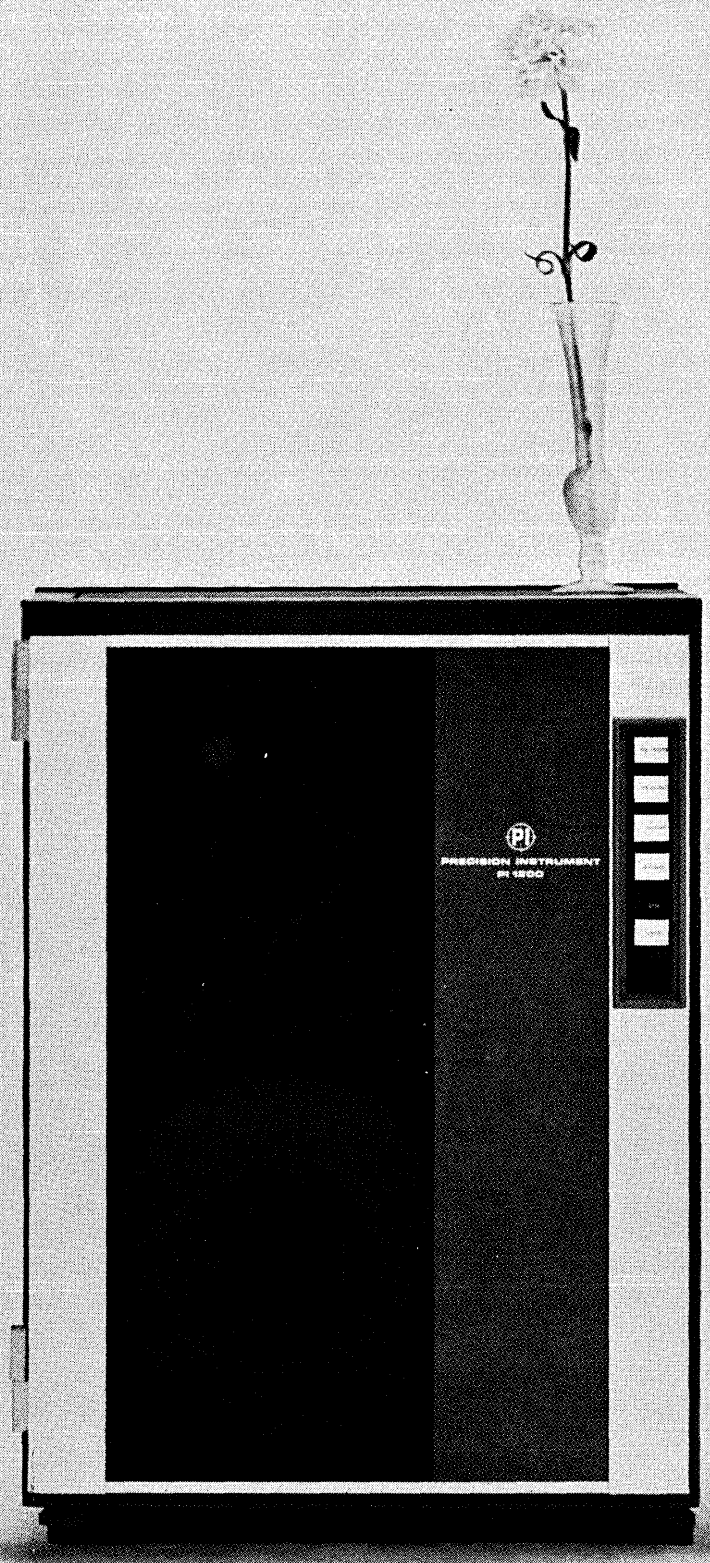

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The PI-1200 has other skills too. Such as a slew rate for writing 0 to 1600 characters per second in incremental blocks and reading the same thing at 0 to 1100 characters per second, stopping on a character. Or, an asynchronous rate of 0 to 300 characters per second for writing random data bit by bit in 200, 556, and 800 BPI formats... with no mistakes. (Optical bit spacing accuracy is 4 times better than IBM specified tolerances.) The PI-1200 reads at 0 to 300 characters per second, too, for 200 or 556 BPI.

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traction and addition too. This easy alteration, in so complicated a machine, pointed up its flexibility as contrasted with mechanical machines.

Another group outside the mathematics department did a large volume of complex computations, so not long after the original installation it was decided to add a second teletype in another part of the building for the convenience of this other group. A third was added later in another location. Any of the three teletypes could be used on a first-come basis, and thus this first Bell relay computer included a feature only now appearing in some of the larger computers: multiple input positions with the lockout facilities required for this type of operation. Even in 1940, in a crude way, we had a time-sharing system.

Further, while the computer had been specifically designed to handle the four complex number operations, users soon found that with certain special variations the computer could be used advantageously for other types of problems.

About the time the Complex Calculator was set up and operating well, Sam and I washed our hands and settled down to our customary work, pausing occasionally to go and peek at our baby, to make sure it was eating, sleeping and operating well. Soon we learned that it was to show off its tricks in public.

the public debut

Through Dr. Fry came a request for a paper on the computer to be presented at the September 1940 meeting of the American Mathematical Society at Dartmouth College. Originally it was planned to present the paper with

First demonstration of remote use of computer occurred at Dartmouth College in September , 1940. Teletype was linked to processor in New York City.

slides showing the equipment, teletype output and so on, and Dr. Fry suggested dictating problems for the computer over a phone link from Hanover to a teletype operator at Bell Labs in New York City.

With my usual genius for making things more difficult for myself and others, I suggested direct telegraph operation from Hanover, and this was decided upon. In July, Sam Williams designed some transceiving panels which were constructed and ready in late August.

The week before the Society meeting was a frantic one. We watched wiremen install the panels in McNutt Hall: arrangements were made for a circuit to New York City, to be protected against interruption, and finally, the day before the meeting, successful remote operation was accomplished. There was little time for a shakedown, but fortunately all went well, and I went to bed hoping the baby would perform well the next day too.

At the meeting I read my paper describing the machine, then Dr. Fry showed how problems could be introduced at the scene of the conference and transmitted to the computer in New York. We were then able to point to the teletypewriter which typed out the answers within a minute. It is believed that this was the first public demonstration of remote operation of an automatic computer, and foreshadowed the present growth of data transmission services.

Members of the audience were invited to submit problems to the computer, and I recall that Norbert Wiener was one who tried to stump it, unsuccessfully. This was Wiener's first introduction to the computer concept. Sam Williams was in New York monitoring the computing equipment, but it was wasted effort. The system worked flawlessly.

The pauses during which the computer solved each problem were as impressive as the operating period. The speed of computation was phenomenal for that time: only 30 seconds or so for a complex division comprising three multiplications and addition, and two divisions in eight-place real numbers.

A few newspaper reporters, in writing about this demonstration, toyed with the idea that some day kids would do their homework on a computer. My crystal ball was dusty and I put this thinking down to the usual journalistic extravagance. I must admit that I never at that time conceived of the computer as the teaching aid that it has become in very recent times.

However, the typical habits of the mathematician were making me try all kinds of generalizations of the relay computer idea. In 1939 and early 1940, I had made some specific proposals for improvements on what we already had, and I was anxious to implement them.

Unfortunately, the Complex Calculator had been so expensive that Bell Laboratories felt it impossible to invest money in further developments. The Calculator development, design, drafting, equipment, construction and debugging had cost $20,000—an astronomical sum in those days.

Then came World War II, and suddenly we were all plunged into unusual work and expenditures. In the second half of this article I will tell more about the life and times of the relay computers, the succeeding models of which we designed at Bell Laboratories for various military purposes. ■

(Next month the concluding article will reflect on the developments during the war, and describe the last models in the series.)

CONVERSATIONAL COMPUTING ON A SMALL MACHINE

why time-share?

by DAVID J. WAKS

Many people have computational problems which could most economically be solved with digital computers, yet which are still solved by pencil-and-paper or desk-calculator techniques, at a high cost in time and convenience. Three major barriers exist to putting these problems on computers:

1. The time required to bring them to the computer, wait for them to be run, and bring back the results is intolerable;
2. The problems are of a scale for which the time spent in explaining them to a programmer is large compared to the time required to solve them by hand;
3. The man with the problem, who should, therefore, write the program himself, is not a programmer, and doesn't want to have to become one to solve his problems.

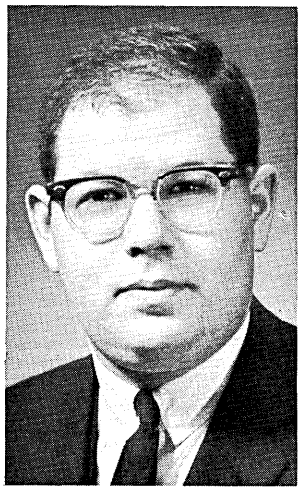
This problem is referred to as being that of "bringing the computer to the user," and is one of the most important problems in the computer business today.

Any solution to this problem requires two prongs: *hardware* to physically place a computing facility at the user's disposal; and *software* to make the computing system approachable by providing an interface with the hardware.

time-sharing as a solution

It is widely believed that the best solution is to share a large computer among many users, in order to reduce the cost per user of the hardware and the software. This requires the construction of an elaborate hardware system and, typically, an even more elaborate software system largely devoted to solving the problems imposed by the complex hardware. Such systems physically bring the computer to the user by giving him a personal console.

The software, on the other hand, leaves him as far from the computer as ever before. This is because most such software systems are "open" in the sense that the entire computer system is available to the user—in fact, much of the hardware/software design effort is devoted to maintaining this illusion for the user. The trouble is that only an experienced programmer can really use these "open" systems. The last thing the true *user*, as opposed to *programmer*, wants or needs is to have to learn about a complex hardware system and even more complex software system (in most systems he must read three or four manuals just to be able to write a FORTRAN program and get it running). The inexperienced user desperately needs to be isolated from the hardware and software. He must have an



Mr. Waks is director of the Research Computing Center at Applied Data Research, Inc. He has been in charge of the design and implementation of almost all types of software, including assemblers, compilers, executive systems, and graphical I/O systems, during his 10 years in the computer industry. He has a bachelors degree in mathematics from Cornell Univ.

environment expressly created for his use in solving his problems.

The first time-shared system specifically directed toward the totally inexperienced user was the Rand Corporation's JOHNNIAC Open-Shop System (JOSS). The major goals in the development of JOSS were: (1) it should be easily approachable by somebody completely inexperienced in computer programming; (2) it should be largely self-teaching—i.e., once a user has some basic knowledge, the use of the system should teach him the rest; (3) the user must be completely isolated from the computer—i.e., he neither knows nor cares about what's going on inside; (4) the user must be protected against his own errors, so that, for example, there is no way for him to inadvertently destroy his program or the system; (5) there should be a minimum number of arbitrary conventions which the user must learn. JOSS was implemented on the JOHNNIAC computer, and provided its facilities to up to eight users simultaneously.

an alternate solution

A completely different solution to the physical problem is to give the user an entire computer for his own use. This is quite attractive if the computer is priced low enough, since the cost of a console in a time-shared system, including communications hardware on the large computer, is comparatively high (about $13 an hour or so). The lease price of a small computer, available 24 hours a day, might well be less than the price for two-hours-a-day use of a console in a time-shared system. The problem, however, is whether a user-oriented software system can be built for a small computer.

Last August, Digital Equipment Corp. announced the PDP-8/s computer, compatible with its PDP-8, but considerably slower and considerably lower priced. The minimum configuration of the PDP-8/s has 4K 12-bit words of memory, an ASR-33 Teletype, and an average instruction execution time of about 50 microseconds. This configuration sells for $10,000, making it one of the lowest-priced stored-program computers on the market. Physically, the PDP-8/s with its Teletype occupies part of the top of a desk, plugs into an ordinary electrical outlet, and requires no air conditioning.

When the author first learned of DEC's plans for the PDP-8/s, he became interested in the feasibility of implementing a JOSS-like system which would operate on a minimum PDP-8/s. The result of the feasibility study is a program, the Engineering and Scientific Interpreter (ESI), which provides most of the facilities of JOSS to a single user on a minimum PDP-5, PDP-8, PDP-8/s or LINC-8 (all program-compatible machines).

ESI is designed as a self-contained system which greatly simplifies the programming and debugging of modest-scale programs. The system is highly interactive with the user, making the transitions from design to coding to debugging to operation of programs very smooth and continuous. The user can try something out immediately, see if it works, discard it and try something else if it doesn't, or build on it if it does. The system is very easy to learn to use, taking less than an hour in most cases. The rules for construction of programs are very concise, and are summarized on one page.

a description

As in JOSS, statements in ESI have the form of English imperative sentences. Every statement contains a main clause which starts with an imperative verb (such as

SAMPLE CONVERSATIONS WITH THE ENGINEERING AND SCIENTIFIC INTERPRETER

```
      1. SAMPLES OF DIRECT STATEMENTS:

1,2   ←DELETE ALL.
3     ←TYPE 2↑2.
            2↑2 =      4
      ←SET X = 5.
      ←TYPE X.
                X =      5
      ←TYPE X↑3, X/7, SGN(X), SQRT(X).
              X↑3 =    125
4             X/7 =       .714285
5         SGN(X) =      1
          SQRT(X) =      2.236068
      ←TYPE X*Y.
6     ERROR ABOVE: UNDEFINED
      ←SET Y = -7
7     ERROR ABOVE: EH?
      ←SET Y = -7.
      ←TYPE XY.
8     ERROR ABOVE: EH?
      ←TYPE X*Y.
              X*Y =    -35
9     ←SET A = 3E-40.
      ←SET B = A↑2.
10    ERROR ABOVE: EXPONENT
      ←SET C = 0.
      ERROR ABOVE: UNDEFINED
      ←SET C = 0.
      ←TYPE A/C.
11    ERROR ABOVE: 0 DIVISOR
12    ←FOR I = 2(2)5, TYPE I, I↑3.
                I =      2
              I↑3 =      8
                I =      5
              I↑3 =    125
      ←SET A(1) = 3.
13    ERROR ABOVE: SUBSCRIPT
14    ←DELETE A.
      ←SET A(1) = 3.
15    ←FOR R=4(2)10, SET A(R/2) = R↑2.
16    ←TYPE ALL VALUES.

              A(1) =      3
              A(2) =     16
              A(3) =     36
              A(4) =     64
              A(5) =    100
                 C =      8
17               I =      8
                 R =     10
                 X =      5
                 Y =     -7

      ←IF X = 5, TYPE "YES".
      YES
18    ←IF I↑2 < 10*R, TYPE THAT'S  ?
      ←IF I↑2 < 10*R, TYPE "THAT'S RIGHT.".
      THAT'S RIGHT.
      ←DELETE ALL.
      ←
```

II. SAMPLE USE OF INDIRECT STATEMENTS—COMPUTE THE AREA AND CIRCUMFERENCE OF A CIRCLE, GIVEN ITS RADIUS.

```
      ←DELETE ALL.
19    ←1.1 DEMAND R.
20    ←DO STEP 1.1.
21    R = ←3
      ←1.2 SET A = P*R↑2.
      ←1.3 SET C = 2*P*R.
22    ←1.4 TYPE "IF RADIUS IS"R", THEN AREA IS"A", AND CIRCUMFERENCE IS"C.
23,24 ←DO A←PART 1.
      R = ←2
25    ERROR IN STEP 1.2: UNDEFINED
26    ←P=3.1415927
      ←DO PART 1.
      R = ←2
      IF RADIUS IS 2, THEN AREA IS 12.56637, AND CIRCUMFERENCE IS 12.56637
27    ←1.5 TO STEP 1.1.
      ←DO PART 1.
      R = ←3
      IF RADIUS IS 3, THEN AREA IS 28.27434, AND CIRCUMFERENCE IS 18.84956
      R = ←17
      IF RADIUS IS 17, THEN AREA IS 907.9204, AND CIRCUMFERENCE IS 106.8142
28    INTERRUPTED IN STEP 1.4
      ←TYPE R,C.
                R =     17
                C =    106.8142
29    ←GO.
30    R = ←1/P
      IF RADIUS IS .3183099, THEN AREA IS .31831, AND CIRCUMFERENCE IS 2
      R = ←2/P
      IF RADIUS IS .6366197, THEN AREA IS 1.273239, AND CIRCUMFERENCE IS 4
      INTERRUPTED IN STEP 1.4
31    ←CANCEL.
      CANCELLED
32    ←DELETE STEP 1.1.
      ←2.1 FOR R = 10(5)20, DO PART 1.
      ←DO PART 2.
      IF RADIUS IS 10, THEN AREA IS 314.1593, AND CIRCUMFERENCE IS 62.83186
33    ERROR IN STEP 1.5: STEP #
      ←DELETE STEP 1.5.
      ←DO PART 2.
      IF RADIUS IS 10, THEN AREA IS 314.1593, AND CIRCUMFERENCE IS 62.83186
      IF RADIUS IS 15, THEN AREA IS 706.8584, AND CIRCUMFERENCE IS 94.24779
      IF RADIUS IS 20, THEN AREA IS 1256.637, AND CIRCUMFERENCE IS 125.6637
34    ←TYPE ALL.

       1.2 SET A = P*R↑2.
       1.3 SET C = 2*P*R.
       1.4 TYPE "IF RADIUS IS"R", THEN AREA IS"A", AND CIRCUMFERENCE IS"C.

       2.1 FOR R = 10(5)20, DO PART 1.

                A =  1256.637
                C =   125.6637
                P =     3.141593
                R =    25

      ←DELETE ALL.
      ←
```

TYPE, DELETE, SET, GO) and ends with a period. Frequently there are parameters between the verb and the period—such as TYPE X. Any clause which does not involve the transfer of control can be preceded by one or more iterative clauses which begin with the word FOR and end with a comma. Any statement, including one which contains one or more FOR clauses, may be preceded by a conditional clause which begins with the world IF and ends with a comma. Thus, the following is a perfectly legal statement:

IF X = Y, FOR I = 1(1)N, FOR J = 1(1)N, TYPE A[I,J].

The printouts on p. 46 constitute a user's manual for ESI. Two pages of "conversations" with ESI, plus explanatory notes on those conversations, constitute an introductory primer; the last page, *Permissible Forms in ESI-B,* is a concise summary which should be the only manual necessary after starting to use ESI.

In reading the conversations with ESI, the reader should look at the notes only if he doesn't understand the statements in the conversation. Much more can be learned by trying to figure out what's happening than by always referring to the notes.

1. A back arrow (←) is typed whenever ESI wants the user to say something. Thus, any line beginning with a back arrow was typed by the user; any without the back arrow by the computer.
2. DELETE ALL commands ESI to clear user storage of everything associated with the preceding user program.
3. TYPE commands the evaluation and typing out of one or more arithmetic expressions.
4. All results are stored and presented as *decimal* numbers with exactly seven decimal digits of precision.
5. The SGN function is the "sign" or "signum" function of mathematics.
6. A variable, such as Y here, which has not been set to any value is considered to be "undefined" and any use of it in an arithmetic expression is flagged as an error.
7. Every statement in ESI is an English sentence, and *must* end in a period.
8. This command is meaningless, since XY is not a valid name for a variable (the only valid names are the single letters A through Z), and the multiplication sign is missing if the intention was to evaluate the product of X and Y.
9. The single letter E means "times ten to the." Thus 3E-40 is ESI's notation for $3 \times 10.^{-40}$
10. All numbers stored by ESI must be in the range of 10^{-63} to 10^{63}. The number "A↑ 2" is out of this range.
11. ESI treats any attempt to divide by zero, including ϕ/ϕ, as an error.
12. In this iterative statement "I" will take on values beginning with 2, increments of 3, until 5; i.e., 2 and 5.
13. A has already been assigned a value as an unsubscripted variable. It cannot simultaneously be subscripted.
14. DELETE commands ESI to make the variable "undefined." It can now be used with a subscript. Note that no declaration (such as DIMENSION) is required before using a variable with subscripts.
15. A more complicated example of subscripting; the subscript expression is R/2.
16. TYPE ALL VALUES commands ESI to type out the values of all defined variables.
17. Note that the values of I and R, after the completion of iterative statements involving them, are not the terminal values specified by the FOR statement.
18. A question mark (?) typed as the last character of a line causes the entire line to be completely disregarded

by ESI. This is used both for the deletion of seriously mistyped lines (see note 23 on the use of RUBOUT to delete minor errors) and for comments.

19. If a number is typed preceding a statement, the statement is not executed immediately, but is stored away associated with that number, called its "step number."
20. DO STEP commands the execution of a previously stored step.
21. DEMAND (here being executed in step 1.1) requests from the user a value for the indicated variable (in this case R). Note that the back arrow (←) again indicates that ESI has given control of the Teletype to the user.
22. Previous TYPE statements illustrated the typing of evaluated arithmetic expressions (TYPE X*Y.) and of character strings (TYPE "THAT'S RIGHT".) This example illustrates how a single TYPE statement may mix these two forms. Character strings in quotes alternate with arithmetic expressions (in this case, note that R, A, and C are very trivial arithmetic expressions).
23. The user can type RUBOUT to delete a typing error. Each RUBOUT deletes one character and types a back arrow to indicate this. Any number of characters can be deleted this way; if RUBOUT is typed with the input line completely empty (all characters rubbed out), the bell is rung.
24. The digit preceding the decimal point in a step number is called the *part number,* and must be in the range of 1 to 9. All steps with same part number are considered to be a *part* of the program. The DO PART command causes each step of the part to be executed in step number order. At the end of execution of the last step (the one with the highest numerical step number), control returns to the step following the DO PART if it was executed from an indirect (stored) statement or to the user if it was executed as a direct statement (from the Teletype).
25. We forgot to give a definition for P. Note that the error was not detected until the statement was executed.
26. This illustrates an abbreviated form of the SET statement which can only be used as a direct statement (executed immediately rather than being stored away). P is, of course, π.
27. TO STEP causes the designated step to be executed next, rather than the next step in step number order. Note that step 1.5 is inserted following step 1.4, causing the entire program to be a five-step loop.
28. At any time during the execution of a program, the ALT MODE key on the Teletype can be typed. At the end of execution of the current steps, the execution of the program is interrupted and an appropriate message is typed. When execution is suspended, the only legitimate statements are GO, CANCEL, and TYPE.
29. GO commands that the interrupted program be continued where it left off.
30. The user may type any arithmetic expression in response to a DEMAND but must make sure that only defined variables are used in the expression.
31. CANCEL commands that the execution of the program be cancelled. It cannot now be continued with GO.
32. At this point, we have decided to evaluate the area and circumference for a given range of values of the radius. We therefore delete the DEMAND statement and insert iterative statement as part 2.
33. We forgot to delete step 1.5, which now refers to a non-existent step number.

34. TYPE ALL commands the typing of everything currently stored by ESI—that is, all steps and all values.

The storage allocation of ESI provides the user of a minimum (4K) machine with about 800 words of core (600 if the optional SIN, COS, SQRT functions are added). This user core is used to store program steps, subscripted variable elements, and work space for the system; unsubscripted variables do not occupy any space in user storage. If no steps are stored, there is room for about 130 array elements; if no subscripted arrays are used, there is room for about 60 program steps. The system provides for the free trading of program steps for array elements; any particular program will strike some balance between them. This amount of storage is adequate for the program and data for the inversion of a 6 x 6 matrix, for example.

The response time of the system operating on the PDP-8/s is very good. Program editing (insertion and deletion of steps) usually is unnoticeable; simple direct statements are also executed very fast. The time required for the execution of indirect statements is, of course, a function of the complexity of the program, but is quite comparable with existing conversational-mode time-sharing systems. The response time of the PDP-8 for indirect program execution is consistent with the 15-time speed advantage of the PDP-8 over the PDP-8/s.

In summary, ESI provides a powerful tool for the solution of modest size numerical computational problems. Many problems currently solved by hand can now be computerized at a reasonable cost. Furthermore, it offers a reasonable alternative to the cost and complications of time-shared use of a larger computer. ■

PERMISSIBLE FORMS IN ESI-R:

```
DIRECT OR INDIRECT:

SET C = A*B+C*D.
SET C(I,J) = B(I-1,J+2)-C(I+1,J/2)
SET Y = IP(X/I).
FOR I = 1(1)N, SET A(I) = B(I)*C(I).

DO PART 3.
FOR R = 0(0.1)1.5, DO PART 2.
DO STEP 3.7.
FOR J = N(-1)1, DO STEP 7.352.

TYPE 2+3+5.
TYPE X.
TYPE X, IP(X), SGN(X), ABS(X).
FOR I = 1(1)N, TYPE A(I).
TYPE "THIS IS A STRING".
TYPE "THE SQUARE OF" X "IS" X↑2.
TYPE STEP 2.3.
TYPE PART 6.
TYPE ALL PARTS.
TYPE ALL VALUES.
TYPE ALL.

DELETE X.
DELETE A(1,3), B(I,J), C, D.
DELETE ALL VALUES.
FOR I = 1(1)N, DELETE A(I).

LINE.
```

```
DIRECT ONLY:

DELETE STEP 1.1.
DELETE PART 2.
DELETE ALL PARTS.
DELETE ALL.

X = 3*ABS(A-B)
Y=Z+R
Z = 14
A(1)=1.3E-6
A(-43) = 1.414E+32
A(2) = 3175*I


INDIRECT ONLY:

1.1 TO STEP 1.7.
1.7 TO PART 4.

2.3 END.

4.1 STOP.

6.1 DEMAND X.
7.35 DEMAND A(I,J).
8.1 DEMAND A(45).
```

```
CONDITIONAL CLAUSES:

IF A = B,
IF ABS((N-O)/N) < 1E-6,
IF IP(X) GE IP(Y),
IF SGN(X) NE 1,
IF (A-B)/C LE D-X↑2,
```

```
NUMBERS:

2
3.141593
.003
0.01
-3.7E5
4.36E-7
-3.273E+17
```

```
OPERATIONS:

+ - * / ()


RELATIONS:

< > = GE LE NE
```

```
FUNCTIONS:

IP(X)     INTEGER PART
FP(X)     FRACTION PART
SGN(X)    SIGN PART
ABS(X)    ABSOLUTE VALUE
SQRT(X)   SQUARE ROOT
SIN(X)    SINE
COS(X)    COSINE
```

```
INTERRUPTED OR STOPPED:

ANY "TYPE" STATEMENT.
GO.
CANCEL.
```

```
← IS TYPED AND THE BELL RINGS WHENEVER A USER TYPE-IN IS REQUESTED.
( AND ) ARE USED TO DENOTE SUBSCRIPTS.
? TYPED AT THE END OF ANY LINE CAUSES IT TO BE DISREGARDED.
"RUBOUT" DELETES THE PRECEDING CHARACTER AND TYPES ← TO SO INDICATE.
STEP NUMBERS ARE IN THE RANGE 1 TO 9.999999.
VARIABLES ARE THE SINGLE LETTERS A THROUGH Z.
"ALT MODE" INTERRUPTS EXECUTION OF A PROGRAM AT THE COMPLETION OF THE
 CURRENT STEP; ON A "DEMAND", "ALT MODE" CANCELS EXECUTION.
```

The Chairman's Welcome

by BRIAN W. POLLARD

The 1967 Spring Joint Computer Conference is the thirtieth event of its type sponsored by AFIPS and its predecessor organizations, and it will be the largest in history. More than 5,000 computer scientists and 110 exhibitors will convene in Atlantic City's Convention Hall, reflecting the tremendous growth of the computer industry in a relatively short time. It is my pleasure to invite everyone who is interested in the information processing field to attend this meeting.

A broad technical program consisting of 34 sessions will be presented. Four general areas of wide and diverse interest—hardware devices, logic and computer organization, programming and applications, and analog/hybrid systems—will be discussed.

The keynote address, "National Data Banks and Privacy," will be delivered by Rep. Cornelius E. Gallagher (D-N.J.). A member of Congress for the past eight years, he is chairman of a special congressional subcommittee studying the invasion of privacy. He also will lead a three-man panel discussion on "The Privacy Problem" April 18 at Convention Hall. The other panel members are Stanley Rothman, TRW Systems, and Professor Alan F. Westin, Columbia University.

Those familiar with past conferences will notice a significant increase in the number of panel discussions. Seven sessions devoted to this purpose will provide a forum for open discussion and debate.

Maj. Gen. John W. O'Neill, chief of the Air Force Electronic Systems Division at L.G. Hanscom Field, Mass., will be the featured speaker at the banquet on Wednesday evening, April 19. He will discuss user-oriented computer technology. Gen. O'Neill is responsible for developing, acquiring, testing and delivering electronic, computer-based command and control systems for the Air Force.

Highlights of the technical sessions will include papers on: ILLIAC IV—its logical structure and its systems and applications programming considerations; logic-in-memory—describing magnetic, semiconductor and superconductor techniques for special purpose memories which have logic capability within the memory cells; and analog hybrid applications.

Interesting panel sessions will include thought-provoking discussions of "What's New in Programming," "Should There Be Standardization of Machine Instructions," and a special session on "Management Conditions for Management Information Systems."

One session expected to attract the interest of those outside the edp community is "Aspects of Computer-Assisted Instruction." Following presentation of the session's technical papers on Wednesday morning, April 19, Dr. Duncan Hansen of Florida State University; Dr. Sylvia Charp, Philadelphia Department of Education, and Mr. Donald Frush of IBM will join the authors for a panel discussion on CAI. Professor Hansen also will address a special ladies' session on Thursday morning, April 20. He will discuss "Computers and Children," explaining computer-assisted instruction, its future and how it affects your children's education. ■

Brian W. Pollard

The Conference Particulars

They say the temperature averages 48.6° around April, and there's usually a cooling 14.8-mph ocean breeze. There's a five-mile boardwalk, eight-mile beach, six ocean piers, 22 theatres, 541 restaurants, hundreds —and hundreds—of hotels and motels, four golf courses, 2000 roller chairs, lots of night clubs without gambling, a Henry Tussaud wax museum, and the world's largest pipe organ in one of the largest convention halls. Oh, and they claim Henry Hudson passed by Atlantic City in 1609.

April 18-20, the Spring Joint Computer Conference will be held in "Convention City"—readily accessible to Philadelphia, New York and Washington, but only close enough to one computer tour. This 30th AFIPS-sponsored meeting is expecting a crowd equalling the one at the last fall meeting in San Francisco. More than 5000 attendees will be strolling—or rolling—on the 15 blocks of boardwalk between Convention Hall and Chalfonte-Haddon Hall, the convention hotel.

More than 100 exhibits, showing wares valued at $35 million, will be set up in the exhibit hall, which boasts 320,000 square feet of floor space. About 7,500 are expected to tour the exhibits, which will be open Tuesday, 11-6; Wednesday, 10-6; and Thursday, 10-5.

A highlight of the SJCC '67 will be the heavy conference proceedings, since about 100 papers will be given during the technical program. The sessions, 27 paper/panel sessions plus seven panel discussions, primarily cover four general areas: hardware devices, logic and computer organization, programming and applications, and analog/hybrid systems.

Considerable attention, however, will be given the problems created by such advances as time-sharing—privacy and security. A major government spokesman on the topic, Representative Cornelius Gallagher (D.-N. J.), will lead off the keynote session (Tuesday, 9:30 a.m.) with a talk on "National Data Banks and Privacy." One of his major concerns has been the danger that a National Data Bank, advocated by the Bureau of the Budget, could be converted into a Personal Dossier Bank. Joining him on the rostrum will be Dr. Alan F. Westin, professor of political science at Columbia Univ., who will speak on "Legal Safeguards to Insure Privacy in a Computer Society." A talk on the "Meaning of Privacy" will be given by Stanley Rothman of TRW Systems, who is chairman of the AFIPS Committee on Privacy and Government Information.

Then a paper/panel session Wednesday morning will treat the technical aspects of guaranteeing information protection. Representatives will be on hand from government, research, university and commercial organizations working with the problem.

Computers in education will be explored in a paper session on computer-assisted instruction and a panel discussion on the expanding role of analog and hybrid computers in education. Among other panels will be a special Thursday morning session presenting management's viewpoint on management information systems: what information management needs and how much it is willing to pay for it. And, in view of, or in spite of, government roadblocks to patenting programs, a panel will deal with legal protection of software.

The sponsoring societies (Association for Computing Machinery, IEEE Computing Group, American Documentation Institute, Simulation Councils, Inc., and the Association for Machine Translation and Computational Linguistics) will also have sessions during SJCC and the Friday after. Those wanting to delve further into the privacy and other social issues can attend the ACM social implications bull session (SIC-II) on Wednesday evening, 9-11.

Advance registration for the conference will be Monday, April 17, at Chalfonte-Haddon Hall, where a preconference cocktail party will be held at 5:30 that evening (Pennsylvania Room). Registration then switches to Convention Hall, Tuesday-Thursday, 8:30-5.

A conference reception is back in its Tuesday slot, 6-8 p.m. in the Pennsylvania Room of the hotel. Wednesday evening, a banquet (same place, 6:30) will highlight a talk by Maj. Gen. John W. O'Neill, chief of the Air Force Electronic Systems Command at L. G. Hanscom Field. John Backus of UC Berkeley will receive the IBM W. W. McDowell award for his work in the field of higher level languages.

The one tour on the SJCC program will be to FAA's National Aviation Facilities Experimental Center, 20 miles from the city. The traditional Computer Sciences Theatre will be showing films in two rooms, A and B, at the Convention Hall throughout the conference, ending at noon on Thursday.

Unlike many past conferences, there will be no student-oriented programs, although the ladies will have a chance to hear a talk and ask questions on how computer-assisted instruction will affect their children. This is given by Prof. Duncan Hanson of Florida State Univ., Thursday, 10-11:30 a.m., in the Solarium of the hotel.

The city itself promises "health and pleasure" in its brochures. (Pure air for city-dwellers.) It has every conceivable sports facility including horseback riding on the beach, ice skating and trapshooting. The night clubs are said to have top names, but their secrecy for competitive reasons is tougher to crack than the Great Fortress in the midst of an anti-trust investigation. A "wonder" for those who collect indescribable restaurants is Zaberer's, outside Atlantic City, where the food is said to be good, if you can get past the Zaberized drinks.

And if you want, you can stick around until September to hear Bert What's-His-Name sing: "Here she is, Miss You-Know-Who." ■

The Exhibitors

EXHIBITOR	BOOTH
Adage, Inc.	602-605
Adams Associates, Inc.	1008-1009
Addison-Wesley Publishing Co., Inc.	130
Advanced Computer Techniques Corp.	"G"5
Amp, Inc.	"L"
Ampex Corp.	406-409
Anelex Corp.	1301-1303
Applied Data Research, Inc.	"P"1&"P"10
Applied Dynamics, Inc.	"H"4-"H"6
Auto-Trol Corp.	803-804
Baldwin Kongsberg Co.	1207-1208
Bell System	901-903
Benson-Lehner Corp.	1401-1403
Beta Instrument Corp.	212
Bolt, Beranek & Newman	13
Brogan Assoc.	1001
Bryant Computer Products	114-115
Burroughs Corp.-ECD	402-403
California Computer Products, Inc.	"M"4-"M"9
Calma Co.	216-217
Comcor, Inc.	214-215
Compat Corp.	118
Computer Design Publishing Corp.	601
Computer Sciences Corp.	306-307
Computers and Automation	101
Computer Test Corporation	304-305
Computer Usage Co., Inc.	"O"8
Concord Control, Inc.	1511-1512
Consolidated Electrodynamics Corp.	302-303
Control Data Corp.	"N" & "F"
Corning Glass Works	301
Cybetronics, Inc.	1105-1106
Dartex	1404-1406
Datamation	412-414
Data Pathing Inc.	"P"5-"P"6
Data Processing Magazine	113
Decision Control, Inc.	"H"8-"H"10
Dial-Data, Inc.	"E"12
DI/AN Controls, Inc.	"M"10-"M"11
Digital Devices, Inc.	109
Digital Equipment Corp.	"E"1-"E"6
Digitronics Corp.	809-810
Electronic Associates, Inc.	"A"
Electronic Memories, Inc.	1005-1007
Fabri-Tek Inc.	"D"
Ferroxcube Corp. of America	"O"4-"O"6
General Computers, Inc.	230
General Kinetics, Inc.	208
General Precision/Librascope	1201-1204
Geo Space Computer Div.	"P"7-"P"9
GPS Instrument Co., Inc.	811-812
Hewlett-Packard Dymec Div. Hewlett-Packard Datamec Div.	"E"7-"E"11
Holt, Rinehart & Winston, Inc.	218
Honeywell, Computer Control Div.	606-610
Houston Omnigraphic Corp.	116-117
Indiana General Corp.	410-411
IBM Corp.-DP Div.	"B" & "C"
Interdata	"M"3
Interstate Electronics Corp.	127
Invac Corp.	"G"8
ITT-Ind. Prod. Div.	1010-1011
Kennedy Co.	1002
Kleinschmidt, Div. of SCM	"P"2-"P"3
Lancer Electronics Corp.	209
Lenkurt Electric Co., Inc.	227
Litton Electronic Bus. Systems	"G"6-"G"7
Litton Industries Datalog Division	904-906
Lockheed Electronics Co./A.I.P. Div.	805-808
Magne-Head, Div. of Gen'l Instr. Corp.	801-802
McGraw-Hill Book Co.	"M"12
Micro Switch Div. of Honeywell	219
3M Co. -Mag. Products Div. -Microfilm Products Div. -Revere-Mincom Div. -Visual Products Div.	308-314
-Reflective Products Div.	110
Monitor Systems, Inc.	"P"4
Mosaic Fabrications, Inc.	123
NCR	501-510
Patwin Electronics	1522
Precision Instrument Co.	1107-1108
Prentice-Hall, Inc.	1012
RCA-EC&D Div.	102-103
RCA-EDP Div.	701-712
Raytheon Co.	201-202
Raytheon Computer	"K"
Redcor Corp.	404-405
Rixon Electronics Inc.	223
Sanders Assoc., Inc.	907-912
Scientific Data Systems, Inc.	"I"
Soroban Engineering, Inc.	1205-1206
Spartan Books	"H"7
Sylvania Electric Products, Inc.	"O"3
Systems Engineering Labs, Inc.	"G"1-"G"4
Tally Corp.	1404-1406
Tasker Instruments Corp.	"M"1-"M"2
Teletype Corp.	1101-1104
Thompson Book Co.	401
Transistor Electronics Corp.	"O"1-"O"2
Univac	"J"
University of Pittsburgh	111
U.S. Magnetic Tape Co.	108
Vermont Research Corp.	1501-1502
Western Union	1003-1004
John Wiley & Sons, Inc.	"O"9
Xerox Corp.	1304-1306
Zeltex, Inc.	204-205

SJCC
ATLANTIC CITY 1967
april 18-20

The Product Preview

APPLIED DATA RESEARCH, INC.
Princeton, New Jersey

AUTOFLOW software system produces two-dimensional flowcharts directly from COBOL, FORTRAN and assembly language source programs. The system automatically performs statement analysis, page allocation, line drawing and rearrangement of program flow. Symbols conform to ASA flowcharting standards.

Company will also demonstrate ESI (Engineering and Scientific Interpreter) software that enables a user to communicate in English with PDP-5, PDP-8, or PDP-8/S computer systems in an on-line conversational mode.

CIRCLE 154 ON READER CARD

APPLIED DYNAMICS, INC.
Ann Arbor, Michigan

Being exhibited is the Applied Dynamics-Four, a 100-volt solid-state analog computer with built-in interface between analog and digital subsystems that provides a single control, addressing and data-conversion system. Programming is accomplished by two separate patchboards, a 3840-hole shielded system for analog signals, and a 1920-hole unshielded board for programming logic and control signals. The operational amplifier is solid-state with an output range of ± 150 volts, and the system can expand to 288 amplifiers.

CIRCLE 155 ON READER CARD

AUTO-TROL CORPORATION
Arvada, Colorado

Model 3400 curve tracer is a digitizer designed for reducing analog graphic data to digital form for computer processing. X and/or Y true plus and minus coordinate values are recorded at operator-selected increments on mag tape, paper tape or cards while operator manually traces the curve. Data is formatted by way of an operator-wired patch panel. Resolution is .001"; accuracy is ± .004".

CIRCLE 156 ON READER CARD

BENSON-LEHNER CORPORATION
Van Nuys, California

The 8000 series incremental plotters operate at a speed of 800 steps per second. The 8125 and 8325 feature .0025-inch step size; the 8105 and 8305 have .005-inch step size. Series includes Benson-Lehner's proprietary Delta Control Logic.

Also being announced is the Digital Drafting System, operating at

a speed of over 700 inches/minute. The system has an accuracy of ±0.002-inch and resolution of .001-inch. DDS has computerized logic, a non-destruct memory and modular design.

CIRCLE 157 ON READER CARD

BETA INSTRUMENT CORPORATION
Newton Upper Falls, Massachusetts

Cathode-ray tube displays have solid-state circuitry and are for applications in flying spot scanners, film readers, radar display, computer output displays and TV monitors. Displays utilize 5" flat-face magnetically deflected CRTs. The PD1000 features a .0015" spot size; PD1100, .001"; and PD1200, .0005". Basic displays include video amplifiers, phosphor protection circuits, x-y sawtooth generators and resolved sweep generating circuitry.

CIRCLE 158 ON READER CARD

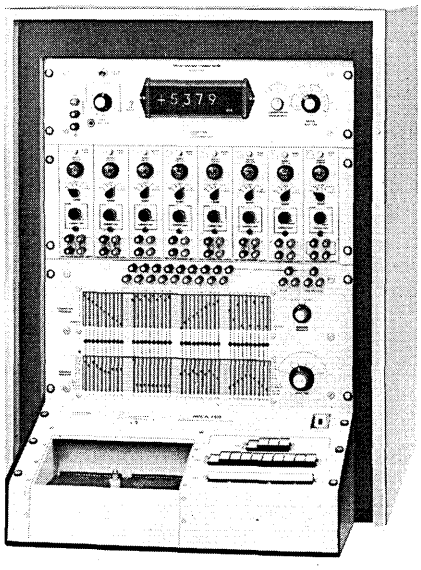
COMPUTER SCIENCES CORPORATION
El Segundo, California

EXODUS translation program converts programs written for IBM 1410 and 7010 machines into System/360 assembly language, eliminating the need for reprogramming or emulators. Translation retains all original program logic. High conversion factor is due to library of 360 macro instructions which interpret portions of original coding not translatable on a direct basis.

CIRCLE 159 ON READER CARD

COMPUTER TEST CORPORATION
Cherry Hill, New Jersey

MICA-150 semi-automatic circuit analyzer is a benchtop tester for DC analysis of integrated circuits having up to 40 pin connections. Ana-



lyzer features crossbar switch programming, push-button test sequencing, built-in digital readout, universal test adapters, device protection, variable test time and modular construction. With an accuracy of 0.1%, the unit can test all standard i.c. packages.

CIRCLE 160 ON READER CARD

DATA MACHINES, INC.
Newport Beach, California

System-oriented DATA/620I i.c. digital computer interfaces with special-purpose components through Party Line I/O system; has Micro-EXEC facility which permits subroutine processing at nanosecond speeds. Offers modular software, up to 32K (16- or 18-bit storage) and a memory cycle time of 1.8 usec.

CIRCLE 161 ON READER CARD

DECISION CONTROL, INC.
Newport Beach, California

4VS VersaSTORE magnetic core memory system features a 4-usec clear-write/read-restore cycle and an access time of 1 usec. Available in capacities from 256-2048 4- to 16-bit bytes, the unit also includes diode-transistor-logic interface circuits.

CIRCLE 162 ON READER CARD

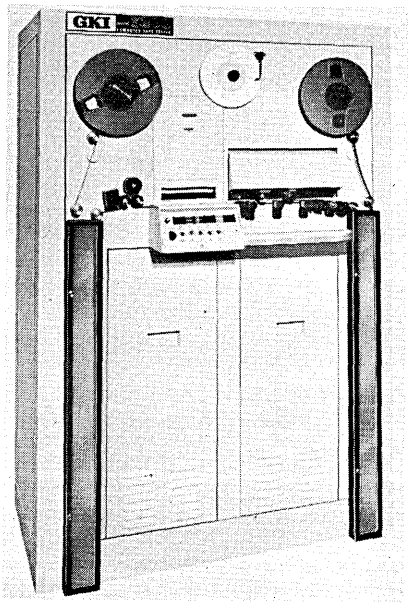
DI/AN CONTROLS, INC.
Boston, Massachusetts

Series 2000 time delay modules for use in timing and control applications are factory preset to timing ranges of from 1-300 seconds, and will hold precision to ±2% over a wide voltage and temperature range. Variations include the Series 2100 timers incorporating a hold feature which enables small increase in the time interval after the delay has been initiated. Series 2200 timers are recycling unit pulsers.

CIRCLE 163 ON READER CARD

GENERAL KINETICS, INC.
Arlington, Virginia

Model 3200 magnetic tape tester has been designed for users of 3200 fci (1600 bpi) computer tape. Instrument checks tape in a single pass operation, uses nine overlapping tracks in a 5 + 4 array, and has built-in cleaning devices. Modes of operation include evaluation, rehabilitation and certification.



CIRCLE 164 ON READER CARD

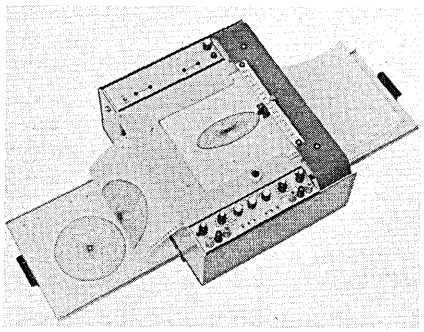
GENERAL COMPUTERS, INC.
Los Angeles, California

Model 200 diode function generator is programmed by punched cards. Functions are composed of 11 contiguous line segments, and may be programmed to any value in range of ± 100 volts to within 0.05 volts. Frequency phase shift is less than 1 degree at 1000 cps; programming accuracy is .1%.

CIRCLE 165 ON READER CARD

HOUSTON OMNIGRAPHIC CORPORATION
Bellaire, Texas

Model 6452 recorder has slewing speed of 15″/second on x axis and 20″/second on y axis with 18 calibrated DC voltage ranges for each axis. Input impedance is 1 megohm on all ranges. Mod 6320 recorder uses



fan-fold paper, allowing a series of consecutive records without individual handloading of sheets. Mod 6650 is a bidirectional incremental plotter in which pen and paper move independently in discrete or incremental steps at speeds up to 18K increments per minute.

CIRCLE 166 ON READER CARD

INTERDATA
Farmingdale, New Jersey

Model 3 i.c. digital computer is designed for use in process control, real-time accounting, sequence control, data acquisition and education. System has 2-usec cycle time, core storage capacity of 1024-65K (8-bit) bytes, sixteen 16-bit registers, and 16- and 32-bit instruction word format. I/O channel can handle 256 devices on a priority basis in a multiplexed transfer mode. Software includes assembler, subroutines, utility routines and ALGOL subsets.

CIRCLE 167 ON READER CARD

DATALOG DIVISION
LITTON INDUSTRIES
Beverly Hills, California

Exhibited will be an alphanumeric page printer which records over a half-million characters per minute on photosensitive paper. The MC 8800 Datalog is a CRT printer which accepts serial data at a rate from 0-8800 characters per second. The record emerging from the printer is a permanent copy. Unit has an MTBF of over 8000 hours.

CIRCLE 168 ON READER CARD

RIXON ELECTRONICS, INC.
Silver Spring, Maryland

PM-24 data transmission modem uses phase shift modulation techniques, and is for computer systems configured to poll remote stations. The modem transmits 2400 bps over a type 4003 (4A) voice-grade line without adjustments due to high tolerance of line distortion, and will operate in a bandwidth of 1200 Hz. PM-24A operates with a minimum spectrum to enhance operation; PM-24B is compatible with the Bell 201B data set. Error rate is less than 1 in 10^5 at a signal to noise ratio of 13 db. MIL STD 188 B interfaces are also available.

CIRCLE 169 ON READER CARD

SYSTEMS ENGINEERING LABORATORIES, INC.
Fort Lauderdale, Florida

Model 80-816A is a computer-controlled graphic display system available for use with SEL Series 800A computers. Unit has 16″ CRT, P31 phosphor, .015 spot diameter, and electromagnetic deflection. Optional equipment includes alphanumeric character generator, constant time vector generator with intensity compensation, and a light pen for detection and modification of graphic information.

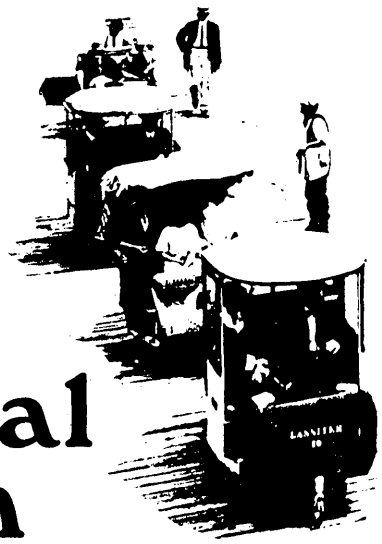
CIRCLE 170 ON READER CARD

TALLY CORPORATION
Seattle, Washington

System 180 data transmitter reads 80-column cards, converts to BCD 7-level code format, and transmits over voice-grade telephone circuits to paper or mag tape receivers. Unit provides automatic error indicator and allows for retransmission of any cards received in error. Transmission speed is 56 cps.

Also being announced is photoelectric tape reader Mod 500R, offering bidirectional reading speeds from 100-500 cps synchronously and up to 200 cps asynchronously. In wind-search mode, unit operates at 1000 cps.

CIRCLE 171 ON READER CARD



The Technical Program

by M. P. CHINITZ

The SJCC '67 technical program consists of 34 sessions treating four areas of broad interest: hardware devices, logic design and computer organization, programming and applications, and analog/hybrid systems. The program committee has tried to present a balanced program with sessions on both theory and practice. Many sessions, especially those on logic and organization, will be of interest to both engineers and programmers. The seven sessions devoted to these subjects of dual interest are an important advantage of joint computer conferences.

Those familiar with past conferences will notice the significant increase in the number of sessions scheduled. This is mainly due to the large number of panel discussion sessions. The program committee believes that a conference should not only be a means for presenting quality technical papers, but should also provide a forum for discussion and debate. Seven sessions are devoted exclusively to this purpose.

The subjects selected for panel sessions are ones which may have a major effect on future developments in the computers arts, but for which the eventual direction of development is not yet clear. The purpose of the panel discussions will be to present informally different points of view and then to explore these views so as to define or clarify principal problem areas and benefits. Since the panel sessions are not described elsewhere in this issue of DATAMATION, I shall list them briefly to indicate the topics treated.

The best approach to large computing capability. Gary Hollander promises a lively debate on the best way to build the super-computer. Should it be a multi-processor, an associative parallel processor, an array-type system, or can it still be done by the traditional single processor approach? Proponents of each scheme will marshall facts and figures to convince you and each other of the value of their position.

The role of analog/hybrid computers in education. John Evans' panelists will discuss the new opportunities available for improving and expanding the educational use of these systems.

Will integrated circuits remove the military commercial computer split? Dr. Van Meter of NASA heads this discussion on whether the innovation of LSI technology will eliminate the need for a separate development of military computers by enabling the best commercial design practice to meet military reliability criteria.

Should there be standardization of machine instruction? A number of competitive computers, recently introduced, are essentially identical in instruction format and order code types. Is this the beginning of a trend toward standardizing machine languages such as has already occurred with card and tape data formats? Dick Utman will chair a panel discussion on the pros and cons of such a standardization.

What's new in programming? In spite of the efforts toward standardized programming languages, recent application developments have actually increased their number and degree of specialization. This panel, chaired by Steve Wright, will discuss whether programming can remain a unified discipline under these conditions and what direction future language developments may have to take.

Analog/hybrid techniques for solving partial differential equations. Robert Vichnevetsky will lead a discussion on the basis for selecting suitable methods for solving PDE's by the newer hybrid systems.

Legal protection of computer software. This controversial subject has generated considerable interest in the programming community. Morton Jacob's panel will consider the legal and economic impact of program patents on the data processing industry.

Panel discussions will also be part of several of the technical paper sessions. The spontaneity of give and take by the panelists is the unique way in which a conference can inform its audience, and that cannot be successfully duplicated by reading a journal.

In addition to the panels, three tutorial sessions are scheduled. Two of these are essentially reports on advanced work. Dr. Gorn will describe his studies on how to structure programming languages enabling them to grow in a systematic manner by incorporating new function definitions. This may be a solution to the problem considered by Wright's panel. The other session is an orientation to ILLIAC IV and is the first public presentation for this Solomon-type computer. This system is expected to be completed by 1969 and to have a speed of one billion instructions per second. The logical organization of the computer, the programming systems planned, and the technique of problem structuring to effectively utilize the large arrays of arithmetic units will be described. The third

M. P. Chinitz

tutorial is a survey session on simulation languages. Dr. Jon Strauss will lead a presentation on the basic principles of both digital and analog types of simulation languages and will compare and contrast their objectives and techniques.

The remaining 24 sessions are described elsewhere in this issue by their chairmen. We are fortunate that among the technical papers presented, eight are from foreign countries. Their subject matter ranges from cartoon animation by analog computers in Japan to a time-sharing system in the USSR. The program committee feels therefore that they have presented you with a conference of broad scope with more than enough sessions in your specialty to stimulate your thinking and fully absorb your interest. ■

The Sessions

Tuesday, 1:00 p.m.
Room h-j

Dynamic Allocation of Computing Resources

Chairman:
Anatol W. Holt
Applied Data Research
Princeton, New Jersey

Resource allocation is the guts of all programming even though it has only become an identified topic of importance in the context of large computing utilities used for the concurrent execution of many independently initiated computations.

In programming a specific complex task on a specific machine, one is first of all constrained by the logic of what subtasks feed what other subtasks. Within that set of logical constraints, there is normally a large area of choice, both in the sequencing of subtasks, and the assignment of alternate subunits of the computer for subtask accomplishment—choice among alternate storage areas, registers, processing units, channels; in other words, choice in what specific resources to allocate to what subtasks. In making these choices the programmer solves a resource allocation problem which is his distinctive contribution.

In some cases it becomes practical for the programmer to express in his code, not a fixed schedule of resource utilization, but rather his policy for making of such a schedule. The degree to which this is desirable depends on the degree to which data available during the computation influences the factors contributing to allocation decisions. Programmers writing executive programs for time-sharing systems for example, are faced with a need to write "schedulers" or "allocators" because: a) the allocation requirements for subtasks (user programs) cannot be known prior to the computation (operation of the time-sharing system), and b) many of the subtasks are sufficiently independent to permit a large area of programming choice as described above. Thus, papers on dynamic resource allocation are really papers about widely applicable programming principles, clearly enough expressed to be amenable to embodiment in scheduling and allocating programs.

A Resource Allocation Scheme for Multi-User On-Line Operation of a Small Computer, by Allen Reiter.

Effects of Scheduling on File Memory Operations, by Peter J. Denning.

Address Mapping and the Control of Access in an Interactive Computer, by David C. Evans and Jean Yves Leclerc.

Tuesday, 1:00 p.m.
Ballroom

Managing the Development of Computer Programs—A User's Viewpoint

Chairman:
I. D. Nehama
Bellcomm, Inc.
Washington, D.C.

At the 1963 FJCC, the keynote speaker recited a list of horrors—cost overruns, slipped schedules, missed objectives, disappointing performance—experienced by the USAF in the development of computer-containing systems. He pointed the finger squarely at software as the culprit and made a plea to the computer profession "to do something about it." The speaker could draw little comfort from the fact that the same experiences and concerns were shared by the majority of computer users, both in and outside the government. These concerns are even more pressing today as computer-containing systems are being designed to perform more complex functions in a ever-increasing number of applications.

Computer programming has reached such a state of technical maturity that, in the majority of cases, the development of computer programs to function as subsystems of larger systems is becoming similar in nature to an engineering undertaking for hardware subsystems. While many techniques have been devised for and used effectively in controlling the development of hardware systems, until recently little attention has been paid to tools for the control of computer program development.

The four papers in this session present and discuss methods and procedures that can be used by the *user* of computer programs—i.e., the person(s) for whom the programs are being developed and who usually pay for them—to ensure that the programs perform as intended, are delivered on time and stay within agreed costs.

The first paper develops the concept of computer programming as an orderly process whose activities are definable and whose outputs are predictable—the concept of computer programs as "end items." The second paper explains the concept of configuration management as a control tool in the life cycle of the computer program. The third paper stresses the importance of the technical specification, both as a means for the user to state the requirements which the computer program must satisfy and as a standard for evaluating the performance of the end items. The last paper discusses the extremely important topics of design verification and test-

ing of computer programs, and presents procedures which can be used during the various phases of development to verify the intermediate and final end products.

The Air Force Computer Program Acquisition Concept, by Milton V. Ratynski.

Configuration Management of Computer Programs by the Air Force: Principles and Documentation, by Lloyd V. Searle and George Neil.

The Technical Specification—Key to Management Control of Computer Programming, by Burt H. Liebowitz.

Air Force Concepts for the Technical Control and Design Verification of Computer Programs, by M. S. Piligian and Capt. J. L. Pokorney.

Tuesday, 1:00 p.m.
Room 20

Computer Logic and Organization

Chairman:
James L. Maddox
RCA-EDP
Cherry Hill, New Jersey

For the most part, computer logic and organization of the general purpose data processing system is decided by logicians. To complete the product, however, requires the services of the systems programmer who designs software, which to some degree is a redesign of the functionality of the hardware, the applications programmer who to some degree redesigns the functionality of the software, and the maintenance engineer who performs some redesign in order to make it function.

The point is that computer logic and organization must take into consideration the total system requirements, and properly support the demands of software, applications, and maintenance. Great strides have been made in this direction with concept of privilege and non-privilege function sets, and special fault location logic to support diagnostics. The growth in diversity, complexity, and performance requirements of computer systems, however, seems to outstrip the development of techniques necessary to the achievement of optimum system performance.

This session of the SJCC is devoted to papers concerned with techniques in computer logic and organization that affect the total system.

D. C. Stanga will present a paper on the Univac 1108 multiprocessor system. This is of special interest since it employs a multiplicity-of-units concept to increase system performance and availability. The 1108 multiprocessor system may be classified as a large-scale data processing system designed for real-time demand processing and scientific batch processing. System performance is increased by parallel processing and availability is increased by modularity of system components.

D. H. Gibson will present considerations in block-oriented systems design, which is a systematic study of the feasibility of transmitting blocks of words between memory and the central processing unit. A simulation model was employed driven by customer-based IBM 7000 series data, indicating that blocks of 4, 8, or 16 words, transmitted to a local storage of 2K-4K words adequately prorate memory access time, providing a performance superior to single-word access.

A paper on intrinsic multiprocessing is jointly authored by Richard A. Aschenbrenner, Michael Flynn, and George A. Robinson. The subject, under study for some time at the Argonne National Laboratory takes advantage of the natural independence of time-shared programs to make efficient use of the execution hardware

and memory of the system. The system essentially employs *n*-time-phased virtual machines which share very high speed execution hardware.

A discussion of ASP, a new development in language and machine organization is jointly authored by D. A. Savitt, H. H. Love, Jr. and R. E. Troop. It will be presented in two parts: the language and the machine. The ASP language is a machine-independent programming language oriented to facilitate the specification of queries and data-base modifications in information retrieval systems. The ASP machine organization was designed specifically to implement the ASP language and permits the entire data base to be processed in parallel by the ASP instruction. Large-scale integrated circuitry is employed to implement an iterative-cell, distributed logic memory which provides the parallel search features of an associative memory and an inter-cell communication feature.

Univac 1108 Multiprocessor System, by D. C. Stanga.

Considerations in Block-Oriented Systems Design, by D. H. Gibson.

Intrinsic Multiprocessing, by Richard A. Aschenbrenner, Michael Flynn and George A. Robinson.

Association-Storing Processor (ASP): A New Development in Language and Machine Organization, by D. A. Savitt, H. H. Love, Jr. and R. E. Troop.

Tuesday, 1:00 p.m.
Room 21

Visual Output Recording

Chairman:
Lawrence Scholten
Philco-Ford Corporation
Willow Grove, Pennsylvania

The advent of time-sharing has extended the requirements for graphic recording and has introduced, to a limited extent, the necessity for pictorial data encoding and reproduction. No single recording device provides the collective features required of these equipments, which include multiple records, graphic recordings, accuracy, resolution, speed, and cost. The performance required of the visual recording devices in a time-sharing system exceeds the speed capability of high accurate mechanical x-y or incremental records, the accuracy attainable from high-speed CRT-to-microfilm recorders, and the speed as well as the reliability of teleprinters used as remote terminals (ignoring the lack of a graphic capability). The objective of this session is to introduce some concepts for improved visual recording in a time-sharing complex with a subsequent panel discussion by the authors of what is ahead in computer visual output recording.

The papers to be given at this session will cover three specific topics in this broad equipment area. The first paper discusses a method whereby equipment accuracy—in particular, a microfilm graphic recorder—may be improved via mathematical techniques. This paper shows how software can be used to greatly improve a device performance and may offer some solution to the visual recording

dilemma. The second paper discusses the handling of photographic material within a data processing system. The digitizing of pictorial data with subsequent ease of scaling and transmission is important within an information retrieval system, as well as many other time-sharing data processing complexes. Some problems and successes in encoding and processing pictorial data are described. The final paper discusses a new thermal printing equipment. With advantages of speed, reliability and low noise over conventional printer terminals, this development could have a significant effect on time-sharing users' terminals.

Mathematical Techniques to Improve the Accuracy of Computer Graphic Devices, C. J. Walter.

Digitized Photographs for Illustrated Computer Output, by R. W. Conn.

A New Printing Principle, by W. H. Puterbaugh and S. P. Emmons.

Tuesday, 1:00 p.m.
Room 13

Application of Analog and Hybrid Computers

Chairman:
Ray Lawrence
George C. Marshall Space Center
Huntsville, Alabama

The analog and hybrid computer techniques session could well be titled, "A Session of Contrasts in the Use of Electronic Computers." The four papers demonstrate: (1) the need for hybrid computation, (2) the lack of need for hybrid computation, (3) a weakness in using a particular analog technique, and (4) a unique means of entertainment through cartoon animation by using just such a system. These four papers plus the others submitted to the session chairman and his review panel point out what is very evident to the computer manufacturer attempting to sell his product. Anyone who has a computer, needs one, or is presently purchasing a computing system is automatically a self-styled expert and has definite ideas on what the computer industry needs to be producing with regard to size and configuration: large analogs with logic, small analogs with no logic, a complete hybrid system by one manufacturer, or a hybrid system to be assembled by the purchaser after securing analog, digital and linkage systems.

An American manufacturer of today is faced with competition from both Europe and the Far East with their relatively inexpensive labor and manufacturing cost. The only way the American manufacturer can outsell his foreign and domestic competition is by mass production. This makes standardization a necessity for the producer of computer systems if his prices are to be competitive and a profit realized. But this brings one to the problem of what should be the standard size or configuration for a computer system.

Over the past years, analog computer systems have developed into recognized classes of small, medium and large computers dependent upon the number of amplifiers. This is not true of the new hybrid systems, defined here as being a combination of analog, digital, linkage and control interface. This new computing system appears to be of the type being used today, as evidenced by the many orders being announced and the amount of advertising being done by the major vendors. Currently, there are at least five hybrid systems being evaluated ranging in price from $1.5 –7.5 million. There are probably many others with range in price and size just as large. Picture the "poor" producer as he tries to outsell his competitor and still make a profit. The ability to produce systems that will be purchased by all classes of buyers has recently reduced two of the oldest vendors of analog computer systems to very limited production.

In summary, due to the aforementioned contrast in the papers received, the wide range of cost and size of orders pending, and conversations with several vendors, I would like to suggest to the analog computer industry and to the computer consumer (especially the hybrid class consumer) that some sort of standardization committee be formed. This committee could define the hybrid size or configuration necessary for several different classes of problems. Possibly, a cost estimate could be made of the system considering such conditions as solution time and the necessary accuracy required.

I hope these comments will start some thinking about where we, who are involved in analog and hybrid computation, are going.

A Time Delay Compensation Technique for Hybrid Flight Simulations, by V. M. Ingalls.

Stochastic Computing, by B. R. Gaines.

Backward Time Analog Computer Solutions of Optimum Control Problems, by Max D. Anderson.

An Application of Hybrid Curve Generation, Cartoon Animation, by Takeo Miura.

Tuesday, 3:30-5:30 p.m.
Ballroom

Data Management

Chairman:
Paul J. Dixon
Auerbach Corporation
Philadelphia, Pennsylvania

Associated with any large organization is an extensive, changing collection of data and files which has the capability of being used as an information resource. The need for data management systems arises when management recognizes that this information resource is dependent on the currency of the data it reflects, and the data must exist in an environment that can be viewed as both an integral set of corporate data, and as a number of separable data sets that model their constituent sub-organizations.

How does one create the environment which makes it possible to use data for effective management planning and control? There must be the ability to alter a data collection system and its structural environment in a convenient, immediate fashion. Inherent in this is the necessity of distinguishing between data in a system and the procedures that process this data. A change in one should not entail the expense of a change in the other.

A data management system contains a growing collection of data services. These range from utility and maintenance routines to a set of user services. Such services are needed to update and restructure the data collection, to do exception reporting and, in general, to render the data available to the people who need it, under any selection criteria. Such services can be maintained, along with their definitions, in a cross-indexed library that is itself a part of the data base.

A versatile handling of data and processing procedures is also the job of an operating system. The distinction is that an operating system emphasizes physical data, while a data management system provides an arbitrarily complex, logical framework—together with related maintenance, utility and user facilities.

Although there is no reason why these systems are distinct, it is presently true that no operating system extant supplies the capability available in a good management system. For this reason, a data management system must either interface with existing operating systems and software, or else it will be unnecessarily expensive.

Data management systems, like all

generalized systems, necessitate an additional overhead. It is a truism that this overhead should be minimized; it is obvious that systems should afford an option to realize this overhead either in required storage capacity or in increased processing time.

If current research and development realizes its promise, the services provided to programmers and nonedp users by generalized data management software systems will bring important new flexibility and economy in the application of computer systems to corporate management and to the application of command and control systems in the military.

The People Problem: Computers Can Help, by E. R. Keller, II, and S. D. Bedrosian.

File Handling at Cambridge University, by D. W. Barron, A. G. Fraser, D. F. Hartley, B. Landy and R. M. Needham.

GIM-1, A Generalized Information Management Language and Computer System, by Donald B. Nelson, Richard A. Pick and Kenton B. Andrews.

Inter-Program Communications, Program String Structures and Buffer Files, by E. Morenoff and J. B. McLean.

DM-1, A Generalized Data Management System, by Paul J. Dixon and Jerome D. Sable.

File Management on a Small Computer, by Gilbert P. Steil, Jr.

Tuesday, 3:30-5:30 p.m.
Room 21

I/O Devices

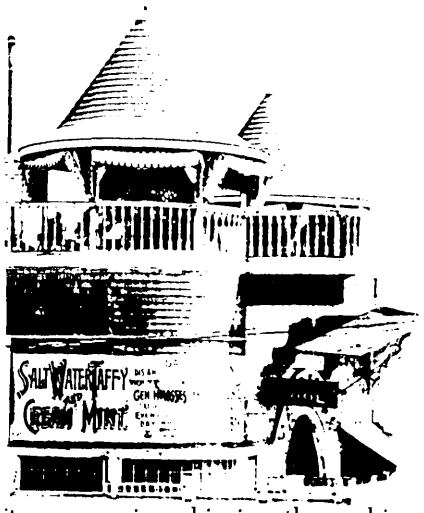
Chairman:
Edwin I. Blumenthal
Burroughs Corporation
Paoli, Pennsylvania

The three papers selected for this session describe computer peripheral devices which contain novel design features.

The papers discuss a militarized magnetic disc (Mem-Brain), a four-station magnetic tape transport (Cluster), and a photo-optical disc file (Photostore). From the standpoint of the peripheral equipment design engineer, these three papers have as a common characteristic the use of unconventional techniques to achieve their respective objectives.

The Mem-Brain's major departure from the standard disc file is in its use, for discs, of sheets of magnetic tape, pre-stressed and held at their periphery, from which they are driven. The overall mechanical design which resulted from this approach has inherently improved capability to withstand the shock, vibration, and environmental extremes frequently encountered in military applications.

The Cluster development had as its primary objective the reduction in cost and improvement in reliability, over conventional magnetic tape transports, achieveable through sharing of electronic and mechanical components among four tape stations. The transport design is unique in that



its success in achieving these objectives has been based on the use of coaxial tape reels: the solution of the tape-guiding problems resulting from the use of coaxial reels at a tape speed of 45 inches per second, and at densities as high as 1600 bpi, form the major portion of the paper.

The Photostore consists of a rotating photo-optical glass disc, coated with a high-resolution emulsion. Recording is via a C-W laser beam at a density of 100 million marks per square inch: playback is obtained by imaging a CRT spot on the desired track and detecting light transmission to a photo-multiplier tube. Sophisticated techniques are obviously required to select the proper track among the more than 2000 located in a one-inch annular region. The objective of this development has been to achieve a large capacity mass store with inherent performance advantages over magnetic disc files; and to demonstrate, with associated search logic, a high speed content-addressable associative memory capability.

The oral presentation of these three papers will not be a reading of what will appear in the conference proceedings, but will instead consist of the author's summation of the paper and an expansion of particularly interesting aspects of the work described.

A Rugged Militarily Fieldable Mass Store, by W. A. Farrand, R. B. Horsfall, N. E. Marcum and W. D. Williams.

The "Cluster"—Four Tape Stations in a Single Package, by J. T. Gardiner.

An Optical Peripheral Memory System, by R. L. Libby, R. S. Marcus and L. B. Stallard.

Tuesday, 3:30-5:30 p.m.
Room 13

Biomedical Computer Applications

Chairman:
Baker A. Mitchell, Jr.
The University of Texas
Houston, Texas

While medicine initially lagged other areas in the broad application of modern computing power to its research and practice, inroads into simulation and statistics have been made. This session presents three examples of applying modern computational techniques to problems in medical research. As an example of a technique not yet utilized by biological scientists, an interesting paper on learning networks is included which presents impressive experimental results.

Computer Applications in Biomedical Electronics Pattern Recognition Studies, by A. J. Welch and Robert G. Louden.

The Oscillating Vein, by Augusto H. Moreno and Peter W. Halbert.

Experimental Investigation of Large Multilayer Linear Discriminators, by W. S. Holmes and C. E. Phillips.

Effect of Stenosis on the Blood Flow Through an Artery, by Peter M. Duida and Louis D. Go'd.

Wednesday, 9:00 a.m.
Ballroom

Security and Privacy in Computer Systems

Chairman:
Willis H. Ware
The RAND Corporation
Santa Monica, California

With computer systems which share configuration resources, there is growing awareness of the risk that data or

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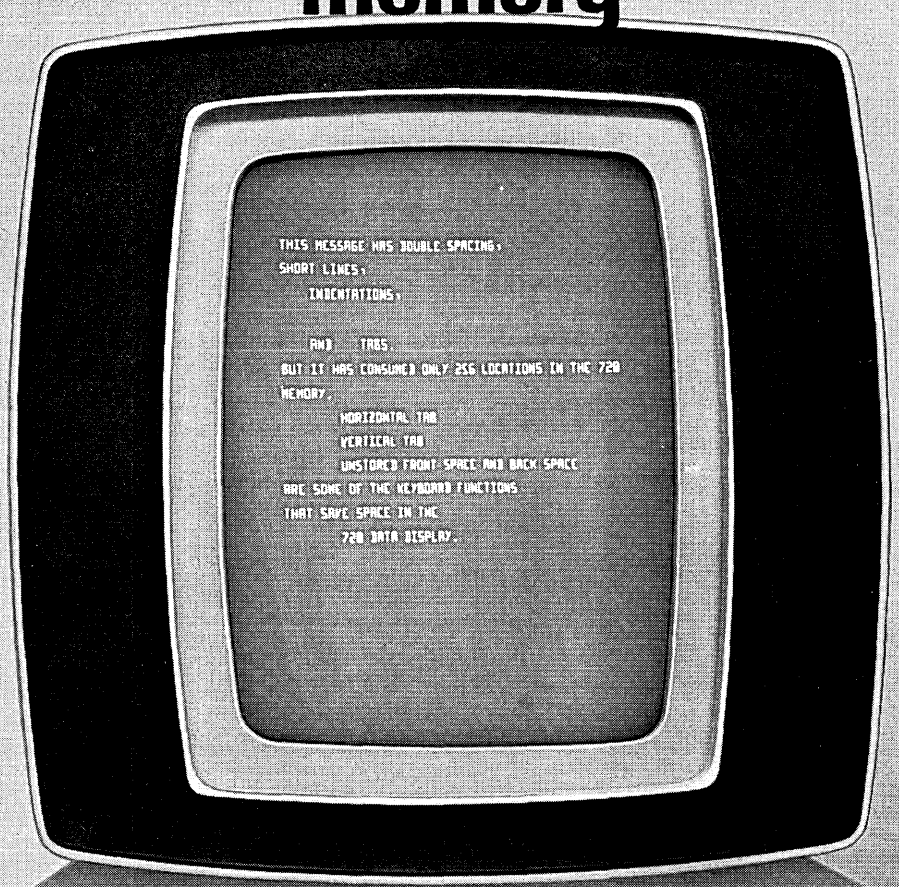

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programs may leak from one problem or user to another.

The necessity for protecting and controlling access to defense-classified information has long been recognized (the security problem). Various forms of resource-sharing computer systems are now making computational power widely available, and it can be expected that each user may wish to protect his files and programs against accidental or deliberate invasion (the privacy problem).

This session takes for granted that the information protection problem is in fact real and does not debate its existence. The purpose of the session is to discuss *technical* aspects of providing such protection and to bring to the attention of the technical and management community

- the nature of the problem
- the vulnerabilities of the resource-sharing systems
- some of the methods which may be used to penetrate a system
- measures which have been taken in presently operational systems to protect information
- measures which might be taken to counter various attempts at penetration
- areas in which further research or development attention is needed

An introduction reviews the configuration of a typical resource-sharing system and identifies vulnerabilities which might lead to information leakage. The first paper describes measures taken to safeguard classified information in a multi-programmed remote-access computer system which must handle several levels of classified information, and control access to files on the basis of authorization. The next paper contrasts the security and privacy problems with the intent of identifying essential differences between them. The final paper summarizes possible methods of penetrating resource-sharing computer systems, and suggests technical approaches for dealing with various

A panel will describe the protective measures which have been incorporated in three planned or presently operating remote-access computer systems.

Information Leakage in a Resource-Sharing Computer System, by Willis H. Ware.

Security Considerations in a Multi-Programmed Computer System, by Bernard Peters.

Security and Privacy: Similarities and Differences, by Willis H. Ware.

Systems Implications of Information Privacy, by Harold E. Petersen and Rein Turn.

Practical Solutions to Privacy Problem: The RUSH Time-Sharing System, by Jame D. Babcock.

Wednesday, 9:00 a.m.
Room 20

Computing Algorithms

Chairman:
Joseph F. Traub
Bell Telephone Laboratories
Murray Hill, New Jersey

The five papers in this session tackle a wide range of problems. The initial paper discusses the effects of hardware design on the implementation of numerical routines, a topic which has come in for considerable recent attention.

The second paper studies mappings from a set of internal number representations to a set of external number representations. Some surprising properties of these mappings are discussed. The following paper is a survey, aimed at the non-expert, of the latest techniques for obtaining accurate solutions to linear algebraic systems. This problem has been one of the most active research areas in numerical analysis in the past decade.

The author of the fourth paper points out the use of recursive tech-

niques as a tool for problem solution and as an aid to programming in areas where recursive techniques are not generally used today. In one sense, a computer library is as good as its validation, and the final paper discusses a technique for testing routines for the calculation of mathematical functions in these libraries.

The Influence of Machine Design on Numerical Algorithms, by W. J. Cody.

Base Conversion Mappings, by David W. Matula.

Accurate Solution of Linear Algebraic Systems—A Survey, by Cleve B. Moler.

Recursive Techniques in Problem Solving, by A. Jay Goldstein.

Statistical Validation of Mathematical Computer Routines, by Carl Hammer.

Wednesday, 9:00 a.m.
Room f-g

Macromodular Computer Systems

Chairman:
Wesley A. Clark
Computer Research Laboratory
Washington University
St. Louis, Missouri

The macromodular approach to computer design emphasizes flexibility and simplicity. There are two advantages to this approach:

First, an experimental element is added to the theoretical and simulational techniques now available to the system designer. Perhaps this can most effectively be employed in research groups having as their main objectives the creation of advanced computer systems for specialized applications. Because of the relative ease with which a given configuration of macromodules can be altered, it is possible for a group to actively work with many different forms to find optimal configurations for different problem classes.

Second, it makes possible a smoothness of growth and refinement in an operating computing system. Because of the electronic independence of macromodules, it is relatively easy to expand a macromodular system to add new functions without seriously affecting the continuity of on-going work and without jeopardizing any existing investment in programs and operating procedures. Macromodular systems are capable of unlimited growth and functional enrichment.

These properties of macromodular systems are of growing importance in the search for more effective information processing systems.

A Functional Description of Macromodules, by Severo M. Ornstein, Mishell J. Stucki and Wesley A. Clark.

Engineering Design of Macromodules, by Asher S. Blum, Thomas J. Chaney and Richard E. Olsen.

A Macromodular Systems Simulator (MS2), by Richard A. Dammkoehler.

A Macromodular Meta Machine, by

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William E. Ball.

The Chasm: A Macromodular Computer for Analyzing Neuron Models, by Charles E. Molnar, Severo M. Ornstein and Antharvedi Anne.

Wednesday, 9:00 a.m.
Room h-j

Some Aspects of Computer Assisted Instruction

Chairman:
Ralph L. Welken
Philco-Ford Corporation
Willow Grove, Pennsylvania

The nature of the learning process is so complex, that there has been little more than a scratching of the surface in our attempts to understand it; it may well be that our prototype and initial CAI systems will in themselves provide an important tool for the continuing and very necessary research.

As a consequence of the current state-of-the-art in CAI, we should not be surprised or disappointed to find that much of the available literature on the topic is of a philosophic or qualitative or even conjectural nature.

Quantification based on experience, experiment, and analysis will follow in the normal course of events. The quantification which does exist today is primarily attributable to a relatively few individuals who have been performing basic research; it comes in the main from the educators' side of the house where research efforts have for too long a time been inadequately supported and where only recently have the proper tools been available. From the computer industry, published quantitative facts, directly concerned with CAI, are virtually nonexistent.

There are essentially three main elements in a CAI system: the student's terminal, the processor controlling the terminal, and the software which provides for the necessary interaction between man and machine. The three papers in this section complement each other in that they consider some broad overall system considerations, some possible strategies within the system itself, and finally a discussion of a specific segment of the system.

Gelman points out that in implementing a CAI system careful consideration should be given to the advantages and disadvantages of a centralized system in which operations at each of several schools would be dependent upon a central processing facility—as opposed to a decentralized system in which each school is independent and autonomous. Major points considered include general mass storage aspects and the reliability/availability considerations.

Dr. K. H. Wodtki discusses some requirements for a student-subject matter interface or in a broad sense the requirements and capabilities needed at the students' terminals. Dr. Wodtki considers the problem in terms of four categories of educating variables, including characteristics of the subject matter and learner, the nature of the instructional process and the objectives of the instruction. Based in part on considerable research to which Dr. Wodtki adds his expert observations, the paper highlights the requirements, capabilities available with current technology, and an opinion as to what we can reasonably expect in the future.

Dr. E. N. Adams takes us inside the system itself where he gives particular attention to the internal allocation of core and mass storage facilities for user and system functions. Dr. Adams' discussion benefits from experience with user programs in the IBM Coursewriter Systems.

Following the presentation of papers, a panel composed of the paper authors and several professionals directly involved with CAI will discuss some of the key points in the papers in addition to accepting questions from the floor.

Central vs. Decentralized Computer Assisted Instruction Systems, by M. Gelman.

Educational Requirements for a Student-Subject Matter Interface, by Kenneth Wodtki.

Reflections on the Design of a CAI Operating System, by E. N. Adams.

Panel: M. Gelman, Kenneth Wodtki, E. N. Adams, Duncan Hansen, Donald Frusch and Sylvia Charp.

Wednesday, 1:15 p.m.
Room h-j

Information Processing in the Business Environment

Chairman:
Gregory M. Dillon
E. I. DuPont DeNemours & Co.
Wilmington, Delaware

This session intends to present three diverse vignettes in the field of information processing in areas other than mathematical and technical computation. The session, of course, is concerned with the forward boundaries of the art. It is concerned, however, with the forward boundaries of presently implemented, operational facilities, and not with "futures."

A paper by C. Allen Merritt presents an advanced information retrieval system in operation. This system illustrates purposeful thinking and advanced techniques in a burgeoning field.

William A. Smith, Jr. will present a paper on control of data errors encountered in the use of automatic recording. This topic is of great interest to those concerned with practical applications of on-line or real-time applications involving continuous updating of data files.

The third paper, by E. K. McCoy, describes an operating real-time system which coordinates and controls a multitude of business operations.

Nature and Detection of Errors in Production Data Collection, by William A. Smith Jr.

Serving the Needs of the Information Retrieval User, by C. Allen Merritt.

The Ohio Bell Business Information System, by E. K. McCoy.

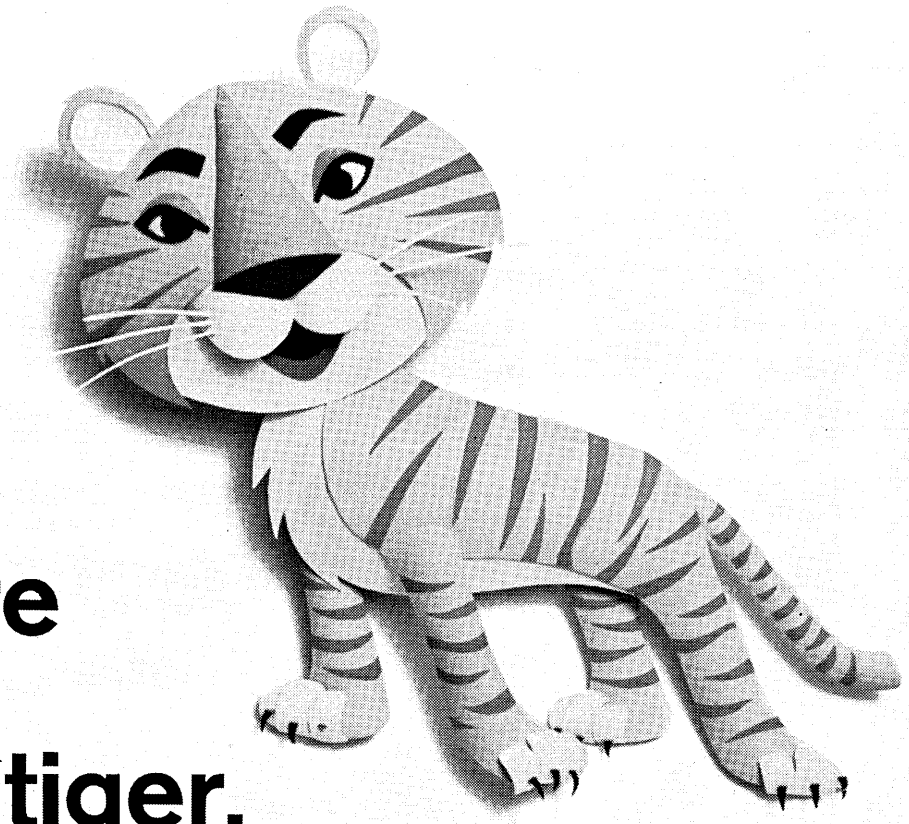
Wednesday, 1:15 p.m.
Ballroom

Techniques In Programming Language —Part I

Chairman:
Grace M. Hopper
Univac
Philadelphia, Pennsylvania

This session concerns itself with three methods of construction of programs.

The first paper, by Allen S. Ginsberg, Harry M. Markowitz and Paula M. Oldfather, brings together four components that form a program generator: a questionnaire, permitting the definition of the scope and logic of a program to be generated; a statement list, containing the commands necessary for program construction; a set of decision tables



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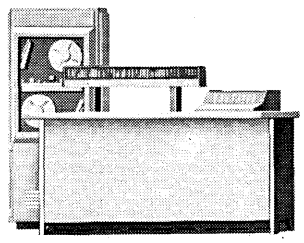

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CIRCLE 33 ON READER CARD

relating the answers to the questionnaire to the statement list; and an editor program processing the first three elements to construct the desired program and define the input data required from the user. The technique is illustrated by application to a job shop simulation program generator.

The second paper by Philip Gilbert and William McLellan presents a compiler generation system which is rigorously based and which allows formal specification both of the source (procedure-oriented) languages and of the object (machine-oriented) languages. An intermediate or buffer language, BASE, is interposed, reducing the required transformation to two logically independent subtransformation. A method is supplied for rigorously defining the entrant languages and the transformation techniques described. The system, so far, includes those elements in BASE necessary to produce ALGOL, FORTRAN and JOVIAL compilers.

The third paper by R. S. Bandat and R. L. Wilkins describes a general purpose compiler whose required input is a description of the desired source language in a defined metalanguage and certain semantics routines. The compiler itself, written in FORTRAN, has been experimentally implemented on a GE 235.

A panel discussion of the papers will be led by two users of programming languages and of their compilers, Mrs. John V. Holberton and Dr. Mary Lister McCammon.

Programming by Questionnaire, by Allen S. Ginsberg, Harry M. Markowitz and Paula M. Oldfather.

Compiler Generation Using Formal Specification of Procedure-Oriented and Machine Languages, by Philip Gilbert and William McLellan.

An Experimental General Purpose Compiler, by R. S. Bandat and R. L. Wilkins.

Panel: Mrs. John V. Holberton and Mary Lister McCammon.

Wednesday, 1:15 p.m.
Room 21

Logic-in-Memory

Chairman:
Theodore H. Bonn
Honeywell, Inc.
Waltham, Massachusetts

The fourth generation of computer systems will have a bewildering and complex environment. There will be a need for program and data compatibility with diverse older machines. The new equipment will be expected to perform efficiently in an on-line real-time environment with at least one background program. Many systems will have to handle communications, multiprocessing, multi-programming, information retrieval and modification, and multiple on-line users together with a large array of applications programs.

This formidable array of system logic requirements will be handled by some combination of hardware and software. Certainly logic hardware costs, in Boolean operations per second per dollar, are decreasing rapidly. Software development costs, in object program or executive operations per dollar, are not. Batch fabrication technology in semiconductors,

magnetics, and cryogenics are not only bringing about the reduction in logic costs stated above but also enable one to economically mix data storage and logic in the same array with one technology and one set of compatible manufacturing processes. Logic-in-memory is the name given this technique.

The session contains four papers devoted to techniques for accomplishing logic-in-memory. A distinguished panel of active workers in the field will briefly describe their work and discuss the benefits to be expected from the technique and systems considerations.

Two of the papers describe work which is broadly applicable to a wide variety of logic arrangements but where the particular embodiment is an associative memory. Semiconductors and cryogenics are the technologies used.

The Chow-Spandorfer paper describes for the first time the logic operations possible with magnetic plated wire. Associative properties are included. The first paper, by Spain, Marino, and Jauvtis, reports on the application of magnetic domain tip propagation to shifting logic.

The panelists will comment on the papers and discuss such questions as: How might different classes of logic in memory arrays be used in future computer systems? What is the future of cellular logic in memory? What work must be done in computer organization and programming to take advantage of logic-in-memory?

The juxtaposition of papers on device developments with a panel discussion on general developments and systems and programming considerations is aimed at producing a balanced picture of the state of the art in logic-in-memory.

DTPL Push Down List Memory, by R. J. Spain, M. J. Marino and H. I. Jauvtis.

An Integrated MOS Transistor Associative Memory with 100ns Cycle Time, by Ryo Igarashi and Toru Yaita.

Plated Wire Bit Steering for Logic and Storage, by W. F. Chow and L. M. Spandorfer.

A Cryoelectric Distributed Logic Memory, by B. A. Crane and R. R. Laane.

Panel: Richard H. Fuller, Dale Sunderson, William H. Kautz and Rabah Shahbender.

Wednesday, 3:30 p.m.
Room 20

Scientific Programming Applications

Chairman:
Harry M. Haugan
Federal Aviation Agency
Experimental Center
Atlantic City, New Jersey

System control, component testing, data analysis—these functions seem to grow proportionately with our expanding computer configurations. We find ourselves constantly researching methodology, probing at the state-of-the-art, and, indeed, inventing ways to investigate system performance and to analyze all data across the spectrum. What others have accomplished in this area does not normally result in a package we can apply to our own application. However, even the germ of an idea is sometimes all we need to trigger off a design of our own. Three important papers dealing with this subject mat-

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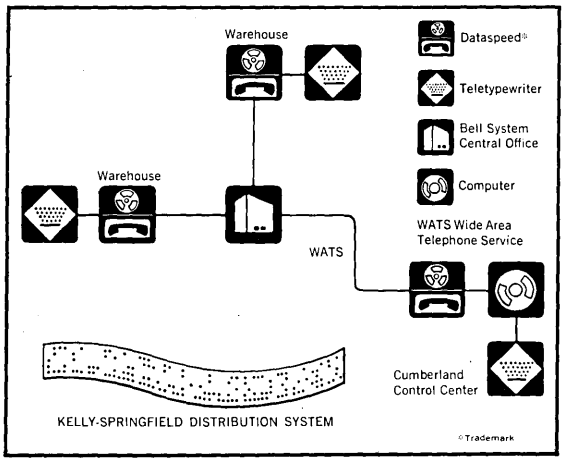

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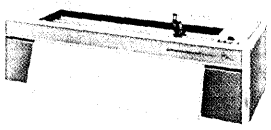

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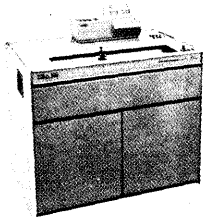

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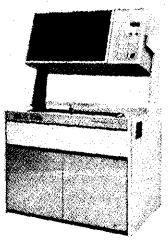

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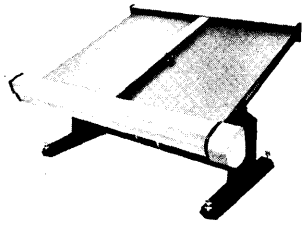

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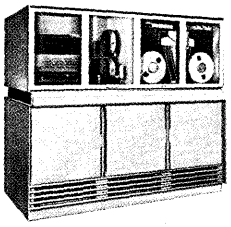

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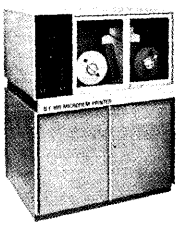

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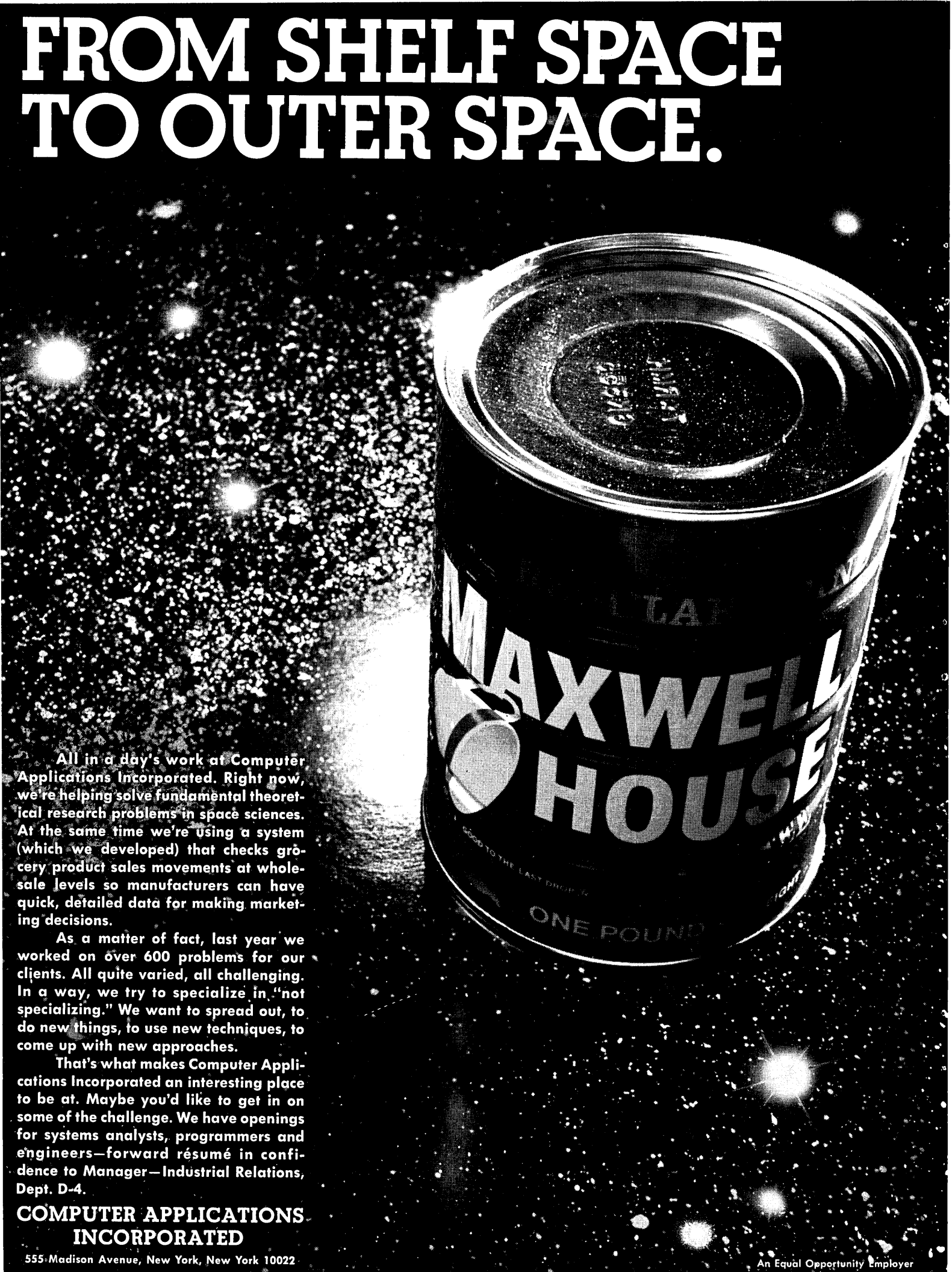

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ter have been selected for presentation at this session.

Data Analysis. More often than not, an experiment, for reasons of either insufficient calendar time or insufficient system time, is confined to readily accessible data. A time-sharing method capable of dealing with large complex sets of data will be described as the session opener. The program, running on-line, offers some distinct advantages in manipulating voluminous data, defining variables and yielding immediate feedback about the utility of operationally defined indices.

Testing. Analyzing the status of communication systems to determine degradation leading to eventual failure is an item of present concern. A paper will cover such an analysis accomplished through theoretical investigation and a digital computer simulation of the problem. The relationship between the degradation and channel noise is examined.

Computer and Radar. The marriage of the computer and radar was inevitable. A second honeymoon is in the offing, with the general purpose digital computer and the array radar teamed up to do great things. The flexible multi-function array radar, with its high data rate, requires the equally flexible, equally fast computer to fully control the environment. Integration of the two can accomplish such functions as radar system control, tracking, system monitoring, display and console data processing. Simulation and incident re-creation, for the purposes of post analysis and training are discussed.

TRACE—Time-Shared Routines for Analysis, Classification and Evaluation, by Gerald H. Shure, Robert J. Meeker and William H. Moore, Jr.

Degradation Analysis of Digitized Signal Transmission, by J. C. Kim and E. P. Kaiser.

Digital Systems for Array Radar, by G. A. Champine.

Wednesday, 3:30 p.m.
Ballroom
Techniques in Programming Languages—Part II
Chairman:
Robert J. Rossheim
Auerbach Corporation
Philadelphia, Pennsylvania

The papers to be presented in this session bring to mind an underlying controversy in programming language development. Various and vociferous viewpoints are most often brought into face-to-face conflict on the subject of programming language standardization. A couple of these papers would seem to support standard languages by describing extensions to these languages to adapt them to recent hardware developments (graphic display devices) and program preparation approaches (on-line programming). The staunch standards supporter might well argue that these unauthorized and unstandardized variations work against the fundamental purposes of standardization and tend to drag down from the high pinnacle those few programming languages that have been coaxed and beaten into the exalted standard form.

There are others, also represented in this session, who are not in the least constrained or impressed by existing standard languages. They freely depart into new domains (with hardly a look back) and invent smart new languages to perform special functions effectively. And why not? Primitive man was admired for his invention of tools to increase his effectiveness. Primitive programmers may also seek admiration and renown by developing effective programming tools. These need not be worldshaking nor must they impinge upon a language standard. There is one evaluation of such developments that ought to be made.

If the incremental improvement in programming effectiveness is small in

relation to the effort invested in development, documentation and distribution, and that same effort could have produced significant results (instead of tools to produce results), then perhaps the effort was misguided. A more extreme example of the same thought is: where would we be now if the thousands of third generation software developers had applied themselves to converting those good old second generation systems and programs? One thing for sure, as of right now we would be computing more and emulating less.

In defense of standard language extensions, some of these may indeed contribute to the standard language of the future, and they certainly tend to attract the large body of followers that a standard already has. As for new programming languages: who is ready to stand up against innovation? Not I, as long as you can afford it.

GRAF: Graphic Additions to Fortran, by A. Hurwitz, J. P. Citron and J. B. Yeaton.

RLP: A Data Reduction Language, by Frank C. Bequaert.

DIAMAG: A Multi-Access System for On-Line Algol Programming, by L. Bolliet, A. Auroux and J. Bellino.

The MULTILANG On-Line Programming Systems, by R. L. Wexelblat and H. A. Freedman.

Experimental Automatic Information Station: AIST-O, by A. P. Yershov.

Wednesday, 3:30 p.m.
Room f-g
Papers of Special Interest
Chairman:
K. P. Clancy
Keystone Computer Associates, Inc.
Willow Grove, Pennsylvania

The papers to be presented discuss solid efforts continuing in familiar areas which, through some quirk, were not widely discussed in other papers submitted.

Ernst and Newell present a summary of their efforts to extend the generality of the general problem solver without sacrificing its power. Their particular interest is devoted to improving the internal computer representations of the problem to approach this goal. The heuristic scan approach to problem solving, which is employed in the general problem solver, is described and related to a sample problem. The relationship of the internal representation to the generality of the solver are clearly characterized and evaluated with the aid of the sample problem.

By some, the remaining papers might be judged as being related. On the contrary, it seems to me that they indicate the growing interrelatedness of once diverse interests in the computer field.

O'Neill summarizes experimental analysis performed to measure the multiprogramming and time-sharing capabilities of a one-level storage machine, the M44. To a certain extent the M44 is a precursor to the IBM System 360/67. The effect of page

Guns, courtesy of Abercrombie & Fitch. For quality reproductions of this photograph, write us at Memorex.

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size and time slice on core storage utilization and multiprogramming throughput are summarized for a variety of program mixes providing additional information on this somewhat uncertain area of modern computing.

• McCarthy, Russell, et al describe THOR, a time-sharing system designed and implemented for the PDP-1 computer. THOR is a somewhat unique system in that it is primarily designed to employ keyboard display consoles, capitalizing on the capability of the display to present large quantities of information quickly and mitigating the unavailability of hard copy at the console. Initial experiences described clarify the more useful characteristics of the system and surprisingly indicate little displeasure with the lack of hard copy.

Van Dam and Evans also discuss the utilization of display consoles. In particular they describe the approach to storing, retrieving and manipulating large files of pictorial information in the form of two- or three-dimensional line drawings. They described a system already implemented in the MULTILANG on-line programming system whch has successfully used a compact data structure and dynamic, "by description," retrieval of both data and programs. The system is now being implemented for the IBM System 360/50.

Some Issues of Representation in a General Problem Solver, by George W. Ernst and Allen Newell.

THOR—A Display Based Time-Sharing System, by John McCarthy, Stephen Russell, Dow Brian, John Allen, Gary Feldman, Brian Tolliver, David Poole and Paul Styger.

Experience Using a Time-Shared Multiprogramming System with Dynamic Address Relocation Hardware, by R. W. O'Neill.

A Compact Data Structure for Storing, Retrieving and Manipulating Line Drawings, by Andries van Dam and David Evans.

Thursday, 9:00 a.m.
Room h-j
Advances in Software Development
Chairman:
Martin A. Goetz
Applied Data Research, Inc.
Princeton, New Jersey

For this two-hour session, software has been defined as programming tools for the computer programmer and designer in building and maintaining programming systems.

The first paper presents a non-procedural report program language, capable of being used by non-programming-oriented users in a time-sharing environment. This system, still in the development stage, uses a simple, English-like command language for specifying the content and format of reports. The second paper represents a unique compiler solution for generating code for parallel processing computers. A comparison is

given between code generation of FORTRAN statements for serial and parallel processing computers. The last paper describes a hypothetical system for evaluating, monitoring, and displaying the performance of computer hardware, system programs, user programs, and user behavior as reflected through terminals. Portions of such a system, currently under development at UCLA, are described.

The second part of this session will be a panel discussion on the lack of software advances relative to the advances made in computer hardware. Are there significantly more programming tools today than there were five or ten years ago? Has today's software reduced the cost of programming? Has today's software made programming easier? Has there been an increase in the efficiency and reliability of the software? Have the new operating systems increased the throughput of application and system programs? These subjects will be discussed and audience participation will be encouraged.

Compose/Produce: A User-Oriented Report Generator Capability within the SDC Time-Shared Data Management System, by William D. Williams and Philip R. Bartram.

Code Generation for PIE (Parallel Instruction Execution) Computers, by J. F. Thorlin.

Snuper Computer—A Computer Instrumentation Automation, by G. Estrin, D. Hopkins, B. Coggan and S. D. Crocker.

Panel: Louis L. Lavine, Jack B. Dennis, William D. Williams, Philip R. Bartram, J. F. Thorlin, G. Estrin, D. Hopkins, B. Coggan and S. D. Crocker.

Thursday, 9:00 a.m.
Room f-g
Techniques in Programming Languages—Part III
Chairman:
John W. Carr, III
University of Pennsylvania
Philadelphia, Pennsylvania

This session represents a broad spectrum of techniques for the development and specification of programming languages and includes: machine synthesis of programs; applications of languages; on-line programming systems; and syntax-oriented recognizers and compilers. Three distinguished panelists will offer a critique after each group of papers is presented.

An Algorithmic Search Procedure for Program Generation, by M. H. Halstead, G. T. Uber and K. R. Gielow.

A System of Macrogeneration for Algol, by H. Leroy.

COMMEN: A New Approach to Programming Languages, by Leo J. Cohen.

SPRINT: A Direct Approach to Listprocessing Languages, by Charles A. Kapps.

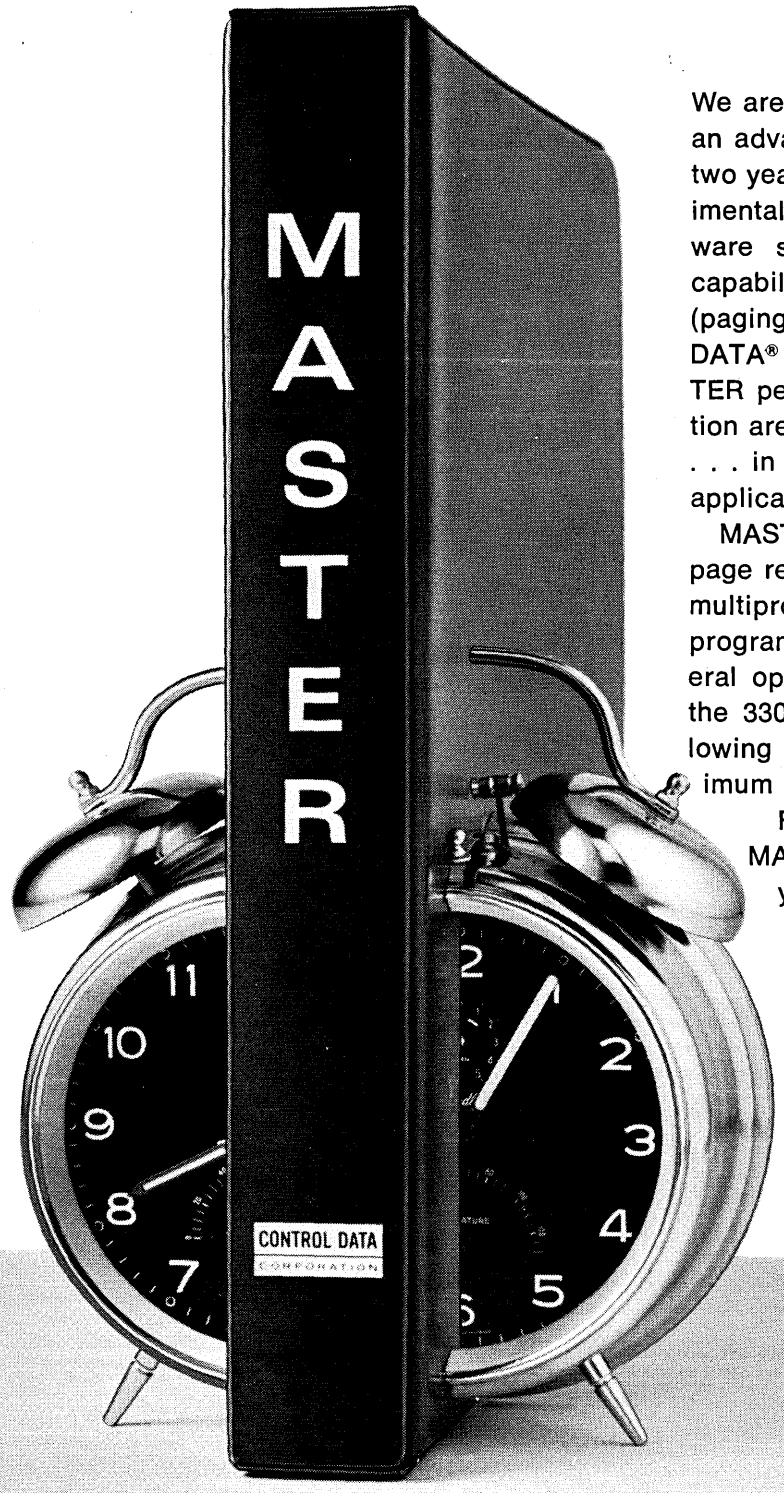
Syntax-Checking and Parsing of Context—Free Languages by Pushdown-Store Automata, by Victor B. Schneider.

The Design and Implementation of a Table-Driven Compiler System, by C. L. Liu, G. D. Chang and R. E. Marks.

Thursday, 9:00 a.m.
Room 20
Some Ideas from Switching Theory
Chairman:
Robert McNaughton
Rensselaer Polytechnic Institute
Troy, New York

For many years, switching theory has been a discipline in its own right, with technical details that are not appreciated by the average computer user. Without in any way deploring

For management... a new time-sharing system that works.



We are now making first deliveries of MASTER — an advanced time-sharing operating system. Over two years in the making, MASTER is not an experimental tool, but a fully supported, standard software system. It brings full-scale time-sharing capability, including dynamic program relocation (paging) and multiprogramming to CONTROL DATA® 3300 Computer System customers. MASTER permits time-shared operation in all application areas: in accounting...in operations research . . . in production scheduling . . . in engineering applications. You name it.

MASTER makes use of the executive mode and page relocation hardware of the 3300. It provides multiprogramming for the execution of multiple programs while performing simultaneous peripheral operations. And MASTER makes full use of the 3300's absolute memory protect features, allowing core memory to be utilized to the maximum with individual jobs.

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the growth of specialization, we should like to present some relatively new switching-theoretic ideas that we think will have some influence on the computer field in the years ahead.

Two papers will focus on logic modules, considering both the choice of the module itself and how to design computers with them. One paper takes the point of view of combinational logic; another discusses adaptive systems. The third paper investigates the problem of error detection by developing a technique for designing diagnosable sequential machines.

A Complex Module for General Computer Design, by Yale N. Patt.

Adaptive Systems of Logic Networks and Binary Memories, by I. Aleksander.

Design of Diagnosable Sequential Machines, by Zvi Kohavi and Pierre Lavellee.

Thursday, 9:00 a.m.
Room 21

Non-Rotating Mass Memory

Chairman:
Gordon S. Mitchell
National Security Agency
Ft. Meade, Maryland

About two years ago, several manufacturers offered mass core memories up to 20 million bits in size at fairly attractive prices. The two-wire stack design was the major contributor in reducing the cost of these memories. It was generally believed that these memories would be in great demand once they were economically feasible. At the present time, only two computer manufacturers offer a mass core memory as a peripheral device in their systems. Why is this? The papers in this session may provide answers to this question.

The paper by T. A. Humphrey describes the utilization of the IBM Large Capacity Storage (LCS) memory in a real-time environment. This memory is a two-wire, 2½D design with an 8-usec cycle time. It permits a real-time system to operate with a lesser amount of main memory than would otherwise be possible.

G. A. Jallen describes the hardware design of the CDC Extended Core Storage (ECS) memory which is used in the CDC 6400/6600 systems. This is a two-wire, 2D design whereby eight computer words are accessed in one cycle time or 3.2-usec. An ECS memory bank contains 16,384 memory words of 488 bits each. Interleaving four of these banks provides a 10 MHz word rate or 60 bits every 100-nsec.

M. H. MacDougall discusses the simulation results of the software operating systems which were designed for the CDC 6600 and the ECS memory. The simulation study compares the various ECS utilization strategies for several applications.

Large Core Storage Utilization in Theory and in Practice, by T. A. Humphrey.

Extended Core Storage for the Control Data 64/6600 Systems, by G. A. Jallen.

Simulation of an ECS-Based Operating System, by M. H. MacDougall.

Thursday, 9:00 a.m.
Room 13

Failure Finding in Logical Systems

Chairman:
T. J. Barry Hannom
Univac
Philadelphia, Pennsylvania

The current tendency toward larger, more sophisticated logical systems has produced a great deal of concern about the growing problem of failure finding. Failures are harder to find, and system downtime is much more critical. A broad spectrum of approaches to this problem is presented in this session, ranging from a highly theoretical development of a structurally-oriented diagnostic procedure to a practical description of failure finding in a telephone central exchange.

Specifically, the first paper examines the conventional approaches to the problems of computer diagnostics and maintenance and presents a unified approach based on graph theory. The techniques developed depend on analysis and manipulation of graphs which are represented by their connection matrices, and hence easily implementable by computer programs.

In this opening paper the machine is examined from two distinct levels: the structural and the behavioral level. A sequential machine is specified purely from the behavioral aspects like input-output relationships. Once the machine is designed, its *structure* (interconnections between components) comes into being. The composite machine can then be looked upon as the *superposition* of behavioral characteristics of the components on its structural form. This separation between behavior and form lends simplicity into understanding but also provides new insight into the problems of diagnosis and maintenance.

Recently there has been increased activity in the area of compiler-level language simulation of digital systems. The compiler-level language has a distinct advantage in that it places a valuable tool in the hands of the design engineer who usually has at least a *prima-facie* knowledge of such a language. The second paper explores this approach by the presentation of a simulation routine for edge sensitive flip-flops. As a vehicle for demonstrating the routine, a ring-counter circuit which requires trailing edge sensitive flip-flops is used. The language employed is MAD (Michigan Algorithm Decoder) which can compile and execute programs in the Boolean mode. In addition, the MAD language is readily available to design engineers.

The third and fourth papers describe practical experiences in automated failure finding in large logical systems. One of these presents possible approaches for automatic trouble isolation in telephone duplex central controls. Of the approaches considered, the method which integrates recognition and diagnosis of a fault into one unified program appears to be the most desirable. This approach offers a reduction in program words without loss of diagnostic resolution or significant increase in recovery time during fault recognition.

A Structural Theory of Machine Diagnosis, by C. V. Ramamoorthy.

Compiler Level Simulation of Edge Sensitive Flip-Flops, by James T. Cain, Marlin H. Mickle and Lawrence P. McNamee.

A Logic Oriented Diagnostic Program, by H. Jacobowitz.

Automatic Trouble in Duplex Central Controls Employing Matching, by E. M. Prell.

Thursday, 1:30 p.m.
Room 20

Computers for Industrial Process Analysis and Control

Chairman:
Lowell S. Bensky
Honeywell, Inc.
Framingham, Mass.

This session will treat results achieved by a user and advances made by two suppliers—one a system sup-

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plier, the second, a combined computer manufacturer/system supplier.

The user, Celanese Research Co., is applying a computer system for real-time acquisition of data from industrial testing equipment. The author of this paper describes the total system objective, operator console integration, and software techniques which implement the immediate requirements and allow for future expansion. The incentives for designing and installing this computer system and the guidelines used as a basis for the system design provide an insight into a broad class of potential real-time industrial measuring systems.

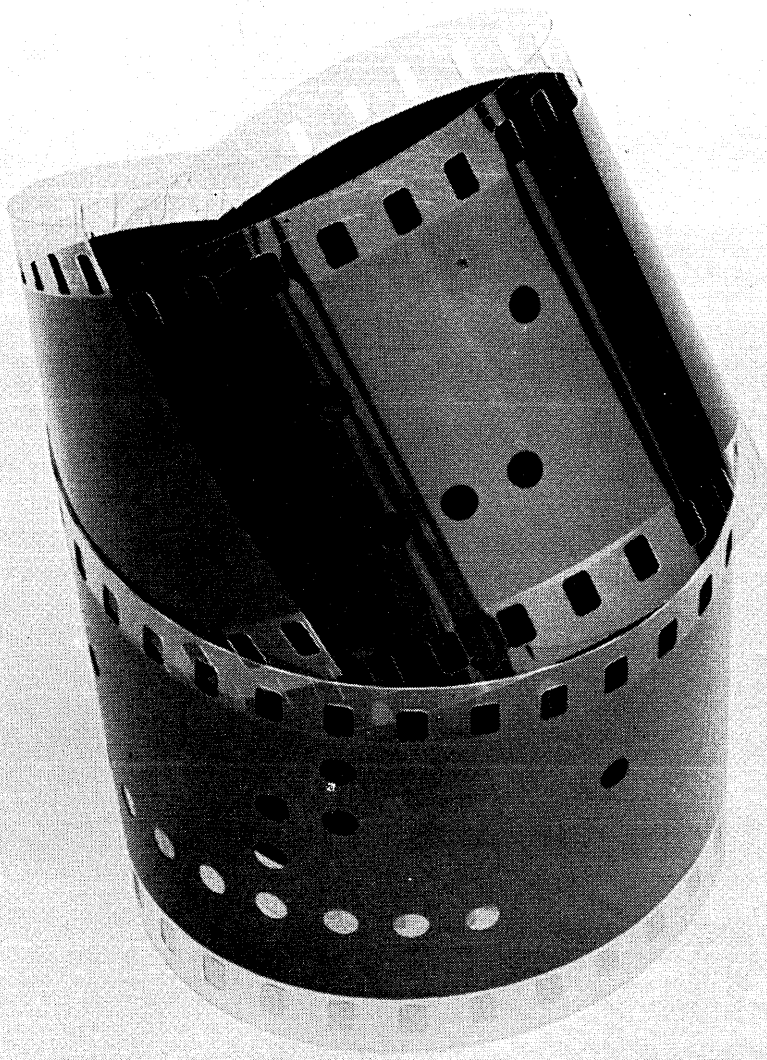
The system supplier, The Foxboro Co., has participated in the application of computers to the industrial process area for many years. The author of this paper deals with some of the techniques which make direct control of industrial processes by computer systems feasible. The central theme of this paper is directed at practical back-up system philosophy. The economy of a computer-based process control system is achieved by centralizing many process loops in one computer. This factor, on the other hand, leads to potential disaster should the central computer malfunction. Several back-up schemes have been explored and applied. This author describes the use of a second or redundant computer; his paper evaluates the compromises between risk and system cost.

The computer manufacturer/system supplier, Honeywell Computer Control Div. deals at length with software techniques which have evolved to handle the special problems encountered in industrial control. From the viewpoint that a computer control system can be compared to training a new process operator, the authors of this third paper describe the flexibility and power which can be built into real-time monitors and compilers which are essential to industrial control applications. These segments of the software package will be increasingly used in the future to reduce the required programming effort and make system evolution in a given process application practical.

Digital Backup for Direct Digital Control, J. M. Lombardo.

Real-Time Monitoring of Laboratory Instruments, by Paul A. C. Cook.

Industrial Process Control Software with Human Attributes, by J. B. Neblett and D. J. Brevik. ■



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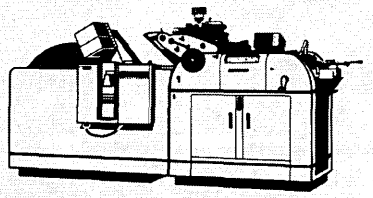

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THE SERIOUS PDP-9 HAS: 18-bit word length for easier addressing, larger instruction set, more data per word; standard 8K core memory, expandable to 32K; 1.0 μsec cycle, 2.0 μsec add time; 18,000,000 bits per second maximum I/O transfer rate; standard real-time clock; 300 cps paper tape reader and 50 cps paper tape punch; console teleprinter; wide range of peripheral options including card readers, line printers, CRT displays, plotters, A/D and D/A converters and multiplexers, magnetic tape, DECtape, and drums. Write for full story.

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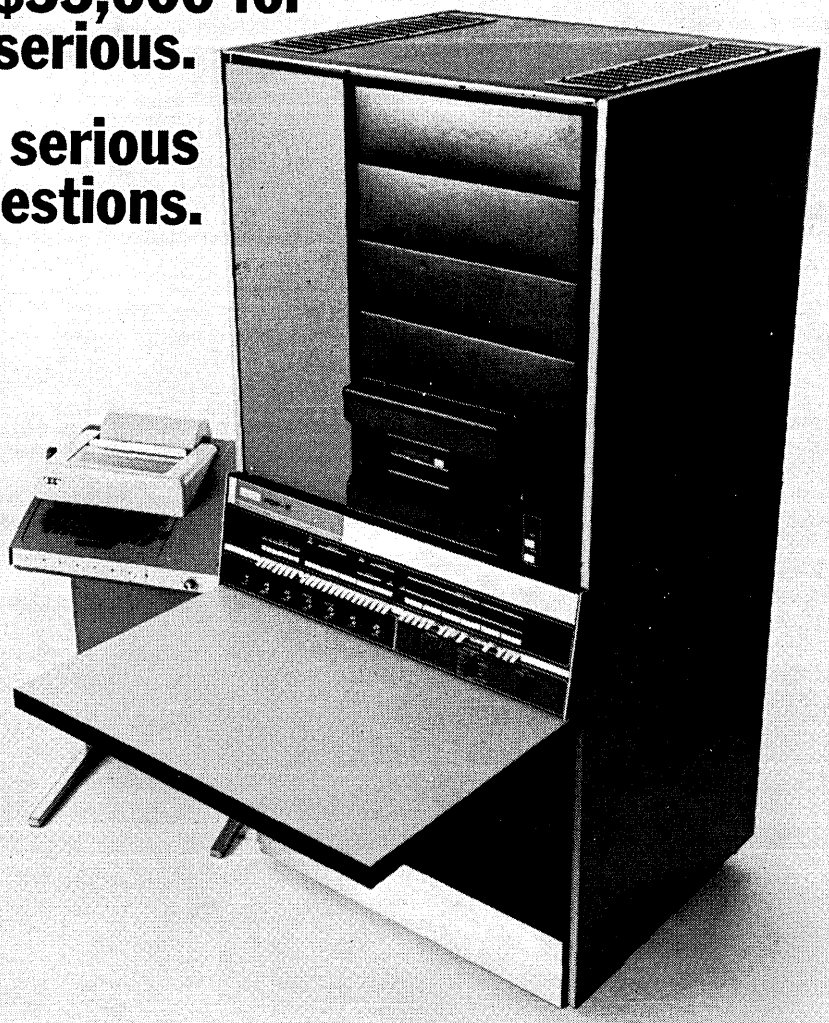

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3M TASK FORCE Reports: Electron beam technology applied to microfacsimile systems

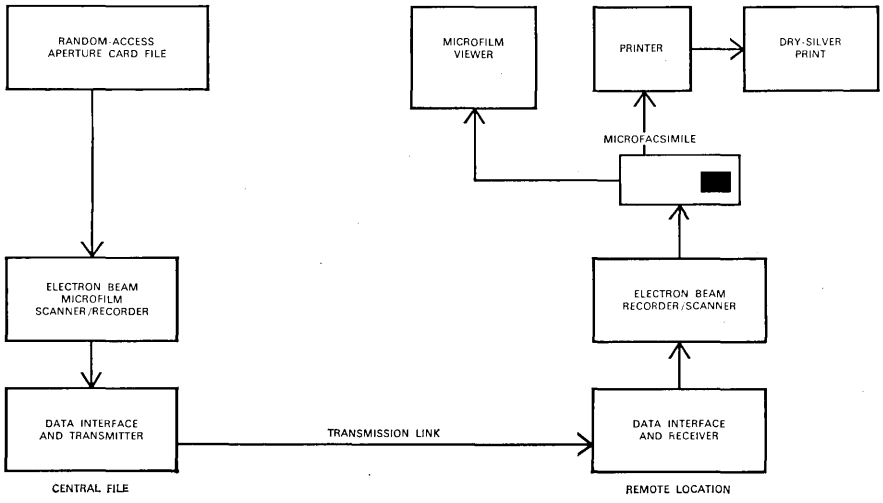
Are centralized engineering files and immediate access retrieval systems compatible?

They should be. But most are not! And if an engineer at a remote location can't get his information immediately the central file just isn't doing the job.

The 3M Company may have a solution to the information access bottleneck: an Electron Beam Recorder (EBR) Microfacsimile system.

Sound complicated? It isn't! Here's how it works: The engineer (he may be located at a plant across town) calls the girl managing the central files. He gives her a drawing or document number obtained from his copy of the central file index. She retrieves the microfilmed drawing or document from her random-access file. The retrieval system can be either manual or automated. She then places the microfilm (in aperture card format) into an electron beam microfacsimile scanner/recorder. Signals representing the information are transmitted to the engineer over a wideband microwave system, coaxial cable or Telpak facilities. Transmission can take only seconds.

A second scanner/recorder reproduces the microfilm image onto a frame of unexposed 3M



Dry-Silver Microfilm mounted in an aperture card. After the electron beam in this scanner/recorder forms a latent image, the film is heat processed — in seconds — within the unit. Output is a stable microimage capable of defining the most minute detail.

The engineer then either views the image or makes a Dry-Silver print . . . this takes only 4 to 5 seconds.

The scanner/recorder could include a CRT monitor. With it the engineer can first view the document before transmission to verify it is the one he needs.

How close is 3M's microfacsimile concept to becoming a functional system? It's here! A feasibility system was set up at the 3M laboratories, and the results were most gratifying. Microfilm images of D and F sized drawings (and of course smaller sizes) were scanned, transmitted and duplicated. Quality of the duplicates met the most discriminating engineering requirements.

We, at 3M, would like to know something about your engineering file and retrieval problems. Drop us a line. Also, if you would like more information on our microfacsimile system call or write:

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3M Company
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In short, when you buy Lenkurt, you buy know-how and experience.

The second question is: *which* system do you buy?

Utilities, right-of-way companies, the military—all buy the Lenkurt 25A. Why? Quality and flexibility. You can get a wide variety of auxiliary and accessory equipment for almost any application—inventory control, branch banks, remote business machines, etc. You can install the 25A at every conceivable data-sending point to deliver information to your central computer. It transmits data up to 200 bits per second. Adapts to any system—teletype or telegraph—and transmits 50% *more* information than any comparable equipment.

If you have heavy data requirements, such as tying large computer installations together, try the Lenkurt 26C Duobinary-DATATEL. It's only 3½ inches high, and weighs just 20 lbs. It feeds downline data at the rate of 150 to 2400 bits per second over an ordinary telephone circuit.

Both systems are accurate, uncomplicated, easy to understand, *competitively priced.* If you plan to buy, call on experience. Lenkurt Electric Co., Inc. Headquarters in San Carlos, California. Other offices: Atlanta, Chicago, Dallas and New York City.

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CIRCLE 46 ON READER CARD

news briefs

BECKMAN GETS INTERSTATE, DIVIDES SYSTEMS DIVISION

Beckman Instruments has had a busy few weeks—getting set to acquire Interstate Engineering Corp. and breaking up the Systems Division to assign the pieces to four other company groups.

First, the acquisition. It began calmly enough, like winter in Chicago, with a brief announcement Jan. 31 that Beckman and Interstate management had reached tentative agreement on acquisition terms. The plans called for exchanging some 770,000 shares of Beckman stock, worth about $44 million then, for the assets of Interstate.

Several days later, reports appeared that Automatic Sprinkler Corp. of America was also interested in Interstate. They were interested, in fact, about $48.5 million worth—also in stock—but by that time Beckman's stock offer had a value of around $50 million.

Meanwhile, Baifield Industries was heard from; they own over 100,000 shares of Interstate, between 8% and 9% of the stock outstanding. And Interstate is apparently a good company to own stock in, since it had sales of $37.8 million last year with a healthy net of $3.8 million. But Baifield pointed out that it was only concerned as a stockholder, even though discussions about acquisition had taken place some time ago.

The matter was presumably settled with the Feb. 16 announcement by the presidents of Beckman and Interstate that the deal was on, for the original number of shares, and would be submitted for shareholder approval in about two months.

So what is Beckman getting—besides the earning capacity?

Thirty-year-old Interstate Engineering of Anaheim, Calif., supplies a mixed bag of products: test instrumentation, timing systems, deep-sea buoy instrumentation, home fire warning systems, home cleaning devices, and mobile home components. Also in the bag is a small computer—the IEC 1010—made by Interstate Electronics Corp., a wholly owned subsidiary. The computer was announced in August last year; it's a 16-bit machine with 4-to-64K core, integrated circuits, and a 1 usec cycle time—selling at a base price of $30,500. The subsidiary making it has been in the instrumentation and systems field for 10 years.

So Beckman is adding to its systems capability. But the company also announced, in February, that it was breaking up the systems division—fitting the parts, and the 280 employees, into four other sections of the company: process instruments, electronic instruments, medical activities, and advanced technology. The intent, the company said, is to apply data processing techniques directly to development of products in these areas. Louis B. Horwitz, who had been manager of the systems division since 1962, was appointed corporate director of engineering.

The products referred to comprise one possible area where the computer acquired along with Interstate might prove to be of use. Products now being announced use small computers. One of these, still in the development stage, is a mobile medical unit that will be aimed at hospital use for gathering and analyzing heart data. Another is the Model 82 Data Processor, shown in the photo on this page with the Beckman/Scott Vehicular Exhaust Emissions Analysis System—or smog cart.

Beckman has long been a major manufacturer of air pollution monitoring instrumentation, and the Model 82 is a data reduction unit that analyzes the exhaust emission collected during a series of tests that take about 20 minutes. To do the calculations by hand would take nearly two hours.

The processor of the Model 82 is a PDP-8/S from Digital Equipment Corp. with output through a Model 33TA Teletype. It can handle input from two of the Beckman/Scott systems. The program for the purpose is self-contained and the company says the whole job can be done by an operator without computer skills or special training.

The only present plans announced for Interstate are for it "to continue under its present management," a general-purpose phrase that, with many companies in the past, has meant "we're still working it out."

ITT WORLDCOM SEEKING CHANNEL-SPLIT APPROVAL

Except for the military, an international communications user cannot now lease a voice-grade channel and use his own equipment to subdivide it at will into teleprinter, facsimile/photo, high speed data, or other circuits. Each service must be leased separately. But Federal Communications Commission approval of a proposal by ITT World Communications could lead the way to a channel-derivation tariff. Under the February ITT application, the customer would be able to create any combination of voice and non-voice,

The Beckman Model 82 Data Processor for Vehicular Emissions Analysis.

Talk's cheap at Applied Logic.

Over twenty users can talk at once to Applied Logic Corporation's PDP-6 computer with its Bryant Memory System at their time-shared computation center in Princeton, N.J. They can listen, too. All because of the low cost and easy access of time-sharing. Scientists, mathematicians and businessmen call in from teletype units night and day, 144 hours a week. Their man-machine dialogue may take only a few seconds. But it saves them hundreds of man-hours of work. And to help the PDP-6 do its work, Applied Logic chose a 6-million character Bryant Auto-Lift Drum. They say it expands the core memory economically and gives ideal swapping and storage for the system. And interfaces with no trouble at all. They must like it! Now they're expanding with a 60-million character Bryant Model 2A Disc File. Write Bryant Computer Products, 850 Ladd Rd., Walled Lake, Mich. 48008. Ask for On-Line Application Note #3. We'll make a Bryant believer out of you, too.

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or just non-voice, communications channels from cable, satellite or microwave voice-grade circuits—and change the combination at any time.

ITT has not commented on a possible tariff, but says it will be more economical than the present total cost of all the separate services that can be created from voice-grade bandwidth. Among users urging such a tariff are airlines, press agencies, and oil companies.

Given the FCC's okay, the international carrier will clear a tariff for service between the U.S. mainland and Hawaii, Puerto Rico, the Virgin Islands, and Guam; between the above and Panama, the Philippines, and other overseas points; between Puerto Rico and the Virgin Islands; and between Hawaii and Guam. However, in providing this service between the U.S. and other countries, ITT Worldcom must also obtain permission from the national communications authorities involved, such as the British Post Office, which own part of the facilities. Such approval is being sought, although no replies had been sent to ITT at time of writing.

PROPOSED PATENT CHANGES EXCLUDE COMPUTER PROGRAMS

An amended patent law, specifically excluding computer programs, has been proposed by President Johnson and is now awaiting hearings in the House and Senate judiciary committees. Action is not expected for two months, at least.

The bills (S1042 and HR5924) leave software out partly because of semantics. A Presidential commission that studied patent procedure said there was "uncertainty" that programs comprise material capable of being patented. The commission added that the Patent Office lacks an adequate system for classifying programs, and also lacks adequate records of the prior art. Both are needed, it is claimed, to establish that a proposed patent application covers a really new program.

The American Inventors Association disagrees with all of these contentions. It says that if program patents were registered, the government would quickly find out about prior art through complaints from programmers who felt they were being robbed. The Patent Office would then be in a position to decide which claim should be granted.

The pending legislation would change patent procedure by: establishing a "first-to-file" system for deciding which of a number of applications covering the same invention should be granted; simplifying application procedure, and lowering its cost; requiring that information in an application should be disclosed within two years of the filing date; and authorizing the Secretary of Commerce to defer examination of applications to expedite the Patent Office workload.

The bill also authorizes an R&D program which would develop better storage and retrieval of patent documents. Currently, the Patent Office is expanding a card-punchable coordinate indexing system. Now, the system is being applied to about a dozen patent subject areas; about 20 others are in various stages of programming. The office has requested funds in FY '68 for a "small-to-medium" computer with random access capability.

The ban on program patents—as we indicated (Nov., p 79)—will disappoint some software houses, but should gladden most equipment makers. Also, it should gladden Congressman Jack Brooks, who feels such protection would hamstring future technological progress. He conveyed these feelings to Acting Under Secretary of Commerce Herbert Holloman, one member of the President's commission. The proposed legislation is a direct outgrowth of the commission's study.

COMPUTERS TAKE THE RAP AGAIN FOR NYSE TROUBLES

Closing time at the New York Stock Exchange has been a nemesis for its computer department in the last few months. December 30th saw computer and communication failures so tangle the closing price reports that it took days to unscramble them. Then at 3:23 p.m. on a mid-February trading day, the bug struck again. This time the IBM 7750 switching system and its backup partner both failed, causing a loss in transmission of transactions on 41 stocks (although not all affected closing prices).

The 7010 processor reported the duplex failure. The fastest solution —a program reload—was done within 1½ minutes, and the ticker was going again in about 3 minutes. But the tickers had to close and the newspapers had to go to press before the missing transactions could be found. The data was in core, but a dump and decoding would have taken hours, so the Exchange technicians went to the floor to search the cards and the card readers to locate the trades, which took 40 minutes.

The duplex failure was not unprecedented; it had just never happened at closing time and affected closing prices. As on December 30th, the problem was in software. A bug caused the programmable chaining queue in the core of the variable line machine to get out of step—the 7010 then indicating it could not communicate with either 7750. Why it happened is still undetermined.

The Exchange is quick to point out that its time commitments are the tightest found in any real-time system in operation; the ticker should be going within 5-7 minutes after a failure, either via computer or manually. A different system, it notes, would not safeguard against such happenings, most crucial at closing time, and it is difficult to correct the software problems without creating others.

USASI COMMITTEE WILL RELEASE COBOL STANDARD

The long-heralded proposed COBOL standard of the USASI is finally emerging from committee deliberation.

The basic issue concerning the relationship with CODASYL's COBOL language defining group was resolved in favor of the existing COBOL, Edition 1965 specifications. This means that the language of the proposed standard will be a direct lift from COBOL, Edition 1965, and will differ only in the way in which it is presented. No attempt at correcting ambiguities or introducing changes will be made by the USASI committee; but rather, all suggestions concerning the language and the meta-language will be passed on to CODASYL. The X3 sectional committee has approved the document for publication and concurrent balloting as a proposed American standard. Before the end of the balloting period, which is usually six months, the USASI technical committee will evaluate the number and type of suggestions received as well as the progress of the CODASYL Committee with respect to those suggestions passed on to them. The decision will then be made whether to modify the proposed standard and extend the letter-ballot period.

The implications of the availability of a COBOL standard may be significant; e.g., dependent upon which level of the proposed stratified standard is chosen, the compiler manufacturers may be hard put to revise their products. On the other hand, if these manufacturers support too low a level of the proposed standard, the users may suffer with a COBOL tool as useful as an American Express Card in a Hilton Hotel. A lot depends upon

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	MEMORY (MICROSECONDS)	CORE STORAGE (THOUSANDS)	WORD LENGTH (BITS)	PRIORITY INTERRUPT CHANNELS	HARDWARE M/D	ADD & SUB	MULT (MICRO-SECONDS)	DIV. (MICRO-SECONDS)	LOAD & STORE	DELIVERY (MONTHS)	PRICE (WITH 4K MEMORY)
650	2.00	4-32	12	1-64	option	4.00	18.00*	18.00*	4.00	2	**$14,800**
655	1.75	4-32	24	1-64	Yes	3.50	14.00	15.75	3.50	2	**27,400**
660	1.75	4-32	24	2-64	Yes	3.50	14.00	15.75	3.50	2	**49,000**
660-5	5.00	4-32	24	2-64		10.00	SOFTWARE	SOFTWARE	10.00	1	**24,600**
670	1.75	4-32	24	2-64	Yes	3.50	14.00	15.75	3.50	3	**63,000**
6700	.95	32-131	24	2-64	Yes	.70	1.95	1.95	.70	12	**420,000**

SCC 6700 Time Sharing Computer has Character and Bit Manipulation, Hardware Floating Point (ADD-2.0; M&D-2.70)

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MNEMOSYNE

Planning Research has designed a search and retrieval system for a consortium of title insurance companies who will share the same computer. The initial data bank consists of 360 million characters. These will increase at the rate of approximately 120,000 per month as new property transactions occur.

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

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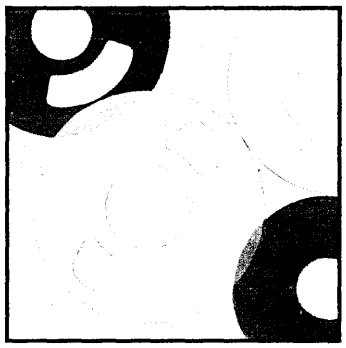
M6-1007



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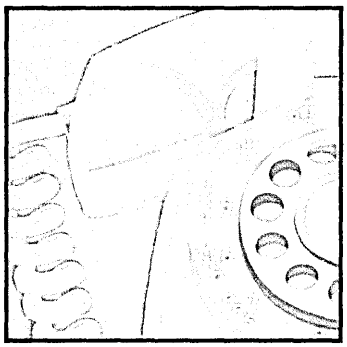
3M gives you the world's most complete line of performance-proven computer tapes for your data processing needs. 3M also provides a wide selection of computer tape accessories, such as sturdy and safe, self-sealing shipping and storage containers to protect your tapes in transit or while stored in your tape library. Whatever your needs in computer tapes or computer tape accessories, 3M can supply them.



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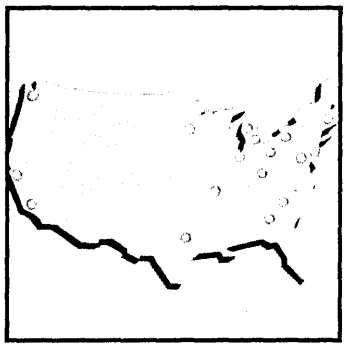

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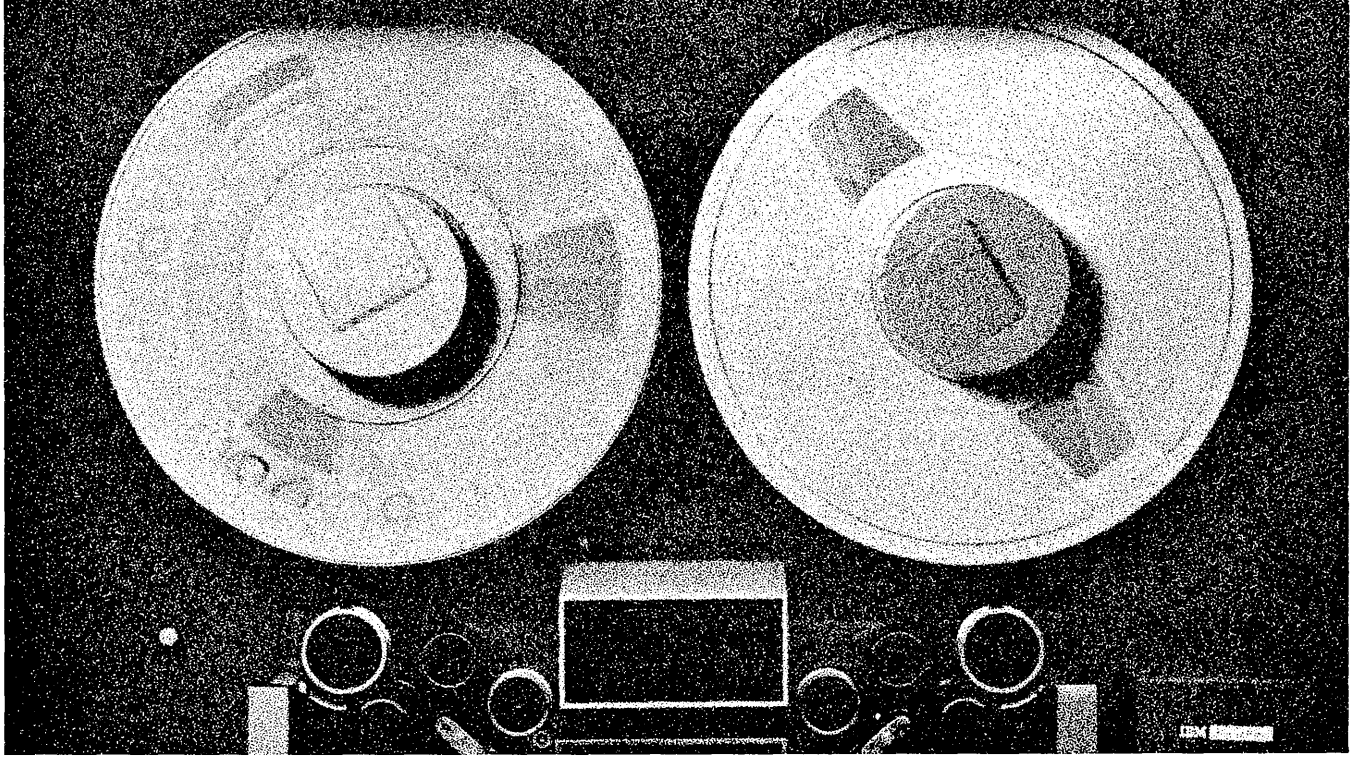
Need fast delivery? Only 3M has three strategically located full capacity tape manufacturing plants in the United States. All plants are governed by the same strict quality controls to assure you of consistently uniform computer tape products. In addition, 3M maintains branch warehouses in sixteen cities throughout the nation to provide you with prompt, dependable supply of all your computer tape needs.

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

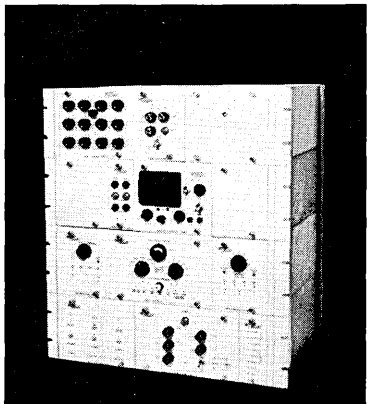
than the people who perfected it?

Are you still on-line transmitting when you should be off-line processing?



A fact of life in the EDP business is that computers are far faster than the communications systems used to gather the data to be processed. As a result computer systems are still on-line communicating when they should be processing. Rixon can help you speed your communications with the Sebit-48M data set. This modem transmits data at 4800 bps over Type 3005 telephone circuits. And as it speeds your data communications it can also help you lower your equipment and communications costs.

Call or write today. Let us show you how to achieve new system efficiency and economy.



The Sebit-48M data set, 1 of 8 RIXON Modem Models

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the rumor of a forthcoming Federal government COBOL standard.

In other areas, the survey of programming languages and processors, which last appeared in 1963, is being revived. While it has never been clear what the specific benefits of such a survey are, no one appears ready to mount a campaign against its continuance. As far as language standardization is concerned, this survey will point out emerging and specialized languages and allow us to determine if the current standardization efforts have restrained language development.

Of continuing interest is the growing schism between the USASI Glossary efforts and the international IFIP-ICC Vocabulary of Information Processing. Even X3 is in a quandary concerning how to resolve not only the U.S. "dictionary" style versus the international "concept" problem, but also the criticism from certain $X3_n$ technical groups stating that the USASI X3.5 Glossary Subcommittee has not reflected their particular specialties. It appears likely that X3 will junk the U.S. Glossary in favor of an extension of the IFIP-ICC Glossary.

OLIVETTI-GE CLOSES DEAL FOR COMPUTER SALE TO USSR

As far as can be determined, Olivetti-GE is the first to announce a sale of computers by an American-affiliated company specifically for use in the USSR.

Under three signed contracts, a GE 415 is to go to a parts distribution agency of the Russian government, and two GE 400 series systems and a 115 will go into the auto manufacturing plant being built by Fiat in Russia. Since the computers are produced abroad by Olivetti-GE, U.S. export licenses are not required (and have never yet been given for sale of U.S. computers to Russia). But applications for approval of the contracts must be and have been made to both the Italian government and the Departments of Commerce and Treasury of the U.S.

Approval of the applications does not seem unlikely in view of the U.S. government's urging of improvements of East-West trade relations and of the recent Congressional approval of a $50 million U.S. loan to Italy to buy American equipment for the Fiat auto plant. Other U.S. computers are reportedly in Russia, although all are said to have been sold originally to satellite countries and were exported from overseas, not U.S., plants.

RCA OFFERING MORE EMULATORS FOR SWITCHERS

The third emulator for use with the Spectra series, to run IBM 1401 and 1460 programs on the 70/45, was announced by RCA in February, and three more will be introduced in May. These are mod 35 emulators of the 1401 and RCA 301, and a 45 emulator of the RCA 501. Two previously announced units were systems for running 1410 and 301 programs on the 45; the system also runs IBM 7010 programs.

After running thousands of programs on the emulators for the last five months, RCA has come up with precise ratios on the internal speed of running programs in emulation of the 70's versus the speed achieved in the older systems. These are in the following table, along with some typical throughput ratios—which are more difficult to determine, being dependent on program differences and peripherals used (e.g., the 1401 printer is slower than that used by most new machines).

	Internal Speed Ratio	Average Throughput Ratio
70/45:1401	4.1:1	2.5:1
70/45:1410	2.3:1	2.0:1
70/35:1401	3.8:1	
70/45:1460	2.0:1	
70/45:301	2.5:1	2.0:1
70/35:301	1.5:1	
70/45:501	2.4:1	
70/45:7010	0.65:1	0.9:1

LAW CONGRESS TO HEAR PLAN FOR WORLD EDP CENTER

"The first step towards a general acceptance of law as a basis for future world peace is to make law more readily known and available." This is the basic tenet of a proposal for an International Center for the Automation of Law, to be made at the Third World Congress of the legal profession in Geneva, Switzerland, July 9-14.

The first draft of this proposal has been issued by The World Peace Through Law Center, Geneva, which is sponsoring the congress. Among the major reasons for the center, it states, are to organize and coordinate as soon as possible the law computer projects around the world "for efficiency and economy"—assigning new projects needed and discouraging projects duplicating effort. ("Only one project in any given field is required . . . provided an information-sharing plan can be executed.") Equally vital is the establishment of standards and techniques (e.g., a common indexing system that will make information-sharing possible.)

The center's proposal notes that the most active on-going computer projects are in the U.S., ranging from the commercial Law Research Service (on national and state statutes) to university projects on various areas of international, national and state law, and activities by federal, state and local government agencies. Several projects are in the study stage in Europe, Israel, and the United Nations.

Other objectives of the proposed automation center would be dissemination of information worldwide on law and on the methods of automation of legal projects. One vital instrument would be a data processing center, to be established in Geneva. Stored on microfilm and in a computer would be data on all projects (and material from their files), texts and briefs on international law, comparative law (such as different national patent laws), and other areas of worldwide interest.

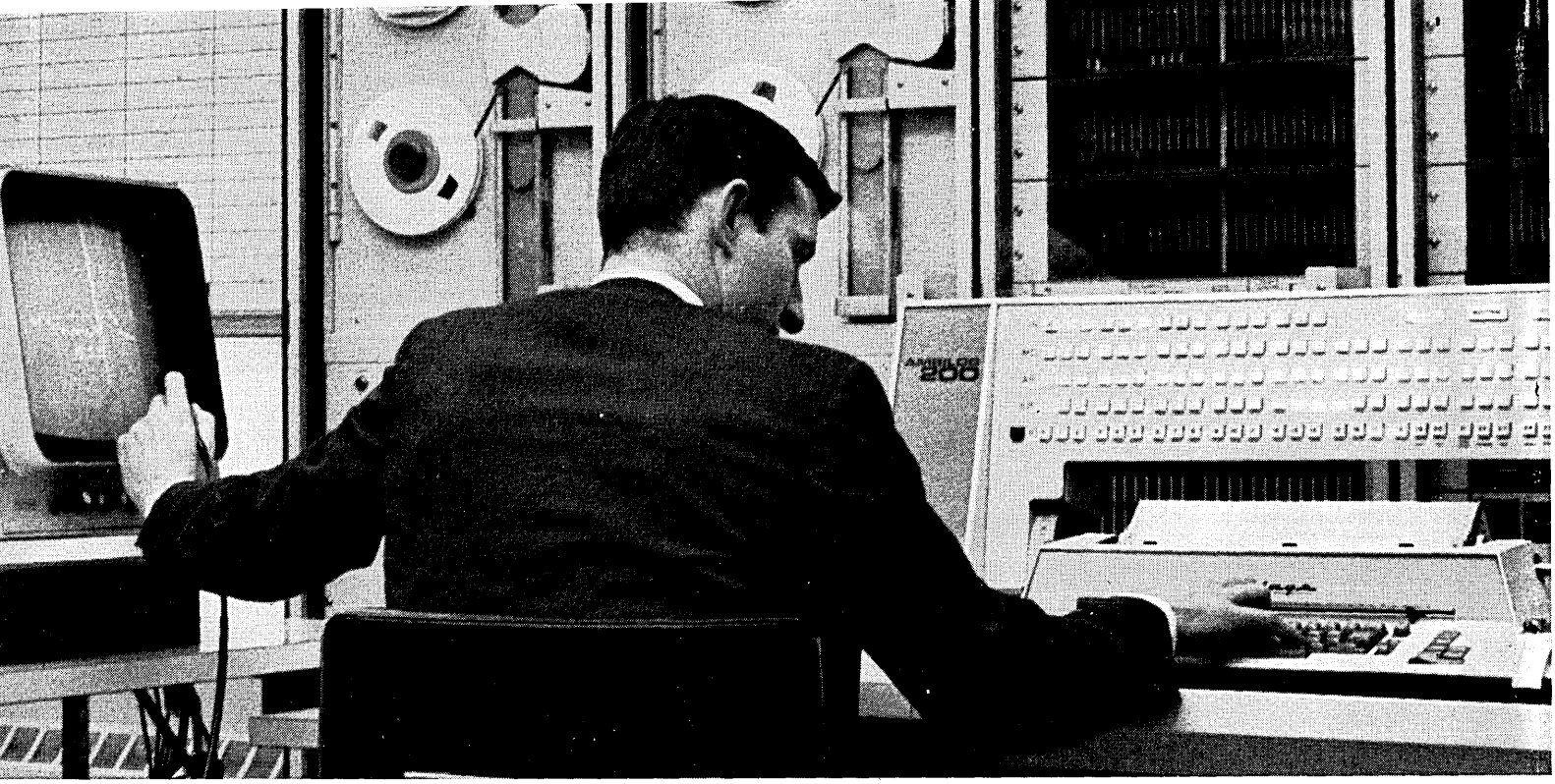
The World Peace Through Law Center, headed by William Rhyne, is seeking the participation of computer professionals in the planning and establishment of such an automation center. Further information on the proposal and the congress can be obtained from the center at 75 Rue de Lyon, Geneva, Switzerland. A pamphlet listing the on-going projects noted, entitled "Law Research by Computer," can also be obtained from the center.

BUDGET BUREAU REPORTS COMPUTER USE IMPROVEMENTS

In June last year the President sent a memo to all federal agencies telling them to see what they could do about using computers more efficiently, more economically, and for further applications. The first of a series of semi-annual reports has now been issued by the director of the Bureau of the Budget, Charles L. Schultze, to describe the response.

It turns out that a number of things have been done to save the government money. Some $70 million worth of equipment has been redistributed; $26 million has been saved through the use of government machines outside the installations needing the extra time; and a saving of rental costs at an annual rate of $200 million is claimed as a result of the wider use of outright purchase.

The report also praises the Congress for passing legislation sponsored by Jack Brooks that gave additional authority to the General Services Administration and the Department of Com-



Adage makes the best computer on the market for signal processing.

It's called Ambilog 200.

Combining the best of both analog and digital techniques, Ambilog 200 was designed right from the start for processing signals (time-related variables, often in analog form). Its unique hybrid structure and ability to handle efficiently both analog and digital information make possible at relatively low cost the extremely high computing rates required in signal processing applications.

DIGITIZING AND RECORDING

Up to several hundred inputs are routed under program control through an array of multiplexer switches, hybrid arithmetic elements, and a 14-bit, 4 microsecond analog-to-digital converter for recording or outputing. Ambilog 200 converts raw data to engineering units, including corrections for calibration error, at even faster sampling rates than conventional systems which simply "acquire" data.

WAVEFORM MEASUREMENT

Peak values, axis crossings, ratios of successive differences, and other characteristics of analog signals are measured in real time. Using complex programmed detection criteria, incoming signals are monitored for events of interest, typically with a resulting 100-to-1 reduction in the bulk of magnetic tape output records.

RANDOM SIGNAL ANALYSIS

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

GRAPHIC DISPLAY

On-line CRT displays of incoming data, or of results derived by reduction and analysis, are generated at frame rates of about 30 per second using line-drawing elements. Other visual display configurations, intended as design aids, generate isometric or true-perspective projections of objects containing more than 1000 line segments, with arbitrary translation and rotation.

FUNCTION GENERATION

In generating arbitrary functions of one or more variables, quadratic or cubic interpolation is achieved at high speed by using hybrid arithmetic elements in parallel to evaluate a polynomial function. Or, where straight-line approximations are adequate, different values of slopes and intercepts for each line segment are fetched from memory for operating on the variable.

SOFTWARE

Programming aids are tailored to the specialized needs of signal processing tasks, and include an Adage assembly system, Fortran, programs for source language editing and on-line debugging and control, and a wide range of applications programs and subroutines. Ambilog 200 signal processing systems are currently being used for seismic research, dynamic structural testing, sonar signal analysis, wind tunnel testing, speech research, simulation, and biomedical monitoring.

For further details, write M. I. Stein, Product Manager, Adage Inc., 1079 Commonwealth Ave., Boston, Mass., 02215.

CIRCLE 52 ON READER CARD

Adage INC

merce in procurement, use, standards, and research, as well as setting up a revolving fund to simplify financial arrangements for buying and sharing computers.

The government computer users also found some new applications that they apparently hadn't tried before. Some examples are computer analysis of data on aircraft accidents; developing a monitoring system to determine effects of new drugs; saving the salmon in the Columbia River by computing proper flow of water from reservoirs; and simplifying the administration of civil service tests: Other examples are given, as well as a list of projects using computers to do things that could not otherwise be done, such as improving the quality of pictures of the moon.

Reduced costs and improved efficiency were cited in several areas, including the agricultural census; processing of veterans' insurance dividends, and the handling of tax reports and military supplies.

In looking ahead, the report notes that further work will be done on standards for both equipment and programming systems and that projects are under way to establish standards for data elements and related codes. Also coming along is development of a government-wide information system.

BURROUGHS SHOWS B2500; DELIVERIES TO START SOON

Less than a year after its announcement in March, 1966, Burroughs showed its B2500 to the press at the Pasadena, Calif., plant in a demonstration that included multiprocessing under control of the full operating system.

Specific sales statistics for the new machine were hard to come by at the press conference, with the most definite statement being "we've sold quite a few." Over-all sales statements were plentiful, however. Orders for the whole Burroughs computer line were over 300 last year, up 75% from the year before; the backlog is now about $100 million; and more than 1500 systems are now installed or on order, of which 1100 are in the B100/200/300/ class.

First deliveries of the B2500 for internal use as demonstrators are starting right away; first customers will get theirs during the second quarter.

Burroughs spokesmen were especially pleased (of course) that the schedule had been met for the operating system, which they call the MCP —for Master Control Program. It was supposed to be ready when the hardware was done and it was. Credit was given to the present organizational set-up, with hardware, software, and systems heads reporting directly to a product project manager, and to the B5500 simulator that allowed concurrent development of hardware and operating system. The company says the MCP was operating seven hours after they first plugged in the computer and a few hours later was handling multiprocessing. The executive responsible for the organizational lines is James A. McCullough, vice president for product management.

The B2500 is at the low end of the 500 series of machines, apparently a reasonable step up from the older B300 and the IBM 1400 series; emulators are available for both. Typical price for a small tape system is about $4200/month. Core memory starts at 10K bytes, goes up to 60K, and has a cycle time (for two bytes) of 2 usec. The processor uses monolithic integrated circuits and programming languages available include COBOL, FORTRAN, and two assemblers.

Next larger machine is the B3500, announced at the same time as the 2500 but not yet demonstrated. It's similar, but has core capacity up to 500K at 1 usec and will be priced up to about $21,000/month for a big disc system. Next is the 5500, which began life as the 5000 some years ago but is selling better now than in its youth. After that in size is the 6500, scheduled for mid-1968, and the 8500; two of the latter have been sold.

Except for the B8500, the main frames, tape and disc units for the whole line are being made in Pasadena. As a result the plant is outgrown and the company has had to rent another 65,000 square feet of manufacturing space about a mile away.

With the new machine ready for delivery, 15 models of disc files to sell, a just-announced input/display terminal, and winning of the ILLIAC IV contract, Burroughs is shaping up as a strong contender for a growing share of that part of the market not permanently presold on IBM products.

OREGON FIRMS DEVELOPING MEKONG RIVER SIMULATION

Two Portland, Oregon, dp firms are participating in a project to control one of the world's great river systems, the Mekong.

United Data Processing, Inc., and Automated Information, Inc., have a contract to program computer applications of a mathematical model that simulates the world's eighth greatest river. The Lower Mekong, excluding sections of China and Burma, constitutes the program area.

From the mountains of northeastern Laos, the Annam Cordillera, which separate Laos from Vietnam, through the Korat Plateau, the large undulating plain of northeastern Thailand through the flat, low Cambodian plain, to the delta of the Lower Mekong in southern Vietnam, the river is virtually uncontrolled.

From its basin it collects sufficient runoff so that when it empties into the South China Sea near Saigon its discharge is only 10% less than that of the Mississippi—and twice that of the Columbia. Seven million people now live in areas to be affected by projects resulting from the computer simulations.

The contract is from the U.S. Army Corps of Engineers, North Pacific Division. The companies were selected on an assigned contract basis because of their experience in preparing flood routing and power programs since 1957. According to Michael A. C. Mann, president of Automated Information (a UDPI spin-off), Thai, Laotian, Vietnamese and Cambodian officials on the Lower Mekong Coordinating Committee and the Corps of Engineers agreed to prepare computer applications of the model for the IBM 360/40 with FORTRAN IV (Level E) disc operating system.

The Corps of Engineers emphasized the importance of storing river system characteristics on-line because of the probable large increase in the 50-60 control point stations now situated on the Mekong, Edward Davis, UDPI systems consultant, said.

When the programs are completed this spring, according to Mark L. Nelson, chief of the Water Control Branch of the Corps of Engineeers in Portland, simulated regulation of the river will demonstrate:

How the river can be controlled most effectively (an optimal control plan).

The level of flow to be sustained for navigation and for prevention of salt water intrusion.

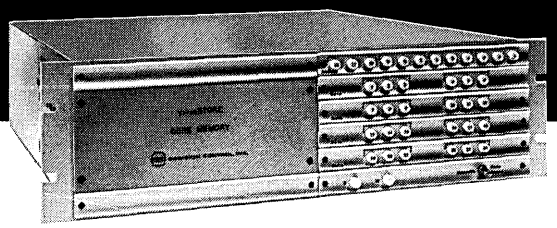
Where water can be made available for irrigation.

The amount of power the total system and each project within the system can develop in flood periods and the secondary power which can be developed in non-flood months.

Comparative economic merit of projects proposed to harness the river.

Preliminary studies of the river basin give some idea of the scope of possible future projects: more than 20 million kilowatts of potential installed power; 10 million-plus acres

Decision Control's VersaSTORE core memories have the best operating margins in the business



Here's why

Magnetic cores used in memory systems change characteristics with temperature, causing shifts in operating margins. Older memory systems used stack heaters in an effort to maintain a constant temperature. Heaters had several drawbacks — warm-up time, temperature gradients throughout the stack, etc.

VersaSTORE overcame the need for a stack heater with a unique and simple servo which allows stack temperature to follow ambient temperature, but compensates by optimizing drive currents, and insures excellent margins under all conditions. Both our standard VersaSTORE and our mainframe VersaSTORE use the unique D.C.I. servoed drive system. To further improve these margins, sense amplifier gain is uniformly maintained to 1 mv without adjustment. And, these VersaSTORE margins are guaranteed at the customer end of the cable — 25 feet for mainframe VersaSTORE.

VersaSTORES are available from 256 to 4096 words of up to 24 bits per word for use in buffers, I/O equipment, etc. Mainframe VersaSTORES for computer mainframes and large digital systems are available from 4096 to 65,536 words of up to 36 bits or 72 bits.

For more data about VersaSTORE's integrated circuit construction, compact sizes, and compact prices, please write.

uVL, VersaSTORE, and Mainframe VersaSTORE will be on display at booths H8-H10 at the SJCC. Stop by and discuss your digital system requirements with a Decision Control applications engineer.

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of land needing irrigation; flood control which will require 70 million acre-feet of effective storage coupled with 36 million acre-feet to be consumed by irrigation; reclamation of untold acres of saline soils, now unsuitable for agriculture; possiblity of opening the main stem of the river to slack water navigation for vessels of more than 2,000 tons all the way to Phnom Penh, Cambodia.

The programs will allow the Asian governments to relate the annual cost of their projects to benefits which the computer simulation has shown can be realized. By changing the projects in the system or varying their size, Asian governments will be able to determine from the computer increases or reduction in benefit from proposed changes.

Ten Asian trainees, all with specialties in hydrology, power economics or engineering, are helping the Corps of Engineers prepare data for the computer. They will take the program with them when they return to Asia in early May and simulations will be run on a 360/40 in Bangkok.

Preparing data for the program has had its unusual aspects. For example, the purpose of the power program is to simulate what will happen when a project with certain specifications is located at a given site. The raw material for such a task is a mass of hydrometeorological data and river flow characteristics. But such data is largely lacking for the Mekong prior to 1960. What does exist, however, is a body of observations regarding precipitation in the river basin.

From this information and scattered observations on river flow characteristics, the model computes flows with theoretical flow equations. Computer model outflows are compared with observed flows and fudge factors adjusted until recorded weather input to the model produces flows which match the observations. In this way, a 25-30 year stream flow history of the Mekong is being synthesized.

Key to the system being developed is a disc-stored run file, representing all data describing the model—the projects of the river basin represented over a time period of several years from five-day to full-month increments.

The power program is broken into three major divisions: input, basic power study program, and output. Some 35 subroutines are structured in the power program, more than 50 in the flood routing program. Approximately a dozen subroutines form the basic structure of the flood routing program.

Some 30 specialized application subroutines have been built into the next level of the flood routing program. These perform such functions as simulating lake or reservoir conditions and evaluating backwater surfaces.

Even as the program teams work to complete final subroutines and work out all bugs, a feasibility study on a dam project with six times the storage capacity of the Grand Coulee system is underway by the U.S. Department of Reclamation 40 miles upstream from Vientiane, Laos.

CREDIT-CHECKING FIRM WILL INVADE EAST COAST

Credit Data Corp. (DATAMATION, Oct., '66, p. 33), a credit-checking firm that has developed computer techniques for fast response to credit inquiries, is adding a New York City facility and hopes to deal eventually with the records of some 50 million consumers in the area between Washington, D.C., and the Canadian border.

The company started this kind of service in Los Angeles in 1965. Since then it has expanded into northern

news briefs

California as well and is now in the file-conversion stage for a Midwest operation based in Detroit, where the company was started in 1930 as a conventional credit bureau.

The New York operation is expected to be in action about July 1. It will use a 360/40 with three mod 4 2302 disc units and a 2311. This equipment is fed by punched cards prepared during phone conversations with the subscribers. In the New York area, these will be banks, retail store chains, and finance, oil, and credit-card companies. The whole operation, from inquiry to approval or rejection of the consumer's credit, is handled within 90 seconds.

Initially, the New York office will provide the service to 18 counties and by this summer will have about 20 million records in the files.

DECISION-TABLE FANS ASKED TO JOIN USASI COMMITTEE

The United States of America Standards Institute has recently formed an ad hoc committee on decision tables, now studying the feasibility of standardization.

The committee has arranged an open forum session on the day after the SJCC, April 21, in Atlantic City. Speakers have been invited to present papers on the variety of uses of decision tables and publication of the papers is planned.

Computer people experienced in this area and interested in joining the committee should write to Marjorie F. Hill, Control Data Corp., 3145 Porter Drive, Palo Alto, Calif. 94304.

IRS COMPUTERS NOW WATCHING EVERYONE

This is the first April that the Internal Revenue Service will be checking all income tax returns by machinery, using their 17 Honeywell 200's at seven regional offices.

Everyone knows about the bad-news aspect of this by now: all those tiny interest payments recorded in your savings account book will be matched against your return to help you remember any extra income.

There is, however, a shred of good news. They're doing the refunds first —saving the returns with zero balances or checks attached for the quieter days.

About 100 million returns will be handled by April 15, with two peaks: one is in February and the other at the last minute in April, the former presumably caused by filers who expect refunds.

The machines aren't idle the rest of the period though—or the rest of the year. Because of business returns, quarterly filings by individuals, and an assortment of other records the IRS deals with, about 600 million documents a year are handled by the H-200's.

Now that the network is complete, processed information from the regional offices on mag tape is sent to the national computer center in Martinsburg, W. Va. Here it is matched against master files that include past returns for each taxpayer as well as a record of his present income from all sources.

The final result is a set of tapes for preparing refund checks—and "a vastly improved means of detecting the small percentage of tax evaders and delinquents."

FIRST RESEARCH ASSOCIATE ASSIGNED TO NBS CENTER

The National Bureau of Standards program to develop information pro-

New DataGard:

the best shape data's ever been in.

This shape helps you increase reel density without sacrificing total tape protection. Here's how.

Start with that little "foot" on the DataGard Trimline case. When it's inserted in the DataGard reel rack you've just gained 40% in storage space over ordinary two-piece cases. Your tapes are stored the way they should be—fully protected. You avoid drop-outs, crimped edges, read-out problems.

Because the DataGard two-piece case seals airtight, your tapes are completely guarded against dust, moisture, and accidental damage in handling and storage. And the DataGard stacking ring interlocks for extra safety while tapes are in transit.

Want a closer look at DataGard? Just say the word. We love to prove our case. Call or write us at TAB Products, Box 2630, San Francisco, California 94126.

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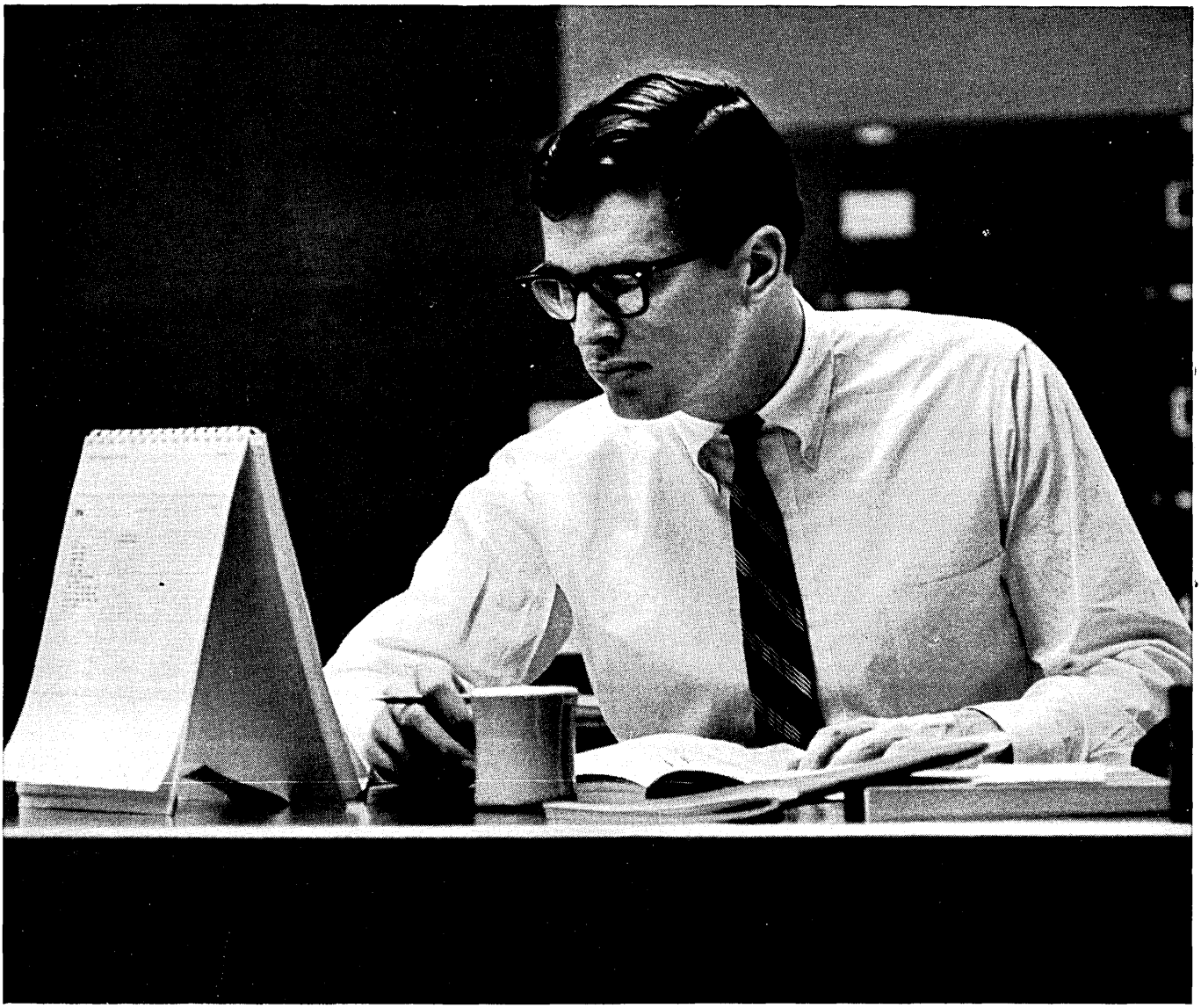
PRODUCTS CO.



The 20-minute education break.

For busy people who need to know.

Maybe you have a programmer who needs to brush up on COBOL, or a tab operator who needs to know about the IBM 85 Collator. Or you may know a junior executive who just wants to learn a little bit about data processing. IBM has an easy way to teach them.

It's called programmed instruction—P.I. for short.

P.I. is an approach to self-study that guides a student through the required material at the student's own pace, a step at a time. He can breeze through five or ten pages whenever there's some time to spare—at home or on the job.

Last year, some 100,000 students took IBM programmed instruction courses. And the results were gratifying. Students learned faster—27% faster on the average—and scored higher than did those in conventional lecture-discussion classes.

Right now there are 29 P.I. courses available to IBM customers covering punched card systems, computer fundamentals and computer programming. More are being developed.

But programmed instruction won't replace your local IBM Education Center. Some subjects are just too complex or too specialized to be taught by P.I. So we'll continue to operate our school system—providing a comprehensive curriculum for everyone from key punch operators to board chairmen.

Either way—sending the student to school or the school to the student—IBM education helps you and your people learn how to get the most productive work from your IBM system.

IBM Education: it's there when you need it. Just like the rest of IBM's services.

IBM®

cessing standards with the assistance of computer industry representatives is now under way. Stanley Buckland of Control Data Corp. is the first research associate to be assigned to the NBS Center for Computer Sciences and Technology.

Mr. Buckland's research will cover analysis of the influence of 8-bit computers on machine-coded information exchange. Other industry-sponsored research associates will be added to support the NBS project, intended to develop standards for computer hardware and software to effect economies in government purchase and use.

ITEK GIVES UP ON MCP STORAGE UNIT

Itek's photo-optical memory system, the MCP-1000, announced in 1965 (March '65, p. 17), has been formally deleted from the product line. Reading from the writing on the plastic discs (which, in modules, were to have formed a bulk memory totalling 10^{12} bits storage capacity) seems to have been a problem. While Itek feels MCP development proves the technical feasibility of optical techniques (laser recording) for digital storage and retrieval, the equipment is not, the firm says, "sufficiently reliable for continuous operations because of inherent defects in some of its electronic circuitry and in some of its electromechanical components."

Originally slated for general marketing and for use in file conversion at a planned New York service center, MCP equipment now will be used as a "test instrument for further technical development." Itek has "charged against profits $566,564," representing undepreciated cost of equipment at the end of 1966.

Itek will, however, continue development of its stenowriter (for computer translation of stenotype transcription), now using magnetic memory for storage of the specialized stenotype dictionary, instead of the photo-optical disc.

PUBLISHING FIRM ENTERS EDUCATIONAL DP MARKET

Follett Publishing of Chicago has entered the computer-based education systems market by becoming a major stockholder in Instructional Systems Corporation, a technology-oriented company based in Palo Alto, Calif. Follett will market a computer-based counseling information service developed by ISC, which promotes mixed hardware systems based on the needs of the particular curriculum in each school.

Robert J. R. Follett, vice president and general manager of the publishing company, believes his is the first publishing firm to move into a company of this sort.

Selecting the best hardware to do specific jobs in a coordinated system with the curriculum as a criteria, he feels, is a more sensible direction than adapting a single manufacturer's equipment to fit the system.

"Others may grope for the complex computer-based learning systems that will revolutionize education," he says. "Our first task is to develop a number of more practical ways in which present computer technology can help today's educators deal with their current problems more effectively."

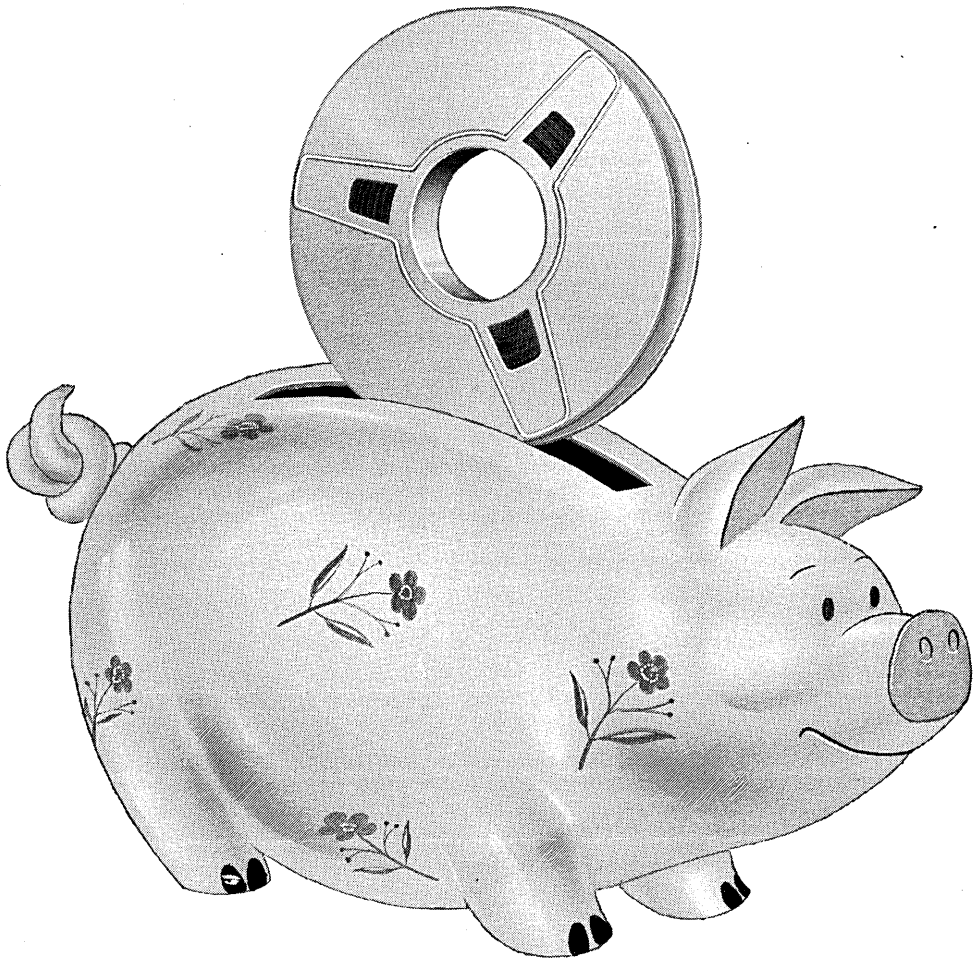
Principal researchers and vice presidents of Instructional Systems Corporation are Dr. Murray Tondow, Director of Educational Data Services for the Palo Alto Unified School District and the former Dean of Research and Development for Chicago Teachers' College North, and Dr. John W. Loughary, Coordinator of Research for the Division of Psychological Services at the Univ. of Oregon and author of *Man-Machine Systems in Education*.

PROGRAMMING NOW REQUIRED COURSE AT PRIVATE SCHOOL

Computer operation and programing is now a required subject, and an instrument for homework, at a private high school in Pomfret, Conn.

Most of the 215 students at Pomfret School have taken week-long courses using a PDP-8 and are now developing programs dealing with such topics as electronic circuit analysis, a new triple precision floating point package, and refraction of light in the atmosphere. Some are using the assembly language, MACRO-8, as well as the CALCULATOR system to do homework and laboratory calculations. The 8 is a 4K-word system with two keyboard printers and a tape reader and punch.

Last fall, the school began by teaching a test group of 34 students computer fundamentals, programming techniques, and FORTRAN (based on the Digital Equipment Corp.'s PDP-8 FORTRAN programming manual). Both programming techniques and machine operation procedure were covered in one class. For a week of classes, the students programmed problems on the system, ending with a program for solving a quadratic equation. The rest of the students were then given



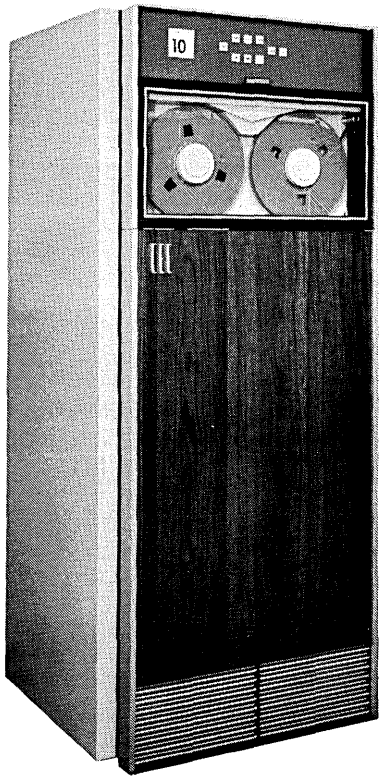
For people who wish to save dollars and data

CEC's DR-3000 Digital Magnetic Tape System is a minor phenomenon in an age of high cost instrumentation.

Not only does the DR-3000 cost less than any other digital tape handler, but it offers a combination of versatility and reliability unmatched by the majority of today's most expensive systems.

Compare these advantages:

- ◘ Highest performance specifications at lowest cost of any tape transport available.
- ◘ The DR-3000 is fully IBM compatible with assured machine-to-machine compatibility at all speeds and all densities, 7 or 9 channel.
- ◘ The DR-3000 is the only low cost transport with straight-line loading for rapid, easy tape loading.
- ◘ CEC's unique, all-metal-front-surface heads guarantee 2500 hours head life—the highest in the industry.
- ◘ Fully computer compatible command structure and selectable logic levels provide wide flexibility of interfacing.
- ◘ Dual capstans with positive drive precludes tape slippage and assures gentle tape handling.



- ◘ Simplified parts provisioning and service with complete interchangeability of parts, regardless of speed requirements.
- ◘ There is one basic model with tape speeds from 37½ to 112½ ips—and a choice of cabinet configurations: horizontal for computer applications; vertical for data acquisition systems. And, due to its rugged compact construction, the DR-3000 is also ideally suited for mobile assignments.
- ◘ Each system is supported by prompt local service and assistance available through CEC's nationwide resident field force.

Is it any wonder that the DR-3000 is considered the "best buy" in digital tape recording?

For complete information, call your nearest CEC Field Office. Or write Consolidated Electrodynamics, Pasadena, California 91109. A subsidiary of Bell & Howell. Bulletin 3000-X12.

CEC

DATATAPE PRODUCTS

BELL & HOWELL

CIRCLE 59 ON READER CARD

courses adjusted to their level of mathematical knowledge.

Pomfret also plans to invite other secondary schools in the area to share its computer facilities for similar training efforts.

KITCHEN TABLE PROGRAMMERS GET MACHINE TIME BY MAIL

So far, nearly 100 people—including a plumber, lab technician, accountantants, and computer operators—are taking the home-study course in computing offered by Computer Usage Education Co., according to director Ascher Opler.

The 24-lesson, $650 (company group discounts available) course is aimed at making the student qualified in programming (in 360 assembly language, FORTRAN and COBOL), while also providing computer background and applications education. Though there are several home-study programming courses, CUE's is said to be the first which runs students' programs on a computer. The course can be completed in 8-14 months. For information:

CIRCLE 148 ON READER CARD

HOME-BUILT HYBRID FOR STOCK FORECASTS

Five-year-old Electronic Stock Evaluator Corp. at Rockville Center, N.Y., has built itself a place in the investment service field by building its own analog/hybrid computer to forecast the stock market. More than 50 major investment institutions (banks, brokers, mutual funds, etc.) use the ESE services, which include market forecasting; short-term potential ratings on stocks, strategies for conservative, aggressive, and all-out trading; and best-buy recommendations. Individual investors can also buy weekly reports at $225/year.

Founded and managed by electronic engineers, led by John Lambert, ESE has used military trajectory prediction, tracking and smoothing techniques in its computer to come up with six million forecasts on over 2000 stocks—four million said to be correct, one million inconclusive, and one million incorrect.

The firm felt that as price action was not only due to fundamental financial data on a company, but also to fads, publicity, character of the market, and other "popularity" factors, a hybrid computer was the solution to testing various evaluation models and formulas at high speeds and minimum expense. As these models are

developed, they are programmed into a digital computer, the H-120, to develop a comparison. Five million items of data on the stocks are now on mag tape and can be sorted and printed in graphical form.

The ESE computer, patented last September, has 60 potentiometers into which scaled financial and price history data are programmed. Tests are then performed to find out the determinates of price action. Validity of evaluations is determined by the prediction error displayed on an R.M.S. meter or oscilloscope. Once the optimal model of a stock is obtained, it is output to and read manually from a digital voltmeter.

PERKIN-ELMER GOES OWN WAY ON TIME-SHARING

A home-grown time-sharing system based on a coupled SDS 930 and 9300 is operating at the Perkin-Elmer Corp. Running only three hours/day but due for longer runs, it can service simultaneously up to 16 on-line users, including lens designers. They get from 1-5-second response times on their 1050 and Teletype terminals.

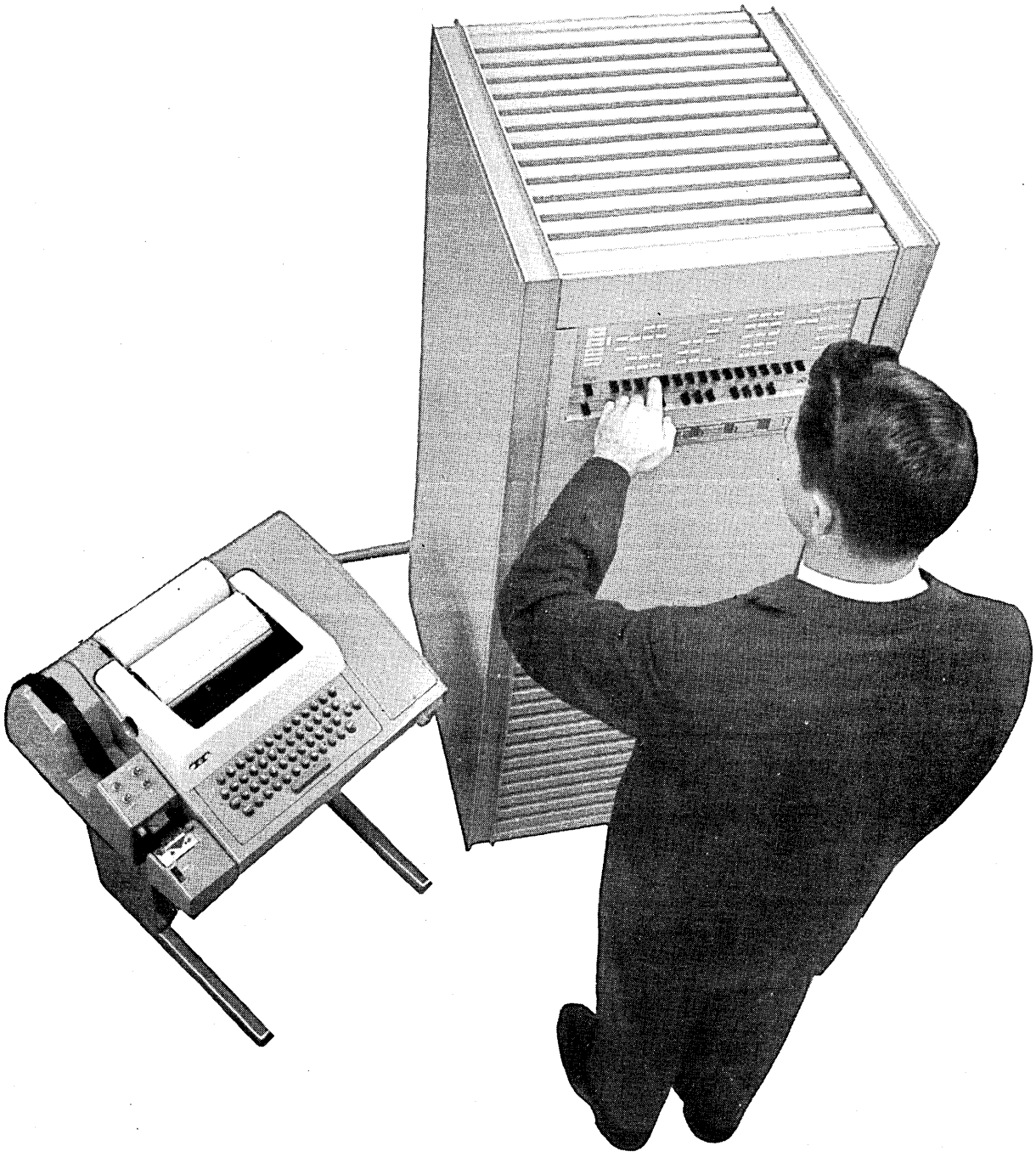
There's no paging: users are serviced on a round-robin basis. And a file management system on the disc has a lock for strangers, a key for privileged users. Software includes FORTRAN IV, meta-assembler and a text editor tailored after UC-Berkeley's QED.

Designed before SDS had its 940 t-s system, this configuration provides the 9300's floating-point capability, a feature lacking on the newer 940.

● The CODASYL COBOL language subcommittee has set up a task force to develop extensions to the mass storage language features of COBOL, permitting definition of file structures using list processing and chaining techniques. Contributions of ideas to this end are invited. Correspondence should be addressed to W. G. Simmons, chairman, P.O. Box 124, Monroeville, Pa. 15146.

● Papers are requested for the "Annual Review in Automatic Programming," which last appeared in 1964 under the editorship of the late Richard Goodman and is being resumed by an international editorial board. It will be published by Pergamon Press, beginning late this year or early next year. Manuscripts should de-

This 16-bit, real-time computer multiplies faster, has a faster throughput, and costs less than the Sigma 2.



It's our SEL 810A, for high-speed data acquisition and control. All integrated circuits, 3 levels of priority interrupt, 4K memory, teletype, high-speed hardware multiply and divide, real-time I/O structure, and an outstanding software package. Price: $23,950. Delivery: 60 days. Systems Engineering Laboratories, 6901 West Sunrise Blvd., Fort Lauderdale, Fla. 33310, Area Code 305 587-2900. Offices also in Washington, D.C.; Los Angeles, Calif.; Boston, Mass.; San Francisco, Calif.; Cleveland, Ohio; Huntsville, Ala.; and Orlando, Florida.

Systems Engineering Laboratories

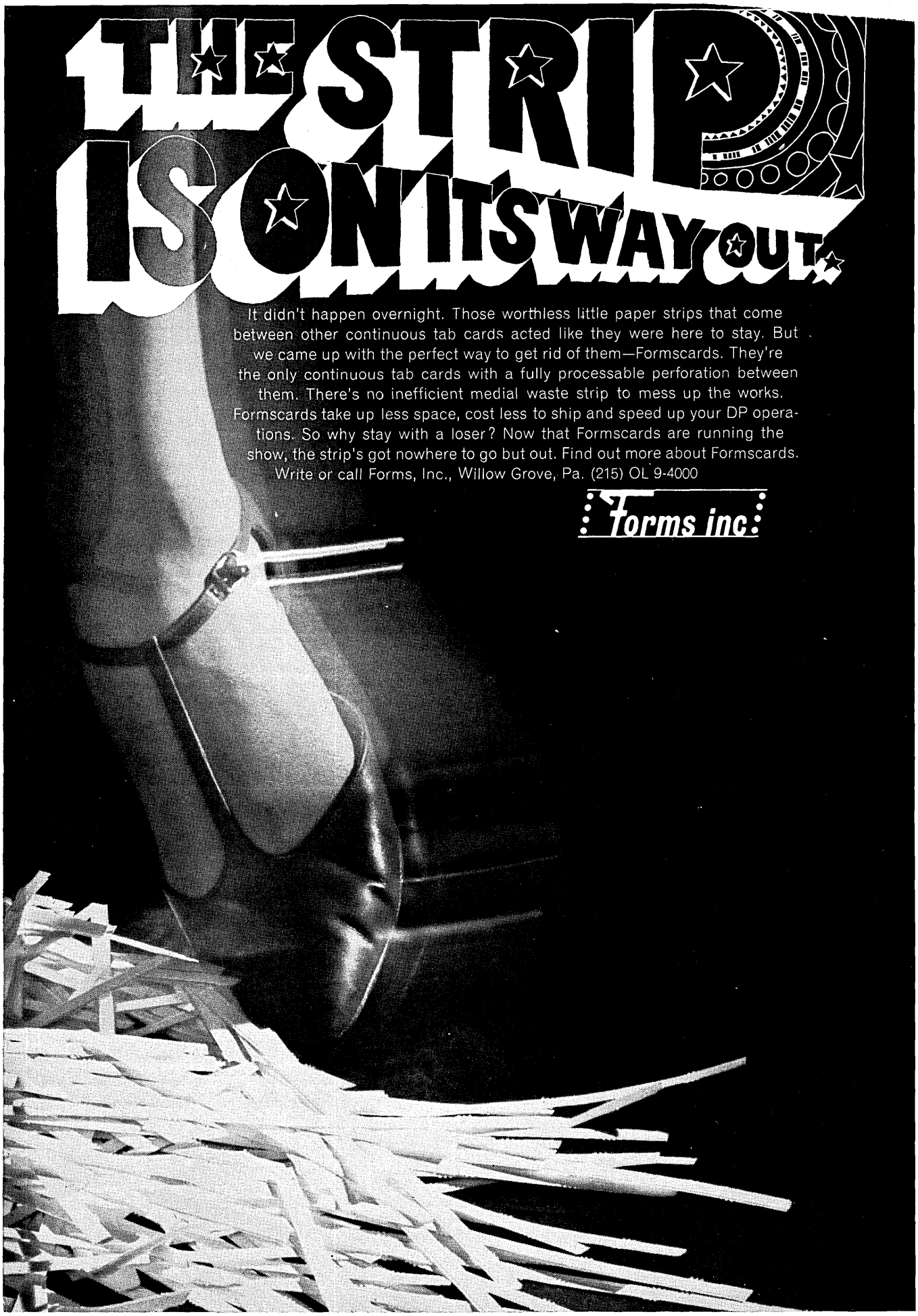
CIRCLE 45 ON READER CARD

scribe advances in using the computer as a tool in developing and applying computer programs. They can be addressed to any of the editors: Prof. Louis Bolliet, Univ. of Grenoble, Boite Postale 7, Saint-Martin-D'Heres (Isere), France; Prof. Robert W. Floyd, Carnegie Institute of Technology, Schenley Park, Pittsburgh, Pa. 15213; Mark Halpern, Lockheed Missiles and Space Co., 3251 Hanover St., Palo Alto, Calif. 94304; Christopher J. Shaw, System Development Corp., 2500 Colorado Ave., Santa Monica, Calif. 90406; and Prof. Andrei P. Yershov, Computation Center, Novosibirsk 90, USSR.

● Hungary has been formally admitted to membership in the International Federation of Information Processing, bringing total member countries to 26. Invitations have been issued by Mexico and by Yugoslavia (whose admission to IFIP is now being considered) for Congress 71 to be held in those countries. The 1968 meeting will be in Edinburgh, Aug. 5-10.

● Phototypesetting on a service bureau basis from computer-generated information on magnetic tape is being offered by a new company in New York City called Sedgwick Printout Systems. The customer supplies the mag tape, recorded by his computer, and gets back completed pages on film, ready for platemaking. President of the new firm is Henry Sedgwick, founder of Foto Comp and former general manager of Simulmatics Corp.

● The Jovial Information Bulletin will be published occasionally by the Special Interest Committee on Programming Languages of the Association for Computing Machinery and distributed as a supplement to SIGPLAN Notices, the group's monthly newsletter. The bulletin will deal with such topics as applications, comparisons with other programming languages, desirable changes of the language, information about Jovial processors, algorithms, and techniques. Contributions of this sort and users' descriptions of Jovial compilers are solicited by the editor, David K. Oppenheim, Abacus Programming, 3507 Barry Ave., Los Angeles, Calif. 90066.



CIRCLE 65 ON READER CARD

washington report

CONGRESS WINS ROUND IN PRIVACY BATTLE

BOB, after meeting with Cong. Cornelius Gallagher last month, agreed to re-study the proposed national data center, using a panel that will include House and Senate delegates. Reportedly, even before the panel is formed, BOB must sell the center to the White House staff, which "has been made aware of the privacy problem," as one source puts it. BOB also agreed the data center cannot be established administratively, that legislation will be required. Thus Congressional critics may kill the whole idea.

COMPUTER-COMMUNICATIONS CONTROVERSY STAGGERS TOWARD SHOW-DOWN

FCC launched the second phase of the computer utility inquiry last month, giving data processors and communication carriers until Oct. 2nd to manufacture their brickbats. The ground rules have been clarified but remain basically unchanged. IBM's request for a narrow inquiry, limited to data teleprocessing and excluding data processing, was denied. So was a carrier's proposal to consider "factual" matters ahead of "policy" matters. Allegedly, this arrangement would have focused attention on dp industry inadequacies and helped the carriers make a more persuasive case for utility-type teleprocessing service.

Meanwhile, RCA and ITT Worldcom were asking the commission to consider (right now) whether, and to what extent, message switching service should be tariffed. This dispute involves RCA's new AIRCON service, which isn't regulated, and ITT's slightly older ARX, which is. The tariff question is crucial because message switching is a major means for carriers to get into data teleprocessing. Data processors say that message switching by the carriers can and should be tariffed, even when this job is performed by a computer that also provides data processing service. Essentially, this is what ITT says. The big question: will FCC agree?

EDUCOM ATTACKS PENDING COPYRIGHT LEGISLATION

The pending copyright bill is "pernicious" because it allows classroom use of copyrighted material without payment of royalty, but denies operators of computer-assisted instruction systems the same privilege. So said the Interuniversity Communications Council (EDUCOM) at a Senate Judiciary subcommittee hearing this month.

The council contended that the copyright protection accorded computer programs is far too broad -- the related algorithms ought to be specifically excluded. Also, it said computer operators should be able to input copyrighted material without running the risk of infringement. The proposed legislation relies on the "fair use" doctrine, which the council says is inadequate. At stake is the desire of copyright owners to collect for applications limited to scanning and summarization, rather than full-text printout.

CAPITOL BRIEFS

The Senate passed a legislative reorganization bill which authorizes a legislative reference service to use edp, calls for the establishment of standardized federal budget data, a dp system to tabulate and analyze it. ... Thanks partly to Jack Brooks' steady sniping, the NBS Pilot project has been shot down. ... NSF wants $13 million in FY '68 to demonstrate new computer applications in colleges and U's.

A Honeywell Report on COBOL.

It's easy to talk

It's easy to talk

TALK TO IT IN THE LANGUAGE YOU KNOW BEST.

Use COBOL, the COmmon Business-Oriented Language that allows easy translation of business procedures into efficient data processing operations. Many of the nation's largest business data processing users have found that COBOL offers the best opportunity to achieve the benefits today's forward-looking managements expect from EDP. Here are a few of these benefits:

Aid in System Evaluation and Selection

COBOL simplifies the problem of system selection. It provides definite, precise answers to a user's data processing problems. COBOL is a powerful management tool that offers effective computer utilization as a key concept. As a result, more and more prospective users are making COBOL capabilities the pivotal issue in their system evaluation and selection process.

Intersystem Compatibility Via Machine Independence

COBOL is now implemented for almost every model and series of computer. COBOL offers the user the ability to move from one computer to another without a major reprogramming effort. Formerly, a prospective user had to be concerned with how the hardware differences that exist among various models of computers would affect their programming. COBOL alleviates

business to a Honeywell computer.

business to a Honeywell computer.

these considerations by providing the user with a high degree of machine independence. COBOL language is not dependent on the logic of any particular computer, thereby offering a sound basis for intersystem compatibility. The result? Lower programming costs, both initially and in the long run.

Improved Communication Between Manager and Programmer

Because COBOL consists of familiar business terminology, it offers a common basis for communication between management and the data processing staff. System proposals, flow charts, and programming conventions involve standard business nomenclature. Management objectives are easily translated into data processing applications with managers and programmers talking the same language. Their increased ability to organize and communicate ideas establishes a firm basis for mutual action and project success.

Standardization For Universal Effectiveness

COBOL brings a high degree of standardization and universality to business data processing. The language structure and syntax of COBOL are a product of years of experience and co-operation between computer manufacturers and business computer users. Standard terminology and usage produced by the CODASYL committee have helped establish a high level of efficiency in data processing applications. Both the language and the translator programs (compilers) must contain an extensive array of features and facilities to maintain the power and flexibility inherent in COBOL system specification.

Manufacturer's Know-How Pays You Dividends

One of the major features of COBOL is that the responsibility for efficient programming is shifted from the user's programming staff to the manufacturer. In effect, the experience and technical expertise of the manufacturer's programming staff are placed at the user's disposal via the COBOL compiler. The quality of the translation depends heavily upon the quality of the manufacturer's implementation of COBOL. If the manufacturer implements the full intent of COBOL language elements and syntax, then the user's programming potential will be both powerful and effective.

HOW TO EVALUATE COBOL SYSTEMS? The answer lies in four key areas:

1. Language Implementation — This includes not only the number of language elements but the overall power or richness of the language. Does it include time-saving coding tools, such as the "copy" verb or automatic segmentation of the object program?

2. Compile Time — An important consideration, since compilation is a parasitic operation using valuable machine time for non-production work. A compiler must offer optimum balance between a high compilation rate and efficient object code. A high-speed compiler makes it economically feasible to operate completely in source language for even the most trivial changes in the program. No machine-language patches are required.

3. Object Code Efficiency — How does the code produced by the compiler compare with the code produced by the computer's assembly system?

4. Reliability — How reliable is the compiler? Does it work when you want it to? Does the compiler introduce undetected errors into the object code?

HONEYWELL SERIES 200 COBOL

Honeywell, in implementing COBOL for Series 200 has taken a modular approach consistent with its operating system design concept. Series 200 COBOL consists of five levels, each identified by its minimum memory requirements. The five levels are: 8K, 16K, 32K, 65K, and 131K characters of memory, including operating system requirements. Each level affords a rich and powerful implementation of the COBOL language and a fast, efficient compiler. Moreover, all levels incorporate the full range of program preparation, execution, and maintenance capabilities that distinguish a total system from a simple compiler.

WRITE FOR MORE ON COBOL

Send for the Honeywell publication entitled "COBOL Orientation for Management." This booklet includes a description of all levels of Honeywell Series 200 COBOL. Wellesley Hills, Mass. 02181.

Honeywell
ELECTRONIC DATA PROCESSING

CIRCLE 66 ON READER CARD

Time sharing marches on...

PDP-10 is **still** the leader.

DIGITAL started time-sharing some time ago. With the PDP-6. Hardware and software. PDP-10 is our second step.

The reason that's important is this: our first step is behind us. Two years' continuous work on the software. Nearly two dozen installations using it. Improving it. Refining it. That's all done.

When the PDP-10 hardware arrives in September (five versions, five software packages, upwards compatible, truly modular), it will be more than cabinets filled with electronics. It will be a working, problem-solving, 36-bit word, 1 μsec, expandable, scientifically oriented computing system with memory from 8 to 262 thousand words.

Two of those versions will offer time-sharing. Second generation time-sharing. Complete, general purpose, simultaneous multiusage, "time-slicing", "time-splicing" time-sharing.

Disc swapping. Batch processing. And in the hardware, 365 powerful instructions. 16 general purpose registers. 7 fully nested interrupt levels. 16 accumulators. 15 index registers. High speed multiplexer channels. 64 programmed operators. Modular mnemonics. Flexible I/O bus structure. Programmed priority-interrupt system. All 16 Boolean operations, each in four modes.

PDP-10 is big. Powerful. In the several million dollar class just a few years ago. But it's little, too. Little enough for a scientist to put the system on-line with his experiment as his personal research tool. Little enough for a physics department with time-sharing needs. And little in price, too. Nearest competitor wants 50% more. Write.

digital
COMPUTERS · MODULES

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

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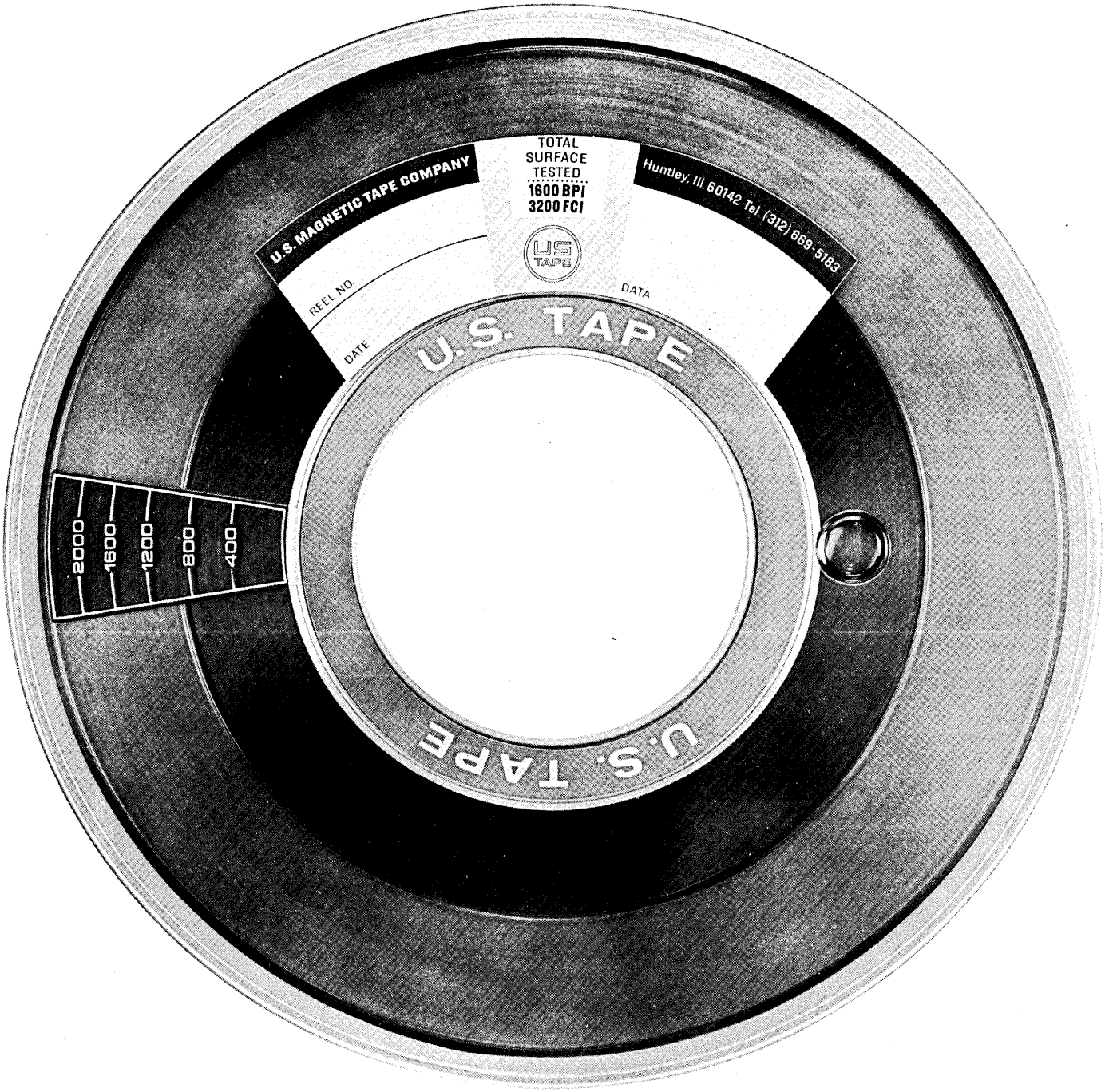
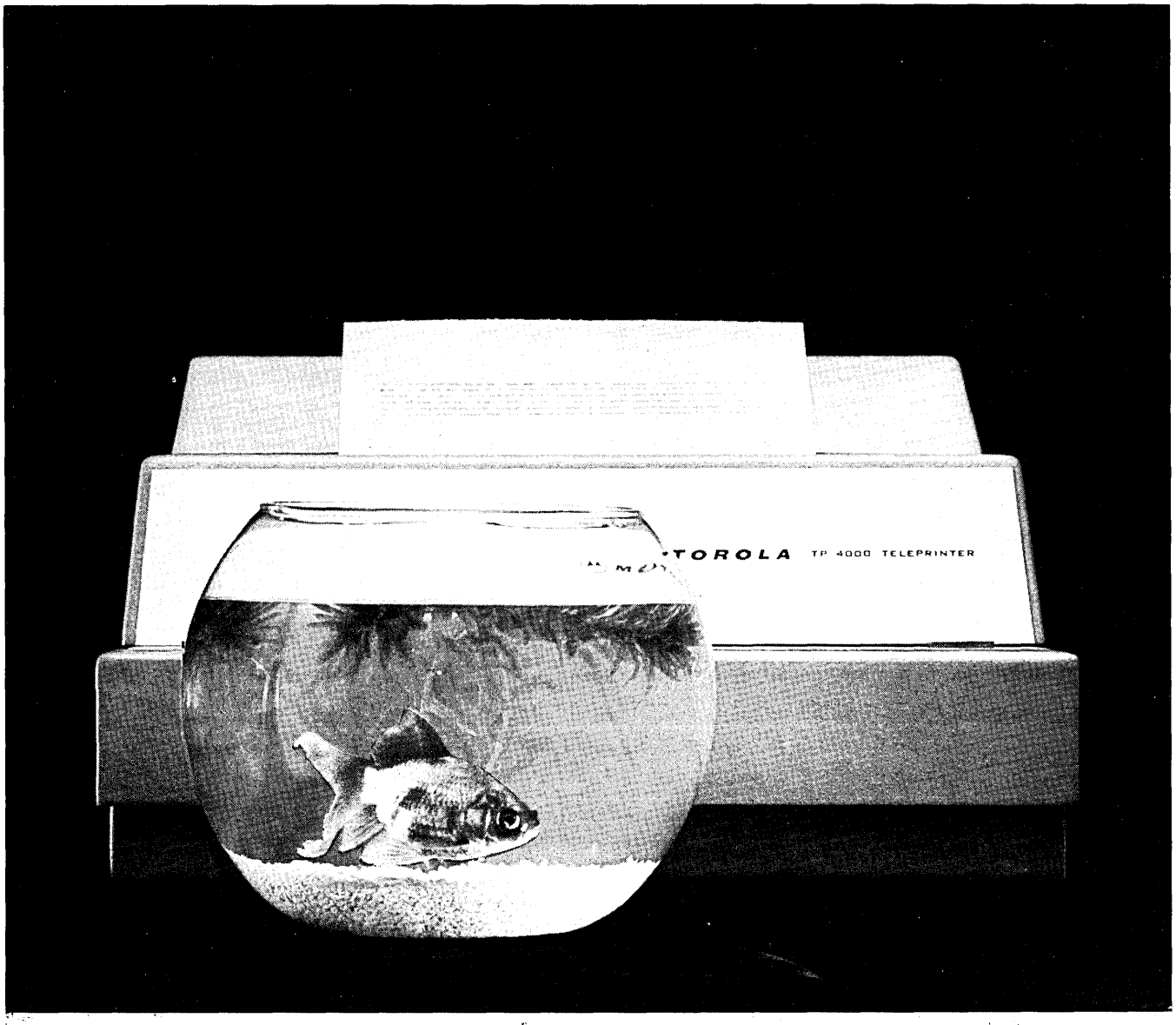


To be as good, some other tape would have to have Duramil 7.

No other tape has.

U. S. Magnetic Tape Company
Huntley, Illinois 60142 / *A Subsidiary of Wabash Magnetics, Inc.*



Q. What does a goldfish in a bowl have in common with a Motorola printer? A. They both sit on your desk and make about the same amount of noise.

What's more, the Motorola TP-4000 has only seven moving parts and turns out up to 4,000 words of hard copy per minute. Which means that if you need a high speed, high reliability, non-impact computer print out that can sit on your desk and not clickity-clack you out of the office every time it runs, you need to talk to us, now.

Let us tell you how our customers, both government and commercial, are using the TP-4000 printer with a wide variety of computers. Let us show you how the TP-4000 would work in your data processing, process control or data communications application.

Write or call: Motorola, Data Communication Mgr., Chicago Center, 1450 N. Cicero Avenue, Chicago, Ill. 60651, Phone: (312) 379-6700.

MOTOROLA
Government Electronics Division

CIRCLE 69 ON READER CARD

world report

IS MINTECH TAKING VITAMINS?

In Britain, the Ministry of Technology is flexing its muscles. Under a grand reorganisation, it has gained a direct interest in the military market, which forms the largest single purchasing area for computers. Mintech now dishes up paternal advice to local government as well as nationalise industries, and would-be purchasers who want equipment with the least trouble are aware that the government body believes in pushing the two local boys, ICT and English Electric-Leo-Marconi. Now Mintech has under its wing some big establishments: Royal Radar and Royal Aircraft -- and through them has gained a powerful voice as link-man between defence markets and manufacturers.

Mintech is also looking after manufacturers' interests through its representation on the Christchurch Committee: a Ministry of Defence body that two years ago began a long saga to specify a standard range of military machines. Last year its specs resembled 360 architecture with hybrid logic, much to the consternation of the local industry. Revised specs that please the manufacturers have now been drafted, and Mintech lobbying is in no small way responsible. The Ministry sits in the middle of the U.K.'s plan to scale the walls of the Common Market: in mid-March a German delegation was VIP-ed around the industry by Mintech officials. Technological collaboration was a major slice of the dining-table talk; but the bread-and-butter aspect was more imminent: how many computers could be sold to West Germany (rumored value $25-30 million) as part of the agreement to offset costs of keeping British forces in Rhineland.

HONEYWELL, DEC STEP UP EUROPEAN OPERATIONS

Honeywell is embarking on an aggressive European campaign. From a new chair as first vp, computer operations, Claude H. Smith forecasts that by 1970 Honeywell's international sales will outstrip domestic activity. Production is being doubled at the Scottish plant where last year machines worth $10 million were exported to the Continent ... Another U.S. manufacturer consolidating its European operation is Digital Equipment Corp., which is starting PDP/8 manufacturing at Reading, U.K. Fifty-six PDP/8s are already on order for Britain.

NEW COMBINES RESHAPE MARKET

West Germany's AEG Telefunken kicked off a month of deals and mergers with a cross-licence deal with U.S. General Electric to make GE/PAC 4000s. In the process control line, this promptly challenges Siemens, who broke ice in this area last year with a new series of processors ... British GE followed by selling out its computer and automation division to Elliott Automation. GEC was franchised to sell and make SDS equipment for U.K. and Scandinavian markets, and this leaves the question of SDS licences in the U.K. wide open. Elliott competes straight across the board with the Santa Monica company's products and it

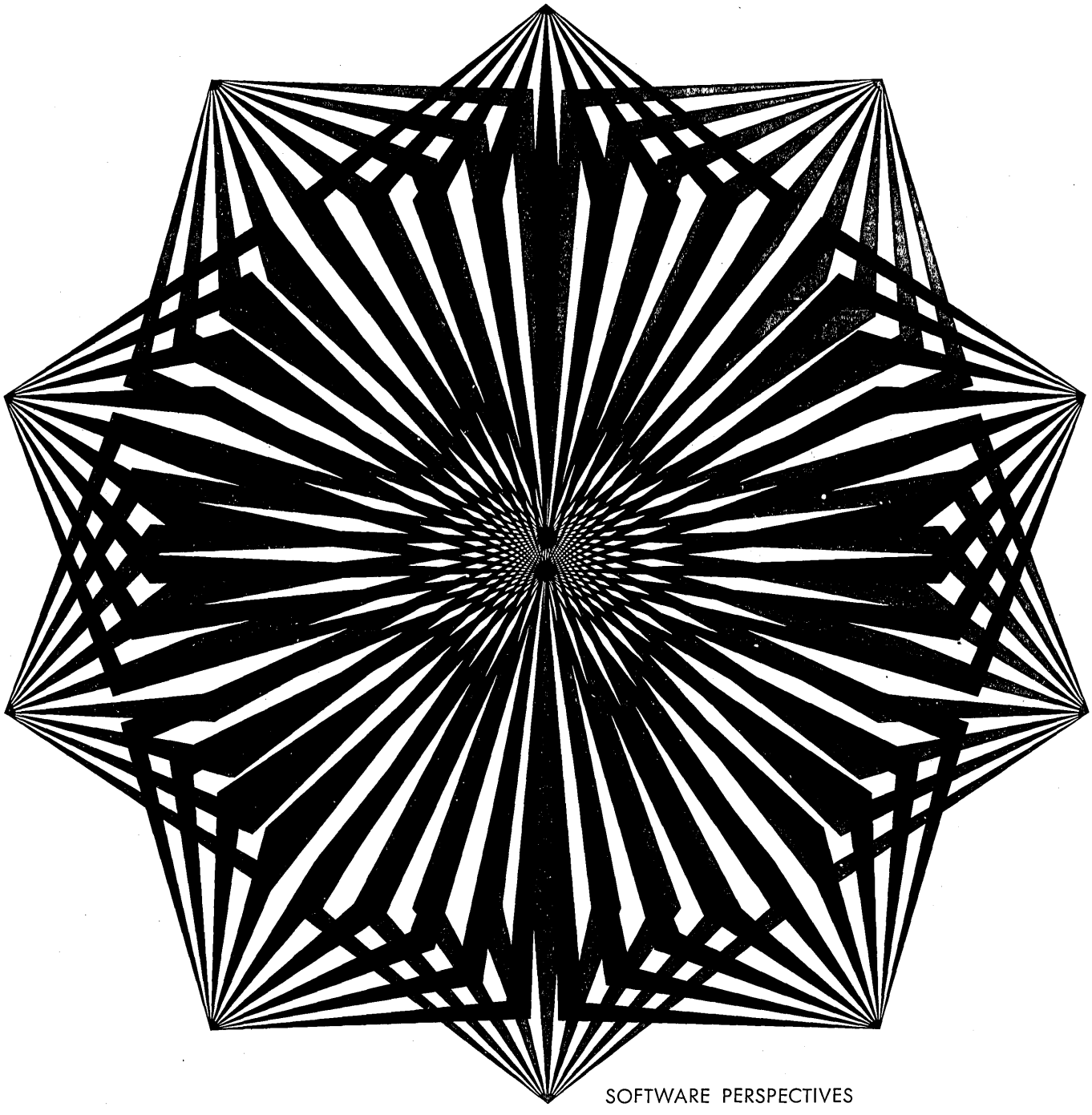
(Continued on page 115)

SOPHISTICATED SOFTWARE?

Highly sophisticated! That's right. That's what our customers say! Our incentive/penalty contract earned an extra 35K bonus for the crew! You won't believe how much software we delivered — a basic control monitor, basic FORTRAN, a basic assembler, a library of mathematical and utility routines, a real-time batch monitor, real-time FORTRAN IV and an extended assembler. Complete with the finest documentation available! What's more we've done it many times — for many different customers, and for their customers too, and always on schedule — or ahead of it! That's right! For very large hardware systems and for very small ones. For computer manufacturers and for computer users.

IDC is software, one pass compilers, complex compiler systems to complete operating systems, and everything inbetween. Analysis and specification to implementation. The IDC target is user satisfaction, not in-group pride. IDC programs for profit, not overhead. We pay our IDC professionals top salaries, with bonuses for extraordinary performance. Naturally, we get superlative talent, exceptional results. The same business philosophy which pays extra dividends for our clients also stimulates our own vigorous growth as a company. Major computer manufacturers bought this idea from the beginning. Now more and more users are coming aboard. How about you? For a refreshing perspective on software management, contact IDC now. 1621 East Seventeenth Street, Santa Ana, California. Or call IDC (714) 547-8861

INFORMATION DEVELOPMENT COMPANY



SOFTWARE PERSPECTIVES

(Continued from page 113)

seems doubtful whether either will be interested in perpetuating links.

Also on the merger list were two hybrid specialists in the flight simulator business. General Precision Systems Ltd. has sold out its flight simulator division to Redifon Ltd. GPS suffered a major set-back when Britain cancelled its own TSR 2 strike plane in favor of the American swing-wing F-111, and a quick switch to civil work failed to produce new markets. Redifon claims it's number one in world-wide civil airplane simulator work, and takes its computer supply from a subsidiary, Redifon-Astrodata, which makes Comcor equipment under an Anglo-American deal.

PLESSEY PUTS FOOT IN SOVIET DOOR

An agreement on technology signed between the Plessey Co. and U.S.S.R.'s State Committee on Science and Technology could bring business worth over $30 million into Western European laps. The Soviets are interested in buying complete systems for air traffic control, overall factory machine tool automation, and mining and industrial plant process control. The first scheme is expected to be a data communications network serving the whole Soviet construction and civil engineering design industry. Central machines at state planning authorities and regional design offices will provide the nucleus for accelerating industrial and urban building. ICT is expected to be co-opted to supply computers; Plessey will specify their own XL micromin series on message switching and process control jobs.

BITS & PIECES

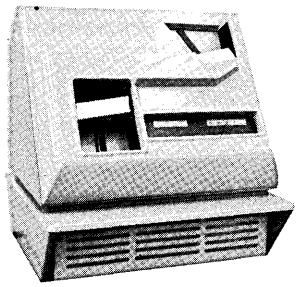
English Electric reported sales of £270 million last year, with £96.5 million of this in direct exports to international markets. Having sold four computers to Czechoslovakia in the last 18 months, EELM is now stepping up its Eastern European activities with negotiations with Russia and Poland ... ICT picked up orders worth $8.5 million from U.K. state-owned industries last month. The Central Electricity Generating Board ordered five 1905s worth $4.5 million; orders from gas utilities produced the rest, including a $1.5 million contract for the upgraded processor model 1905F. Central Electricity also has a 360/75, but an existing 7094 II still handles most of the network and power stations analysis studies. Present throughput of the 75 is about 1½ times up on the '94 ... IBM 360/67 takers in Europe are still digesting the decommitted software schedules. One customer, the U.K. Atomic Energy Authority, may take quick delivery of models 50 and 65 as an interim solution ... The British Army has placed an order for 75 Elliott 920 B micromin computers worth $5 million, with options for twice this number. They will be used in the field for computing artillery firing ranges ... Univac, which withdrew from the Australian market more than three years ago, will take another shot at same. Re-entry was sparked by order of a twin message switching system for the Overseas Telecommunications Commission ... Growing need for processing of seismic data has triggered the importation of a TI 870 by the Australian office of Geophysical Service International Ltd., a TI subsidiary. IBM is offering seismic services on a 360/50.

Compact... Reliable... Fast!

Economical card readers **- durable, simplified card handling mechanisms. A new standard of quality and performance. The first truly low-cost high-performance card reader.**

Soroban's end-fed photoelectric card readers operate on demand at speeds up to 1100 cards/minute with extreme reliability. An integral picker/reader head handles cards so gently and precisely that a single deck can be read hundreds of times without degradation...and the extreme simplicity of the mechanism effectively eliminates routine maintenance. Associated circuitry provides a ready strobe interface with data presented as 12 parallel bit characters with strobe. Vertical 1000-card bins are provided with facilities for offset of selected cards in the stacker. Features include light/dark check of the read station, card motion checks, and jam detection.

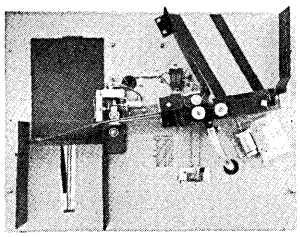
Model ERC - Compact console 59" H x 35" W x 35" D contains standard control and interface circuitry, ample space for custom circuitry. **$6,500**



$4,800

Model ERD - Desk top card reader, only 36" H x 35" W x 35" D. Self-contained control and interface circuitry. Convenient, quiet operation.

Model AR - Reader panel without circuitry for custom installation (shown with cover removed). Same reliable, high performance mechanical components and features as above models. **$3,000**



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See Soroban's complete line of computer and data processing peripherals ....high-performance Card Punches, Tape Punches and Readers, Printers, Keyboards. Call or write now for your copy of the new Soroban General Catalog.

CIRCLE 72 ON READER CARD

What do Vidar • Kimball Systems • Victoreen Instrument • Systron-Donner • Calma • Berkeley Scientific Computer • Hewlett-Packard • Bisset-Berman and Raytheon Computer **have in common?**

US

The outstanding firms listed above, and many others, include Kennedy incremental magnetic recorders in their data gathering systems because of the simplicity, reliability, and easy handling designed into every Kennedy recorder.

See them at the Spring Joint Computer Conference and visit us at Booth 1002.

We may have a lot in common with you.

THINK INCREMENTAL **Kennedy Co.**

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CIRCLE 29 ON READER CARD

DRUMS
•
MODULES
•
SYSTEMS

A Page from the Vermont Research MEMORY FACT BOOK

Fact:

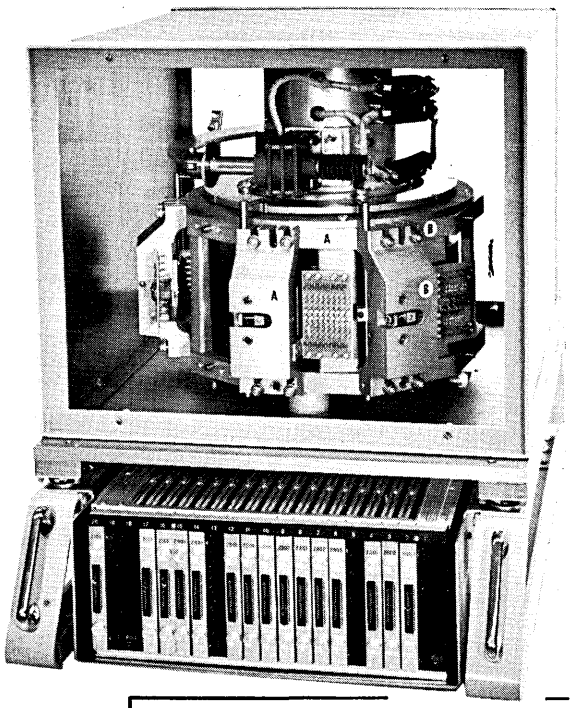
A Computer-Quality Drum Memory System Has Broken the Price Barrier

Take a tremendously versatile drum memory system. Put it into less than 3½ cubic feet in a standard 19 inch rack. Give it data storage capacities from 200,000 to 4,000,000 bits. Add average access times as fast as 3.7msec. Factor in an operating life exceeding 100,000 hours. Attach a drum price tag starting at just $3,000.

What have you got? The VRC 104S . . . a drum memory system with ideal characteristics for solving just about everybody's memory problems. To illustrate, versions of the 104S are already earmarked for such widely divergent applications as improving control of automated mining operations and simplifying oceanographic research. Others are being readied to expand memory capabilities of several popular computers.

VRC custom tailors the 104S exactly to your needs, furnishing it in standard or hermetically sealed versions . . . with oxide or plated drum . . . with everything from basic read/write electronics to full digital interface circuitry.

Give us the essential memory requirements of *your* application. We'll show you how a 104S can meet them, at a price guaranteed to make even your budget director beam!



See the 104S and other VRC memory innovations at Booths "O"-6 and "O"-7, SJCC

Computers are known by their MEMORIES

. . . so is

Vermont Research
CORPORATION

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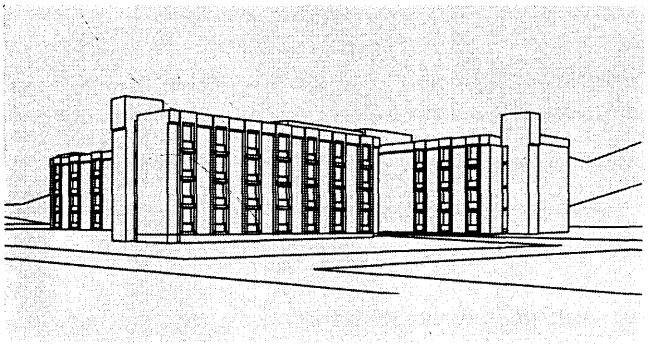
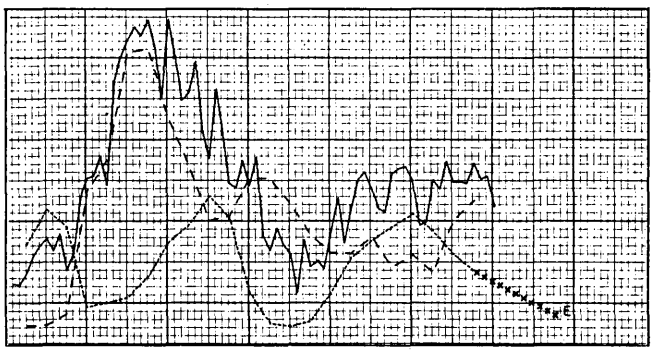
CIRCLE 71 ON READER CARD

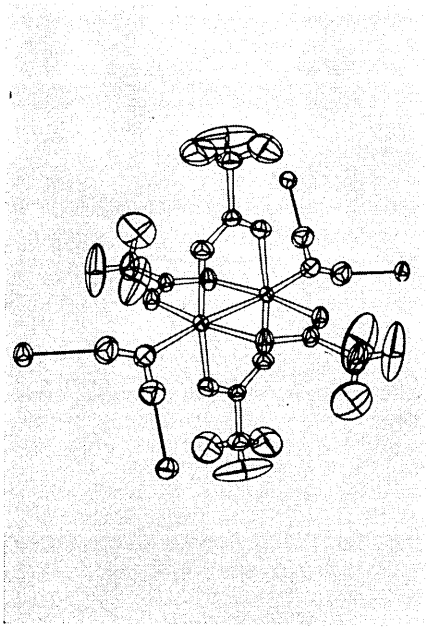
Would you believe a CalComp plotter and any computer can draw pictures like these in seconds?



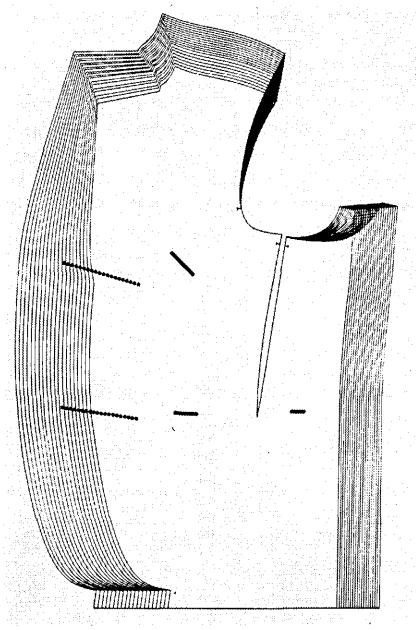
a perspective sketch of your new plant



statistical trend charts



molecular structure diagrams



apparel patterns, graded for sizes

and even the Mona Lisa

it can

Call or write Dept. D-4, California Computer Products, Inc., 305 Muller, Anaheim, California 92803, Phone (714) 774-9141.

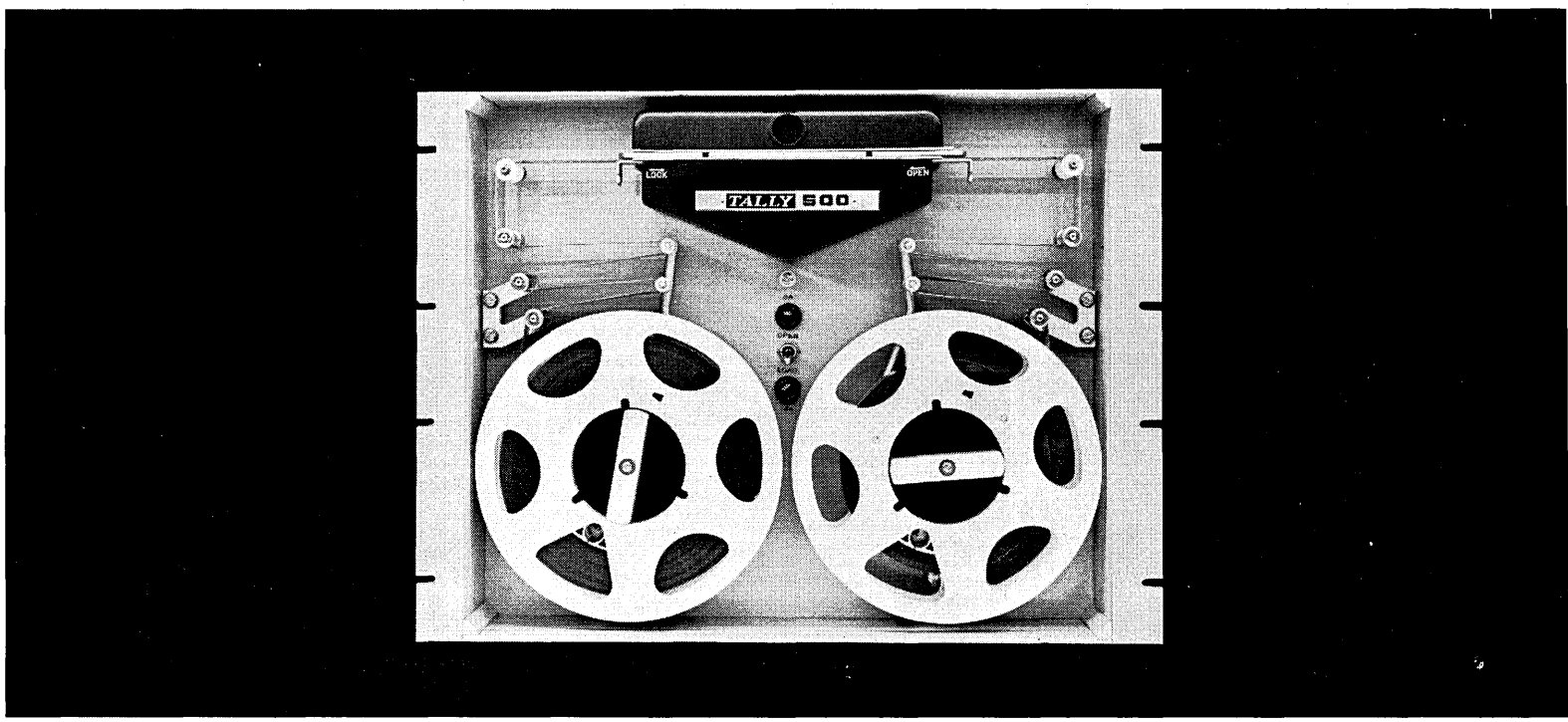
CALCOMP

Standard of the Plotting Industry

(Talented Engineers and Programmers required—right now.)

New Tally 500 series photoelectric tape readers work up to 1000 characters per second.

That's not unique.



But working without pinch rollers, friction brakes, clutches, or solenoids – that is!

There's no point in Number 1 introducing just another "me too" product. Just to give you an idea of how good the new line is, in a recent life test, one photoelectric reader ran for 15,000 hours at maximum speed without a failure. You can see why we say these new readers represent genuine "state of the art" achievement. Adding them to the Tally line rounds out the broadest line of perforated tape equipment on the market today.

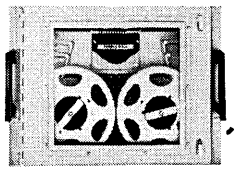
The 500R, 500RF, and 500T.

These three readers operate at up to 200 characters per second asynchronously (stop on character), up to 500 char/sec in the synchronous or free running mode (stop before next character), and 1000 char/sec in the wind/search mode. All feature printed motor direct capstan drive, and bi-directional reading and winding. The Model 500R (recess mounted) and the Model 500RF (flush mounted) are reader and spooler combinations, while the Model 500T comes without the reel servo system. For tape handling only, two spoolers using printed circuit motors and proportional reel servo are offered, one with 8 inch reels, the other with 10½ inch reels.

MIL-SPEC reader, Model 500RM and "ruggedized" reader, Model 500RF/10

Fully militarized, the Model 500RM is the first high speed reader that meets all applicable military specifications without exception. Featuring the same basic design as other Series 500 photoelectric readers, this unit will work in environments of −40°F to +145°F, in humidities of 100%, and take more than 15 g's shock. Pertinent RFI specs are met. MTBF is 5,000 hours. Expected life is 10,000 hours minimum.

Where severe environmental conditions are not encountered, the Model 500 RF/10 will perform with the same accuracy and life for about half the cost. Reading speeds for both readers are 150 char/sec asynchronously, 500 char/sec synchronously, and 1000 char/sec wind/search.

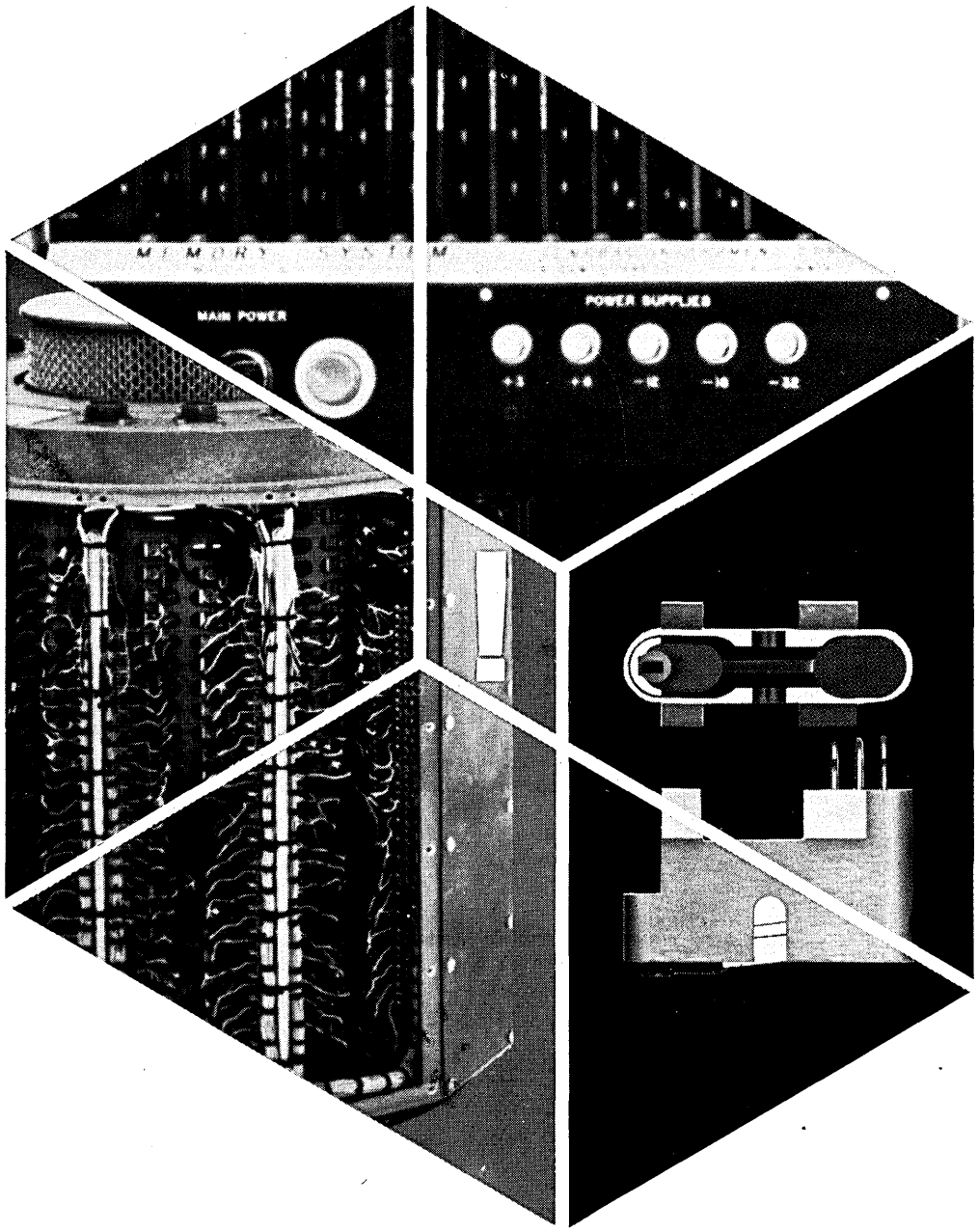


Model 500 RM

Full disclosure. For all the facts, call your full service Tally sales engineer (see EEM), or write Ken Crawford, Tally Corporation, 1310 Mercer Street, Seattle, Washington 98109. In the U.K. and Europe, address Tally Europe, Ltd., Radnor House, 1272 London Road, London, S.W. 16, England.

TALLY®

CIRCLE 74 ON READER CARD



SINGLE SOURCE RESPONSIBILITY FOR A COMPLETE MAGNETIC MEMORY SYSTEM!

Component integration can be costly and time consuming if a memory system is purchased piecemeal. Magne-Head engineers and technicians form a team with the proven capability to interface with any digital data source at the source input-output terminals. ■ Write today for free DRUM MEMORY SYSTEMS BULLETIN.

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CIRCLE 75 ON READER CARD

new products

tape cluster

Four-station magnetic tape cluster has two levels of spooling and operates on a co-axial reel. Each station operates independently at speeds of 45″/second. Tape is moved by means of sealed pinch roller drive modules; capstans for all four stations operate continuously at a synchronous speed of 900 rpm. Capstan power is supplied by a single motor, and flywheels provide sufficient inertia to maintain tape fluctuations at a minimum regardless

of pinch roller activity. Tape chamber is a sealed compartment; air flows through a micronic filter and is recycled 60 times per minute.

Cluster logic is a hybrid combination of discrete components and integrated circuit chips. Read/write electronics accept either 7- or 9-channel input in any code combination. Standard read/write densities of 200, 556, 800 and 1600 bpi are offered. Using phase encoding recording techniques at 1600 bpi, the information transfer rates are 72 KB and 144 KB. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 100 ON READER CARD

process control computer

The 855 i.c. process control computer has a 2-usec cycle time, core memory capacity of up to 32K (25-bit) words, and provides a basic decimal add time of 4 usec. Central processor is equipped with 32 I/O channels and has a transfer rate of 250K words per second. Also standard: 12 direct memory access channels with a transfer rate of 500K words per second. Multiprogramming capability is provided for real-time control functions, background - foreground processing, and/or concurrent I/O operations with a hardware configuration of interrupts, real-time allocation, multiple-area memory protection and peripheral protection. Software package consists of assembler, maintenance diagnostics, decision table interpreters, on-line executive and I/O subroutines. A FORTRAN compiler will be available in '68; deliveries of system begin in Dec. '67. BAILEY METER CO., Wickliffe, Ohio. For information:

CIRCLE 101 ON READER CARD

coordinatograph

Micro/Plotter can produce art master layouts for printed or integrated circuits, originate resolution targets for optical characteristic data, and construct grids and plot control for photogrammetry. Eight individual configurations offer ranges from 32 × 32″ to 48 × 60″; all are equipped with rack and pinion construction, zero setting anywhere within work area, carriage controls equipped with positive lock and slow motion control, abcissa rail pivots to permit angular adjustment to working reference, and

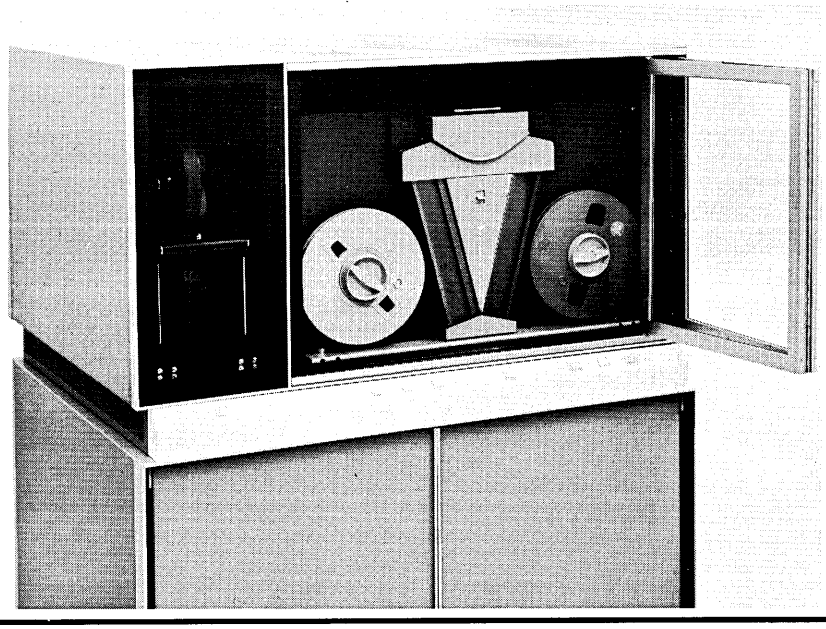
PRODUCT OF THE MONTH

The B-L 180 microfilm printer reads magnetic tape input and records alphanumeric data on microfilm at speeds in excess of three frames per second. Unit operates off-line with provisions for systems and applications adaptability. Standard dual input is compatible with both the IBM 1403 and the S-C 4400.

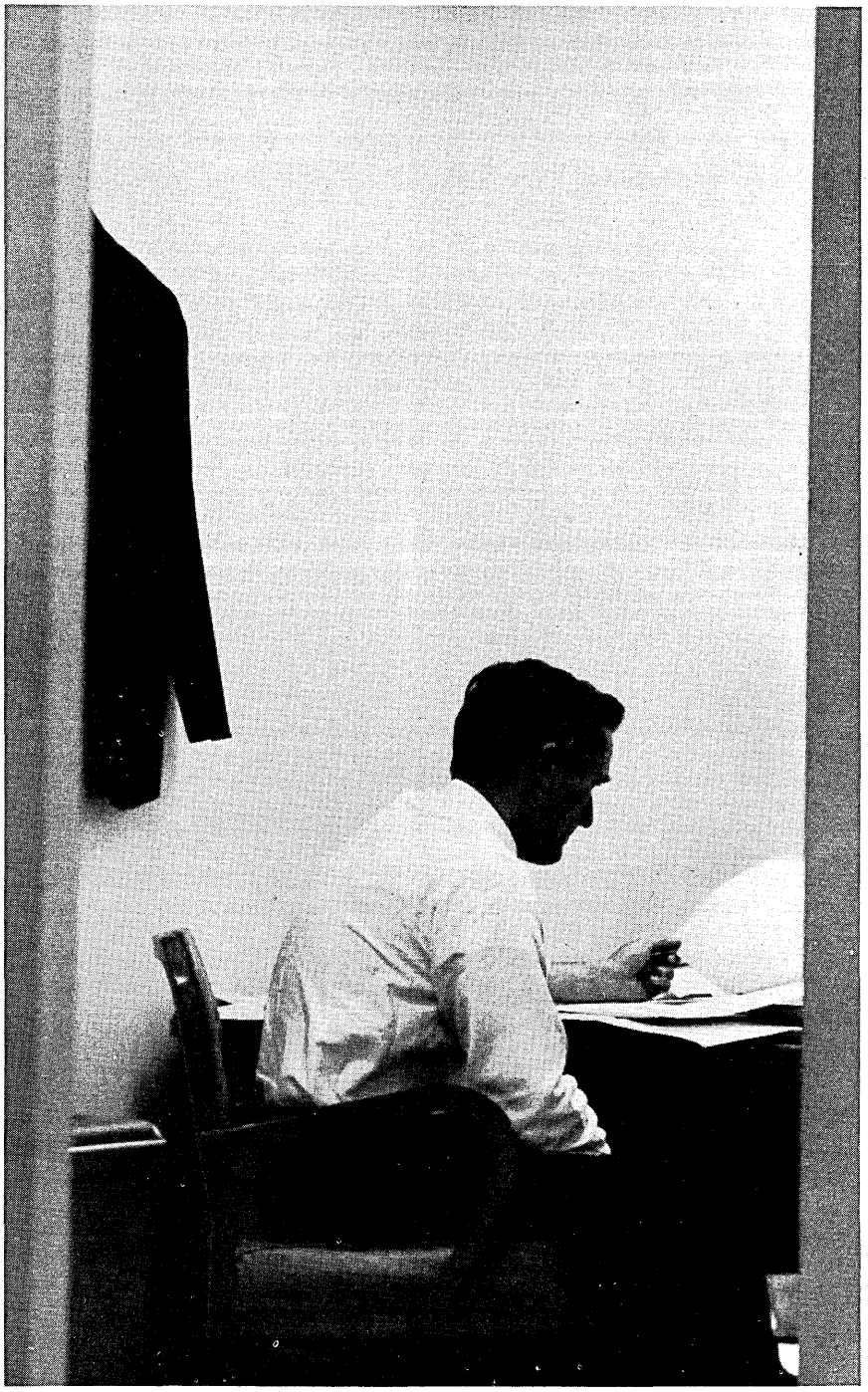
Coding for information retrieval, such as Miracode and Kodamatic, may be handled by printer system with no loss in throughput speed. Patch panel programming and manual switch selection extend control over output formats, including line spacing, tab sets, horizontal and vertical data arrays, and other standard-forms printing requirements.

Printer uses a monoscope, a special CRT with 64 standard characters etched in a metal face. When stimulated by input control signals, a light beam from the monoscope scans the stencilled shapes and causes letter/number configurations to be recreated on the CRT display phosphor. Throughput of the B-L 180 is 36K cps; full-page printing allows 132 characters per output line, 76 lines per frame of microfilm. Delivery lead-time is 90 days. BENSON-LEHNER CORP., Van Nuys, Calif. For information:

CIRCLE 102 ON READER CARD



What does computer usage mean to him?



He doesn't think about it. Right now, he's involved in an analytical problem on a project to orbit the moon.

Sitting alone in his office he's solving the problem—in his own way. But if he needs help, it's right next door or down the hall, with the most experienced people in the field.

If he had the time to think about it he'd probably say that CUC means many things to him—excitement, frustration, exhaustion and sometimes even boredom.

But right now it's the lunar project. Next week a library filing system for a large eastern university, or a FORTRAN compiler, or making the government's poverty program work.

Because CUC is people—concerned with extending the range of computer capabilities.

That's a lot to think about.

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interchangability of precision drawing and plotting accessories. AERO SERVICE CORP., DIV. OF LITTON INDUSTRIES, Philaldelphia, Pa. For information:

CIRCLE 103 ON READER CARD

core memory systems

Four core memory systems designed for military and aerospace computers include LCM 710, random access, DRO; LCM 210, serial access, DRO; LCM 410, random access, DRO/NDRO; and LCM 220, random access, NDRO. The 710 provides a combination of coincident current addressing and linear select operation; units are available as complete systems or with modified electronics. Standard expandable capacity is 256-2094 32-bit words.

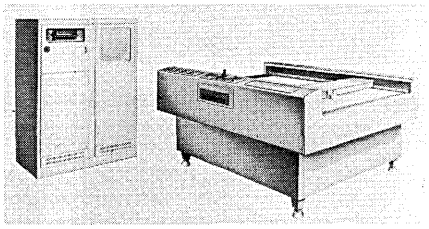
The 210 is a nonvolatile digital delay line permitting plug-in of additional sections of core. The 410 systems are capable of storing both electrically alterable and fixed data in the same array. Capacity is 512-8192 32-bit words.

LCM 220 is a hard-wired memory with a capacity of 256-4096 60-bit words. LITTON INDUSTRIES, New York, N.Y. For information:

CIRCLE 104 ON READER CARD

drafting system

Mark II model 1215 Kingmatic automatic drafting machine system offers speeds of 200-400 ipm and accuracy of ±.002″ to ±.004″ using a standard 4′ × 5′ drafting table. A special table gives .001″ accuracy at speeds of 100-260 ipm. Optional equipment includes



mag tape input unit, photoexposure head for production of integrated circuits, a 90-symbol printing head and revolving turret, and integrated digitizer unit. System is capable of straight line, circular or parabolic interpolation. Software available. BALDWIN KONGSBERG CO., Cincinnati, Ohio. For information:

CIRCLE 105 ON READER CARD

circuit design software

CIRC FORTRAN computer program is for circuit design engineering for small- or medium-scale computers

Introducing

the DATA 620·I new systems computer

The DATA/620-I integrated circuit computer is the newest member of the DATA/620 family of system computers. DATA/620-I fills the gap between general purpose and special purpose computers. It belongs in a system, and solves problems previously considered too difficult or expensive for computer solution.

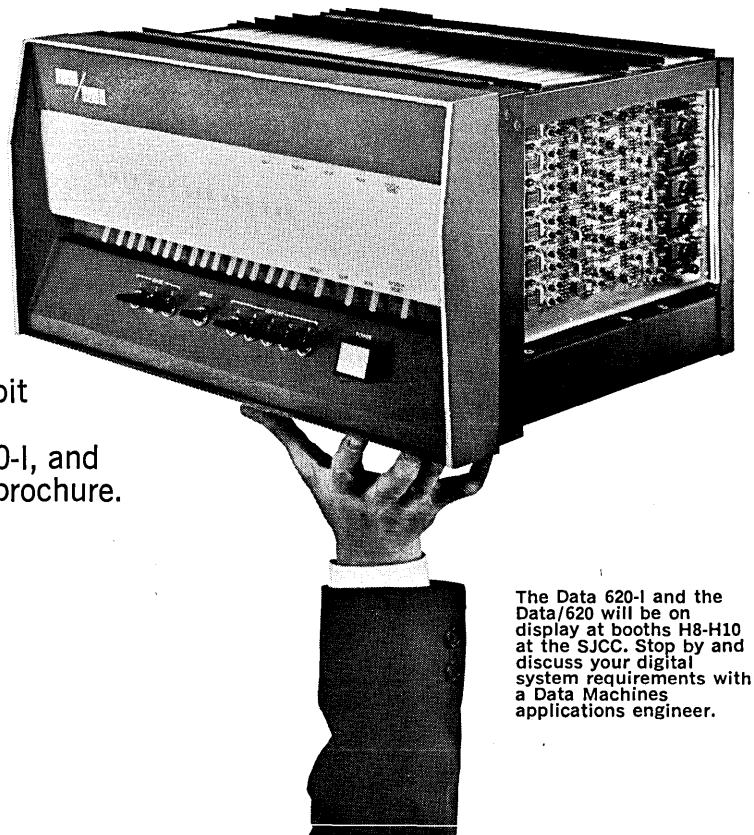
Designed for faster problem solution the DATA/620-I has a bigger instruction set, integrated circuit reliability, is smaller, has one-half the components, and costs less than any computer in its class.

DATA/620-I comes complete with software, field-proven and refined on the DATA/620.

Extremely compact, the DATA/620-I requires only 10″ of 19″ rack space. It's available with memory modules from 1024 to 32,768 words of 16 or 18 bits, and with a selection of control, arithmetic and I/O facilities, including D.M.I.'s unique Micro-Exec.

Price: $13,900 with 4096 words of 16 bit memory, including ASR 33 teletype.

We are very proud of our new DATA/620-I, and would like to tell you more in a fact filled brochure. Please write for one.



The Data 620-I and the Data/620 will be on display at booths H8-H10 at the SJCC. Stop by and discuss your digital system requirements with a Data Machines applications engineer.

DATA MACHINES

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Tel. (714) 646-9371 TWX (910) 596-1358
Division of DECISION Control, Inc.

CIRCLE 78 ON READER CARD

with a 16K core memory. CIRC enables engineers to analyze circuits containing 50 or more nodes and also provides non-linear models that accurately simulate semiconductor components. A conversational system, the program directs the engineer's input, then provides an evaluation of the circuit. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For information:

CIRCLE 106 ON READER CARD

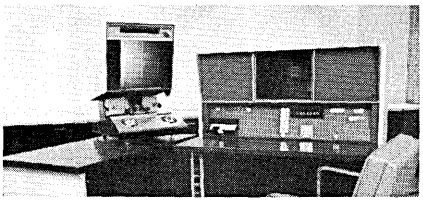
data retrieval display

Data retrieval television display produces a 5-mil-diameter spot on a 17″ rectangular display, with a resolution of over 2500 lines. Unit uses transistor circuits, and is available with video bandwidths in excess of 30 megacycles. Display can operate over scan frequencies from 15-40KC horizontal and 15-80 cps vertical. Raster geometry and deflection linearity are less than 1%. MIRATEL ELECTRONICS CO., St. Paul, Minn. For information:

CIRCLE 107 ON READER CARD

ekg recorder

The 1260 EKG recorder receives heart traces acquired in homes, clinics and hospitals as transmitted over telephone lines, and displays them on a monitor and CRT and a microfilm



processor-camera. Camera photographs the image on the tube and completes film processing in 45 seconds. Microfilm of EKG is then displayed on reader-printer. 3M CO., St. Paul, Minn. For information:

CIRCLE 108 ON READER CARD

emulator system

Emulation system for use with Spectra 70/45 computers will permit users to run IBM 1401 and 1460 programs, reportedly with a four-time increase in execution speed. Includes both hardware and software elements and leases for $500/month. RCA EDP, Cherry Hill, N.J. For information:

CIRCLE 109 ON READER CARD

photographic typesetter

Photographic typesetter uses CRT and integrated circuitry, and produces

RCA's new 1-us Integrated Circuit Memory System is expandable up to 32,768 words X 36 bits

(It's here! It's available! See this new 1-μs Memory System in operation at the Spring Joint Computer Conference RCA Booths 102-103.)

Integrated circuits in this new RCA memory system increase speed, reduce size, and lower power needs. Complete front-panel accessibility provides easy maintenance...panels slide out and open like a book.

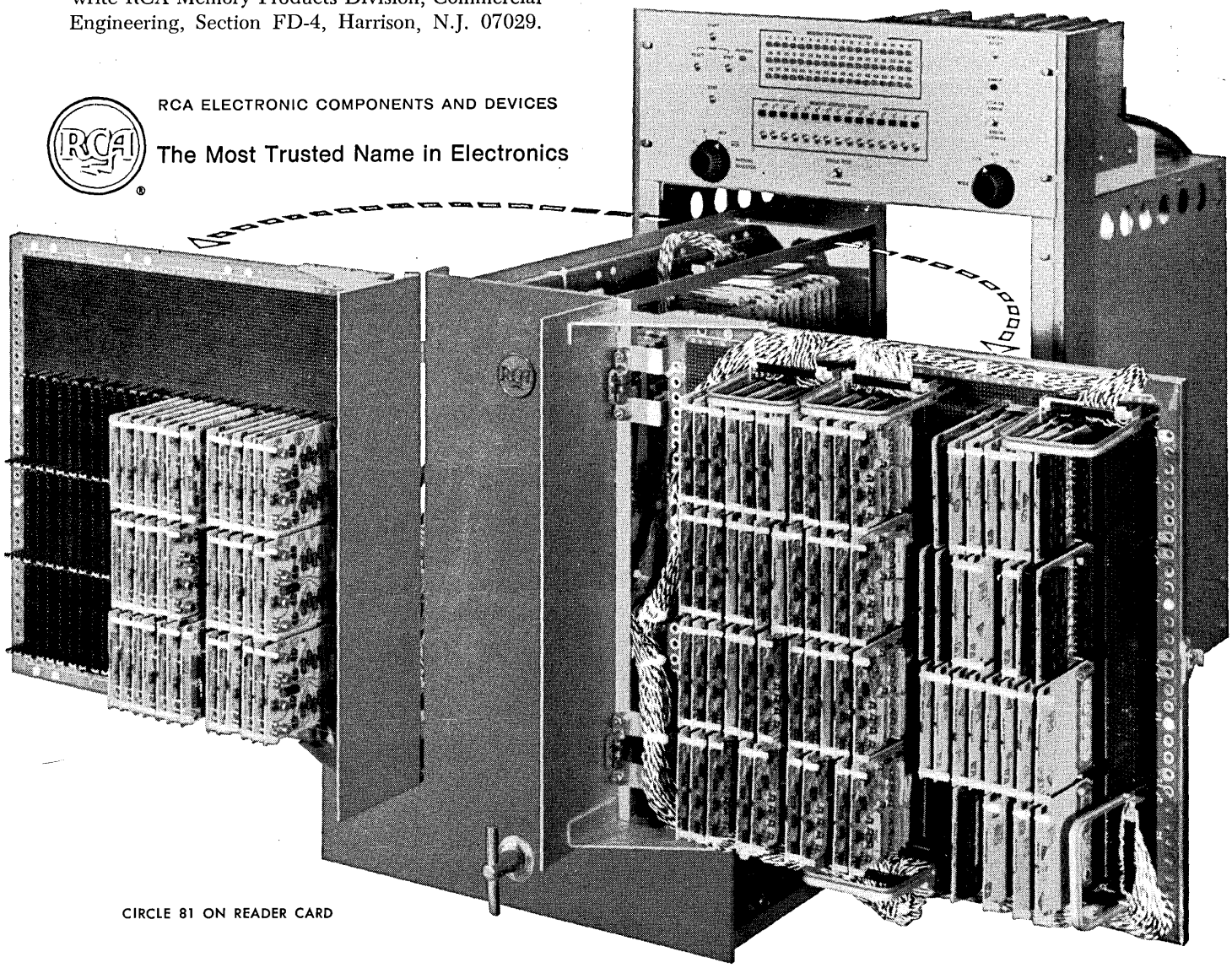
Field-proved RCA circuit modules assure high reliability. And you have maximum flexibility with such optional features as: expandable memory size, a self-tester, Read/Modify/Write operation, and easy interfacing.

Ask about the new RCA 30/18 high-speed cores that make this system unique...and reduce the cost to you.

Call, write or wire your RCA Field Representative today for price and delivery information. For a technical data brochure, write RCA Memory Products Division, Commercial Engineering, Section FD-4, Harrison, N.J. 07029.

RCA ELECTRONIC COMPONENTS AND DEVICES

The Most Trusted Name in Electronics



CIRCLE 81 ON READER CARD

up to 1,000 type characters per second. CRT can display a 9 x 11″ page without enlargement, and has a resolution of better than 100 lines an inch. Text on a page is transferred to mag tape and read into a computer for hyphenless justification; the tape then feeds into the typesetter, which generates the characters on the face of the CRT. An optical system photographs these characters on film, from which a plate can be made. HARRIS INTERTYPE CORP., Cleveland, Ohio. For information:

CIRCLE 110 ON READER CARD

tape supply unit

Model TS-3000 tape supply unit can be rack mounted and is for use with paper tape perforator. Unit works asynchronously; data can be fed to the perforator at random speeds up to 15 inches/second with minimum resistance on the tape flow. With a 3000-foot tape capacity, the model can operate in 1-100°F, humidity up to 85%. TALLY CORP., Seattle, Wash. For information:

CIRCLE 111 ON READER CARD

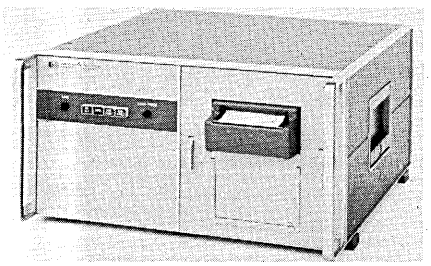
accounting system

The EBS/1210 is a desk-size in-plant billing, invoicing and analysis machine for small businesses or remote locations of large companies. Unit accepts ASCII input from keyboard, punched tape and edge-punched cards. Up to 98 input characters can be generated at the keyboard at a rate of 10 char/sec. Memory capacity is 300 36-bit words. Capabilities for individual locations include order entry, billing, back-order control, accounts receivable, sales analysis, etc. Price is $6900. MONROE INTERNATIONAL INC., DIV. OF LITTON INDUSTRIES, Orange, N.J. For information:

CIRCLE 112 ON READER CARD

digital recorder

Model 5050A digital recorder uses continuously spinning print drum, and converts BCD data into printed decimal form. Unit has 18-column capacity; 16 different characters can be



new products

printed in each column at rates up to 20 lines per second. Input code can be any 4-line BCD code. HEWLETT PACKARD, Palo Alto, Calif. For information:

CIRCLE 113 ON READER CARD

flow chart decals

Decal reproductions of Models 33 and 35 page printers, tape punches, readers, etc., simplify data communications flow charts and systems layouts. Each set includes seven 8½ x 5½″ decal sheets with 94 self-adhesive reproductions. TELETYPE CORP., Skokie, Ill. For information:

CIRCLE 114 ON READER CARD

data processor

The 5610 Computype Data Processor has micro-integrated circuits and two memories: one for data storage has 60 registers of 13 digits each plus sign; the second memory contains 1118 alphanumeric characters for internal program storage. Programming is done by company's SWIFT (Soft-Ware Implemented Friden Translator) composed of 38 alphabetic command statements. The 5610 includes a diagnostic program and is primarily for business applications. Five on-line I/O units are available to expand capabilities. FRIDEN, INC., San Leandro, Calif. For information:

CIRCLE 115 ON READER CARD

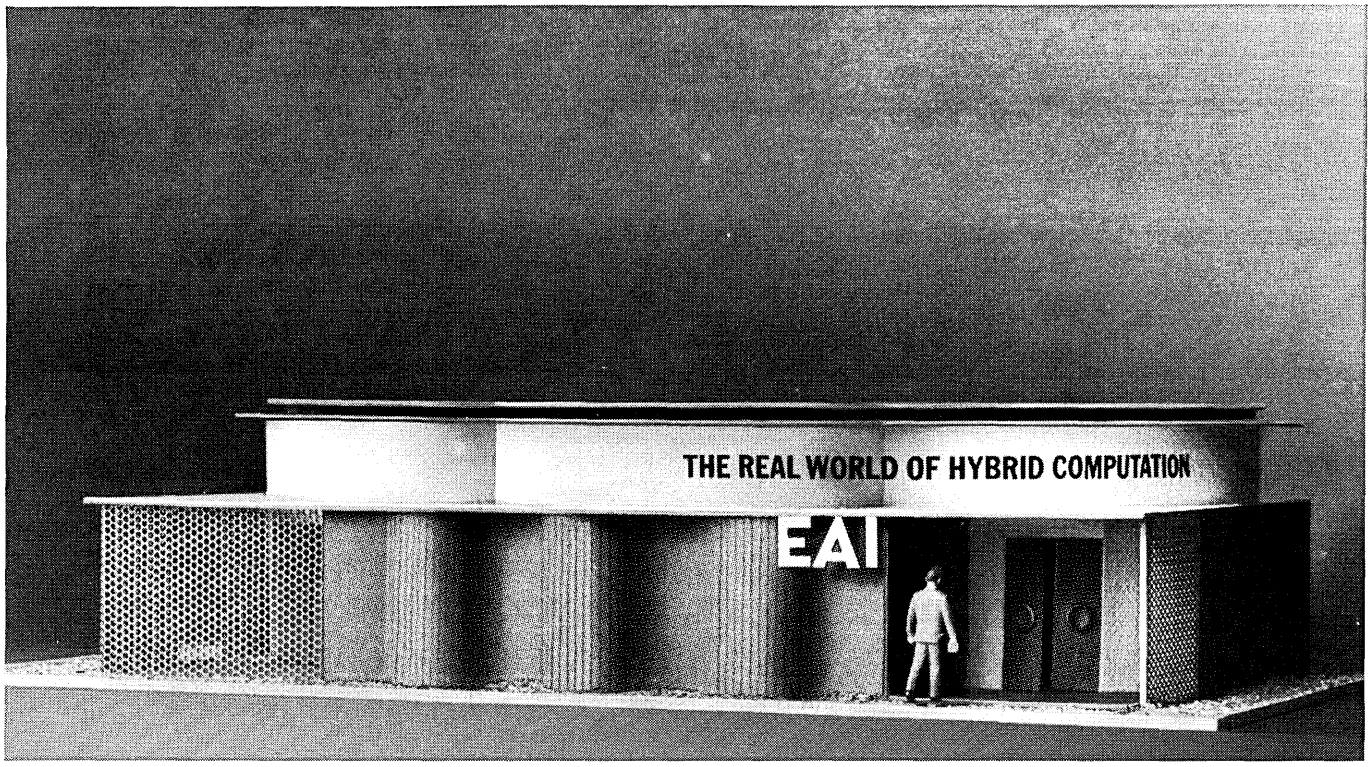
memory module

Model FT 40 128-bit i.c. memory module is for use in small memory or buffer storage systems. Write or read time is 125 nsec. Data is organized in 16 individually addressable 8-bit bytes; up to 32 modules can be connected to form a 4096-bit memory or buffer storage having 512 addresses. Other applications include shift registers, delay lines and ring counters. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For information:

CIRCLE 116 ON READER CARD

display system

Input and Display System is available in two models: one has single display/keyboard and a control unit that contains power supply and memory logic of the system. This self-contained unit includes a 1020-character memory and a 2000-character display screen. The second model has a



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Unless you come in the back door.

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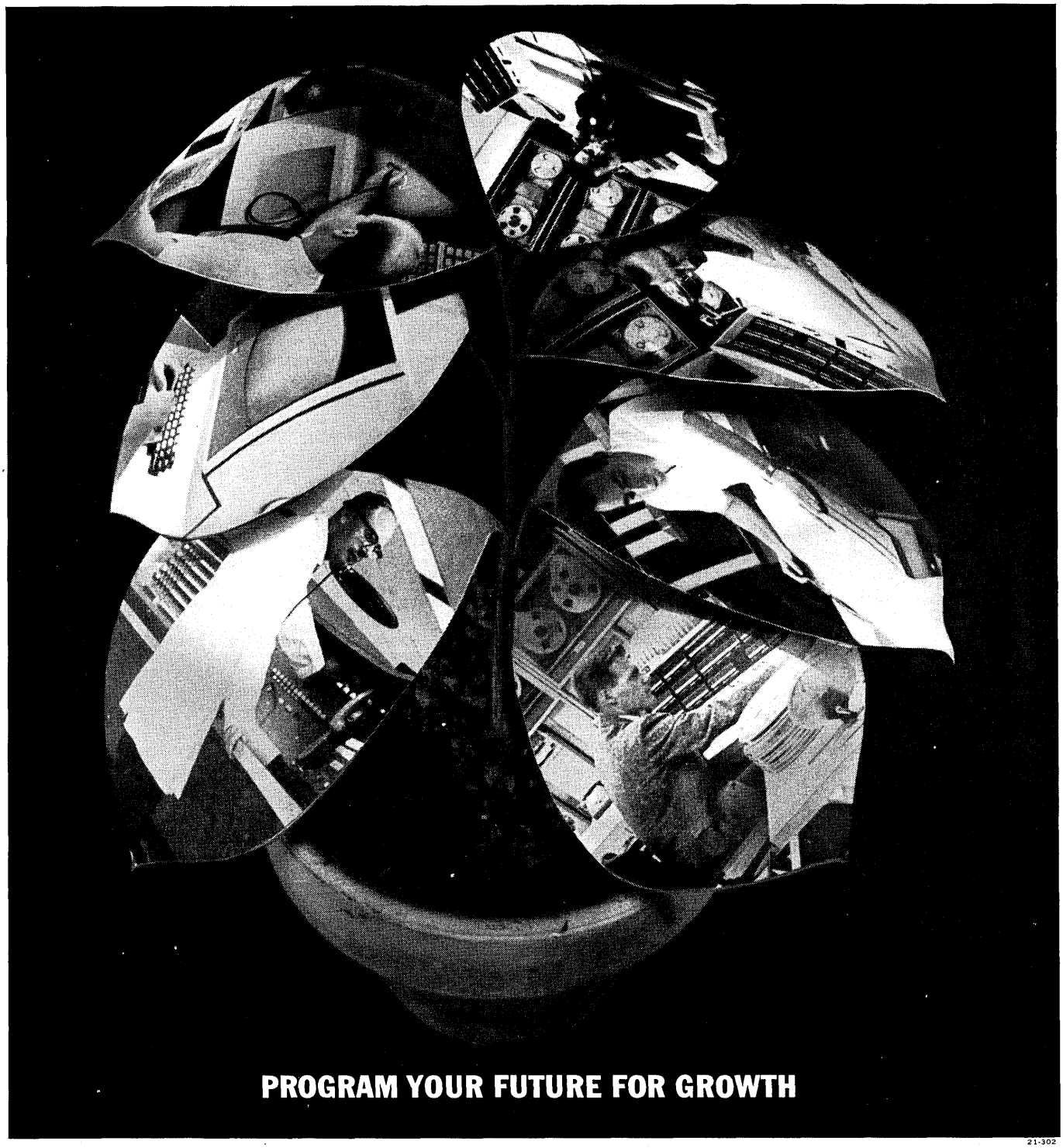

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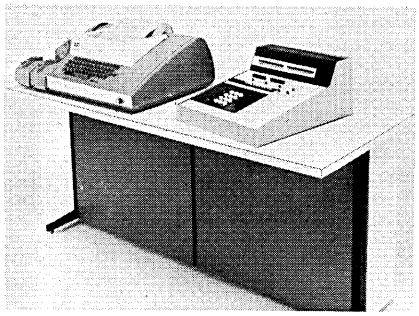
shared-logic central control unit and up to four separate display/keyboard units. It may be used with two display stations to provide 508 display characters, or with three-four stations for 252 characters.

In either model, the 9 × 12″ screen can display 25 lines of data, up to 80 characters of information. Optional features include insert and delete functions for both characters and lines, formatting capabilities, hard copy output, tab stop and position indicator. Communications capabilities provide for transmission speeds of from 1,600 –18,000 characters per minute. Deliveries begin in fourth quarter '67. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 117 ON READER CARD

desk calculator

Mathatron 4280 desk computer/calculator has over 4K bits of storage, accepts standard algebraic and decimal numbers, and has up to 82 individual addressable storage registers with internal programmable



memory of 480 program steps. I/O devices include numeric keyboard, alphanumeric typewriter, punched paper tape, serial strip and page printers and electronic interface. MATHATRONICS DIV. OF BARRY WRIGHT CORP., Waltham, Mass. For information:

CIRCLE 118 ON READER CARD

optical code reader

The 9600 Optical Code Reader reads information in company's bar code language as recorded on source documents and converts numerical values to 8-level code which is punched into ASCII paper tape at a rate of 10 cps. Printout is simultaneous and an accuracy check is provided. Reader is part of system that includes systems control and printer/punch units. ADDRESSOGRAPH MULTIGRAPH CORP., Cleveland, Ohio. For information:

CIRCLE 119 ON READER CARD

mis software

MISSIL (Management Information System Symbolic Interpretive Language) is designed for use with IBM 1800/1130 computers. Developed from the firm's DRI and DART proprietary codes, MISSIL is compatible with software systems to be released for the System/360; will handle all matrix generation, file management and information system requirements. Communicating with MOSS (IBM-supplied linear programming system), MISSIL will produce information from operations accounting, analysis and display, inventory projection, decision models and process-oriented functions. BONNER & MOORE ASSOCIATES, Houston, Texas. For information:

CIRCLE 120 ON READER CARD

multiprogramming software

DAPS (Direct Access Programming System) provides multiprogramming and communications capabilities, permits use of GE-400 systems for information retrieval, file inquiry and updating, and program debugging from remote locations. DAPS incorporates GE's multiprogramming operating sys-

FABRI-TEK OFFERS TODAY'S BROADEST MEMORY CAPABILITY

Fabri-Tek's business is electro-magnetic memories. Core stacks or systems, 2½D and 3D organization, thin film systems, low-cost systems with "off-the-shelf" delivery or special designs, Fabri-Tek does it all.

But offering the widest possible product range is only halfway to leadership in memory technology. Research and design capability is the rest of the way, and Fabri-Tek is advancing the state of the art.

Symbolic of leadership is the fact that Fabri-Tek now is stringing cores at the rate of 40 per second or a billion per year. That's a lot of customer-confidence. By the way, an added benefit is price. Stringing that many cores that fast helps attain lowest possible cost per bit.

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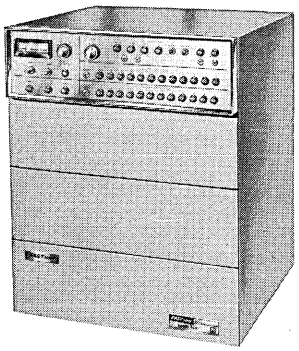
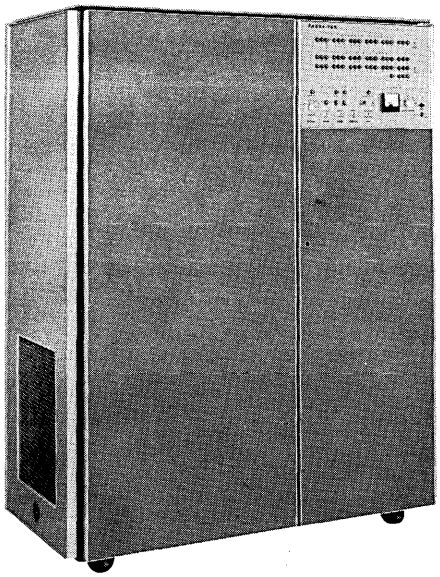
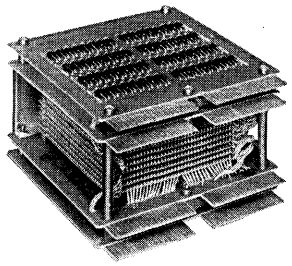
2½D STACKS: FABRI-TEK led the way with 2½D more than two years ago. Speeds to 650 nanoseconds. Unique low-noise design and manufacturing techniques.



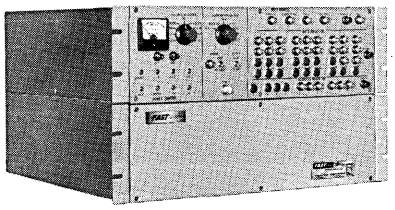
CORE MEMORY SYSTEMS: Speeds from 500 nanoseconds to 10 microseconds, 2½D and 3D organization. Use of integrated circuitry. Custom performance at "off-the-shelf" prices.



MASS CORE MEMORY: 2½D mass core storage at less than 2 cents per bit for 20,000,000 bits. Cycle times at computer speeds.



3D STACKS: FABRI-TEK is the world's major producer of 3D stacks. Get 1 microsecond or slower with everyday delivery. Now shipping 200 per week.



THIN FILM SYSTEMS: Scratchpad to main memory. FABRI-TEK has delivered many 300 nanosecond systems for commercial and military applications and is the only manufacturer supplying a large thin film system to a computer manufacturer for main memory.

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new products

tem (MPOS); other supporting software includes a system generator, librarian, job stack converter, disc service programs, system output converter, tape service programs, checkpoint restart, and math and service subroutines. Hardware modifications required are memory protection, interval timer, non-halt mode and second-level interrupt. GENERAL ELECTRIC CO., Phoenix, Ariz. For information:

CIRCLE 121 ON READER CARD

upgraded computers

Software-compatible, upgraded model of the DATA/620, the 620 A and 622 A have cycle times of 1.8 usec, memory sizes from 8-32K. Some features optional on the 620 are standard: multiply and divide, extended addressing, ASR 33 Teletype, and front access cabinet. The 620/A has 16-bit memory; 622/A, 18-bit. DATA MACHINES, INC., Newport Beach, Calif. For information:

CIRCLE 122 ON READER CARD

ocr paper

Two grades of OCR paper, energy bond and energy ledger, are dust and lint free, have smooth and level surface, controlled porosity, high brightness and ridigity. Bond is available in regular finish, white only, 16 and 20# basis weights. Ledger is sold with smooth finish, white only, in 24 and 32# weights. KIMBERLY CLARK CORP., Neenah, Wisc. For information:

CIRCLE 123 ON READER CARD

document reader

Type 8100 document reader is fitted with CMC-7 read logic and can be used for processing checks. Unit feeds documents at a rate of 20/second and has a data transfer rate of 1000 cps. Suitable for both on- and off-line operation. CROSFIELD BUSINESS MACHINES, LTD., London, England. For information:

CIRCLE 124 ON READER CARD

cryptographic scrambler

CRYPTEL 240 cryptographic machine scrambles messages for storage on punched tape prior to transmission. Basic cypher key is a set of pins on a pinboard giving different codes that can be changed by non-technical personnel. Approximately 2.5×10^{26} different settings are possible.

new products

Machine works in conjunction with a standard teleprinter comprising a tape punch and a tape reader. ITT WORLD COMMUNICATIONS, New York, N.Y. For information:

CIRCLE 125 ON READER CARD

tape reader/spooler

RRS-502-10½ photocell punched tape reader/spooler features 500 cps reader and 50 inch/sec. spooler equipped with 10½ inch diameter reels. Choice of output signals is available in solid-state unit. Both unidirectional and bi-directional configurations are available. Spooler portion includes independent bidirectional rewind and soft take-up. Deliveries are within ten weeks of order. REMEX ELECTRONICS, Hawthorne, Calif. For information:

CIRCLE 126 ON READER CARD

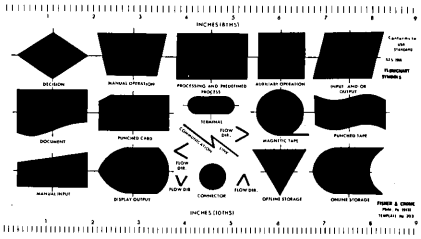
drum subsystem

The FH-1782 drum (two-million-word capacity) and FH-432 drum (262K words) have been tied together in a subsystem for use with the 1108 and 494 computers. Up to eight drums—either model, any combination—can be in the subsystem, handled by one control unit. Two control units may be used, however, each with access to any drum (wired for dual channel operation), to provide for execution of two operations simultaneously and to provide for the backup necessary in multiprocessing. ATI drums and control units in the subsystem are logically and electrically independent so that a failure in any one unit will not affect the others. UNIVAC DIV., SPERRY RAND, Philadelphia, Pa. For information:

CIRCLE 127 ON READER CARD

flow chart template

Flow chart template conforms to USASI X-3.5-1966; is 9″ long, 6″



wide. Other sizes are available. FISHER AND CROME, INC., Philadelphia, Pa. For information:

CIRCLE 128 ON READER CARD

strip printer

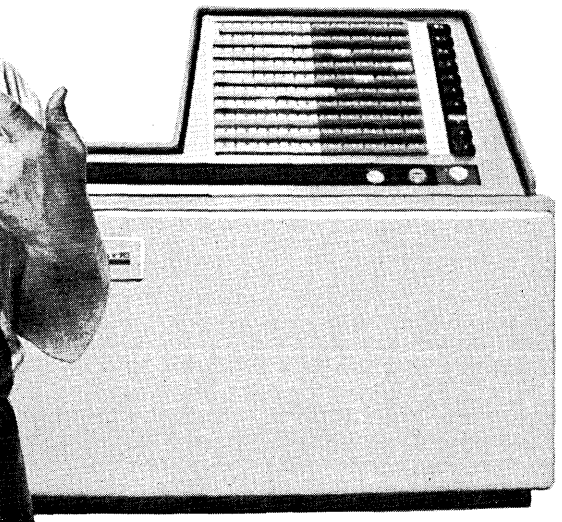
AN-16 is a Mil-spec alphanumeric strip printer and tape-up spooler weighing less than 5½ lbs. and occupying 200 cubic inches. Designed to meet Mil-E-5400 and Mil-1-26600. Printed information is presented serially to operator at up to 25 cps with a selection of 64 characters and can be adapted to accept any parallel 6-line BCD code at several interface logic voltage options requiring low driving currents limited by the 5 K ohm input impedance. Need for ribbons is eliminated by use of 5/16″ wide press-sensitive tape. Take-up spooler has reel which permits threading without removal from spooler assembly. CLARY CORP., San Gabriel, Calif. For information:

CIRCLE 129 ON READER CARD

keypunch scheduling

The Eley System, which schedules work, determines work loads and measures results, consists of instruction manual, plastic Converta-Rule eliminating most arithmetical calculations, performance status Report Forms, Time Sampling Sheets, Work Load Records, and punched card Scheduling Tickets. Schedule tickets are de-

Larry Brown just had a word with a computer.



Instead of filling out forms he reported what he had accomplished by means of RCA's new Data Gathering System. All he did was insert his badge and a punched card and pick out a few numbers on the keyboard.

With this kind of information from the floor, production managers can get up-to-date scheduling, machine utilization, finished inventory, material requirements and other operating information simply by asking the computer directly.

RCA's SPECTRA 70/630 Data Gathering System is faster, spans a greater distance, at lower cost than competitive systems. If timely information from many remote sources is important to your business, write us for full details. Dept. D, RCA Electronic Data Processing, Cherry Hill, N. J. 08101.

RCA SPECTRA 70

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new products

signed to keep operators and supervisors on schedule and serve as objective reports on efficiency of operations. EDUCATIONAL METHODS, INC., Chicago, Ill. For information:

CIRCLE 130 ON READER CARD

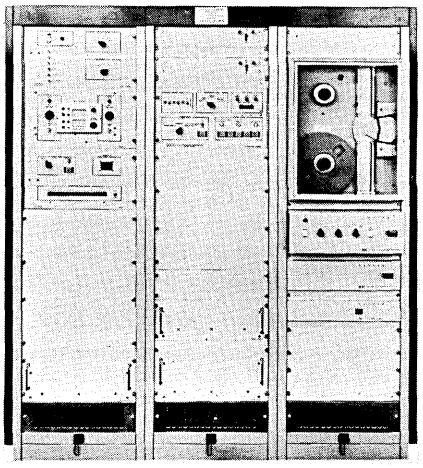
project planner

The Series V Planalog is a project or program planning and control instrument, designed for users of Critical Path Method (CPM) and PERT systems. It consists of an aluminum channel board of variable size, precut plastic gauges that correspond to the time scale on the frame (they represent the events of a project), and precut fences that separate the events into activity groupings. It can be wall-mounted or used as a desktop unit. PLANALOG INC., Philadelphia, Pa. For information:

CIRCLE 131 ON READER CARD

correlation computer system

Real-time digital correlation computer system features auto- and cross-correlation and a post integrator for averaging up to 1000 individual correlation functions. Model CFC 500 is one unit in a family of signal processing systems used in sonar, radar and vibration low frequency applica-



tions. Specific time for integration of the 1000 correlation functions is determined by frequency scale selected, and ranges from a 100-second maximum for a frequency band of 200-5000 cycles to 100,000-second averaging time for 0.2-5 cycles. CFC generates computer compatible outputs. Optional features are an interface system, digital tape recorder, and other than 4-bit resolution. Family includes spectrum analyzers, power spectral density and probability distribution units. MARQUARDT INDUSTRIAL PRODUCTS CO., Syosset, N.Y. For information:

CIRCLE 132 ON READER CARD

multiplexer/converter

Model VT7-AB/VMX-4 multiplexer/converter digitizes up to 10 channels of high-frequency analog data in 1.5 usec; has total throughput rate of 667 kHz. Resolution is 8 bits including sign, and accuracy is 0.5% of full scale ± ½ LSB. Designed for use in radar and nuclear instrumentation systems, price is $8780. ADAGE, INC., Boston, Mass. For information:

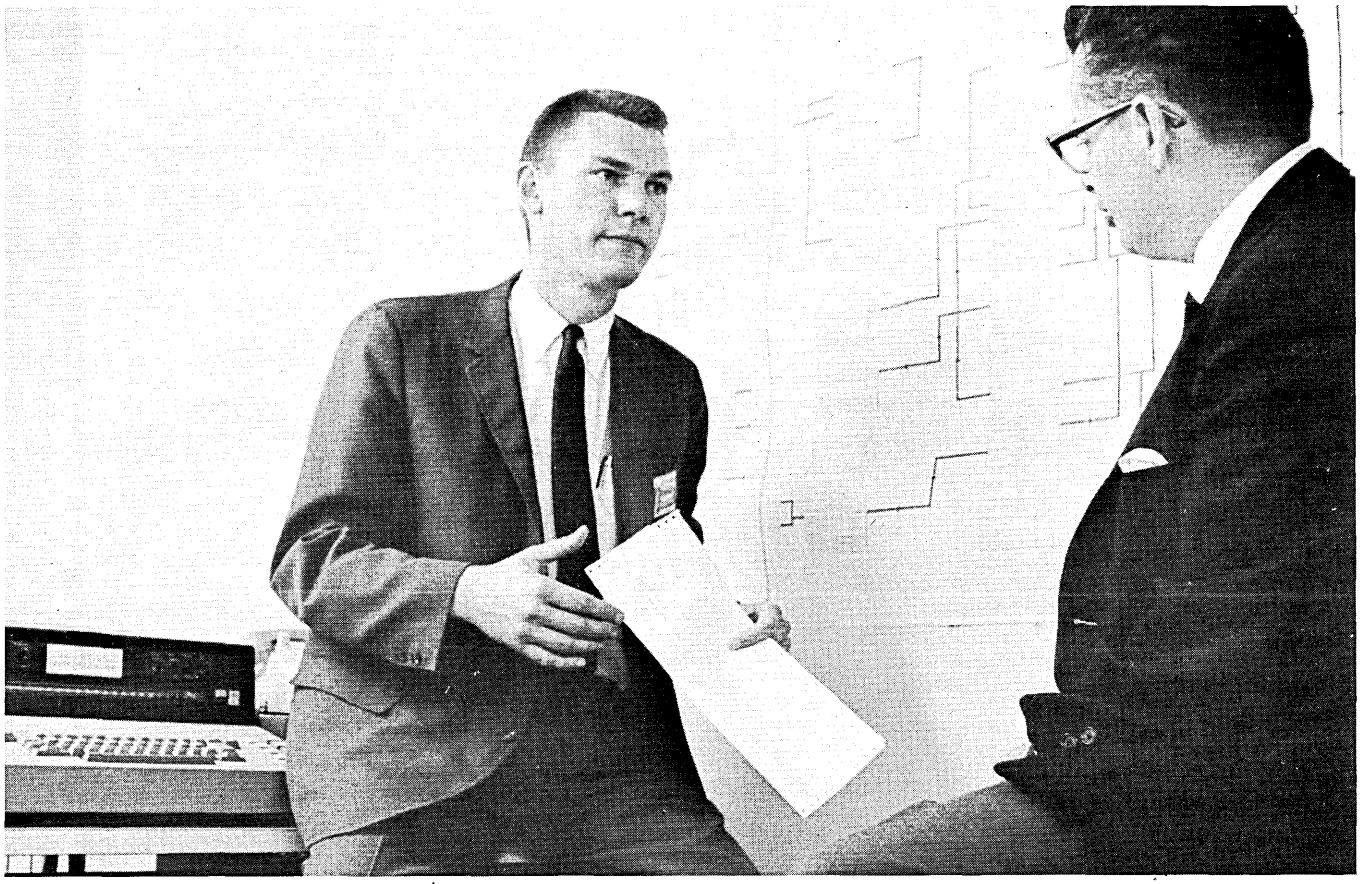
CIRCLE 133 ON READER CARD

keyboard approach

The Mark II Keyboard Approach, based on a 3-oz. magnetic snap key switch and an i.c. switching matrix with electronic interlock, makes possible a variety of coding systems with variable stroking and high-speed bounce-free outputs. The approach can be used with any specified keyboard: only restriction is a ¾" minimum center-to-center key spacing. Circuitry allows BCD, ASCII, and other codes. CONTROLS RESEARCH CORP., Garden Grove, Calif. For information:

CIRCLE 134 ON READER CARD

TRW is Tom Wangsness retrieving data-bank information for a buyer.



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SENIOR SYSTEMS ANALYST:
With ability to lead other Analysts in design and implementation of integrated data bank management information systems. Requires degree in Business Administration, Mathematics or equivalent, knowledge of programming, and five to seven years practical experience with higher level computer language.

MANAGEMENT SYSTEMS ANALYST:
To aid in design of random access and data bank systems, using latest state-of-the-art techniques. Degree in related field required, plus three to five years systems analyst experience in systems design and the programming of a broad range of management information systems.

PROGRAMMER ANALYST:
Must possess ability to grow and improve skills in all business systems areas. Concentrated programming in any language necessary, with two to five years business systems experience on any computer. Degree preferred, but not essential.

SOFTWARE SYSTEMS ANALYST:
To design and implement unique software application packages oriented to business programming functions. Degree preferred. Requires two to five years experience and complete knowledge of manufacturer's software systems, including utility routines, operating systems and compilers such as COBOL and Assembly.

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Must possess ability to establish and program networks for planning and controlling complex projects. College degree desired but not essential.

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CIRCLE 304 ON READER CARD

new literature

LOGIC CIRCUITS TABULATION: Updated edition lists 5,000 circuit type numbers from 90 manufacturers and includes 800 types whose specifications have been revised since the previous edition. Engineers are provided with information on characteristics of a type number, possible substitute for a given number, manufacturers producing circuits meeting certain electrical and mechanical requirements and package and dimension specifics of a given circuit. Drawings indicate the circuits' mechanical characteristics and schematic drawings provide information on performance. Subscription cost: $32.50 in the U.S. and Canada; $34.50 elsewhere. D.A.T.A. INC., Box 46, Orange, N.J. 97051.

SAMPLE AND HOLD SYSTEM: Designed for data acquisition applications, the system is used between an analog multiplexer and a time-shared digitizer, reduces errors caused by frequency of input signals. Bulletin explains theory of operation, features, specifications and demonstrates aperture time versus input signal frequency in graph form. SYSTEMS ENGINEERING LABORATORIES INC., Ft. Lauderdale, Fla. For copy:

CIRCLE 140 ON READER CARD

INSTRUCTOR'S MANUAL: Available for teachers using the "Business Systems" textbook in classrooms. Manual contains discussion points, true-false and multiple choice questions and a list of supplemental reading materials for each chapter. SYSTEMS AND PROCEDURES ASSN., Cleveland, Ohio. For copy:

CIRCLE 141 ON READER CARD

PRINTOUT FILING: Six-page folder deals with such dp filing problems as heavy binders, research time, use of space, file appearance and indexing and offers solutions. ROBERT P. GILLOTTE & CO., INC., Columbia, S.C. For copy:

CIRCLE 142 ON READER CARD

WIRE MEMORIES: Woven plated wire memory interweaves thin-film, magnetically coated wires with insulated wires. At each wire junction, a magnetic field is created so a bit of information can be stored. 16-page brochure provides technical information and describes how it is adaptable to computer systems for main or scratchpad memory, buffer storage, as a control memory or a supplement to other memories, buffer storage, and can be used in telemetry or control systems. LIBRASCOPE GROUP, GENERAL PRECISION INC., Glendale, Calif. For copy:

CIRCLE 143 ON READER CARD

TAPE TRANSPORTS: Brief descriptions and photos of digital tape transports and tape memory systems, featuring single-capstan design, are contained in a four-page brochure. Transfer rates, packing densities, tape speeds, start/stop time and rewind time are covered. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 144 ON READER CARD

GP COMPUTER: 12-page brochure describes Model 3 which is desk size and designed to solve industrial control and scientific computational problems. Schematic illustrates building block structure, I/O interface is described and three instruction formats are listed. Five software packages are available as well as full line of peripherals. INTERDATA, Eatontown, N.J. For copy:

CIRCLE 145 ON READER CARD

LOGIC MODULE: Four-page brochure on the series M Wyle IC includes information on 60 logic cards, power supplies, card files, card drawers, accessory parts, an automatic module tester, and an experimenter for breadboarding up to a 10-card system. Also gives discount schedule, 10-year warranty and list of sales representatives. WYLE LABORATORIES, PRODUCTS DIV., El Segundo, Calif. For copy:

CIRCLE 146 ON READER CARD

NOTCHED CARD SYSTEM: Brochure illustrates how Keysort enables users to process and retrieve information at their desk. Applications include bibliographies, accident reports, questionnaires and surveys, personnel records and statistical studies. Available ac-

new literature

cessories are shown. MCBEE SYSTEMS, DIV. OF LITTON INDUSTRIES, Athens, Ohio. For copy:
CIRCLE 137 ON READER CARD

MECHANIZED LIBRARIES: Report deals with mechanized systems being planned, developed and used within defense technical libraries and information centers. Described are efforts in thesaurus building, file structure, input processing, serial control, selective dissemination of information, circulation control, equipment, information retrieval systems, organizations, operation and application, summaries on mechanization status, scope and size of collection. Cost: $7; microfiche, $1.75. AD 640 100. CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION, 5285 Port Royal Rd., Springfield, Va. 22151.

MAG TAPE: Six-page booklet describes MRX-III tape and includes specifications, microphotographs, profilometer readings, charts on durability and dropout activity and explains Tensaflex. MEMOREX CORP., Santa Clara, Calif. For copy:
CIRCLE 138 ON READER CARD

TYPESETTING BIBLIOGRAPHY: References cover the period 1960 to 1966, and list publications under the following categories: management, economics, systems and applications, equipment, I/O, graphics, editing, program and theory, style and tape codes. Most references have been selected from periodicals. Cost: 3 shillings, 6 pence. HERTFORDSHIRE COUNTY COUNCIL TECHNICAL LIBRARY & INFORMATION SERVICE, Hatfield College of Technology, Hatfield, Hertfordshire, England.

COMPUTERS FOR CONSTRUCTION: 20-page brochure features estimating, labor reporting, daily earnings computation, job cost distribution, weekly job summarization, payroll summarization and fringe benefit reporting for the construction field. Based on an installation of an electronic accounting system. NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:
CIRCLE 139 ON READER CARD

CORE MEMORIES: Described in bulletin is system with cycle times of 0.6 to 1.0 usec. Included also are block

If having a real-time for yourself doesn't send you here...

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REFERENCE SERVICES: Pocket guide lists and describes publications serving users, manufacturers and consultants. "Standard EDP Reports" is an eight-volume service offering an appraisal of 80 dp systems. "Computer Notebook" is a current guide to system characteristics comparing costs and capabilities. "Data Communications Reports" comes in two volumes and furnishes information on common-carrier data transmission facilities, communications processing and terminal equipment and systems design. "Data Handling Reports" is a loose-leaf reference on characteristics, performance, prices, applications and limitations of source data recording, input preparation, data transcription and unit record equipment, forms handling devices and computer supplies. AUERBACH INFO. INC., Philadelphia, Pa. For copy:
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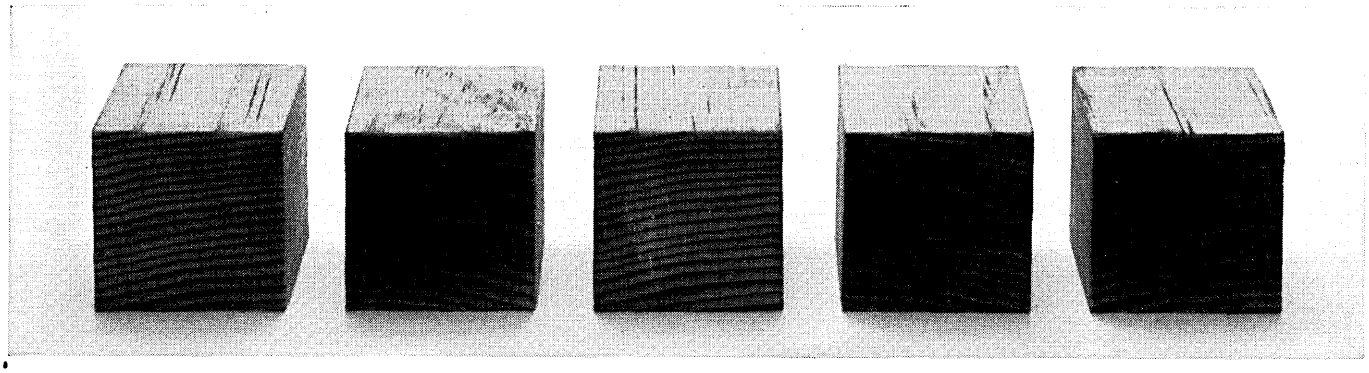

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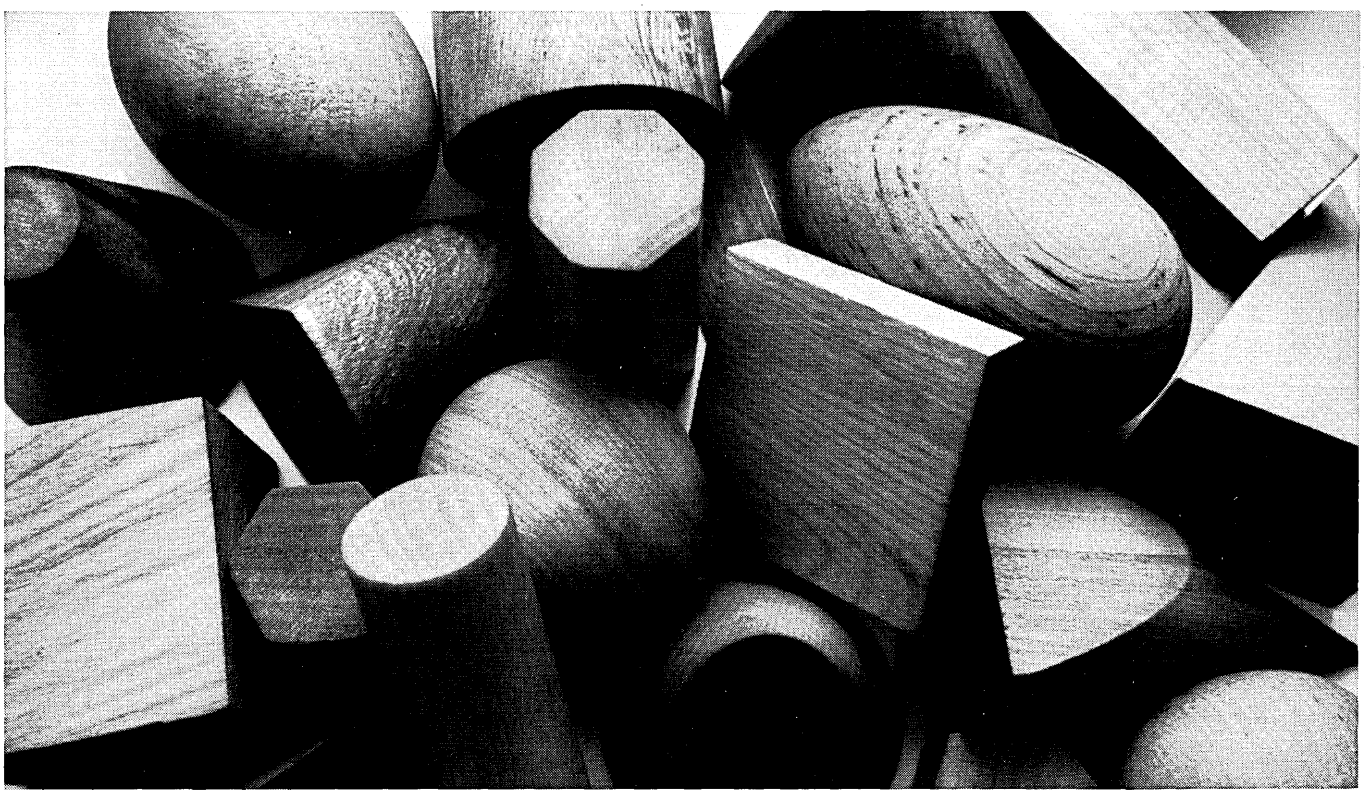

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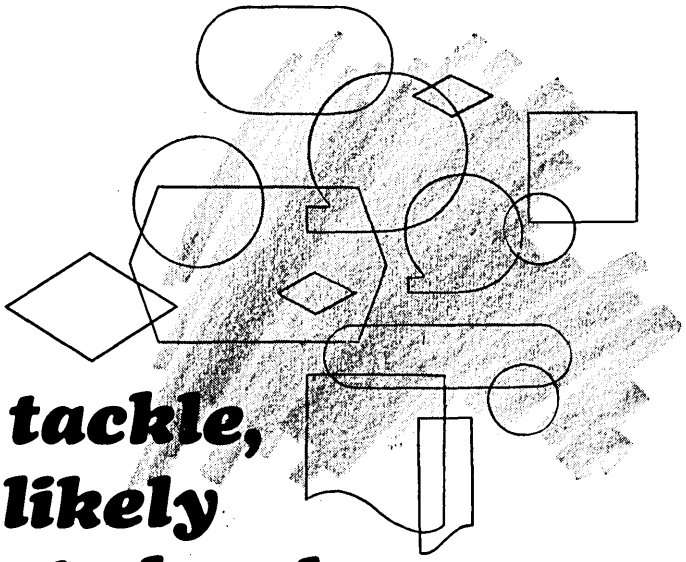

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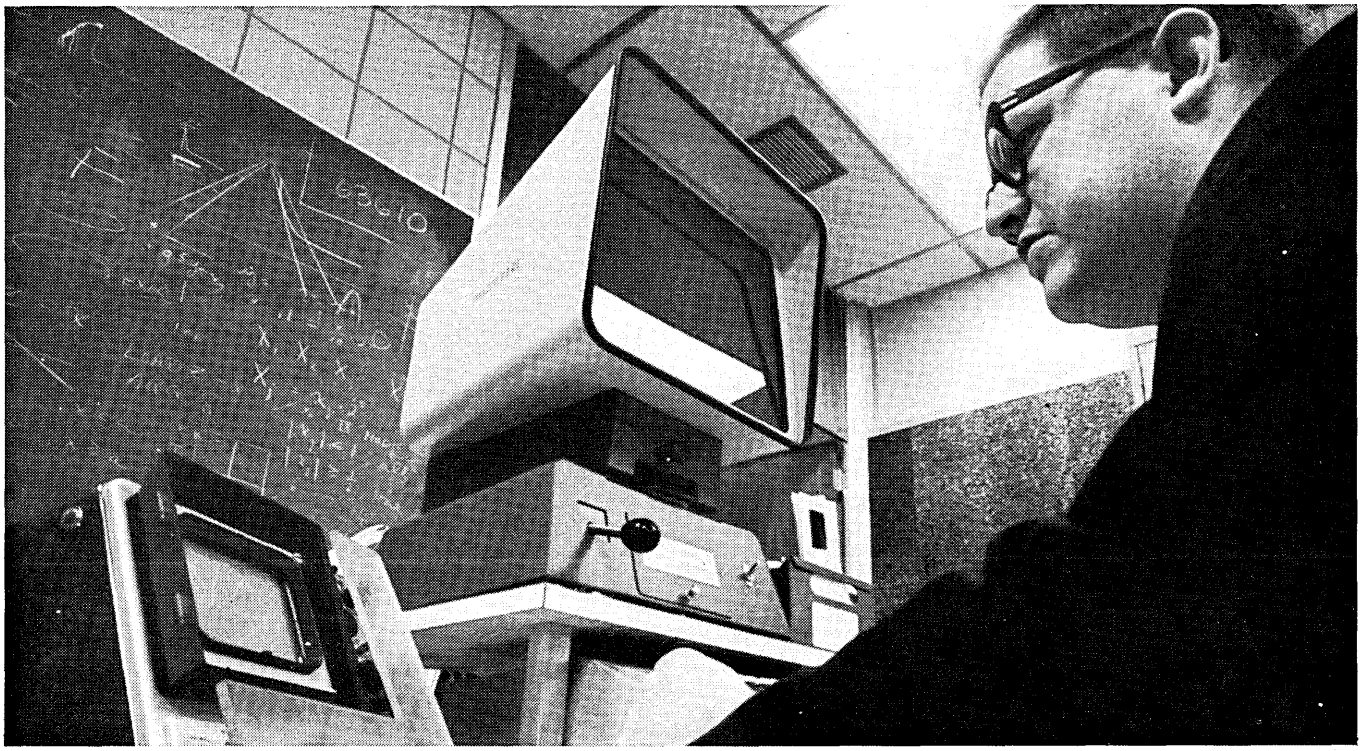

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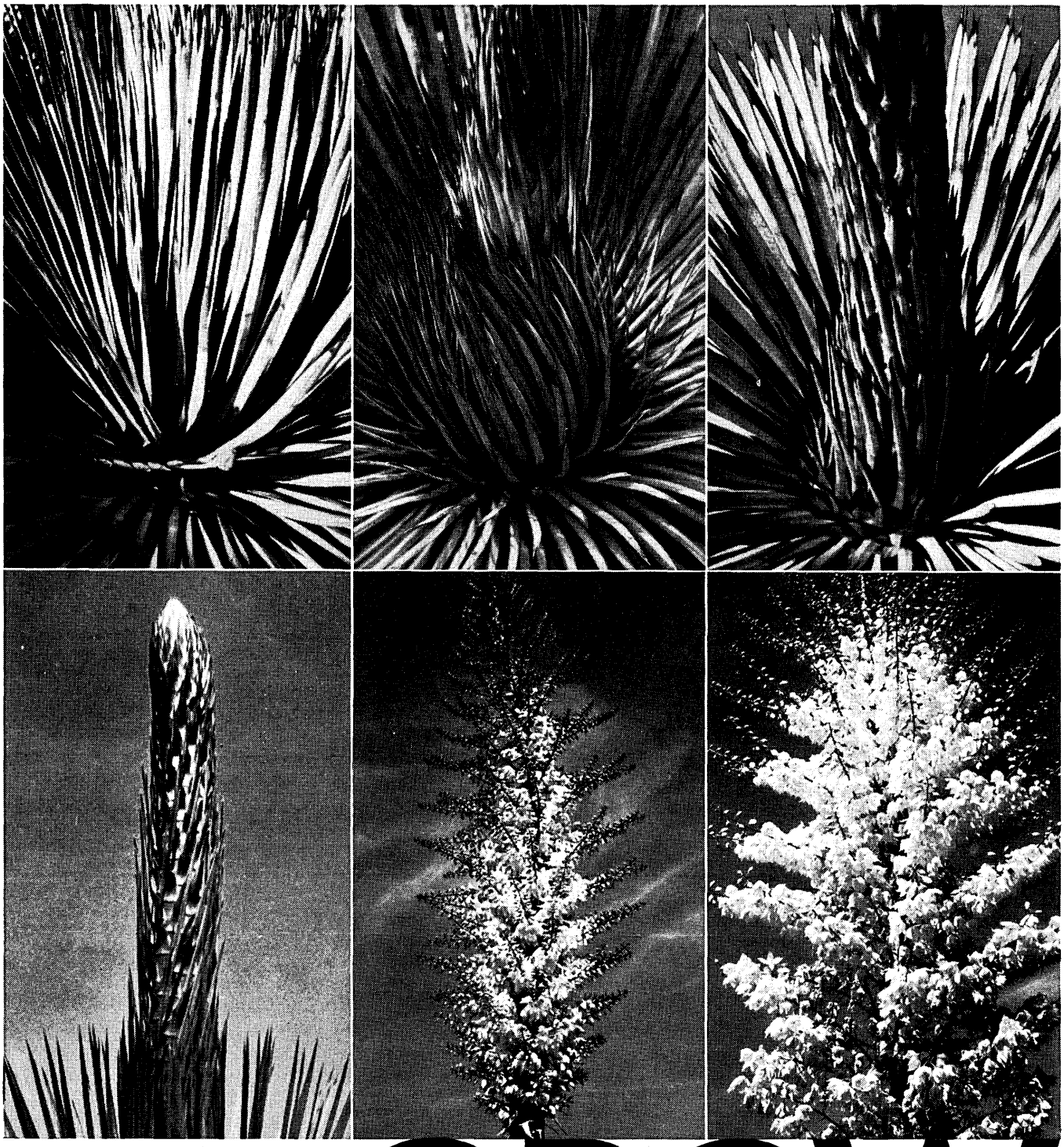

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books

***The Challenge of the Computer Utility*, by E. F. Parkhill, Addison-Wesley, $7.95.**

This is probably the first book covering with some comprehensiveness the subject of the computer utility or, alternatively, "on-line computer systems" or "time-sharing computer systems." The author has done a creditable job of gathering together the history, motivations, technological and social aspects of these new computer systems. The book covers most of the important technical aspects, but cannot be said to cover them incisively or analytically. The book can probably best be described as a survey or as an introduction to the technical subject matter.

The book begins with a short historical sketch which is rather well done. Once again, one is impressed with the accuracy of Babbage's vision, the significance of the development of the vacuum tube flip-flop, the historical significance of the appearance of ENIAC in 1946, and the conceptual importance of von Neumann's idea for the common storage of data and instructions. A number of paragraphs pinpoint the significance of some of the early computers: EDVAC, EDSAC, Whirlwind, SEAC, etc. (A notable exclusion is the ERA 1101, the world's first drum computer, delivered about 1950.) Detracting somewhat from the presentation of this historical development is the fact that the development of software is not chronicled nearly as well as hardware. There are no references to early significant software publications, for example.

These early chapters are weakened only slightly by some questionable facts or opinions: The RW 400 computer with its emphasis on modularity is confused with a variable structure computer; the American Airlines Reservisor system was the first operating time-sharing system and therefore occupies an important niche in history —much more important than implied here; and it is questionable whether the IBM 701 "played an important part in the Korean war," since first deliveries were in mid-1953 when the Korean war was drawing to a close.

The book has very good descriptions of early military systems which contributed to the technological development (although the importance of SAGE as a predecessor to time-sharing systems is much understated). Also, it has good descriptions of time-sharing systems currently in operation, and it has good descriptions of computers such as the IBM 360/67, the CDC 6600 and the GE 635/645 systems. In particular, the notion of paging and memory swapping done with modern computers is described very well.

There are, unfortunately, some notable omissions in the book. Software systems necessary to implement time-sharing systems are almost totally neglected. Examples are not given of the functions and advantages of conversational systems from the user's point of view. Just what the operator does at his console is never fully disclosed or discussed. There are no examples of query languages or display formats presented in the entire book.

Economic considerations of the computer system are treated comprehensively, if not incisively. The author points out, for example, that the advantages of these systems are fast response, reduced user capital investment, better utilization of computers, and convenient access to a data base. The acknowledged arguments against the system are costs of communications facilities, the executive control requirements, reliability and maintenance problems, system saturation problems, and lost time due to "swapping." Under "executive control requirements," the author alludes only briefly to complexities in hardware and software, and seems to ignore the fact that these may make over-all costs of time-sharing systems greater than their batch counterparts. The very significant extra hardware costs for controlling the computer in the multi-user environment are not specifically mentioned—items such as extra memory complexity, extra memory size, and hierarchies of memory systems. Repeatedly, the author refers to speed and costs being $1 - \frac{1}{n}$ in the case of n users, thereby ignoring speed reductions and extra costs due to such items as operation of the executive, computer speed degradation in paging, idle time, swapping time, and the like. Puzzlingly enough, in still other parts of the book, he refers to the existence of these factors.

The author has included an interesting discussion of the legal factors involved with the computer utility. He covers, with good results, such factors as data privacy, ownership and control, and the need for legislation. Missing in this discussion is the development of message switching which

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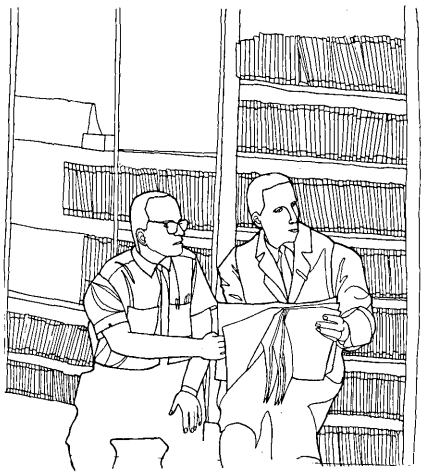
is a communications or common carrier function and the evolvement from message switching into communications/computer networks such as that being planned by Western Union. Indeed, one of the most important legal considerations is the question of what are common carrier functions and what are data processing functions. Or, stating it differently, what is the boundary between the concepts of the computer serving the communications system and the communications system serving the computer? The legal factors in future government regulations will revolve around these considerations.

At the close of the book, the author presents a very engaging discussion of the uses of the computer utility and the social implications. The author indulges himself in presenting such future applications as computerized shopping, information services to be used in the various professions, automatic publishing, economic planning and control. He closes with some serious concern about employment and the need for "drastic revamping of many cherished economic myths."

The author is obviously a strong proponent of computer utility systems and sometimes gets carried away. For example, he speaks of the fact that it



is now technically feasible to bring the full power of a large scale computer complex to anyone in the world who has teletypewriter service available in his home or his office. In so doing, he ignores the high speed output and input devices which might be necessary to fully utilize this "full power of a large scale computer complex." In still another part of the book, he sees the need for terminals costing less than $1,000 apiece while at the same time spelling out requirements which would put the terminal device in a cost bracket of upwards of

books

$30,000 for many, many years to come.

Despite these comments and criticisms, it should be emphasized that this is a good book, especially in consideration of the newness of the subject and the fact that the ground swell of interest in these systems only first began in mid or late 1965. The author has provided a vehicle for the professional not immersed in these systems to become familiar with the salient historical and technical factors. He has likewise provided the intelligent layman with the information which will make less traumatic the transition from the present to the "great computerized society."

—WALTER F. BAUER

book briefs

(For further information on the books listed below, please write directly to the publishing company.)

***Network-Based Management Systems (PERT/CPM)*, Russell D. Archibald and Richard L. Villoria. John Wiley & Sons, Inc., New York, N.Y. 1967. 508 pages.**
Definition of management information and control systems, including problems, cost, fundamentals and implementations, and numerous case histories.

***Computers in Europe 1966*, Report by The Netherlands Automatic Information Processing Research Center, Amsterdam, The Netherlands. 1966. 47 pages. $5.00.**
Surveys historical development of data processing in Europe, and includes present installations and applications, forecast of the overseas market to 1975, and 14 tables.

***Concatenated Codes*, G. David Forney, Jr., Research Monograph #7, M.I.T. Press, Cambridge, Mass. 1966. 147 pages. $8.50.**
An introduction to concatentation: a technique for constructing long codes without an excessive number of computations. Development of this technique can be used by communications engineers as well as those engaged in coding research.

***The PL/I Converter*, Eric Weiss. McGraw-Hill Book Co., New York, N.Y. 1966. 113 pages. $3.95.**
An abbreviated primer of PL/I general programming language, written for a FORTRAN programmer. Contains example programs and classified list of keywords.

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Interviews in Atlantic City During SJCC April 18, 19, 20

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Design solid state circuits for application to communications, signal processing, information handling, radar, countermeasures and simulation.

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Perform the logic design of special purpose digital equipments as well as system interface and display equipments. Problems include specifying necessary digital and analog interface equipments and the design of digital systems for a variety of applications.

To arrange an interview while attending the Spring Joint Computer Conference call:

The Melpar Suite at (609) 345-3251
Lafayette Motor Inn
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(around the corner from Convention Headquarters)

Interviews can be arranged from 10:00 a.m. to 8:00 p.m. on Tuesday, Wednesday and Thursday, April 18, 19, and 20.
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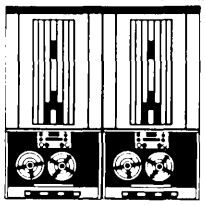

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people

■ Computron, Inc., Waltham, Mass., has elected Claus Schneider president and Albert A. Fried, chairman of the board of directors. Schneider was formerly co-manager of the BASF Magnetic Tape Div., and Fried was marketing manager of GE's chemical and metallurgical div.

■ Dr Murray Tondow has joined Planning Research Corp. as senior specialist for educational data processing. He will also head the new PRC office in Palo Alto, Calif.

■ Sanford Kaplan, sr. vp, finance and administration, and Dan L. McGurk, sr. vp, operations, were elected to the board of directors, Scientific Data Systems, Santa Monica, Calif.

■ Bill O. Barancik has been chosen assistant manager of System Development Corp.'s research and technology division. Former head Donald L. Drukey has joined Computing & Software, Inc., Panorama City, Calif.

■ Don Sundeen, ex-head of the business software effort at Scientific Data Systems, has formed Applications Software, Inc., San Pedro, Calif.

■ Dr. Walter E. Simonson has been named vp, multi-access computing research and development for CEIR, Inc., Washington, D.C. He had previously been the company's director of management sciences.

■ Vernon E. Leas is now vp, systems and applications, Sperry Rand's Univac defense systems div., St. Paul, Minn.

■ John P. Puhala has been promoted to vp, management information systems, B-R Data Systems, Inc., Silver Spring, Md.

■ Donald A. Alexander has been appointed dp manager, electronics division, General Dynamics Inc., Rochester, N.Y.

■ Daniel H. Thomas has been chosen coordinator, dp systems, Smith Kline & French Laboratories, Philadelphia, Pa.

■ Emil R. Borgers has been elected executive vp, Systems Engineering Laboratories, Fort Lauderdale, Fla.

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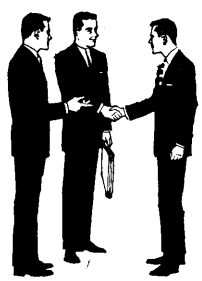

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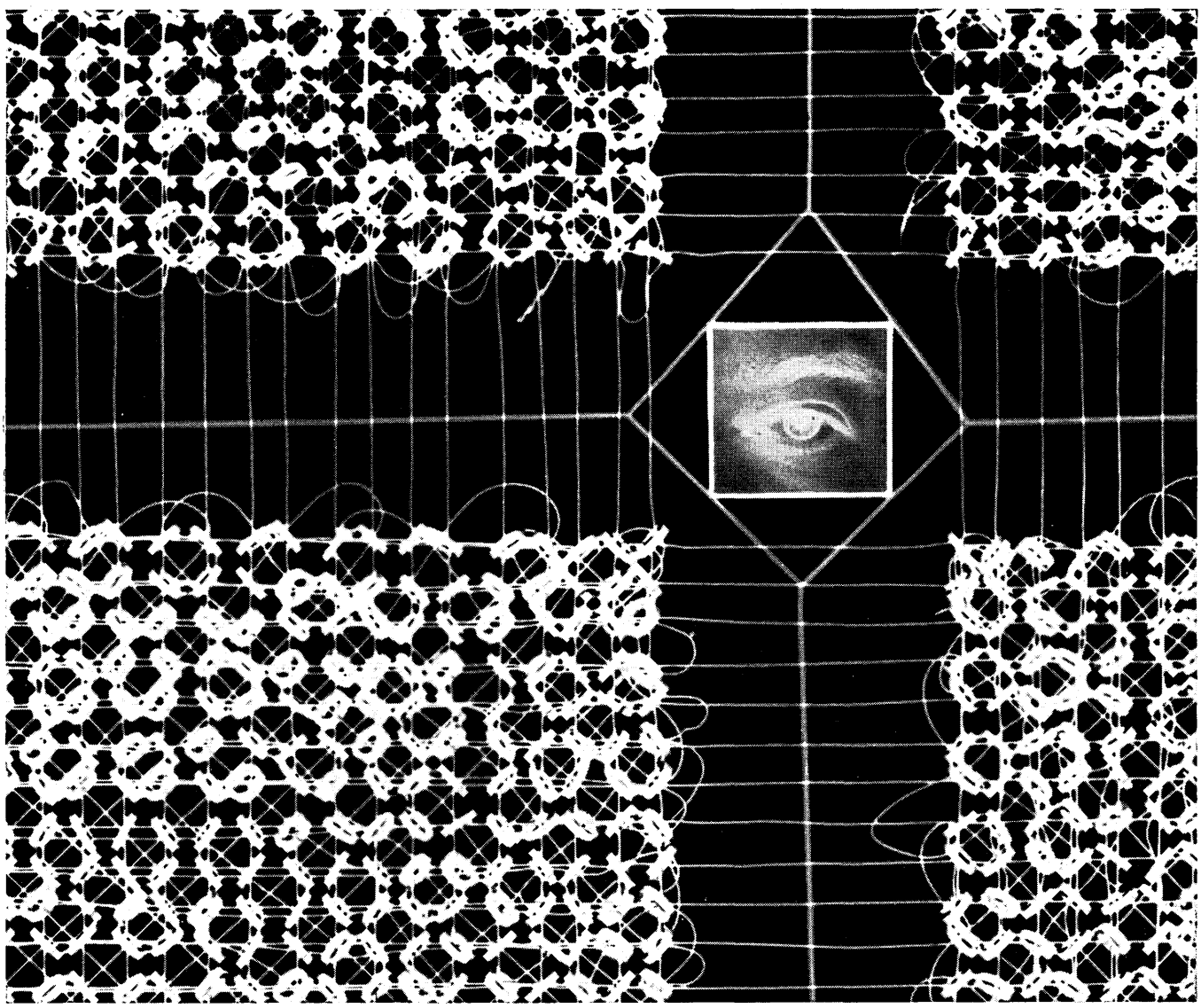

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Engineers and scientists are invited to write Professional Placement Manager, Lockheed Missiles & Space Company, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

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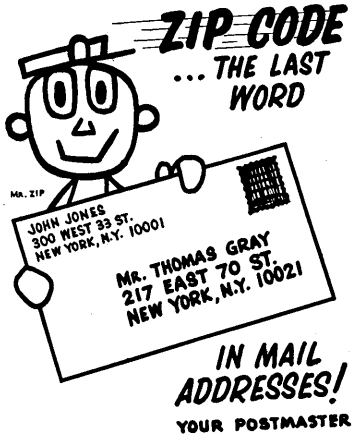
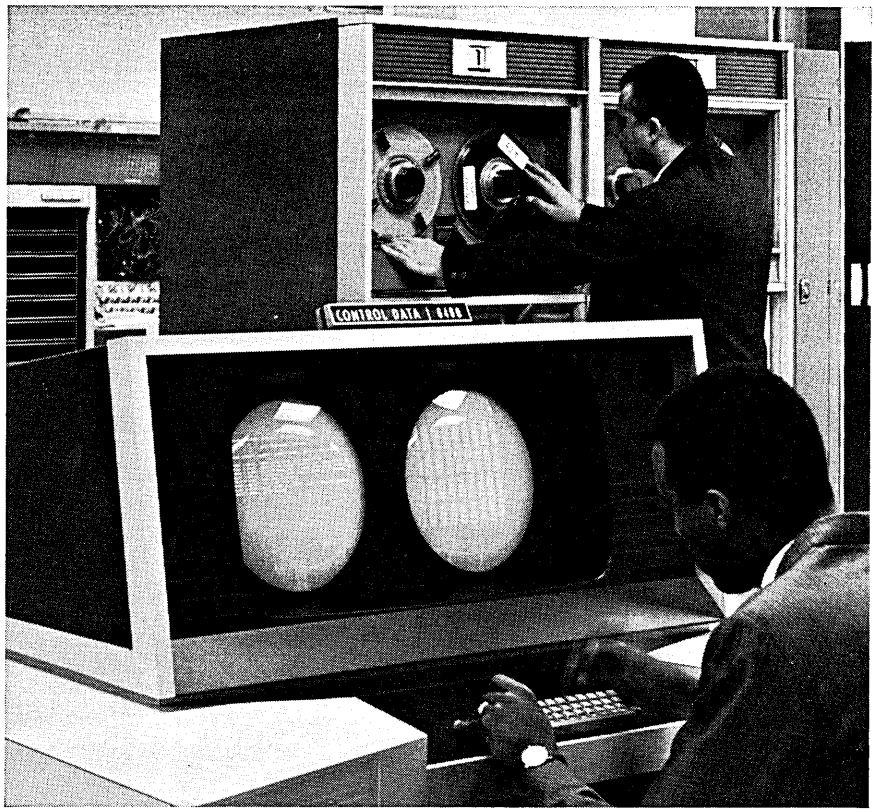
For further information please contact: DATAMATION Magazine, Classified Advertising Dept., 35 Mason St., Greenwich, Conn. 08630 (203) 661-5400.





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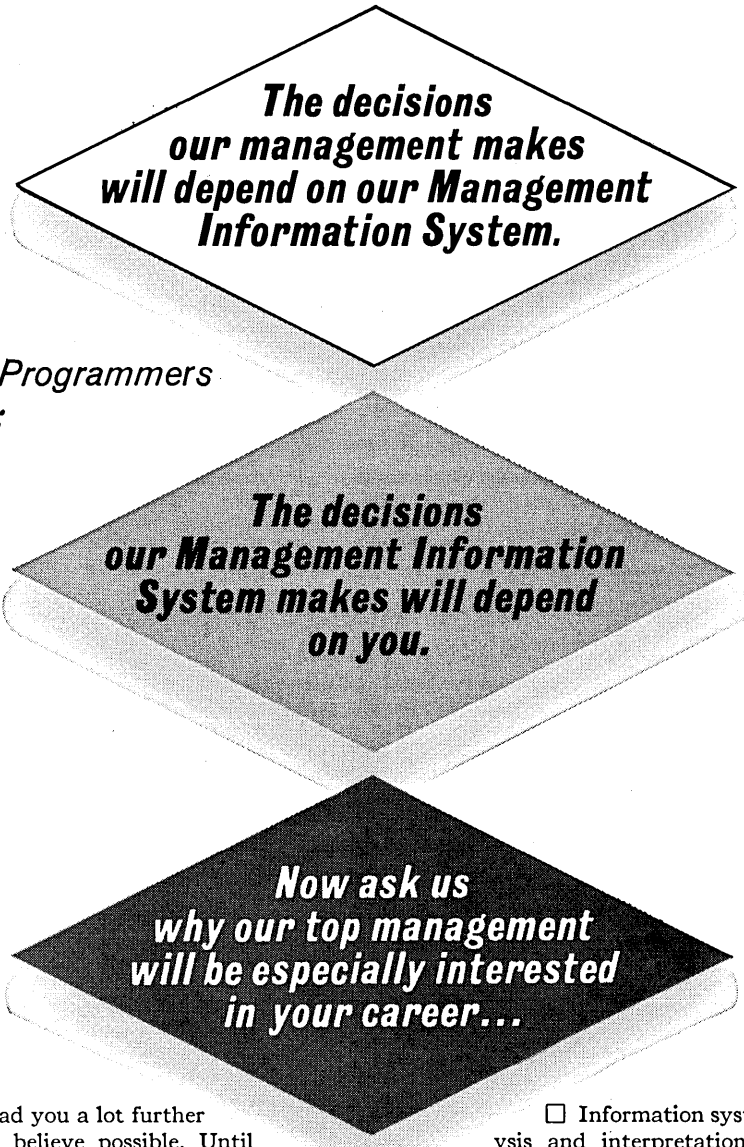

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GENERAL DYNAMICS

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look ahead

(Continued from page 19)

Demonstrated was a time-sharing mode with only one terminal hooked up, but an assortment of Teletypes, and CRT consoles can run simultaneously with high and low-speed I/O gear in a batch mode.

Due soon from CDC, which has a $90-million backlog of orders for OEM gear alone, is an ASA Fortran compiler for the 6000 series. And we hear the new drum operating system for the 6400 runs four times as fast as the present disc system.

BACK TO SCHOOL FOR PHILCO

That Philco 102 computer which the Philadelphia school system has ordered for on-line CAI is a 32-bit (plus parity) machine which will address any word, character or bit in an up to 65K word core. Cycle time is 1.5 usec,and add time is approximately 4.5 usec. The cpu can simultaneously handle communications between two drum or disc memories and up to three mag tape controllers commanding 12 tape units. Part of the cpu is a processor-independent I/O controller which overlaps cpu operations except during main memory access, which takes about 5.5 usec per character. There's a scratchpad memory which includes 7 index registers, A & Q registers and two program control registers. Some 60-65 102's will go to the overseas Autodin program as store-and-forward message switchers. At Philly, each 102 will at first simultaneously control up to 16 CRT/keyboard remotes, and communicate with a central processor. Approximate price of a 16K 102: $120K.

RUMORS AND RAW RANDOM DATA

Following significantly large Spectra 70 orders from Pacific and New York Telephone companies, RCA has rung the gong at New England Bell. Being purchased are eight 70/35's, eight 70/45's and three 70/55's with tapes and RACE units, which will replace some 16 IBM 360's. Price hasn't been set yet, but we hear its rental equivalent would exceed $300K per month. ... The RAND Corp. is reportedly working on a portable version of the RAND Tablet, battery-driven and capable of microwave transmission to the computer. ... In Miami, Milgo Electronics has a 4800-bps modem that uses the 900-2500 Hz portion of a 3KHz bandwidth conditioned line. Their 2400-bps modem uses portions of unconditioned lines. ... The Bell data set for 5400 bps transmission speed will be tested by some operating companies this year. Plans are to use it in the dial-up network. ... New entry in tape certification biz is Certa Corp., Los Angeles. They have a tape cleaner now being introduced, will follow in July with a certifier that uses IC's, covers 7-, 9-track, and full-width tapes in the $35-40K price range. ... Don Wood, formerly manager of applications at ASI (now EMR) Computers in Minneapolis, has formed Mauchly-Wood Software Corp. in Newport Beach, Calif. ... An ex-Digitek vp, William R. Neal, has formed CALACO, Los Angeles. First product is a portable card punch for questionnaire answering,etc., that may sell for less than $25. They may enter software biz., too. ... EMR's computer div. will speed up its 6130, with the 900 nsec memory rising to 650 nsec. Burroughs & EMR are entering joint proposals on several systems. ...Infant Standard Computer Corp. has sold its first machine to Fluor Corp., has a good chance to crack IBM stronghold North American Aviation with its IC 6000-19 and maybe a larger machine to follow.

programmers • analysts

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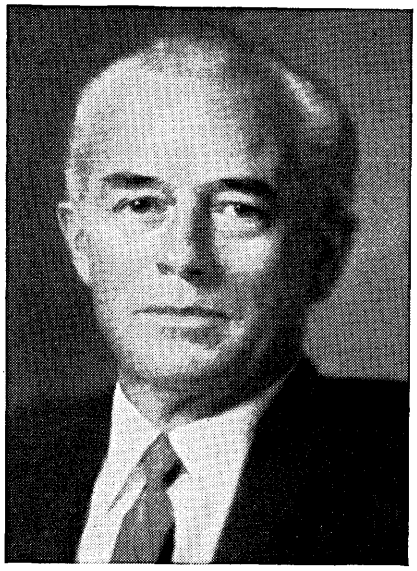

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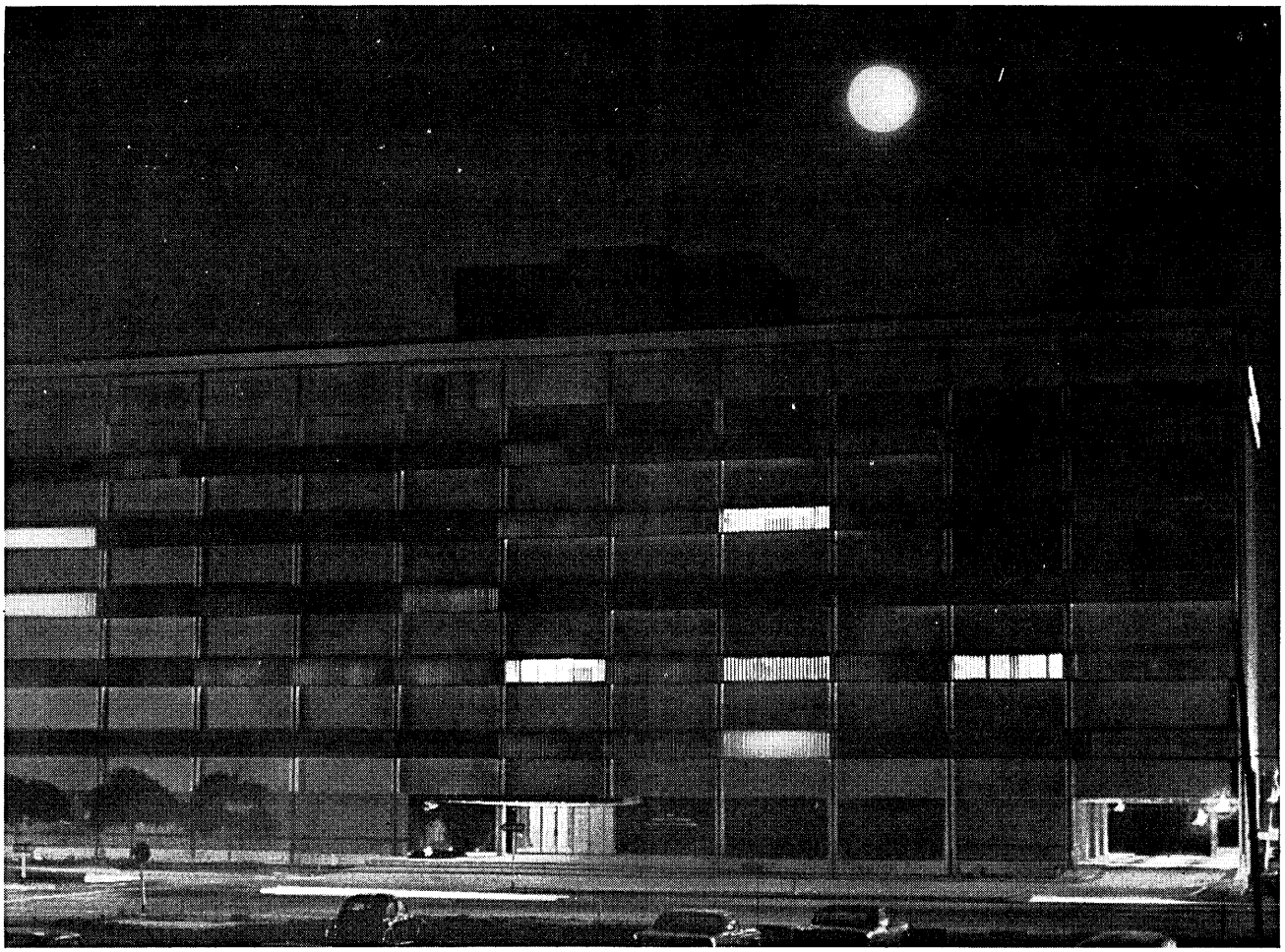

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the forum

The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

WHAT A PROGRAMMER DOES

It has been believed that a programmer occasionally writes code and gets it running on a computer, and that this is what he is paid for. In spite of his obvious inefficiency, no one else seems to do this work more effectively. However, his activity is still observed principally as loafing—a kind of ritual (like the British and teatime) which must be put up with.

Another view of what a programmer does addresses more constructively all that "wasted" time and ritual. To understand this view, we must see what it is the programmer is trying to build. We all have some idea of what a program is, but not very often do we see a program from its author's point of view. Whatever a program is, it exists as an organization of many pieces with a high degree of structural integrity, and it is stable in its environment. That environment includes the mechanisms of the program itself, as well as the input data. To establish this integrity is the usual debugging task.

However, there is more to the environment of our program. It must be stable with respect to the threat of operator misunderstandings, with respect to invalid data, and to changes in specifications, up to a point. Obviously, to develop a code structure that is stable in the face of all these unknowns is a very difficult task. As a matter of fact, we programmers all cheat. The structure we develop includes more than the running code, more than the symbolic code, or even the operator's guide, the maintenance guide, or the design guide. For in fact, in response to any serious breach of the program's integrity, a programmer will become involved, as part of the integral organization built by the original programmer. If one now looks closely, he can begin to recognize the intent of those steps in the ritual of programming.

program dybbuk

In this ritual, the programmer must clearly anticipate the sources of threats to his program. He must imagine techniques to deal with those threats, and anticipate the instabilities of those techniques. Of course, as the programmer has a mind trained in objectivity, he will realize that in fact he cannot scare off the dybbuk who already is making its home in his structure by the time debugging begins. It is at this point that the agony of programming begins. The structure is now nearly mortal, and its vitality may well be stolen by a form of the "enemy" which could and ought to have been anticipated by its creator. The enemy, the dybbuk, of course is entropy; it appears in many forms, and sometimes in many places simultaneously.

The program must not only have a static stability, in withstanding such things as invalid data, but must also further respond to dynamic changes in environment. Of these two types of stability the first can generally be provided by careful programming, provided the ultimate operating environment is reasonably organized. A program is rarely killed by a failure of static stability. The death usually occurs because of a failure in the program's mechanisms for maintaining stability, in its abilities to respond to environmental change.

One mechanism for maintaining stability is the maintenance programmer. The longevity of the program is therefore dependent on the capability, comprehension and intelligence of this person. But humans are not omniscient in comprehending programs. As a matter of fact one of the most difficult intellectual endeavors is the analysis and comprehension of an existing program structure. Thus the resistance of a program to unsettling forces is critically dependent on its structural clarity, as measured by the effort required to analyze and comprehend it.

We see, then, that the structure called a program consists of more than we first thought, and includes stabilizing mechanisms which are far broader than the code itself.

the traumatic periods

We should consider the traumatic periods of the life of a program. The terminal trauma of a program occurs when it is challenged by entropy beyond its capacity to adjust. Obviously every program will have, or has had, this trauma, after which it is of no use. Most programs go through at least two additional traumatic periods. The first is when the static stability is first being developed—that is, during debugging. The second is when the program is first placed into a real, instead of artificial, environment—during system testing.

In both of these periods a major problem is the exercise and further development of the stabilizing mechanisms which allow the program to run under extreme, unsettling entropic forces. In both of these periods the primary instrument of stability is the original programmer, who reacts toward an indication of disorganization (a "bug"). He may well have built into the program checks which aid him in identifying the disorder and its cause.

The ritual of programming is of great consequence because it deals with the communication between the

original program author and the programmer responsible for maintaining the structural integrity of the program. When these two are the same man, there is still a significant amount of communication between them; in a large program one cannot remember the whole program. The author must organize the program into concept units, and leave a clear trace of the organization, as well as the content, of each unit. Thus that part of the ritual which attempts to provide *the basis for comprehending* a program structure is, in fact, the part of the programming activity which *most directly supports* the vitality of the program, from debugging on.

In fact, experience generally shows that an intense concentration by the programmer in optimizing the comprehensibility of a program's structure pays off, not only in debugging, but also in ease of coding and program layout. If a program is structured so that it consists of a set of functions that can be understood separately, then the layout of the program should be obvious, or at least explainable. Furthermore, the coding effort should be uncluttered by considerations beyond the algorithms for the "current" function.

the primary role

Thus, a programmer develops his program so that a human can comprehend it. Initially this is merely self-protective, as he must understand the program enough to get into production. It would appear that all good programmers attempt to do this, whether they recognize it or not. Furthermore, no one has seen a program which the machine could not comprehend but which a human did. Not even bad programmers (those whose programs die young), write comprehensible code; if they did, their programs would survive and they would be better programmers. Both the value and quality of a programmer's work improve directly with the importance he places on communicating his program to a human, rather than merely to the machine.

A programmer does not primarily write code; rather, he primarily writes to another programmer about his problem solution. The understanding of this fact is a final step in his maturation as a technician.

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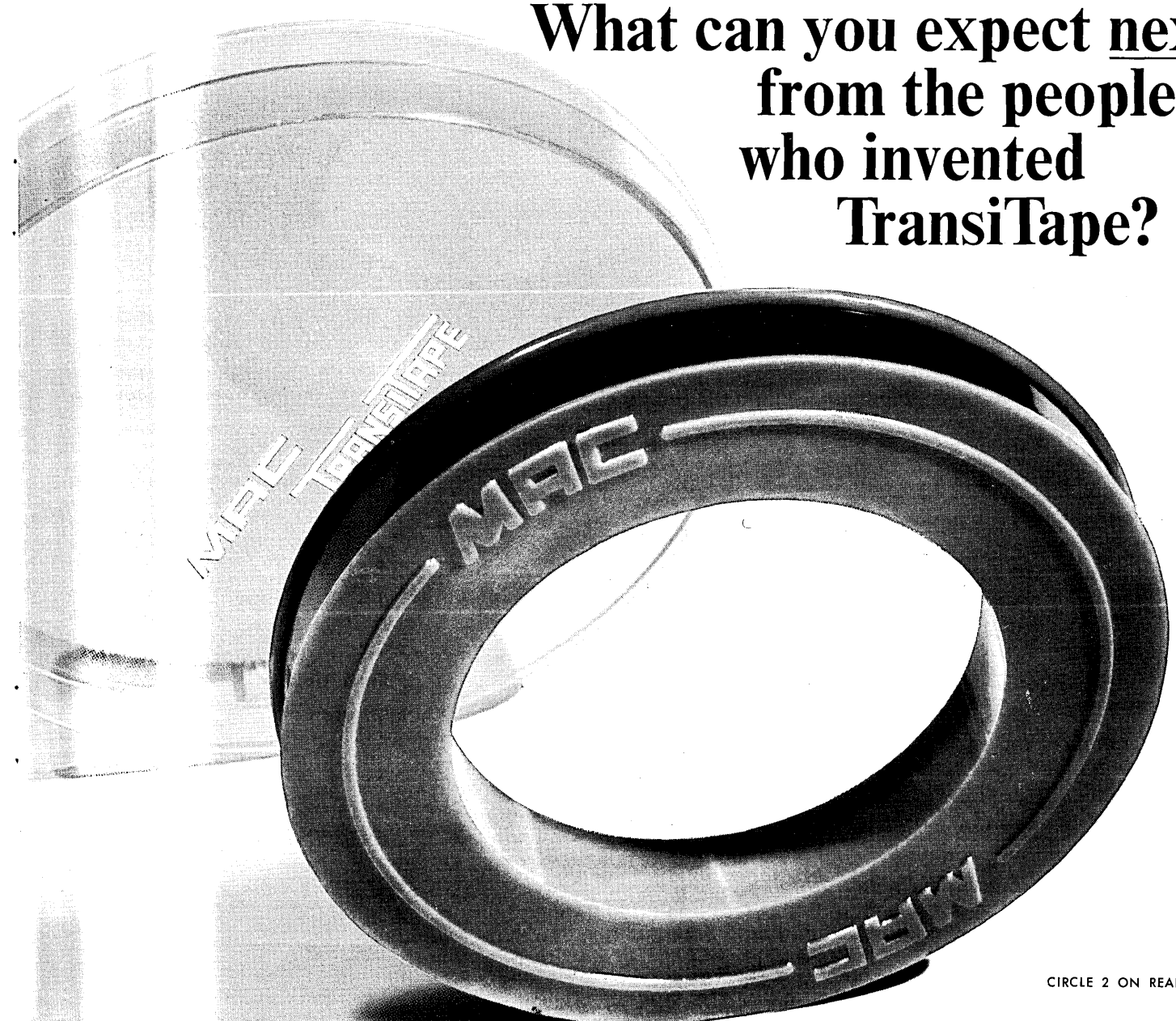

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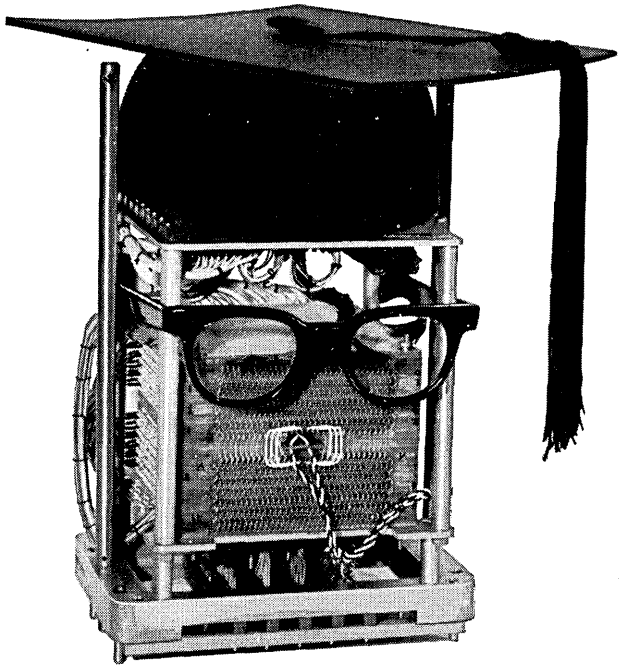

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