DATAMATION

67

October

FALL JOINT COMPUTER CONFERENCE ■ NOV. 14 ■ 16 Anaheim


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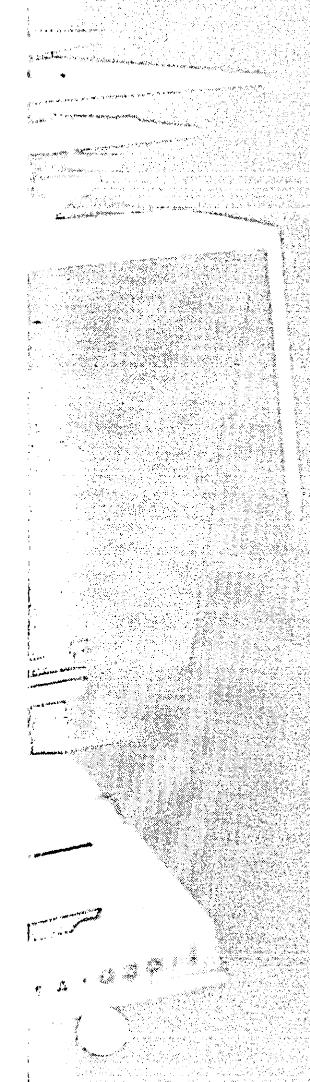

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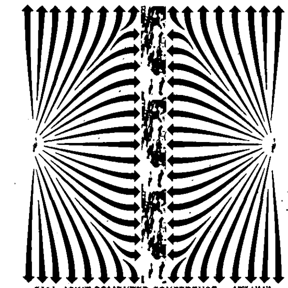
CIRCLE 4 ON READER CARD

DATAMATION



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volume 13 number 10

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TAPE EDGE COMPARISON

TVP2 | BRAND A | BRAND B | BRAND C

EXCLUSIVE PRECISION SLITTING

TYPICAL INDUSTRY SLITTING

NOW...
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☐ You have probably never worried about how your computer tape looks in cross-section, but believe it or not, it's an angle worth considering.

☐ The unretouched photos above are representative cross-section views (at approximately 500X) of three leading "premium" tape brands, together with Computron's new TVP2.

☐ You can see at a glance that, of the four specimens, only TVP2 displays a clean, rectangular edge. Why is this important? Primarily because in this way TVP2 greatly reduces the possibility of error-producing edge debris.

☐ When oxide overhang is present, small fragments are almost certain to break off in use. With a non-rectangular cut there is uneven edge wear between the oxide and backing, weak spots develop and the edges fracture and chip. This means an increased probability of dropouts, both transient and permanent.

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☐ TVP2's exceptional edges are the result of an exclusive new Computron slitting technique . . . another important factor in the Total Value Performance of this exceptional new tape.

☐ Consider it the next time you select computer tape.

HOW THESE PHOTOGRAPHS WERE MADE

1. The two ends of the tape were inserted into a plexiglass tube.
2. The tube was then filled with epoxy and allowed to cure.
3. When completely cured, the cylinder was put on a lathe.
4. The ends of the cylinder were then polished in several stages until the required smoothness was achieved.
5. The edges were then photographed under a microscope using a parallel light source, eliminating shadows which might result in undefined tape edges.

TVP2

COMPUTRON INC
CROSBY DRIVE, BEDFORD, MASSACHUSETTS 01730

CIRCLE 8 ON READER CARD

DATAMATION®

october
1967
volume 13 number 10

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WE JUST OBSOLETED EVERYBODY ELSE'S COMPUTER GRAPHICS.

Our new CRT computer terminal makes all other graphics systems suddenly look like Theda Bara vamping Rudolph Valentino. Nostalgic, maybe, but very, very obsolete. □ The difference is that the Adage Graphics Terminal is a fully-integrated general-purpose system. It has its own internal computer and is delivered complete with operating software for communicating with the remote central computer and for local image control and console I/O. □ Hybrid processing techniques exclusive with Adage (our Ambilog 200 hybrid computer is standard in every terminal) produce dynamic displays of 3-dimensional objects which really move continuously. Pictures are bright and clear. Even complex images don't flicker. □ You can start with the Model 10 Graphics Terminal at $75,000, and get 4K of 30-bit core memory, CRT console, and Dataphone interface to the central computer. □ For around $250,000 the top-of-the-line Model 50 buys you 16K of core, extended arithmetic capability, and disk memory for local storage of image and program libraries. The console has a full complement of operator's controls for image translation, rotation, and scaling. Options include a hard copy display recorder and an analog input tablet. □ Would you like a demonstration? In your office? Write David Sudkin, Manager of Marketing Services, at Adage, Inc., 1079 Commonwealth Avenue, Boston, Mass. 02215, on your company letterhead. We will send you a 16mm demonstration film showing the system in action. □ The movie is on us. You bring the popcorn.

Adage INC

CIRCLE 9 ON READER CARD

calendar

DATE	TITLE	LOCATION	SPONSOR/CONTACT
Nov. 1	Appl. deadline, exams for cert. in DP, to be held Feb. 24	Various locations in U.S. and Canada	Educ. Div., DPMA, 505 Busse Hwy., Park Ridge, Ill. 60068
See below:	Seminars on time-sharing. Cost: $15-$20	See below:	ACM/J. M. Adams, Jr., 211 E. 43 St., N.Y., N.Y. 10017
Nov. 3		Camelback Inn Phoenix, Ariz.	
Nov. 6		Sheraton Ritz Hotel Minneapolis, Minn.	
Nov. 7		Broadmoor Hotel Colorado Springs	
Nov. 8		Hotel Utah Salt Lake City	
Nov. 9		Hyatt House Hotel Seattle, Wash.	
Nov. 10		Hilton Inn San Diego, Calif.	
Nov. 6-8	Computer Graphics Conference	Univ. of Illinois Urbana 61801	Prof. C. W. Gear, Dept. of Computer Science
Nov. 9-11	SDS Users' Meeting	Airport-Marina Hotel Los Angeles, Calif.	Ed Noyce, SDS, 1649 17th St., Santa Monica, Calif. 90404
Nov. 10	Symposium on application of computers to problems of urban society	Hilton Hotel New York, N.Y.	ACM/J.M. Spring, Computer Methods Corp., 866 Third Ave., N.Y., N.Y.
Nov. 10-11	Users' Meeting on computers in the laboratory	Jolly Roger Motor Inn Anaheim, Calif.	DECUS, Maynard, Mass. 01754
Nov. 14-16	Fall Joint Computer Conference	Convention Center Anaheim, Calif.	AFIPS
Nov. 28-Dec. 1	Inst. on computers & hospital admin.	Gramercy Inn Washington, D.C.	American Univ., Ctr. for Tech. & Admin., 200 G St., N.W., Wash., D.C. 20006
Jan. 18-19	First Annual Simulation Symposium Dec. 4 reg. deadline	Sheraton-Tampa Motor Inn, Tampa, Fla.	Ira M. Kay, P.O. Box 1155, Tampa, Fla. 33601

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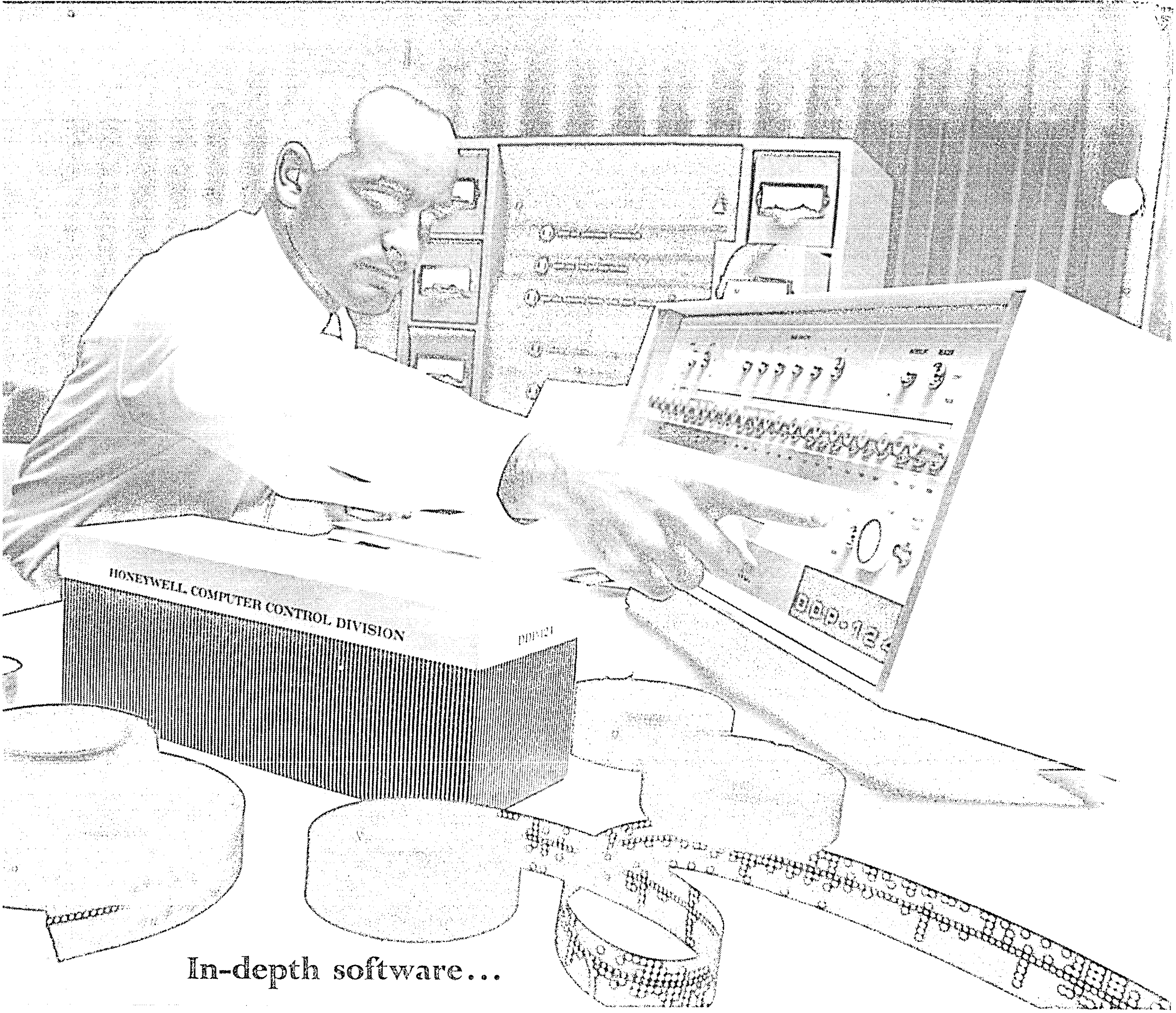

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COMPUTER CONTROL DIVISION

CIRCLE 12 ON READER CARD

letters

optimum revenue

Sir:
The simple test suggested by D.L. (The Forum, Aug., p. 140) is too simple and the validity that it possesses is lost in the ridiculous extreme to which it is carried.

No one would argue that manufacturers desire optimum revenue, but in a competitive situation it is not the manufacturer alone who decides what that revenue will be. The consumer has the power and the responsibility to force product improvement through selective buying. It is a sad commentary on the data processing field that, with a plethora of willing competitors, one finds a dearth of sophisticated and demanding consumers. The inevitable result is a loss of the individual qualities of other suppliers in the life and death struggle to gain consideration from computer users who are afraid to vary much from the standards set by IBM.

JOHN HUEY
Columbus, Ohio

historical sidelight

Sir:
My friend Stephen Palffy's laconic historical details (Aug., p. 14) regarding Transylvania's past can only serve to mislead your readers. Transylvania is a territory inhabited by Rumanians after the Roman conquest (A.D. 105) and conquered by Hun-

garian tribes some 1000 years ago. By the 15th century, the Rumanian nobility had been denationalized and the peasants reduced to serfdom. Transylvania was united to the Rumanian kingdom after World War I, when the Austrian-Hungarian empire broke up, because of her vast Rumanian majority. Her north-eastern half was attributed to Hungary by Hitler in 1940 following the notorious Vienna Diktat (as a sop to Horthy's pro-Nazi regime) and returned to Rumania after the end of the war.

J. C. VORVOREANU
London, England

libraries and dp

Sir:
You were kind enough to review a small monograph written by two of my colleagues and myself (Aug., p. 127, by Wm. R. Eshelman). Your reviewer wished for a companion to the volume reviewed "to explain libraries to datamateurs."

Your readers may be interested to note that a colleague (M. W. Grose) and I have this companion volume well in hand, and that it is to be published by Oriel Press Ltd., of Newcastle upon Tyne early in 1968.

N. S. M. Cox
Newcastle upon Tyne, England

virtual memory

Sir:
Fie on you for publishing Ivan Flores' "tutorial" on virtual memory concepts in the August issue (p. 31). In one swoop he negates our industry's feeble efforts to adopt a meaningful vocabulary. Mr. Flores is in trouble from paragraph three, where he equates *segments* with *pages*, and he subsequently foists on us all manner of common ideas in disguise. However catchy his *spacemaker* and other subsystem names, the last thing we taxpayers and the AEC want for our money is another set of non-descriptive pseudo-definitions. A much clearer discussion of the subject was given by B. W. Arden at the IEEE National Conference in New York in March.

TAD PINKERTON
Ann Arbor, Mich.

(Ed. Note: The paper mentioned by

letters

Mr. Pinkerton is "Time Sharing Systems: A Review," by B. W. Arden, Univ. of Michigan, Ann Arbor, Michigan.)

Dr. Flores responds: I generally emphasize my definitions by placing defined words in bold type, but the editors chose to abandon this. This would have clarified my use of *segment* according to its common meaning (Webster's Int'l, 2nd Ed.: "A severed piece; fragment, portion"). "Paging," of course, is jargon and I feel free to "define" it by popular use and intent.

Perhaps Tad is vitriolic without real substance because he and his cohorts have espoused a system (i.e., paging as in MULTICS or TSS) which is truly "costing us taxpayers mucho bread" but where benefits are yet to be made apparent.

memories of erma

Sir:

In the September issue you published an article written by Robert V. Head entitled "Old Myths and New Realities." I make reference to the portion about Bank of America's demand deposit accounting system. The author states, "Bank of America, San Jose, California, 1959, designed with the aid of Stanford Research Institute, a fully computerized demand deposit accounting system." More accurately, General Electric and Bank of America programmers designed the demand deposit accounting system. Stanford Research Institute aided in the design of the hardware logic required in a computer to be used for this purpose. Mr. Head states, ". . . it was implemented using GE210 computers."

The system was implemented using GE100 computers. The GE210 computers were used to implement the demand deposit accounting system at Security First National Bank some time later. While on the ERMA team at the Bank of America, 1959-1963, I was called upon occasionally to give assistance to the technical people at Security First National Bank while they were in the debugging stage of their system.

Thomas E. Lang
Wheaton, Maryland

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

The terminals have: 2000 characters/page, character generator, multi-channel memory, 10-17 inch screens, format and editing capability, options for message verification, error detection and correction, and — on the high end — options for split screen and straight-line graphics, with software. The 3000 uses a delay line memory (basic 2K characters), while the 4000 has both delay line and core (6K-12K). Drum storage, starting at 500K characters, is used in larger models. A control unit is also offered for handling 6-12 terminals; cost is $2K-9K, while the basic cost for each terminal is reduced 10-15%. Additional modules handling six terminals each can be added to the controller.

NEW HARDWARE FROM SOFTWARE FIRM

A portable desk-top computer designed to sell for less than $5K has been made by Logicon Inc., San Pedro, Calif. Current configuration has micro-programmed functions for scientific jobs (easily changed), storage for 114 program steps (any 15 can be branches), keyboard/CRT for I/O (with plans to add Teletype and tape reader punch). No manufacturer, Logicon is looking for licensees.

A fast-growing systems engineering & software firm, 6-yr-old Logicon has 160 people, recently was awarded the job of evaluating PL/I for ESD. (Staff engineer Dick Southworth is editor of the PL/I Bulletin.) They're also big on missile guidance computers, almost totally dependent on gov't contracts, but expanding into the commercial field.

TWO MORE FROM THE BIG "I"

Interdata, building a compatible family of 16-bit computers, will announce at FJCC two new systems to bracket the $6K model 3. Model 2 will cost "significantly less" than $6K, while model 4 will run about $20K, offering cycle time faster than the 3's 2 usecs plus optional "firmware" (read-only memory) and floating point. Memory size of the family will range from 1K-65K bytes. A wide range of peripheral devices, modules, and upward compatible software (no compilers yet announced) come with the systems. The year-old company expects to go over the megabuck sales mark for calendar '67.

UNIVERSITY COMPUTING WILL UNVEIL HIGH SPEED TERMINAL AT FJCC

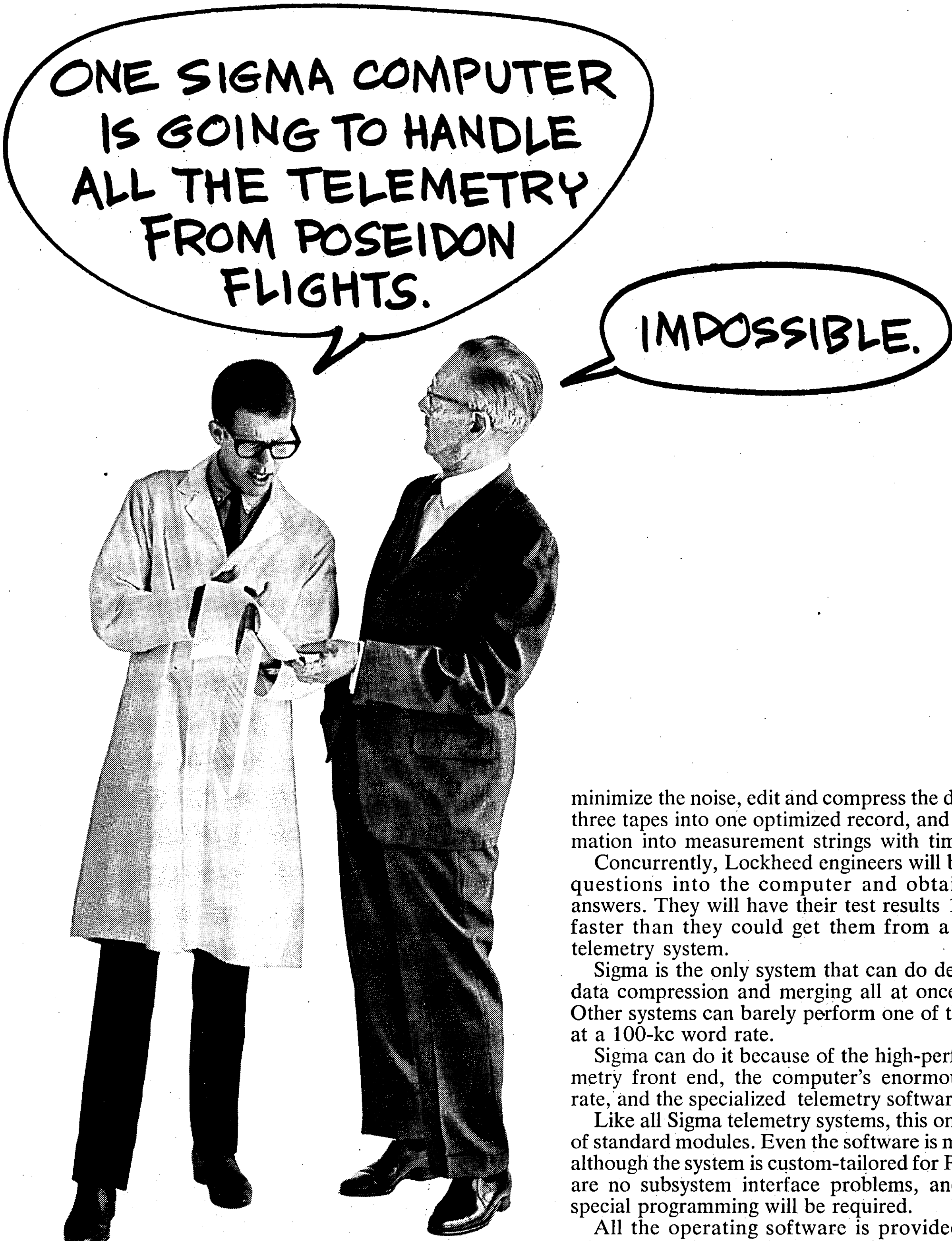
University Computing, laudably determined to avoid announcements of products from its new hardware division until they're really complete and ready to run, will show its Cope terminal at FJCC.

It's much more than a "terminal" in the usual sense, consisting of a remote controller with 4096 (12 bit) word buffer, console, and Teletype; a 1000-1250 lpm line printer; 1500 cpm card reader; and a 4800 bits/sec full duplex communications unit for voice grade lines, all on customer's premises.

Back at the 1108, in UCC's computer centers, is the rest of the Cope system — each controller handling 10 of these terminals. This unit includes a PDP-8. With typical confidence, UCC has ordered 100 of these from DEC and has an option on at least that many more.

The terminals won't be sold separately as a standard product because the controller/interface is designed to fit the 1108 — and because there are three levels of software, at the terminal, controller, and central computer. But there are many large organizations with one or more 1108's who could use it in-house and several are already interested.

(Continued on page 183)


ONE SIGMA COMPUTER IS GOING TO HANDLE ALL THE TELEMETRY FROM POSEIDON FLIGHTS.
IMPOSSIBLE.

WE STILL NEED SPECIALISTS

Nearly everybody we know who has to attend or exhibit at computer conferences has felt for a long time that there are already too many such beasts, and those of us who have to report on them are almost frothy-mouthed on the topic.

So the decision of the IEEE Computer Group to hold an annual confab didn't exactly call for toasts, cheers and welcoming banners, in these quarters at least.

Nevertheless, we dutifully attended the First Annual IEEE Computer Conference in Chicago last month, hoping that Editorial Objectivity would overcome our Initial Prejudice toward conference proliferation. (Some reactions to the Conference can be found in this month's News Briefs.)

We're not qualified to judge the technical content of the sessions and the papers, but the initial reaction of a small, unscientifically selected sample was favorable. And, generally speaking, the Conference was well run and well attended by clean-cut, serious-looking and -suited citizens.

The rationale, the raison d'être, for another computer conference interested us, and IEEE Computer Group chairman Sam Levine was happy to oblige. It seemed to the IEEE CG, he said, that the Joint Computer Conferences, in their increasing attention to big-picture generalities, were overlooking topics of more narrow, specialized technical interest to hardware types. Thus, the need for this conference and those which will follow it.

It would seem that if the software types, as represented by the ACM, can hold an annual conference, why not hardware-happy people? Despite the industry's current preoccupation with software, it's apparent that the software has to operate through hardware.

On a more philosophical level, it also seems that the specialists in our field—no matter how narrow their interests—still have to have a forum and a mechanism for sharing their concerns and their enthusiasms. The IEEE Computer Conference—along with the IEEE *Computer Group News*—would seem to offer them. But we hasten to add that this need does not take precedence over that for specialists to crawl out of their water-tight compartments from time to time to confront specialists in other subtechnologies.

So, our Initial Prejudices shattered, we welcome the IEEE Computer Conference and wish it good health. We hope that the Conference does not, like some before it, succumb to the lure of the exhibitor's dollar, and forget its primary technical mission. And we hope that future sessions will be more narrowly and carefully structured.

In the meantime, all we have to worry about is how to find more and better ways to allow the hardware and the software people to get together.

MARKETING THE COMPUTER

room at the bottom

by LAWRENCE ELLIOT SCHWARTZ and GEORGE H. HEILBORN

It is questionable that the assumptions and concepts of computer market economics which underlie, and are thus guiding, the current development of the field can be valid. The reason is that the basic concepts of computer market economics have changed little over the 15 years since the inception of the industry. Some of the main ideas which we question are that:

1. The computer market is fast approaching maturity.
2. New uses for edp will, however, lead to a further expansion of the market for large machines.
3. The two major areas in which new uses will be found are management information systems and information utilities.

We shall show, in contrast to these ideas, that:

1. Far from being on the verge of fully saturated markets, the computer industry may not yet have reached its maximum rate of growth.
2. The segment of the market which is most likely to grow rapidly in the next few years is one largely neglected until recently—the small computer market. Expansion will come from the extension of proven applications to thousands of small firms now unable to afford computers, rather than from radically new uses developed by large firms.
3. Management information systems and information utilities will not materially contribute to the growth of the market as a whole during the foreseeable future.

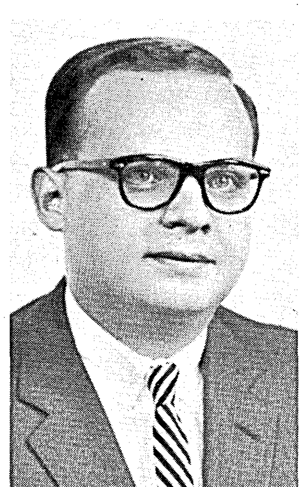
maturity and market structure

The structure of the market for computers has had a peculiar influence on the maturation of the market. The structure of the market is an oligopolistic one with a single dominant firm, IBM, and a fringe of small followers. Because there are eight to ten small followers splitting up about one-fourth of the total market among themselves, a good measure of IBM's dominance is given by the ratio of its percentage market occupancy to that of its next largest competitor. Actually, there are two firms tied for second place this year, Univac and Honeywell, each with about 8% of the market. According to this estimate, IBM's normal 75% would make it more than nine times bigger than its nearest competitor. As a consequence, IBM's market conduct and policies should be quantitatively more important in determining the development of the market than are the policies of any of the other market participants. For this reason we shall examine IBM's market conduct and policies first.

Clearly, IBM's most important policy has been to lease equipment to its customers, rather than to sell it outright. In justification, IBM has denied that it is selling a product, "a computer," but has claimed to be providing a service, "data processing." In point of fact, the product sold on the computer market is a service. In business data processing, which accounts for the bulk of the market in dollar terms, the product is the handling of lists, checks, bills, and other such items. It is only the larger machines, used mainly for scientific applications, which can really be said to have "computing" as a principal product. In either case, the commodity sold by the industry is priced, as is any other service, on the basis of usage.

Only in the last 10 years has equipment been for sale by IBM; and sales have been made only because of the antitrust consent decree of 1956. But even today, IBM's pricing policies—such as the ratio of rental to purchase prices, the virtually negligible trade-in values offered for purchased equipment, and the higher cost of maintenance imposed on purchased equipment—have encouraged a preponderance of leases.

Contrary to what might be expected in a market structured as this one is, the most important effect of IBM's leasing policy has been to spread the market, not to restrict it. Leasing stretches the market for computers primarily by lowering the apparent price to the customer. The buyer regards the rental price of the computer as the price of a flexible service, available on a monthly basis like electricity and telephone, and easily turned off on 30-90 days' notice. Since the buyer does not view his computer



Dr. Schwartz is assistant professor of economics at Queens College of the City Univ. of New York. He was previously corporate econometrician with IBM and an economist with RAND Corp. He holds a doctorate in economics from Harvard and a bachelor's from Northwestern.

as a fixed capital investment, he is not at all concerned about the purchase price quoted for the equipment. In addition, the buyer need not worry about maintaining his computer, or about replacing it when it becomes obsolete, as he must with all capital goods which are owned. This last consideration also tends to broaden the market by making the cost of renting a computer appear lower than it may turn out to be in practice.

At the same time, leasing slows the rate of technological innovation rather than increasing it as is generally believed. Computer manufacturers are much more hesitant to produce new models which would outdate their existing equipment when they, rather than their customers, own it. Maximum profits can be achieved only by keeping the equipment leased for as long as possible, even at the risk of making most of the equipment technically obsolete. This has been IBM's policy for both eam and edp equipment. Only when the technological lead has been taken away from them by the competition has IBM outdated its equipment.

small competitors

As small competitors in the industry find that more and more of their machines are leased, they will probably develop a stronger aversion than IBM to "impacting" their older equipment. In the first place, smaller firms in the industry are less adequately financed, and it is necessary to have a large capital investment to finance each dollar of sales, primarily because of leasing. A competitor also has considerably more trouble in developing a secondary market for its machines than does IBM, with its large sales force and extensive customer list. A policy of maximizing market share through rapid technological innovation will thus not be profitable for anyone in the industry, and the rate of technical innovation will consequently be slow. The slowing of technological innovation will, in turn, destroy the basic rationale for leasing offered now by the manufacturers: a hedge against the uncertainties of new computer technologies. The market-spreading function of leasing will thus be diluted.

Any leasing which does continue during this period of minimal technical change which lies ahead will be carried out by independent leasing companies as well as by the computer manufacturers themselves. Insofar as these specialized leasing firms use the expected long technological lifetime and the residual values expected at the end of the prime lease term to lower the effective monthly price to the user below that offered by the manufacturers, leasing will continue to be an important means of broadening the market.

A second important IBM policy has been to provide a number of services to their customers, in addition to supplying equipment. These services have included training of management and programmers in the use of the computer, the provision of systems analysis and other services to get a new installation "on the air," and the supply of software (applications programs and systems software). In the early period of the market's development, these services had to be provided by the manufacturers because computers were both too novel and too complex for the customer to be able to cope with them by himself, and most importantly, there was no one else to provide such services. The supply of these services has always been, however, in the nature of a tie-in sale, in which the customer has no choice but to pay pro-rata for these services, whether required or not, as they are included in the rental price of the equipment.

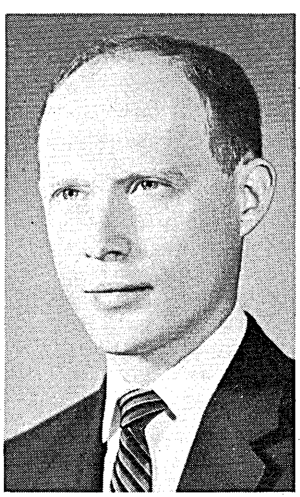
a software gap

Perhaps the worst side effect of these tie-in sales has been the gradual development of a software gap—a gap between software requirements and capabilities, resulting from the fact that hardware developments have far outstripped the evolution of software. The software gap has widened with the advent of the third generation of computers. With improvements in hardware cheaper than improvements in software, the natural inclination of the manufacturers has been to speed up the computer to solve any and all systems problems. A good part of the fault lies not with the manufacturer but with the user. The user regards the price tag on the computer as the price of the machine, forgetting, or ignoring, the fact that software is not free just because the price of the software is not stated separately. One measure of the relative sizes of these two cost components is that over one-half of IBM's total costs for its 360 system this year will be accounted for by software.

It has generally been believed that to cover the costs of its software and other services, IBM has had to charge high prices. This policy, it is alleged, has provided the small competitor with a price umbrella. To stay under the price umbrella in the face of higher unit costs of production resulting from lower volume—and the high costs of innovation—most competitors have been thought to provide less than the complete range of "free" services customarily provided by IBM. On this hypothesis, the rate of technical advance in the industry would have been much slower had the umbrella, and hence the competitive fringe, not existed. (The competitors would have had even less to spend on innovation, and IBM would have had less incentive to innovate.) This point also has important antitrust implications, for it has not been clear that any competition would remain in the industry if the price umbrella were eliminated.

It is thus interesting to see if such a price umbrella exists. Clearly, in order to estimate the height of the umbrella, estimates of the throughput of competitive machines which sell at comparable prices must be made first. As with other services, such as those of the doctor or lawyer, the throughput of the computer is difficult to measure, and becomes more difficult the more sophisticated the application. The measurement of throughput is particularly complicated by the fact that it is heavily dependent not only on the logical design of the computer itself, but also on the assemblers and compilers used to write the working programs, and the skills of the programmers and systems analysts involved.

Throughput of computers has thus been measured by an arbitrary set of standard jobs that eliminate the most glaring comparability problems. Using throughput data obtained from Auerbach Corporation's *Auerbach Standard EDP Reports*, and making the appropriate comparisons, it



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appears that in certain cases among the second generation equipment there may have been a small price umbrella, as for example between the IBM 7090 and the CDC 1604, after adjusting for CDC's conscious attempt to undersell IBM in the large scientific computer market. However, among the newer third generation equipment, there appears to be no evidence that a statistically significant price umbrella—expressed as the throughput per dollar of monthly system rental—exists among the small and medium-priced computers manufactured by IBM and its major competitors. As their volume increases, even though it remains a relatively small percentage of IBM's, and as production cost per system decreases, the small competitors will be better able to afford the expenditures on service needed to either maintain or increase their share of the market. This occurs as an increasing percentage of the sales price becomes available for services.

Because there are very complex trade-offs among hardware, software, and other variables which are both economic and technical, the attempt to substitute hardware speed for analysts capable of designing effective programming systems has not been successful. As a consequence, some of the nation's largest corporations, as well as hundreds of small- and medium-sized ones, routinely experience difficulties in getting economic systems and programming work from their in-house staffs. An increasing number of small firms specializing in the software field have only now begun to fill this gap by supplying programs and systems to both the manufacturers and to users who are disappointed with the manufacturers' packages of programs.

personnel shortage

Because of the failure of existing software concepts for machines of all sizes, there is an increasing demand for systems analysts and programmers. The lack of adequate software will have serious consequences as additional computers are installed, particularly in the less glamorous commercial installations which have always had recruiting problems. A recent report of the American Federation of Information Processing Societies highlights another potentially serious problem. That report projects *exponential growth* in the number of systems analysts and programmers in the next few years. With about 350,000 people to be recruited and trained by 1970, continued exponential growth obviously must be limited.

To bridge the software gap, better "master programs" will have to be developed as a substitute for the thousands of programmers and systems people who will be needed if present methods are continued in use. These master programs would be generalized ones, written by highly skilled programmers, with options which could be activated as required by semi-skilled users. For example, one might be a payroll program with a wide variety of options and features, allowing it to be used for different companies, localities, classes of workers, etc. These features could then be activated (or deactivated, as the case may be) for a specific computer installation.

Proper changes in the organization of software will also free thousands of existing programmers and systems people who are now merely duplicating each others' work for more productive assignments in other installations. The emphasis must thus shift from quantity to quality of software personnel, at least among those who are to write the new master programs. Those who will implement the working programs, on the other hand, need not be skilled at all, but need know only which switches to turn on in order to customize the general programs for their own firm's use.

To the casual observer it may appear that whatever factor is going to ultimately limit growth, it has already produced a relatively mature market. The spectacular 15-20% growth rates of the 1960-1964 period fell to 4.5% in 1965 and were forecast by the Dept. of Commerce to rise to only 8% this year. The question that then arises is: what percentage of the ultimate saturation value, the maximum effective theoretical demand for computers, has already been achieved?

One method of estimating the present level of saturation uses the exaggerated S-shaped or sigmoid curve in Fig. 1. Economic theory holds that the rate of growth of demand depends on both the present size of the market and the difference between that value and some hypothesized saturation level. Such a theory obviously allows us to estimate the saturation value once we have measured the present size of the market and we have assumed continuity between future and present measured growth rates.

The reason for using this S-shaped curve here is that it fits quite well the observed behavior of many markets over time. In Section A of Fig. 1, demand grows exponentially in the period after the introduction of computers, because the potential customers want the product badly. Section B

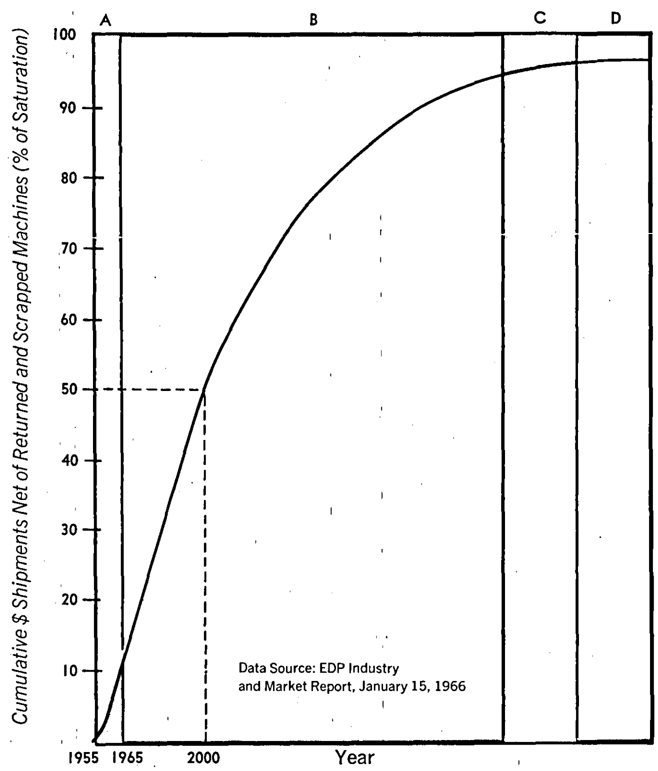

Fig. 1.

shows that the rate of growth gradually declines until the absolute year-to-year growth becomes stationary as initial demands for the computer are satisfied. Demand falls as more and more capital in the form of computers is added to fixed amounts of labor and natural resources so that the profitability of investing in additional equipment falls. In Section C, the absolute rate of growth declines because the profitability of investing in new machines is still falling and existing computers, being long-lived, need not be replaced. Finally, Section D shows the gradual approach to saturation. At saturation, every buyer in the market has as much computer capacity as he can use, and all effective demand is for replacements and upgrading.

There are some obvious reasons why this type of curve was thought not to apply to the computer market in the past. Arguments have been advanced along two lines: (1)

technological changes dominate the market; and (2) saturation recedes as new generations of machines are introduced and the price per unit of computation is slashed so that new uses can become economically feasible. Both of these arguments are not really incompatible with our sigmoid curve explanation of the growth rate. While technological change probably did dominate the development of the market in the earliest days, the progressive slowing of technological change which has, and will be, experienced make appreciable shifts in this static curve unlikely so that identification should not be difficult. In reply to the second point, it can be argued that it is only in the mind of the beholder that the saturation level has appeared to recede to higher and higher levels with the introduction of new technologies. The true saturation level has always been much higher than anyone thought, and technological change merely showed how inadequate were previous estimates of that value.

When we consider the amount of paperwork still done manually or semi-automatically on eam machines, it becomes clearer why the market has shown such rapid growth in the past. The U.S. market alone will account for $3 billion in computer shipments this year. The extent to which our economy has yet to automate its routine industrial, commercial, consumer, and educational functions is also shown in Fig. 1. The size of the vast untapped market for computers makes it clear that even IBM has probably tended to underestimate potential effective demand.

Using the observed dollar value of shipments, corrected for the value of returned and scrapped equipment, for the last 10 years of the computer industry's life, we find, using Fig. 1, that the data is consistent with a sigmoid curve showing that the market is no more than 10% saturated as of 1965. There is no known mathematical method which will allow a more precise estimate of the ultimate size of the market, given such a short life history. The exaggerated S-shaped curve thus shows the most probable future course of development of the market now evident, based on standard statistical curve fitting procedures used on available data. On the basis of the sigmoid curve shown in Fig. 1, we project a 50% saturation level by about the year 2000.

A detailed inspection of market shipments in the present transition period between second- and third-generation machines indicates that the five-year model change is an important factor in determining the rate at which saturation is approached. Without the present five-year change cycle, the growth to saturation would be very much slower. These model changes not only provide new equipment to stimulate sales in existing market segments, but are also the vehicle by which the manufacturers introduce equipment for new markets.

This analysis, once again, takes into consideration only the U.S., or domestic, market. Over 90% of the world's population lives abroad. Even in the most advanced of these countries, those in Western Europe, the computer market is only about one-third the size of the U.S. market. The potential size of the world market may thus be on the order of 40-50 times larger than it is today. Admittedly, the explosion in the number of computers will not take place overnight, for many countries are just now finding their way into the post-1850 industrial world. Over the next three to five decades, however, the market's potential staggers the imagination.

avenues of growth

Small computer market. It appears at first blush, as we said earlier, that the computer manufacturers should more than ever be dependent on replacement and upgrading for most of the new growth in the market for computers. This view conforms to the manufacturer's traditional belief that it is necessary to promote advanced applications on large machines to produce growth rates in excess of the rate generated by the growth of the economy as a whole. New applications, in their view, should thus more than offset the reduced total revenues resulting from the lower average cost per unit of computation which is typical of the third generation. Since marginal applications which no firm could formerly afford to use are added to those in which the same or similar systems had previously been used, decreases in the cost per unit of computation should do more than any other pricing policy to stretch the market.

In reality, the computer market for any given level of application technology is much larger than industry analysts now believe. The difficulty in their analyses is that they have misread the history of the industry. The first applications which have been computerized have always been the ones which could not be done without a computer. Very complicated computations and massive input and output of data are in this class. By their very nature, these applications have required the use of large-scale computers. Only after the large machines have been installed have the smaller machines appeared. These small machines have *not* become economically successful because of their low cost per unit of computation. On the contrary, their price per unit of computation has necessarily been higher than for the larger ones. The price of the system has, however, been lower. Thus, smaller firms and other institutions such as universities have been able to afford the equipment for the first time.

The classic example of such a machine is the IBM 1401. It is likely that the 1401 alone has done more to expand the market than all the "advanced" applications which have been made barely economic through successive reductions in incremental costs per unit of computation. There is no reason to expect the historical pattern, of which the 1401 is a prominent example, to change in the near future. In order to expand the present and future market, each manufacturer should, therefore, be trying to add lower-priced machines to his line in analogy to the marketing strategies of automobile and appliance manufacturers. They should be developing "small" computers to reach previously untapped segments at the lower end of the computer market.

These "small" computers are those which are sufficiently low-priced to replace large numbers of semi-automated systems, eam or tabulating equipment. Naturally, IBM, as the firm with virtual control of the unit record business, has no desire to make obsolete the $1 billion of such equipment now earning rentals, while capital costs and design-engineering costs have long ago been written off.

some problems

There are some major problems which must be overcome in the next few years before this small systems market can begin to expand at a rate closer to its potential. The most important problem of the small computer market lies in software. The small user would hesitate to replace an existing "tab" shop with a small computer, even at a slightly lower price, or at the same price with additional capacity, unless he were assured that software were available which would eliminate the need for in-house programmers and systems people.

Users, in order to correct the failings of currently available software, will, in short, have to depend more on standardized programs. Most businesses have essentially the same problems, and it should be possible to share such master programs as payroll, market research, and so on. As software problems become worse and the cost of increased computer speed continues to decline, it will be cheaper to run an "inefficient" program in terms of computer running time to compensate for reduced systems personnel requirements.

Not only would a satisfactory set of standard programs save the user the expense of an in-house programming staff, but it would also save the manufacturer the expense of the detailed systems analyses that must now be made for each prospective customer. As a consequence the cost of support services, which now make up an appreciable part of total cost, could be heavily cut.

The pricing of small computers could then be done on the assumption of a mass market, since production could be set up on a scale assuring large economies. If computers are to be manufactured on an assembly-line basis, large improvements in quality control must be made, for a large fraction of present manufacturing costs consists of "debugging" and checkout after the machine is already completed. The use of integrated circuits, by eliminating thousands of individual connections, may be critically important in reducing the costs of checkout.

As soon as these manufacturing problems have been solved, a large market for small computers will develop. The obsolete unit record equipment now being used by a majority of small firms will be the first target. The computer makers should be able to make their offerings palatable to a wide variety of firms by offering dozens of options among which the buyer can choose. Because there are so many potential small user firms, and the elasticity of demand is favorable, penetration of this market should be very profitable.

Large computer market. The industry's long-term effort to expand the large computer market by cutting the price per unit of work has eventually led to the management information system (MIS) and the information utility. An MIS is generally a real-time, communications-based computer system aimed at capturing some or all of the economies of scale of very large machines. At the same time, the system aims to minimize the diseconomies of data processing for geographically decentralized production, transportation, warehousing and selling facilities of a single firm. The information utility supplies data collection, storage, processing, analyzing, computing and display services to many subscribers for a charge based on usage. An information utility may also supply financial services of various kinds.

On the cost side, the characteristics of both the MIS and the information utility are very much alike because their technologies are very similar. On the other hand, there are also some striking economic differences. For the firm providing information utility services, the computer is the means of production, not merely an administrative aid. Small changes in technology can thus have critically important consequences for the total costs, and hence the profitability, of the entire firm. It is, on the other hand, highly unlikely that an MIS will be a critically important proportion of the total cost of a firm primarily engaged in the production of goods or services other than those supplied by an information utility.

Presently, examples of both the MIS and the information utility exist, but are obviously experimental. The investment in these systems has been a larger gamble than the investment in the more familiar batch-processing systems, as adequate cost-benefit information is not yet available. Intangible benefits in the form of better service to data customers have been one basis on which the new systems have been installed. In far too many cases, however, it has been assumed that the extra costs involved will automatically generate equivalent benefits. In essence, the analysts responsible have been saying that the new systems will supply greater value to the customer through increased speed alone.

Increased speed may be an adequate justification in certain types of military applications, because the cost of not having the required information in time may be incredibly high. The best example extant of such an application is the investment in the military early warning networks in the face of a clear danger of impending attack by enemy bombers. But despite the many eager advocates of MIS, a system allowing instant managerial response may be negatively related to profitability in most firms engaged in civilian pursuits. The few obvious exceptions like airline reservations systems and stock quotations systems should, of course, be noted.

diminishing returns

There are several reasons why either the apparent or real payoff of better information may be far less than anticipated. First, the decision-maker may not be able to digest enough data to make meaningful decisions if he is flooded with too much of it. Second, additional data may cause the decision-maker to over-react and to overemphasize the importance of preliminary data on the effects of a policy or program. Even if neither of these factors is important, it is virtually impossible to prove that a communications-based MIS is clearly superior to a batch system, at least for the present. Let's see why.

On the basis of military experience and the experiments of a few business pioneers, the costs of various component parts of the system are well known. The most expensive single element of the system is not the computer, but the communication network, which may cost as much or more than all of the hardware. Because of the communications and multiple-user characteristics of the system, programming, systems analyses, and other software is likely to be far more expensive than comparable work for the batch system which an MIS replaces. And finally, a user station must have not only a full typewriter keyboard but also a TV-like tube large enough to display an entire page of information. Although prices are decreasing, such a fast, flexible terminal is still expensive.

After performing a cost-benefit analysis of the type shown in Fig. 2, most firms will find that there is no net difference between costs and benefits, or that there is an excess of costs. Communications-based MIS will thus remain a luxury which few firms will be able to afford until data transmission and input-output costs have been reduced and the benefits of the system have been more clearly demonstrated. MIS and information utilities, like a number of consumer durables—autos, refrigerators, and color TV—may consequently evolve from luxury to necessity only as mass production and technological improve-

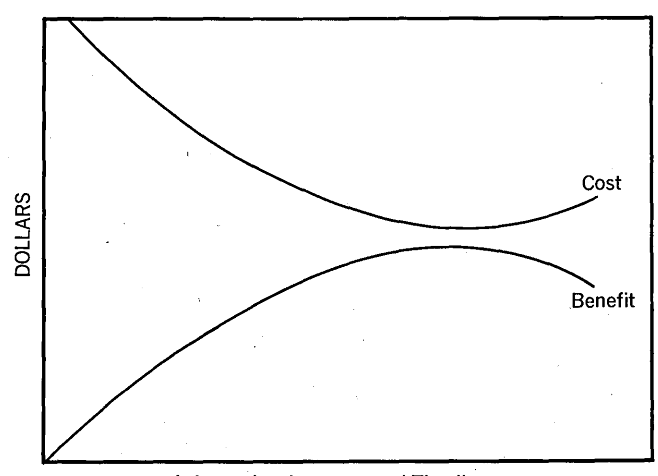

Fig. 2.

ments lower prices to little more than the prices of substitute batch systems.

When prices fall, and most large and many small firms have installed internal MIS, there will be extensive overlapping of communications networks. Such overlapping will become very expensive when, to improve routine operations, such as ordering and billing, customers and suppliers interlink their systems. The lower costs of a single set of communications channels connecting all firms may lead to a monopoly communications-computer utility under public regulation—very much the results that the same logic produced in the telephone industry during the 1870's and 1880's.

It is thus reasonable to believe that neither the MIS nor the information utility will have significant effects on the growth of the computer market in the next five to ten years. Since information utilities will probably develop out of the MIS, it is reasonable to assume that they will lag behind MIS as an important avenue of growth for the computer market. It also follows from this discussion that large and extra-large computers may never again hold the same position of importance in the market which they have held since the very earliest days of commercial computers.

We can now correct a number of popular misconceptions about the computer market by summarizing our results:

1. More than 10 times as much growth remains to be experienced in the years ahead than has been realized in the entire previous history of the industry.
2. Only new classes of equipment which meet the price and other needs of a mass industrial market are now capable of producing large-scale growth in the industry.
3. Management information systems and information utilities will not be important quantitative factors in the growth of the market for a number of years.
4. New concepts of programming and new methods of software design and organization must be developed and introduced if the present software gap is to be bridged.

After stripping away some of the economic mythology encrusting the computer industry, we hope that the true economic identity of the industry will be clearer to analysts both inside and outside the industry. ■

OPERATING SYSTEMS FOR OLRT

in S/360 hardware

by LEON DAVIDSON

This article reflects the views of the author, and not necessarily those of his employer.

In "dedicated" on-line real-time communications-oriented systems such as are used for savings banking, airline or hotel reservations, brokerage, message-store-and-forward, etc., there is typically an *application control* system. This *executive* program stays active all during the business day in a bank, and all around the clock in an airlines system. In the latter case, to allow for equipment maintenance, etc., several separate computers are installed, so that at least one can be free for executing the control program at all times. Even where shutdowns for maintenance can be scheduled, as in a bank, it may be desirable to provide at least two computers to guard against system failure due to computer trouble during business hours.

The brief discussion above is intended to establish, in the reader's mind, the concept that a dedicated[1] on-line real-time (OLRT) system has, as its very heart, an executive or control program which must be kept running steadily during all the time that the system is "on the air." This control program will, of course, call upon various other programs or routines from moment to moment, to handle the particular transactions which come in from the communi-

[1]The word "dedicated" does not mean that background or fill-in work of a non-real-time nature (e.g. "back-office" or business data processing work) could not or would not be run on the same computer, even during on-line hours, if time and facilities permit. It merely means that this on-line application is the main priority task of the system, and must not ever be dropped during its scheduled hours.

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cations network or from local terminals or consoles. Even though, in a literal sense, the control program is not actually "in execution" after it passes control to one of these transaction routines, it is correct to say, as a practical matter, that the control program runs continuously. Any unexpected result or error will transfer control immediately to the control program or certain of its adjuncts, and normal completion of the processing of each transaction (typically requiring a time measured in fractions of a second) also returns control to the control program.

Since the heart of a real-time on-line system is thus embodied in the executive or control program, running steadily for the full duration of the business day, it should occupy as little memory space as possible, and should be coded as efficiently as possible. These features seem to contraindicate the use of the "control program" portion of a multi-purpose operating system, such as OS/360, as the control program of an OLRT system.

The following sections will discuss:

1. The conventional pre-1966 concept of operating systems.
2. The System/360 concept that the operating system replaces basic hardware.
3. Use of operating systems for running the off-line and after-hours work of the OLRT system.
4. Use of the operating system in conjunction with a special OLRT executive or control program.

the conventional concept

The "operating system," as the name implies, started out as a system of programs and procedures which was intended to improve throughput by assisting the *operators* of a computer system. Some of the functions of operating systems which can be seen to fall into this area are the logging of batch jobs on and off machine, notification to the operator of the detailed assignment of scratch tapes for specific output files, clearing of memory between jobs, loading in the library programs or loaders of compilers or job programs and data, etc. Examples of such operating systems are FMS (Fortran Monitor System) and IBJOB.

The normal growth of software led to increasing size and complexity in this type of job monitor system. Other kinds of functions were added. For example, IBSYS took over the function of deciding which compiler was needed from the library tape for a given job. Of course, this had the result that the library tape for a given "operating system" now had to contain the full contents of the library tapes of several (formerly independent) compiler systems. In general, size brings increased overhead, as a rule, and this phenomenon was duly noted by those who used IBSYS.

It can be seen that an on-line real-time system, of the types mentioned earlier, probably has little need of all of the conventional functions of a true operating system, during its on-line hours of operation.

This means that during the business hours of the on-line application (in banks, reservation systems or message-store-and-forward systems), the main on-line computer will not be called upon to run assemblies or compilations or similar jobs.[2] Thus there is no need to load and reload various language processors, compilers, link-editors, or other "jobs" during business hours, on this computer. There is no need for job logging, memory clearing, etc.

The same set of programs resides in the system all during the on-line tour of duty, under control of the executive program of the system. The operators' functions might consist of little more than demounting and mounting transaction log tapes, and changing the communications net configuration. Routines to assist them in such operations could be included in the on-line utility package. Thus there would be no need to keep the full "operating system" continually loaded and operable.

Of course, during system development and debugging sessions, the full conventional operating system could be used in its normal manner, to handle the mixture of assembly, compiling, and test runs. Presumably, an operating system worth its salt to such a project would be able to co-exist compatibly with the real-time executive program during test runs of the on-line system programs.

the system/360 concept

The people responsible for developing the "architecture" of System/360 were well aware of the duality between hardware and software; i.e., that almost anything that hardware logic can do can be done by programming. For economic reasons, perhaps, they chose to delete many necessary functions from the hardware category and assign them to certain software routines. For example, the multiplexor channel function in the smaller models is carried out by programs contained in the memory, as well as by microprogramming in the hardware logic. Likewise, the safe storage of the CSW (channel status word) after each channel interrupt occurs must be done by program steps, since the hardware design forces all eight channels to store their CSW's into the same word (location 64) in core memory.

The System/360 architects could have incorporated all of these and similar "hardware substitutes" into an appropriate independent program package for use with each model of S/360 hardware, to provide a "minimum viable computing system." This need not have had any logical connection with the programs or functions constituting the "operating system" as defined in (1) above, but would merely have been the pseudo-hardware required to let the computer operate as a functioning piece of electronic gear.

The S/360 architects chose instead to embed or incorporate such "pseudo-hardware" routines (without which the S/360 computers absolutely cannot run at all) within the package of software which handles the "operating system" as defined in above. It cannot be denied that this "pseudo-hardware" is necessary if the computer is to *operate* at all, hence there might be semantic justification for including it in the "operating" system. However, the system designer who might like to try to set up an S/360 installation without the "operating system" of above, will not find it possible to extract the necessary "pseudo-hardware" package from the operating system delivered for S/360. The "architects" have intertwined them all into an indivisible mass.

To make matters more difficult for those who might seek to weed out unwanted bulk from the "operating system" as delivered, the S/360 architects and programming managers decided to incorporate many additional features into their "operating system" which had not heretofore been considered to be contained in operating systems. Although these features are, in general, individually useful and desirable in many computer installations, the architects designed the system so that these features could not readily be deleted by a space-conscious user, even if they were not wanted. For example, the operating system itself makes use of many subroutines and techniques which were originally intended as additions for the user's benefit. Hence, it is impossible to delete such features, for the operating system will not run without them, and the computer will not run without the pseudo-hardware which is embedded in the operating system.

[2]A standby computer, if one is provided at the installation, might be assigned these jobs, and indeed that computer would probably use the conventional type of operating system, rather than the OLRT control program.

One example of this "pretzel-bender" style of system design is the fact that a user's program cannot be run under OS/360 unless it is actually "incorporated in the Operating System." Likewise, the operating system's own programs are held in a library on a disc pack, catalogued by use of the data management functions, so that the data management portion of the operating system must be retained if the computer is to be able to be run at all.

running the off-line work

It may be deduced from the above that it will be next-to-impossible to dispense entirely with OS/360 if using an S/360 computer installation. However, it may prove possible to extract from OS/360 the bare minimum of coding required to handle the "pseudo-hardware" routines and IOCS types of functions (e.g., by using the EXCP or XDAP macros for developing data access methods). Using this minimum as a base, a real-time on-line executive program might possibly be written, to do an efficient job of running the actual on-line system.

Given the situation just described, it might still be useful and desirable to make use of the full-fledged OS/360 for the non-real-time operations of the installation. This refers to the assembly and debugging of the real-time programs, the supervision of batch jobs for the after-hours production functions of the real-time system, etc. This plan might run into roadblocks, however, for it is quite conceivable that the OS/360 software would struggle against compiling the real-time executive routines, if they were not designed to be usable as part of the OS/360 package.

a special olrt executive or control program

After all is said and done, the path of least resistance may turn out to be to generate a stripped-down version of OS/360 (through regular SYSGEN procedures) which can reside in the system during the scheduled on-line real time application period, supplemented by a specially-written real-time *application executive* program to do the actual running of the on-line application. The built-in services of OS/360 would provide the I/O monitoring and supervisory features and data management services needed for the real-time activities, as called upon by the application executive program.

Although this is the path of least resistance, it may not be the least-cost path if the real-time system is going to be very heavily used for a good number of years. There will be a price to pay in the large amount of core and disc space which tends to be occupied by OS/360. Some performance will be lost due to having an extra layer of overhead, as well as due to the built-in inefficiencies of some OS/360 techniques, such as queue handling. (Assigning the full 64-byte "SAVE" area at once for each item placed in the timer queue, instead of waiting until the item comes up to the head of the queue, for example.)

These extra costs of space and time, however, may be outweighed by the savings in the programming grief and misery which would have been incurred if one attempted to untangle and dissect OS/360 as outlined earlier. Thus most real-time installations using S/360 may find it expedient to live with OS/360 as indicated. Another compensation which this course of action provides is that there is no question about the compatibility of the application programs and application executive with respect to being assembled, catalogued, maintained, and fully supported by OS/360, using any of the available programming languages.

Before firmly adopting this course, however, one should ascertain that inability to use the privileged instructions directly will not harass the real-time executive program design. One should also be sure that one can pay the price of waiting for delivery of a stable "Option 4" (and also making room for it when it arrives.) Option 4 (sometimes called "multiprogramming with a variable number of tasks") would seem to be a most important ingredient of OS/360 for use as a support of OLRT executive programs, if for nothing more than the ability to enforce limits on the running time of a job step. The roll-in, roll-out capability which it provides will also presumably be needed on occasion to handle conflicts for core space arising in some OLRT systems between tasks of different priorities.

One point which may be worth examining in some large or important systems, such as air traffic control, is the ability of OS/360 to *support* the OLRT executive program system when it resides in several CPU's, which are either sharing the same basic load, or else handling functionally separate parts of the job.

By "support," I mean the ability of OS/360 to assemble and load and link and catalog the various versions of the OLRT executive program which may be slightly tailored to meet the needs of the individual CPU's in the multiprocessor environment, but which are basically the OLRT executive program, with the same subroutine names, the same source program structure, etc. In this connection, note that the 9020 Air Traffic Control system developed for FAA by IBM, which runs in several CPU's which are essentially S/360 models, does *not* use OS/360 for the on-line multiprocessor real-time control program. However, the individual CPU's can run individually under OS/360 for some off-line activities. (See *IBM Systems Journal*, Vol. 6,No. 2, Summer 1967.)

Finally, in an attempt to improve performance of S/360 systems, one should not overlook the hardware improvements suggested by the competitive but compatible hardware systems. For example, a sharp reduction could be expected in the cumulative time for saving and restoring the general registers (arising from the countless subroutine transfers within OS/360 itself, as well as in application programs) when multiple sets of general registers are provided in the hardware, as they are in several competitive compatible systems.

conclusions and suggestions

"Operating System/360" has been constructed on such an integrated and ingrown basis that it is difficult to dissect out of it just those portions which one might like. Certain vital pieces of "pseudo-hardware" are embedded in it, without which the S/360 computers cannot even run. Therefore, if the S/360 is to be used for a real-time system installation, OS/360 will probably be adopted also, by most projects.

An alternative course of action, abandoning OS/360 completely and writing the "pseudo-hardware" routines from scratch, would be very difficult for most programming groups, without detailed access to the hardware people and specifications at the manufacturing plants. However, at least the groups within IBM which wrote CCAP and PARS have accomplished this task, so it's not really impossible, only expensive. Furthermore, support by OS/360 services is then lost.

It remains ideally possible, however, to design a real-time executive program, to be run in S/360, by extracting from OS/360 the necessary "pseudo-hardware" to do this. Such a program could retain compatibility with OS/360 services and facilities. This approach should be evaluated by each project faced with the necessity of implementing a real-time on-line system in S/360 hardware, when performance requirements are severe.

The path of least resistance may be to stop worrying about size and costs, and learn to live with OS/360, at least until an improved generation of computers comes along. This course is heartily recommended for all those who don't have to worry about size and costs. ■

WHAT IS AN ALGORITHM?

by DONALD E. KNUTH

This is a portion of the first chapter of Fundamental Algorithms, Volume 1 of a seven-volume series titled *The Art of Computer Programming,* to be published by Addison-Wesley. The author's intent is to explain and illustrate in the series most of what is known about basic computer programming techniques exclusive of numerical analysis. Several thousand exercises (with answers) will be included. The project was begun in 1962 and the first volume will appear at the end of this year. The others will be published at intervals of about six months.

The notion of an *algorithm* is basic to all of computer programming, so it is a good idea to analyze this concept carefully.

The word "algorithm" itself is quite interesting; at first glance it may look as though someone intended to write "logarithm" but jumbled up the first four letters. The word did not appear in *Webster's New World Dictionary* as late as 1957; we find only the older form "algorism" with its ancient meaning, i.e., the process of doing arithmetic using Arabic numerals. In the middle ages, abacists computed on the abacus and algorists computed by algorism. Following the middle ages, the origin of this word was in doubt, and early linguists attempted to guess at its derivation by making combinations like *algiros* [painful] + *arithmos* [number]; others said no, the word comes from "King Algor of Castile." Finally, historians of mathematics found the true origin of the word algorism: it comes from the name of a famous Arabic textbook author, Abu Ja'far Mohammed ibn Mûsâ al-Khowârizmî (*c.* 825)—literally, "Father of Ja'far, Mohammed, son of Moses, native of Khowârizm." Khowârizm is today the small Soviet city of Khiva. Al-Khowârizmî wrote the celebrated book *Kitab al jabr w'al-muqabala* ("Rules of restoration and reduction"); another word, "algebra," stems from the title of his book, although the book wasn't really very algebraic.

Gradually the form and meaning of "algorism" became corrupted; as explained by the Oxford English Dictionary, the word was "erroneously refashioned" by "learned confusion" with the word *arithmetic*. The change from "algorism" to "algorithm" is not hard to understand in view of the fact that people had forgotten the original derivation of the word. An early German mathematical dictionary, *Vollständiges Mathematisches Lexicon* (Leipzig, 1747), gives the following definition for the word *Algorithmus*: "Under this designation are combined the notions of the four types of arithmetic calculations, namely addition, multiplication, subtraction, and division." The Latin phrase *algorithmus infinitesimalis* was at that time used to denote "ways of calculation with infinitely small quantities, as invented by Leibnitz."

euclid's algorithm

By 1950, the word algorithm was most frequently associated with "Euclid's algorithm," a process for finding the greatest common divisor of two numbers, which appears in Euclid's *Elements* (book vii, prop. i. and elsewhere). It will be instructive to exhibit Euclid's algorithm here:

Algorithm E (*Euclid's algorithm*). Given two positive integers m and n, find their greatest common divisor, i.e., the largest positive integer which evenly divides both m and n.

E1. [Find remainder.] Divide m by n and let r be the remainder. (We will have $0 \leq r < n$.)

E2. [Is it zero?] If $r = 0$, the algorithm terminates; n is the answer.

E3. [Interchange.] Set $m \leftarrow n$, $n \leftarrow r$, and go back to step E1. ∎

Of course, Euclid did not present his algorithm in just this manner. The above format illustrates a semi-formal style for presenting algorithms, which has several practical advantages.

Each step of an algorithm having this form (e.g., step E1 above) begins with a phrase in brackets which sums up as briefly as possible the principal content of that step. This phrase also usually appears in an accompanying *flow*

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chart (e.g., Fig. 1), so the reader will be able to picture the algorithm more readily.

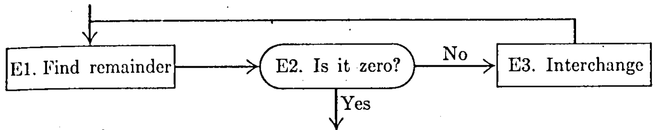

Fig. 1. Flow chart for Algorithm E.

After the summarizing phrase comes a description in words and symbols of some *action* to be performed or some decision to be made. There are also occasionally *parenthesized comments* (e.g., the second sentence in step E1) which are included as explanatory information about that step, often indicating certain characteristics of the variables or the current goals at that step, etc.; the parenthesized remarks do not specify actions which belong to the algorithm, but are for the reader's benefit as possible aids to comprehension.

The "$\leftarrow$" arrow in step E3 is the all-important *replacement* operation (sometimes called *assignment* or *substitution*); "$m \leftarrow n$" means the value of variable m is to be replaced by the current value of variable n. When algorithm E begins, the values of m and n are the originally given numbers; but when it ends, these variables will have, in general, different values. An arrow is used to distinguish the replacement operation from the equality relation: We will not say, "Set $m = n$," but we will perhaps ask, "Does $m = n$?" The "=" sign denotes a condition which can be tested, the "$\leftarrow$" sign denotes an action which can be performed. The operation of *increasing n by one* is denoted by "$n \leftarrow n + 1$" (read "n is replaced by $n + 1$"); in general, "variable $\leftarrow$ formula" means the formula is to be computed using the present values of any variables appearing within it, and the result replaces the previous value of the variable at the left of the arrow. Persons untrained in computer work sometimes have a tendency to denote the operation of increasing n by one by "$n \rightarrow n + 1$," saying "n becomes $n + 1$"; this can only lead to confusion because of its conflict with the standard conventions, and it should be avoided.

Note that the order of the actions in step E3 is important; "set $m \leftarrow n$, $n \leftarrow r$" is quite different from "set $n \leftarrow r$, $m \leftarrow n$," since the latter would imply that the previous value of n is lost before it can be used to set m. Thus the latter operation is equivalent to "set $n \leftarrow r$, $m \leftarrow r$." When several variables are all to be set equal to the same quantity, we use multiple arrows; thus "$n \leftarrow r$, $m \leftarrow r$" may be written as "$n \leftarrow m \leftarrow r$." To interchange the values of two variables, we can write "Exchange $m \leftrightarrow n$"; this action may also be specified by using a new variable t and writing "set $t \leftarrow m$, $m \leftarrow n$, $n \leftarrow t$."

An algorithm starts at the lowest-numbered step, usually step 1, and steps are executed in sequential order, unless otherwise specified. In step E3, the imperative "go back to step E1" specifies the computational order in an obvious fashion. In step E2, the action is prefaced by the condition "if $r = 0$"; so if $r \neq 0$, the rest of that sentence does not apply and no action is specified. We might have added the redundant sentence, "If $r \neq 0$, go on to step E3."

The heavy vertical line, "**|**", appearing at the end of step E3 is used to indicate the end of an algorithm and the resumption of text.

learning by doing

So much for the *form* of algorithms; now let us *perform* one. It should be mentioned immediately that the reader should *not* expect to read an algorithm like he reads a novel; such an attempt would make it pretty difficult to understand what is going on. An algorithm must be seen to be believed, and the best way to learn what an algorithm is all about is to try it. The reader should always take pencil and paper and work through an example of each algorithm immediately upon encountering it in the text. Usually the outline of a worked example will be given, or else the reader can easily conjure up one. This is a simple and painless method for obtaining an understanding of a given algorithm, and all other approaches are generally unsuccessful.

Let us therefore work out an example of algorithm E. Suppose that we are given $m = 119$ and $n = 544$; we are ready to begin, at step E1. (The reader should now follow the algorithm as we give a play-by-play account.) Dividing m by n in this case is quite simple, almost too simple, since the quotient is zero and the remainder is 119. Thus, $r \leftarrow 119$. We proceed to step E2, and since $r \neq 0$ no action occurs. In step E3 we set $m \leftarrow 544$, $n \leftarrow 119$. It is clear that if $m < n$ originally, the quotient in step E1 will always be zero and the algorithm will always proceed to interchange m and n in this rather cumbersome fashion. We could add a new step:

"E0. [Ensure $m \geq n$.] If $m < n$, exchange $m \leftrightarrow n$,"

if desired, without making an essential change in the algorithm except to increase its length as well as to decrease the time required to perform it in about one half of the cases.

Back at step E1, we find that $\frac{544}{119} = 4\frac{68}{119}$, so $r \leftarrow 68$. Again E2 is inapplicable, and at E3 we set $m \leftarrow 119$, $n \leftarrow 68$. The next round sets $r \leftarrow 51$, and ultimately $m \leftarrow 68$, $n \leftarrow 51$. Next $r \leftarrow 17$, and $m \leftarrow 51$, $n \leftarrow 17$. Finally, when 51 is divided by 17, $r \leftarrow 0$, so at step E2 the algorithm terminates. The greatest common divisor of 119 and 544 is 17.

So this is an algorithm. The modern meaning for algorithm is quite similar to that of *recipe, process, method, technique, procedure, routine,* except that the word "algorithm" connotes something just a little different. Besides merely being a finite set of rules which gives a sequence of operations for solving a specific type of problem, an algorithm has five important features:

1. *Finiteness.* An algorithm must always terminate after a finite number of steps. Algorithm E satisfies this condition, because after step E1 the value of r is *less* than n, so if $r \neq 0$, the value of n *decreases* the next time that step E1 is encountered. A decreasing sequence of positive integers must eventually terminate, so step E1 is executed only a finite number of times for any given original value of n. Note, however, that the number of steps can become arbitrarily large; certain huge choices of m and n will cause step E1 to be executed over a million times.

(A procedure which has all of the characteristics of an algorithm except that it possibly lacks finiteness may be called a "computational method." Besides his algorithm for the greatest common divisor of two integers, Euclid also gave a geometrical construction that is essentially equivalent to Algorithm E, except it is a procedure for obtaining the "greatest common measure" of the lengths of two line segments; this is a computational method that does not terminate if the given lengths are "incommensurate.")

2. *Definiteness.* Each step of an algorithm must be precisely defined; the actions to be carried out must be rigorously and unambiguously specified for each case. Algorithms stated in a semiformal manner, as in our example above, will hopefully meet this criterion, but since they are specified in the English language, there is a possibility the reader might not understand exactly what the author intended. To get around this difficulty, formally

defined *programming languages* or *computer languages* are designed for specifying algorithms, in which every statement has a very definite meaning. An expression of a computational method in a computer language is called a *program.*

In Algorithm E, the criterion of definiteness as applied to step E1 means that the reader is supposed to understand exactly what it means to divide m by n and what the remainder is. In actual fact, there is no universal agreement on what this means if m and n are not positive integers; what is the remainder of -8 divided by $-\pi$? What is the remainder of 59/13 divided by zero? Therefore the criterion of definiteness means we must make sure the values of m and n are always positive integers whenever step E1 is to be executed. This is initially true, by hypothesis, and after step E1 r is a nonnegative integer which must be nonzero if we get to step E3; so m and n are indeed positive integers as required.

3. *Input.* An algorithm has zero or more inputs, i.e., quantities which are given to it initially before the algorithm begins. These inputs are taken from specified sets of objects. In Algorithm E, for example, there are two inputs, namely m and n, which are both taken from the set of *positive integers.*

4. *Output.* An algorithm has one or more outputs, i.e., quantities which have a specified relation to the inputs. Algorithm E has one output, namely n in step E2, which is the greatest common divisor of the two inputs.

(We can easily *prove* that this number is indeed the greatest common divisor, as follows. After step E1, we have:

$$m = qn + r,$$

for some integer q. If $r = 0$, then m is a multiple of n, and clearly in such a case n is the greatest common divisor of m and n. If $r \neq 0$, note that any number which divides both m and n must divide $m - qn = r$, and any number which divides both n and r must divide $qn + r = m$; so the set of divisors of m, n is the same as the set of divisors of n, r and, in particular, the *greatest* common divisor of m, n is the same as the greatest common divisor of n, r. Therefore step E3 does not change the answer to the original problem.)

5. *Effectiveness.* An algorithm is also generally expected to be *effective.* This means that all of the operations to be performed in the algorithm must be sufficiently basic that they can in principle be done exactly and in a finite length of time by a man using pencil and paper. Algorithm E uses only the operations of dividing one positive integer by another, testing if an integer is zero, and setting the value of one variable equal to the value of another. These operations are effective, because integers can be represented on paper in a finite manner and there is at least one method (the "division algorithm") for dividing one by another. But the same operations would *not* be effective if the values involved were arbitrary real numbers specified by an infinite decimal expansion, nor if the values were the lengths of physical line segments, which cannot be specified exactly. Another example of a noneffective step is, "If 2 is the largest integer n for which there is a solution to the equation $x^n + y^n = z^n$ in positive integers x, y, and z, then go to step E4." Such a statement would not be an effective operation until someone succeeds in showing that there is an algorithm to determine whether 2 is or is not the largest integer with the stated property.

Let us try to compare the concept of an algorithm with that of a cookbook recipe: A recipe presumably has the qualities of finiteness (although it is said that a watched pot never boils), input (eggs, flour, etc.) and output (TV dinner, etc.) but notoriously lacks definiteness. There are frequent cases in which the definiteness is missing, e.g., "Add a dash of salt." A "dash" is defined as "less than ⅛ teaspoon"; salt is perhaps well enough defined; but where should the salt be added (on top, side, etc.)? Instructions like "toss lightly until mixture is crumbly," "warm cognac in small saucepan," etc., are quite adequate as explanations to a trained cook, perhaps, but an algorithm must be specified to such a degree that even a computer can follow the directions. Still, a computer programmer can learn much by studying a good recipe book.

We should remark that the "finiteness" restriction is really not strong enough for practical use; a useful algorithm should require not only a finite number of steps, but a *very* finite number, a reasonable number. For example, there is an algorithm which determines whether or not the game of chess is a forced victory for the White pieces; here is an algorithm which can solve a problem of intense interest to thousands of people, yet it is a safe bet that we will never in our lifetimes know the answer to this problem, because the algorithm requires fantastically large amounts of time for its execution, even though it is "finite."

In practice we not only want algorithms, we want *good* algorithms in some loosely-defined aesthetic sense. One criterion of goodness is the length of time taken to perform the algorithm; this can be expressed in terms of the number of times each step is executed. Other criteria are the adaptability of the algorithm to computers, its simplicity and elegance, etc.

Occasionally, we will have several algorithms for the same problem, and we must decide which is best. This leads us to the extremely interesting and all-important field of *algorithmic analysis:* given an algorithm, the problem is to determine its performance characteristics.

algorithmic analysis

For example, we can consider Euclid's algorithm from this point of view. Suppose we ask the question, "Assuming that the value of n is known but m is allowed to range over all positive integers, what is the *average* number of times, T_n, that step E1 of Algorithm E will be performed?" In the first place, we have to check that this question does have a meaningful answer (since we are trying to take an average over infinitely many choices for m). But it is evident that after the first execution of step E1 only the remainder of m after division by n is relevant. So all we must do to find the average, T_n, is to try the algorithm for $m = 1$, $m = 2$, . . ., $m = n$, count the total number of times step E1 has been executed, and divide by n.

Now the important question is to determine the *nature* if T_n; is it approximately equal to $\frac{1}{3}n$, or $\sqrt{n}$, etc.? (As a matter of fact, the answer to this question is an extremely difficult and fascinating mathematical problem, not yet resolved. For large values of n there is very good empirical evidence that T_n is approximately $(12 \ln 2/\pi^2) \ln n$, that is, proportional to the *natural logarithm* of n, with a constant of proportionality that might not have been guessed offhand!)

"*Analysis of algorithms*" is the name the author likes to use to describe investigations such as this. The general idea is to take a particular algorithm and to determine its average behavior; occasionally we also study whether or not an algorithm is "optimal" in some sense. The *theory of algorithms* is another subject entirely, dealing primarily with the existence or nonexistence of effective algorithms to compute particular quantities. ■

PERGO: A PROJECT MANAGEMENT TOOL

simplified

by LARRY L. CONSTANTINE and JAMES F. DONNELLY

Computer-oriented project management tools are not new; a profusion of them have been in use for some years. The systems currently in use, like CPM, PEP, PEPCO, RAMPS, and PERT and its many variants, are all based on essentially the same model of "the project." This model is based on the idea of a set of partially ordered sub-projects. Through the network for the ordering, we can determine the longest time dimension path (or paths). This path corresponds to the longest cumulative completion time for completely ordered paths and is called the critical path. The time value for this path is the time for completion of the entire project. The objections of PERT purists notwithstanding, we shall refer to all such systems, regardless of derivation or refinements, as critical path method (CPM) systems.

Any project management tool, including the PERGO system, will have shortcomings. It is not our intention to elaborate on specific problems in CPM systems or their use. However, a consideration of certain broad limitations is necessary to an understanding of PERGO and its departure from CPM.

The limitations in CPM are, for the most part, consequences of the basic model itself. There is no point in debating its validity. Model validity is a question of usefulness, and CPM has proven useful in many applications. The fact is that there are many situations for which CPM was not intended, for which it is not a model, that yet need this kind of tool. The value of CPM is generally only fully realized in very large, highly sequenced jobs, especially where the ultimate objective is the planning, design, and fabrication of a complicated system. There are, however, many companies which work under service contracts or numerous small, semi-related contracts, are operated as job shops, or are otherwise confronted with inherently less ordered projects where the strength of CPM cannot be brought to bear.

Under these circumstances, many of the job interrelationships are very loose as to ordering, and the critical path is trivial. The simple additive completion time of CPM is of little value.

The technical managers of such companies have unique problems to face. A manager in one of these companies may find himself in charge of two or three small contracts involving R&D studies, hardware, and services. This man could be responsible for a number of jobs, from ten to a hundred, each requiring a different viewpoint, some interrelated, others totally separate and distinct. CPM is of little help to this manager, yet, as an entity or type, he is probably in the majority.

Now the preparation of a PERT network, for example, is an involved and exacting task. Early claims to the contrary, the analysis required to establish a good model generally requires an expert. But our technical manager for smaller projects is often in a smaller company that cannot afford to give each contract a cost specialist or even share a cost specialist over three or four contracts. Yet it is essential to provide the technical manager in this situation with an accurate, meaningful, and easy-to-analyze management tool: a tool which frees him as much as possible from involved modeling and analysis to do the technical job he was hired to do and can contribute most to.

PERGO (Project Evaluation and Review with Graphic Output) is a new computer-oriented project management tool intended to fill the gap and be of value to the type of manager just described. It is based on a model developed at Edgerton, Germeshausen & Grier, Inc., and refined and implemented by C-E-I-R, Inc. It is designed to aid in answering the standard questions of: Are we going to stay within budget? What job is holding us up? Can we pull resources from somewhere to improve the total project picture? The indications PERGO gives are in the form of graphs of estimated and actual expenditures, estimated and actual technical progress. The actual data, compared with the initial estimates, yields a continuously revised graphical projection of future progress, including both a new estimated completion data and estimated completion cost. PERGO uses data for jobs, the basic building-block of the system, to develop graphs for subtasks, sub-projects, projects and other summaries defined by the user.

technique

PERGO recasts an old approach to cost analysis into a modern computerized tool. It is, in fact, not strictly comparable with PERT and CPM, though that is the comparison which undoubtedly will be made. PERGO uses a different set of assumptions to produce a different set of outputs for a different kind of situation.

In brief, PERGO uses an easy to prepare, hierarchical summarization model (HSM) to develop graphical presentations of technical progress and expenditures. A sim-

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ple model, combined with user-oriented input, graphical output, and an efficient internal list processing technique, results in an inexpensive system especially adapted to the needs of many smaller organizations.

The hierarchical summarization model, which will be clarified by example, is based on these assumptions:

1. The project manager knows something about the starting times of jobs in the project but does not necessarily know the exact detailed nature of the technological ordering.
2. He can specify which jobs are part of which tasks, are part of which sub-projects, etc., in a hierarchical arrangement.
3. He can prepare estimates of the technical progress to be made on the basic jobs and the corresponding expenditures.
4. A job's contribution to the total technical progress is proportional to the fraction of total cost represented by the job.

Graphically, this model is shown in Fig. 1. Project constituents are assumed to overlap in ways dependent

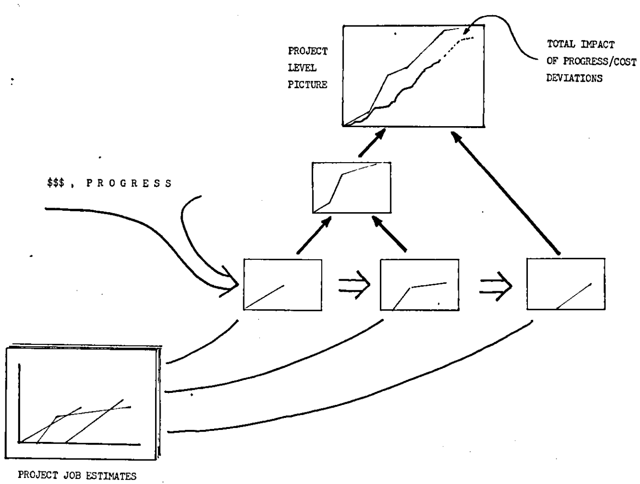
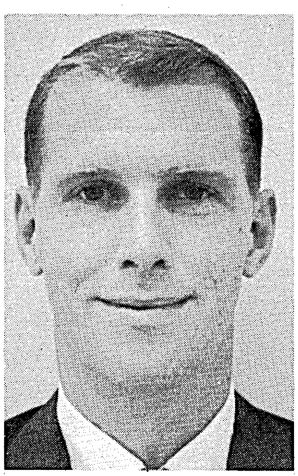


Fig. 1. The hierarchical summarization model.

on proposed starting dates, perhaps even derived from CPM-type analysis. The total picture, however, is the result of summarization through the summary structure. Projected over-all deviations from planned performance are then a function of the impact upward of performance deviations at low levels. This is in contrast to CPM models



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where over-all projections are a function of the horizontal (time-wise) effect through the technological ordering.

The PERGO technique is probably easiest to understand from a graphical example which represents what the manager might have to do himself to develop the same outputs as PERGO.

Let us assume that we are interested in one job, a basic unit which does not have any further breakdown for purposes of processing. For initialization, we develop the graph in Fig. 2. This represents cost over time based on our estimates of how expenditures will run. The shape of this key estimate data is probably determined by a number of factors.

First, some factor dictated that we start the job on week 2, and we knew for one reason or another that it would take about 18 weeks to complete it. Note that between weeks 2 and 8 we projected cost at one spending rate, between weeks 8 and 15 a different rate, and between 15 and 25 still another. This was done because at weeks 8 and 15, we were aware of some factor which would cause our spending rate to change. Factors that could cause this might be:

1. On week 2 we will begin.
2. Weeks 2 through 8 we will be staffing up and procuring materials.
3. By week 8 most of the materials will be in and assembly will begin; by week 15 all material should be in and the system well on its way in assembly.
4. Weeks 15-25 will wrap up assembly and final test, and we will ship at the end of week 25.

There are some additional, highly important facts available to us. The dollar estimates were derived by relating them to some specific events, milestones, or technological accomplishments. The important point is that they are often already there, readily defined, waiting to be used. We will hereafter refer to weeks 2, 8, 15 and 25 as breakpoints. These breakpoints can be assigned a percentage of completion or technical progress.

Fig. 2 includes a bar graph across the top running from 0% technical progress at week 2 to 100% at week 25. In addition, we assume that week 8 represents about

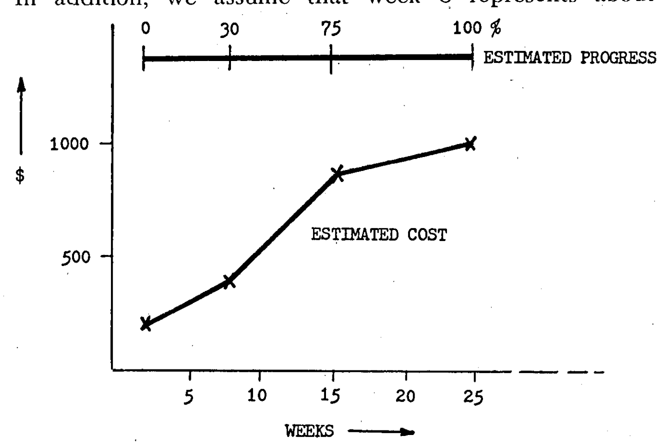


Fig. 2. Estimated cost and progress.

30% of the technical progress and week 15 represents 75% completion. The scale from 0-100% does not have to be linear; in fact, one should get suspicious if it is, because technical progress is not something which normally proceeds at a perfectly steady pace.

This type of preliminary estimate data is often a part of good project planning. Much depends on the reasonableness and accuracy of the estimates; however, by having them prepared at the lowest level, by personnel closest to the actual job, we are more assured. This data, in tabular form, is one of two basic model inputs to PERGO.

As the project actually gets underway, additional inputs are available. At successive points in time, we know how much we have actually spent. It is a simple fact of project management that the actual expenditures will deviate from our plans. Let us say that in week 5, we have spent $500; this is point *Q* in Fig. 3. Clearly, we are overrun by Δ *C* and in trouble. But what of technical progress? We are 25% complete. In other words, we are overspending but ahead of schedule by Δ *T*.

To achieve 25% technical progress, we expected to have spent *R* dollars. This enables us to project from our current point the dotted line in Fig. 4. Thus a more reasonable picture shows we are Δ *T* (about two weeks) ahead of schedule and only Δ *C′* over-run.

This last graph, Fig. 4, is in the actual form that PERGO presents output.

The second initial model input is the summary structure. The simple graphical output for jobs as described above is of somewhat limited use and would hardly in itself justify a computerized system. However, PERGO accepts a description of how jobs are interrelated to make up larger tasks, projects, and total programs. Fig. 5 is a

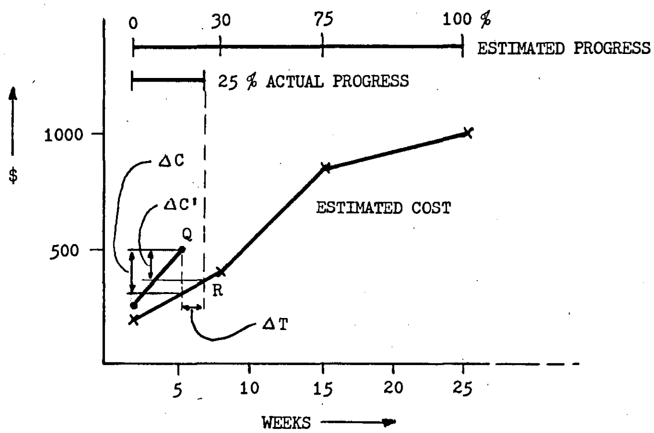


Fig. 3. Actual progress and expenditures integrated with estimates.

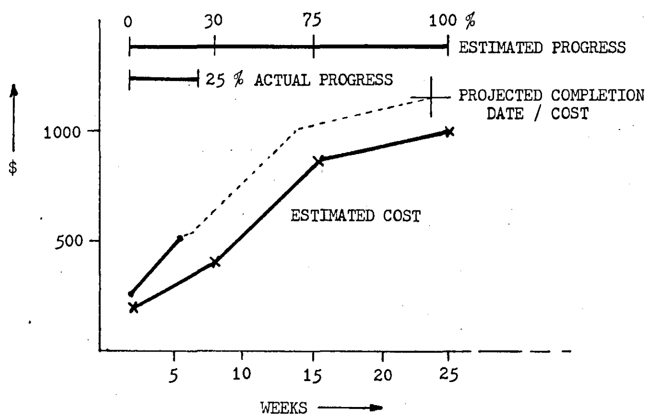


Fig. 4. Complete projection.

representation of such a structure. Equivalent output for these summaries is prepared by:

1. Simple addition of estimated cost and actual cost data from lower level constituents. This yields an over-all estimated expenditure that reflects all the many constituent breakpoints as well as a total cost curve.
2. Weighted additions of estimated and actual technical progress from lower level constituents. The progress for a given constituent is weighted by the fraction of total completion cost which the constituent represents.

Note that summary estimates and projections will contain a breakpoint for every breakpoint in every lower level job or summary; thus, the project level data may be very complex.

the processor

PERGO I, the initial implementation of the PERGO system, consists of a FORTRAN II program for the IBM 7090. Magnetic tape output may be created for off-line control of three graphical devices. Off-line plotting may be done at high speed in the General Dynamics SC-4020, a cathode-ray tube photographic plotter. The SC-4020 produces both 35 mm microfilm and hard-copy output at about one graph per second. Plotting can also be done on the Benson-Lehner Draftomatic, an incremental ink type of mechanical plotter. The Draftomatic takes about

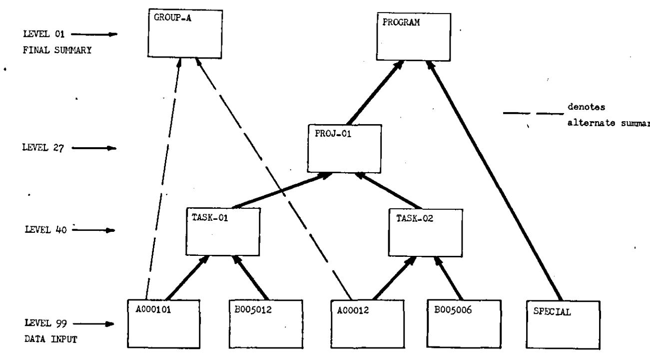


Fig. 5. A summary structure.

five minutes per graph, but is better suited to small volume production of larger format, drafting quality graphs. Finally, the IBM 1403 printer may be used to stimulate a plotter at high speed where resolution and appearance is less important.

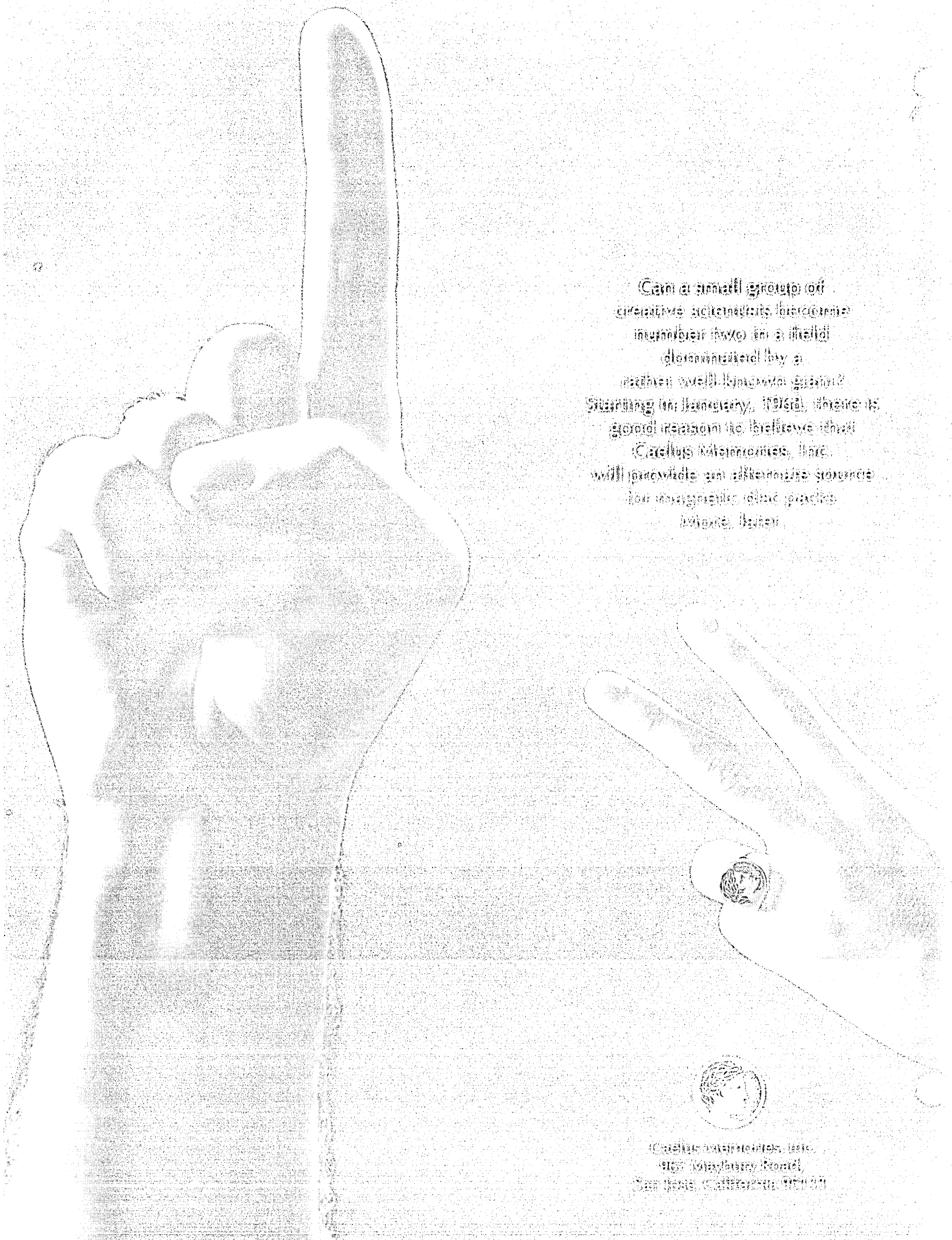
input

All processor actions are controlled by the input, thus affording maximum flexibility. A master control card is used to tell the system:

1. The source of the input. Card, tape, or cards and tape to be merged may be specified. Thus, some or all of the inputs may be the automatic tape by-product of another system, as, for example, an accounting program.
2. The date. The week number and calendar date are specified each week. At any time, a specified date may be assigned as week 1, thus discarding earlier data and keeping the files from becoming cluttered.
3. The outputs desired. At any time a complete listing of the master file may be obtained. In addition, plots (graphical output) may be requested in the format for the B-L Draftomatic, the General Dynamics SC-4020, or the IBM 1403 printer.

The summarization structure may also be changed at any time. By adding, deleting, or changing the links in this structure, the output can be made to reflect the changing nature of the projects, errors can be corrected, or special summaries may be created. Other transactions specify additions, deletions or changes to the tables of estimated data and to the actual input from earlier weeks. The current week's technical progress and cost are used to update the master file and create the new projections. For convenience, all inputs may be in either incremental or cumulative form.

Finally, the user may request plotted output, in the format specified by the master control card, for any jobs or summaries. The input may be split in any way between the SYSIN1 tape, which comes from the card-to-tape operations, and a second tape; the data will automatically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there is
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will provide an alternate source
for magnetic disc packs.
More, later.
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San Jose, California

be merged.

PERGO accepts an almost arbitrarily complex summary structure. Unlike many systems which use CPM or HSM models, PERGO places no direct limits on the number of jobs summarizing to a task or other summary point, on the number of alternate summarization links from one particular point, or on any other feature of the shape of the summary structure. Only the total amount of structure information is limited, and that is core bound. Presently, up to 500 jobs or summary points and up to 750 job-summary or summary-summary links may be accommodated on a single master file. Moreover, no restrictions are placed on the ordering of job/summary names relative to the structure. Thus, high numbered jobs may summarize to low numbered tasks, and the user's current accounting or project control names and numbers may be used directly. In addition, there is no requirement that the structure be connected. It is possible to have isolated jobs and to place on one master file the data and structure of many different projects from different departments or even different companies. Thus, many users may process in a single weekly run on one file. The ability to have multiple alternate links makes possible summarization, not only by project structure, but by contract, sub-contract, department, supervisor, contract type, or any other meaningful characteristic.

This flexibility and the very low cost of implementation were achieved by highly modular programming, the use of list processing techniques and a unique preliminary design technique using a list processing language.

The summary structure is treated as independent of the data. The internal representation of this structure is a collection of paired address pointers. In processing, the external form of the structure is inputed, internal equivalents are assigned to each external name, and a coded list structure is built of all links. Fig. 6 illustrates

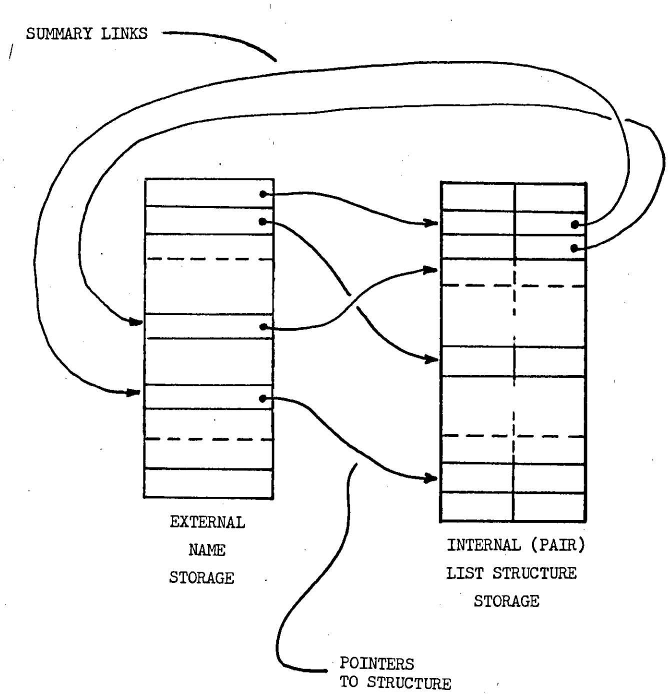

Fig. 6. Pergo storage organization.

the memory organization used which corresponds closely to that of some symbolic processing languages.

When the updated structure has been established in memory, all summaries are created by propagating the various data transactions through the structure. This process of taking inputs at the lowest level and passing the effect through some hierarchical summary is known as impacting. The data at any level is the result of the combined impact of all lower levels.

Clearly, the job level data must be processed against all points in the chain of links that start from each job. However, alternate summaries at some point result in more than one chain; that is, the over-all propagation from one point is a branching tree structure. The ingredients are well suited to list processing techniques: a set of names is used to represent data stored elsewhere (symbolic representation) and the names are connected into complex chains (list structure).

The LISP processing language was used as a powerful and succinct design tool. The program in Fig. 7 is the

```
TRANS ≡ λ((NAME; XACTION);                       /Trans: Function of Name & Xaction.
     PROG((TO; LINKS);                            /Program with two temporary variables.
       TO:= NAME;                                 /Destination is name.
XACT,  WRITE(LIST(TO; XACTION));                  /Write a transaction.
       LINKS:= STRUCTURE(TO);                     /Get list of links.
RECUR, (NULL(LINKS)→RETURN;                       /Links empty means top of chain.
         NULL(REST(LINKS))→GO(LOOP));             /One link means follow chain.
       TRANS(FIRST(LINKS); XACTION);              /Many links, do entire first chain.
       LINKS:= REST(LINKS);                       /Get next chain from here.
       GO(RECUR);                                 /And try again.
LOOP,  TO:= FIRST(LINKS);                         /Destination is link.
       GO(XACT)                                   /Go write.
     ))
```

Fig. 7. LISP function for transacting through multiple chains.

actual processing algorithm used. For running efficiency, this LISP program was recoded, almost one for one, into an equivalent FORTRAN subroutine of less than 50 statements. This particular algorithm has the advantage that processing is iterative so long as single summarization links are encountered. Only when alternate links are found is a recursive call made.

As transactions are generated against summary points in the chains, they are output onto an intermediate storage tape. Because the impacting can generate transactions in complex order depending on the structure, a fast callable sort is used to bring these into sequence with the master file for updating and final output. This scheme has proven surprisingly fast in practice.

limitations and conclusions

PERGO I is currently limited in several ways. First, like PERT, CPM and other project management tools, PERGO is limited in accuracy and utility by the accuracy and comprehensiveness of the specific model established by the user. No such system is better than the people using it and sloppy estimates will, of course, be reflected in sloppy results. Feasible methods of circumventing this fundamental limitation are probably far beyond any horizon.

Secondly, it would perhaps be desirable to extend the basic HSM model in two directions. Currently, one week slippage at any point in a job is interpreted as one week delay at the end. Moreover, technical progress of a project is dominated by high cost jobs. This is often, but not always, the case. Thus, it would be desirable to have a slack/slippage algorithm which reflected the well known fact that delays early in a project generally have more impact on total time than delays late which, in the limit, cause exact effects. Models for this effect, and for the more subtle idea that delays are often more "real" than advances, are being studied by one of the authors*. The

*Mr. Constantine.

other problem of weighted progress could be handled by allowing the user to specify this weight independently if so desired.

The other major direction for model extension is to allow technological ordering in the CPM sense. For applications in which both CPM and HSM models are a sensible representation of aspects of the project, PERGO could be used to develop new, intermediate level, estimated completion times and the output supplied directly to a CPM program for processing through a network representation.

Applications of PERGO, other than simple project management, are possible. For example, a shop use report can be obtained. By substituting required machine hours for cost and per cent utilization for technical progresses, one can obtain a report of long term projected shop availability or unavailability.

Furthermore, PERGO is particularly adapted to resource allocation, since the user knows not only what areas are ahead or behind in progress, but where and how much dollars (resources) are available or are needed. Although the problem has not been examined in depth, initial indications show that the HSM model, even the present PERGO I, can be used as a valuable tool for profit projection, cash requirement forecasting, and sales forecasting. In general, PERGO is adaptable to many problems where actual versus estimate measures in both resource quantity (dollars, hours, etc.) and quality (as a per cent of standard) are available, and where graphical projection of various summaries of this data are described.

In summary, we have described a new project management tool of wide applicability. The PERGO system, because of a simplified model, flexible user-oriented input, and practical graphical output, may be a small but significant step forward in project control. Further, the use of recursive list processing techniques and the unique method of design in a sophisticated symbol processing language followed by implementation in a conventional language suggest themselves to other commercial applications. ■

a lawyer's monopoly?

COMPUTER LAW SEARCHING: PROBLEMS FOR THE LAYMAN

by R. N. FREED

The Caryl Chessmans of the 1970's will have an even tougher time unless present discussions in the organized bar produce affirmative programs to insure that computer law-searching systems are open to all laymen.

Laymen accustomed to use traditional law libraries freely are unaware that lawyers, through their bar association, presently are considering the extent to which nonlawyers should be permitted to use the entirely computerized law libraries of the future—although the right of laymen to use law books for themselves is regarded to be fundamental.

It is ironical that the advent of improved information processing through computers, which should enhance the right to learn the law directly, should cause that right to be questioned. The cloud arises from the suggestion that the very operation of computerized legal search systems might involve the practice of law and hence should be performed only for lawyers. If that view were to prevail, the serving of laymen through those systems would constitute the unauthorized practice of law by all law-finding systems structured like those presently functioning.

The views expressed in the article are those of the author, and do not necessarily reflect the opinions of his employers or associates.

Mr. Freed is Division Counsel for Honeywell, Inc., Computer Control Division. He is a graduate of Yale Law School and a member of the Massachusetts, Connecticut, Pennsylvania, and U.S. Supreme Court Bars. As an author and lecturer on the relationship of computers and the law, he is well known for his pioneering paper, "A Lawyer's Guide through the Computer Maze."

We are not discussing here systems that produce legal documents (such as pleadings used in court proceedings, agreements, wills, and papers for the formation of corporations), briefs, or conclusions on points of law, in the nature of definitive opinions to be used as such. Preparation of the excluded types of items probably is the practice of law and, as such, permissibly could be done by machine for ultimate use of a non-lawyer only if the computer system is operated by an unincorporated lawyer or law firm that does not advertise the service.

This discussion is limited to machine systems that search legal literature (consisting, for example, of statutes, decisions in cases, and regulations) and either merely identify the pertinent items or state what the law is on a particular set of facts (which is not yet being done) and also identify the items from which the conclusion was drawn.

right in question

Current discussions within the American Bar Association indicate an effort to allow direct access by laymen to such computer systems. But many non-lawyers still will be interested to know that their right has been questioned and that the bar is undertaking to prescribe how they may use the mechanized law libraries of the future.

It is important that that right be clarified promptly, while computer library searching is in its infancy—before policies are adopted that might harm persons who want to enjoy that right. The various interests that merit protection should be identified and persons affected should have the opportunity to satisfy themselves that their needs are provided for.

This questioning of the right of non-lawyers arises largely because of the entirely reasonable first impression that the end product of the computer approach is more like legal advice than is the result of using more familiar printed indices, digests, encyclopedias, and citation lists. But careful consideration of the mechanized technique probably will dispel the notion that any differences of substance exist. If such substantial differences are identified, this should stimulate efforts to find ways to make the improved services available to laymen nevertheless, giving them the full benefits of the new information processing technology.

If laymen were to be restricted in their use of computer law-finding systems, they would suffer real injury. Now they can go to the regular law library instead. Later, however, traditional libraries may be outmoded. Even now, everyone should be able to use the most efficient tools offered; that alone justifies concern and preventive action. When the material is stored as micro-images or on other media readable only through machine systems, the only access will be through searching machines of the types now becoming available. Limiting the use of those systems would be a genuine barrier to laymen.

All people in our society must be free, as a practical matter, to go directly to the law books in the most effective manner to determine their own legal rights and obligations. That few non-lawyers do so is no justification for diminishing their opportunity. If, as is very likely, improved law-searching systems will make it easier for laymen to find pertinent legal literature, more will want to do it themselves. That laymen might be ill-advised to handle their own legal matters does not derogate from their right to make their own mistakes. Some actually have achieved vindication of their rights they could not secure otherwise. That unscrupulous laymen might be tempted to use the results of machine searching in the unauthorized practice of the law, by rendering legal service for others, does not justify reducing the rights of those who will not. The remedy for that evil is continued prosecution of violators under existing rules and procedures, which are entirely adequate.

the variety of present systems

Computer law-searching systems do not all provide the same service. They differ in what they require from the user to make a search and what they give to the user as a result of a search. For input, they might require the user to specify search words to be fed to the computer. Or they might accept statements of the legal question or of the facts that give rise to it, both of which have to be converted for search purposes either by a person working for the system operator or by the computer system itself. For output, the systems now merely perform document searches, finding the statutes, cases, or other materials that presumably contain the information desired. The more optimistic students of information processing technology hope and expect that systems can be developed that will find information in the law library, as distinguished from documents that contain the information. Answers in those systems would tell what the law is with respect to particular circumstances and indicate the basis for its conclusions.

Some additional technical aspects of mechanized library systems generally should be noted because they indicate the severity of the impact on non-lawyers of limiting their access to law searching systems. Those systems can be expected, eventually, to give users images of the text as readily as their citations—at the user's own location. The text of the literature will be stored in a form that can be converted readily to humanly readable language and displayed remotely. On demand, paper copies of material selected after scanning will be produced. With such an arrangement, traditional books probably would be discontinued.

Regardless of differences in the nature of the service provided by machine law-searching systems, laymen should have full access to them directly. In fact, the more sophisticated the service, either in accepting poorly structured questions or in giving more conclusive answers, the greater the obligation the operator has to help laymen use it effectively.

Brief consideration of the natures of the different types of services will indicate why all are truly similar to each other in essence and also are similar to law-searching opportunities presently available to laymen. When users themselves select the search words from a list provided by the operator, the activity is analogous to the use of traditional printed indices or digests. Where users merely supply the questions or the facts and the system operator chooses the search words, it might appear that the operator is exercising legal judgment and hence rendering legal service. But regardless of the input of the customer, the operator merely delivers citations or copies of legal literature for the customer to study to draw his own conclusions. Where the operator accepts fact statements or questions and himself selects search words, his function does not differ materially from that of publishers of treatises and encyclopedias when they undertake to expound the rules of law under various sets of facts.

Even if the system operator, in the ultimate law-finding system, were to supply statements of the law and supporting items of literature to users in response to either specified search words or statements of fact situations, this also would be comparable to the publication of traditional treatises and encyclopedias. Admittedly, professional judgment still would have to be exercised by the customer in using the statements of the law comprising the machine output, and the services of a lawyer would be advisable for that purpose. Nevertheless, laymen who prefer to risk

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making their own judgments should be permitted to get that type of information from such services.

Since, despite their analogous aspects, the use of computer search systems actually differs from that of printed indices, digests, and other search tools, their use probably cannot be characterized as merely a traditional library function. In any case, the tags "practice of law" and "library function" reflect conclusions, which should be reached only after a consideration of the nature of the mechanized search activity. They are not useful in assessing that activity. It is preferable to identify the socially desirable result that should be achieved through the accessibility of the new legal machine systems to laymen. Taking that approach, such unfettered accessibility to all non-lawyers for themselves, probably even with affirmative assistance in using the machines, will be supported.

In exploring the reasons for assuring all laymen free access to the law library through machines, it is appropriate to consider what types of people such laymen are, how they might be frustrated in their efforts to use the new systems, and what should be done to prevent that frustration.

who will use the services?

The types of laymen who want to be able to look up the law by themselves span a very wide range of capabilities, interests, and activities. At one end of the spectrum are inmates of prisons who seek to vindicate their rights. At the other end are specialists who require a knowledge of the law in order to practice their professions properly. They include accountants, utility consultants, economists, patent agents, and realtors, for example. In between are non-lawyers who choose to represent themselves in litigation or to learn the legal aspects of various types of matters apart from court action and, probably more significantly, sociologists and other social scientists.

All the types of laymen identified have entirely legitimate interests in securing direct access to the law books, interests that deserve full protection. Although few people take advantage of their right to represent themselves in court, those who do are entitled to every reasonable opportunity to make that right genuinely effective. Prisoners have gained some noteworthy successes in pursuing their rights. Recognizing this, the New Jersey State Prison established a law library for them. The small claims courts exist for laymen to resolve legal matters without professional aid. Although few, if any, litigants in those courts now use law library materials, they well might see a possibility of benefiting from the improved new services and undertake to use them.

Probably the largest group of laymen who need access to law books consists of persons practicing professions other than law. They require knowledge of the law to perform their professional work or to serve others in entirely legitimate ways. For example, many economists have become recognized experts on the anti-trust laws and numerous political scientists have studied legislative reapportionment and redistricting. In a somewhat different manner, social scientists want to know about the law in action in order to study the judicial process. Their research efforts using reported decisions are very important scholarly activities.

What is the likelihood that laymen will not enjoy unlimited access to computer law-searching systems? It is great unless operators of those systems are encouraged by the legal profession because they have a natural disposition to bar many, if not all, types of non-lawyers. Already, one system has announced that it will provide service only to accredited practicing attorneys. Furthermore, a probably particularly enlightened operator of such a system advised the writer orally that he would serve professionals other than lawyers but not other laymen, such as prisoners.

By force of circumstances, system operators have more reason to bar laymen entirely than to serve them. In the first place, non-professional laymen would be infrequent users and would require much special attention. Profit-conscious operators want repeat customers who know how to frame search inquiries by themselves. More significantly, operators undoubtedly believe, with much foundation, that many in the legal profession would prefer that laymen, at least the non-professionals, not be served. Furthermore, until a clear official ruling has been made blessing the serving of laymen, operators very likely are unwilling to risk a charge that they are performing a legal function. Since the assumed negative attitude of the bar probably influences system operators to exclude laymen, that assumption will have to be dispelled by the legal profession before the systems will be opened freely to non-lawyers.

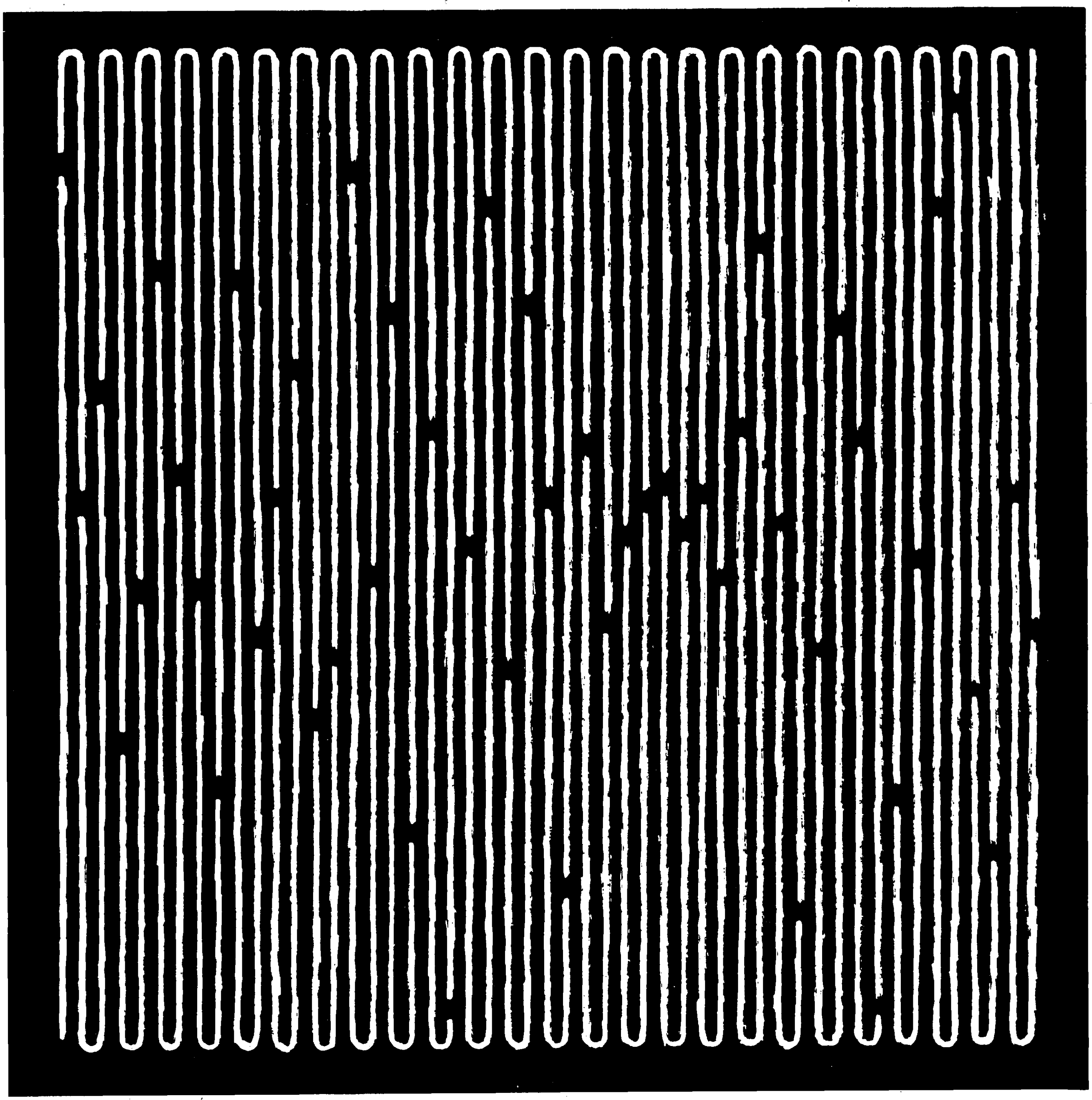
what to do

In view of the types of people who might be barred and the reasons for this, a number of preventive action programs are in order. The first responsibility rests on the legal profession to take affirmative action. Such action includes specific recognition of the right of non-lawyers to use such systems. It also includes announcement of the propriety of rendering that service without the risk of a charge of unauthorized practice of law.

Non-legal professionals, especially those who work with legal literature, also should act. Being highly organized and articulate, they can be particularly effective in that respect. They should insure that the organized bar acknowledges that right to its full extent and takes measures to assure its full enjoyment. Inter-professional committees should discuss the subject without delay. There is some precedent for such activitiy, if precedent be needed. The Unauthorized Practice of Law Committee of the American Bar Association negotiated with law book and legal service publishers policies on the promotion of law books, including disclaimer statements to accompany looseleaf services.

But genuine enjoyment of the new systems requires more than mere ready access for some laymen, namely those who can grasp the search technique easily and can afford to pay for the service. System operators should be persuaded to cooperate with non-professional laymen and to provide reasonable assistance to them. The operators should provide at least the help that could be expected from a sympathetic law librarian. The volume of requests for such aid probably always would remain within tolerable limits. Going even further, steps should be taken to remove economic barriers to lay use of the systems. Unlike most law libraries, machine search system operators will charge for their service. Although those charges probably will be reasonable for professionals engaged in business, they might be greater than some ordinary laymen can afford. Arrangements should be made for those situations.

The legal profession, other professionals, and operators of law-searching systems all must take prompt action to insure that improved library search systems today and entire law libraries of the future will be open to any layman who wants to discover the law by himself. It will be much more difficult to take the necessary corrective measures later, if improper policies and attitudes have become frozen. The wonderful new information processing technology, which should eliminate many shackles on men's minds, should not be the means for taking the key to law libraries away from any layman. ■



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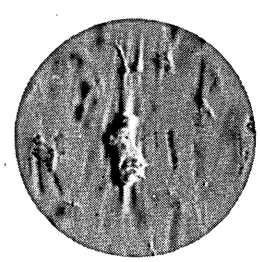

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OH BOSS, SO CROSS A LITTLE MISTAKE AND ALL IS LOST

IN SEVEN SCENES

by R. W. TRAUTMAN

After a computer is installed in a corporation, and during the rush to consider the many possible system applications, a consistently over-looked factor is the reliability control of the data processing equipment itself. Because of the responsibilities of the operations manager, and the importance of the system's basic hardware, observation and evaluation of the equipment performance tend to be limited to the immediate proximity of the data processing area.

SCENE I: *The present. A weekday morning at the Multicorp Data Center.*

BILL JOHNSON, *vice president of sales, worked late last night before leaving on the company's sleeper jet for the annual convention headquarters in the Bahamas. At the office, he left a dictaphone tape with some forecast changes. This morning, his secretary* JILL *is typing and verifying the figures before she goes to the inquiry teletype to send it in to the real-time forecast allocation of the memory.*

At this moment, 20 other sales branch teletype operators are pecking away at remote inquiry stations, sending and receiving information to satisfy their customer's demands. The engine producing division was built 500 miles from the main assembly plant for reasons of labor shortages and economics. Their satellite computer is being readied to receive a dump of the corporate forecast for a verification against a build capability forecast which they ran yesterday.

JILL, however, *is having difficulty with* MR. JOHNSON'S *forecast figures due to an intermittent recording fade-out on the dictaphone. She had called a week ago when she first noticed it, but was fairly sure the service man had been in to fix it (or could it have been the typewriter man? or perhaps the one for the calculator? there were so many of them, and each time a different one).* JILL *has placed a call to* MR. JOHNSON'S *hotel in the Bahamas, but he is on the scheduled first day tour and probably can't be reached for the rest of the day.*

JILL: Let me see . . . emergency rule of thumb: look up last forecast. There will generally be insignificant changes in the first few periods. This is six weeks out and was for 150. Well, deadline is only 30 minutes away, and it does *sound* like 150, so I'd better get it in before forecast check is made by our production divisions. I won't reach Mr. Johnson before deadlines anyway.

Yesterday JOHN PIKE ("BIG JOHN") *punched in on the Mill Shop time clock at 6 a.m. (instead of the usual 8 a.m.) to get a special project out. His card went through the keypunch section, and the girl then forwarded it to data-verting. Data-verting is now placing the tape in the computer operator's hands.*

The computer performed well last night, and the schedule is only 15 minutes behind on the miscellaneous batch runs which have not yet been converted to real-time.

A truck backs into the receiving dock and unloads. The remote input station there swallows a now consummated purchase order and transmits the information into the real-time memory.

Two weeks from now, BIG JOHN *will ask* ART HELD, *his foreman, why he wasn't paid his two hours over-time for that special job. A subsequent check will uncover the fact that the ribbon wasn't moving on the time clock and* JANE *the keypunch operator and* ALICE *the verifier thought the six was an eight (everyone else punched in at 8 a.m.). Although they do transfer the output from all of the time clocks, they hadn't noticed the print fade-out on the cards from the clock used by* BIG JOHN. *And* BIG JOHN *was planning on that extra pay for a real blast that evening. He'll get the overtime pay—but by the time he does, the cost will be multiplied by ten, due to the demand on everyone's time it took to run down the mistake and get it rectified.* JOHN *will grumble and promise himself that it will be a cold day in hell before he gets up at that time of day for a job again.*

SCENE II: *Same time. High in a plane over Maryland.*

TOM BURNS, *Multicorp's Eastern Manager, leans back in his seat and rechecks the 900 unit order he has just closed.*

TOM: What a break. We were able to beat out Joe's firm, the White Company. Imagine, strictly on a firm delivery promise. Bill Johnson called me last night after he finished putting his forecast on the dictaphone to tell me that the inventory people had actually shouted for joy when he made out his stock checks. Seems like this overseas order is going to pull out a lot of dusty inventory that has been collecting since Joe's outfit blasted our eight month forecast in June last year with their new model. Glad they don't have the computing system we do. Like

Mr. Trautman is currently developing a corporate system for control, selection and maintenance of all background information processing equipment supporting the main EDP complex at Clark Equipment Co. He was formerly corporate Univac operations supervisor at Clark, and has also been a service manager for NCR.

Bill said, one day made the difference getting this in. Many of the inventory items were on the path to the scrap yard, what with the president pinging away for inventory reductions all over. What a convention this is going to be! Boy, that commission check is sure going to make a big dent in the mortgage balance. Mary was so happy, she didn't even seem to mind my going away this week.

SCENE III: *One week later. The office of the data processing manager at Multicorp's Data Center.* BILL JOHNSON *has just returned from the convention.*

BILL: Why that 6#*& $#%?ﬄ@%¢☆# computer system forecasted only 150 of those white elephants we've been trying to move—150!—instead of 1050! Some of our production managers are climbing around on scrap piles, at the risk of their lives, trying to dig out tons of parts they scrapped last Friday with that lousy schedule you gave us. They're trying to get that 900-unit order filled. Tom Burns took the order, and he told me we were faced with delivery penalties of $50,000 minimum if we don't make it.

SCENE IV: *Later, the same day. The dictaphone tape has been located and* BILL JOHNSON *is talking to his assistant in the sales department.*

BILL: By golly, it can be interpreted as 150, not 1,050. Get Jill from the washroom . . . guess I got a little carried away. Sure would hate to lose that girl, best secretary I've ever had. A note from Tom Burns just came in. Says he understands how these things can happen, but his wife is highly emotional and isn't going to be able to take many more of these shocks. He's thinking of buying a hardware store and watching this crazy business from the outside for awhile. Can't say that I blame him. And we've got a new dictaphone on the way. Jill says this one is OK now, but you know how it is. I'll never trust it again. If it were only handier to get good service on these things . . . I guess the companies are all in the same boat as we are—it's just hard to hold technical people . . . my ears are still red from finding out the mistake was all due to that blasted dictaphone. . . .

Impossible? Improbable? Or does this hit where it hurts? What can be done? Let's analyze. . .

SCENE V: *A flashback. The Multicorp Co. about 1952. The time clock (since twice replaced) has a problem now and then, too.* ART, *the foreman, is in the habit of thumbing through the time cards. (In later years, he will have to plot numerical control production output, and he won't have time to check the odds and ends.) Now, however, he catches many errors and occasionally remarks: "It's only normal to check through these."*

BILL JOHNSON *is a salesman in the field. He has just returned from spending two weeks at the Wheel Specialities Corp. (parent of Multicorp), checking all the angles on filling that big (17-unit) order he has been working on.*

BILL: Sure great to have those engineers of ours so far ahead of that other outfit. The White Co. doesn't have anything to match us (yet)—going to have to watch them, though. They have some impressive innovations on those new models.

SCENE VI: *Two weeks later. Same place.* PAUL CONRAD, *Wheel Specialities company sales manager, strolls into the small tab section.*

PAUL: Fred, Jim, Pete, Ralph, how're ya? Say, will you guys give me a machine run to back up the figures I've received from the expediters? And Ralph, check it closely, huh?

(Aside) Couple days ago, Ralph forgot to add up some of those engines on Bill Johnson's order. I'll sure hit him up on that later. Come to think of it, Ralph made a couple of errors two months ago. If I can't find out what's bugging him, I may have to find someone else. Can't be exposed to careless mistakes like this for long. No harm done, though. Sure is handy to have this re-checked on those punched card machines. . . .

SCENE VII: *Once again, the Multicorp Co. The present.* ART HELD, *the foreman, is discussing the payroll error involving* BIG JOHN.

ART: Somewhere, 'long about '57 or '58, those efficient data processing people across the street cut my payroll complaints down to the point where I made more errors interfering than if I let things take their natural course. Besides, I was given more to do and was glad to have the extra challenges. Had a good man on those time clocks for awhile. But I hear he's fixing computers in California now. Saw him on vacation last summer . . . I'll bet that ribbon wouldn't have been stuck if he had been watching after it. But then, these things are still going to happen, even with the best of service. Maybe it just seems to take longer to get things like that done today. Say, that reminds me . . . my new color T.V. has been acting up . . . you found a good place for service yet? Seems the place I bought it doesn't have a real sharp color man. . .

And BILL JOHNSON *comments on the forecast incident.*

BILL: Along about '59, the engine and other requirements started coming out of that run they call an explosion. Works the inventory against the bill of material or something. All we have had to do since is give them the number and type of models we sell, or expect to, and they hit the requirements closer than we ever did. Glad we got rid of that miserable figuring chore.

And PAUL CONRAD . . .

PAUL: Remember Ralph? He just up and quit one day. Never did figure out why. I thought of letting him go a couple of times for one reason or another, but it worked itself out. You know, I haven't had to intentionally let anyone go on account of that new computer, and have actually had to put a couple more on. I guess it's just that we are growing fast enough to let our people take over the higher type jobs as the system does all the detail work. I've placed an order for a desk dictaphone like Bill Johnson's so I can put my information on it when I work late and my secretary can pick it off in the morning. Seems like I get twice as much done at night now . . . believe it or not, last week I made two appointments in the same day . . . 2,200 miles apart . . . tremendous things those jets. I was talking to a pilot of one of those the other day, and he said they are as easy to fly as operating a computer. I guess computers are taking the detail work out of everything now.

If you're not fidgeting in your chair by now, you sure as hell ought to be!

A corporation produces through a combination of people and machines in an environment of material. A short visit to a company's production facilities will no doubt establish the importance placed on the "in plant" ability to maintain all production machines in prime operational condition and to restore them immediately when necessary.

In a majority of cases, the production machines feeding the final assembly line (the computer) are affected by the performance of over 50 un-coordinated vendors. This "outside" influence naturally has a direct bearing on the quality and quantity of production. The occasional feeling of loss of control is not imaginary—*it is real.* ■

TECHNOLOGICAL CHANGE AND POLITICS

their interrelationships

by HARVEY M. SAPOLSKY

Technological change and its impact on society are certainly among the most popular of current topics for study and discussion. In recent months many reports and conferences on the effects of technological change have been sponsored by international organizations, government agencies, universities, professional societies, business firms, and journals. Specialists in the analysis of technological change have begun to be found in the corridors of power as well as in the stacks of libraries.

The impact of technology on society is, of course, not a recent phenomenon. The steam engine helped develop a new class of man, the railroad facilitated the development of a continent, and the machine gun assured the demise of the horse cavalry. What makes the present situation unique, however, is the scale and consciousness with which technological change is being pursued.

World War II marked a watershed in the relationship between technology and society. The massive research and development effort that brought forth innovations—such as the atomic bomb, radar, and sonar—to hasten victory, also produced a profound appreciation among political leaders of the value of organized attempts to create technological changes. The federal government from that time has assumed the role of the prime financial benefactor of scientific research and has considerably increased the amount of resources devoted to applying the results of scientific research to current problems. Industry and the universities have joined the government in the pursuit of technological change, resulting in a blurring of the traditional distinctions between what is public and what is private, and between the creation of knowledge and the application of knowledge.

rate in question

Whether or not this effort has increased the rate of technological change—the pace at which new techniques are introduced into society—is an unanswered question. Economists focusing on productivity indexes can find no measure of change that sets our generation off from its immediate predecessors. Sociologists focusing on society's adjustment to change are less certain of the continuity of experience. From a certain perspective, however, the question is an irrelevant one. That society and its instrumentalities have become concerned about rates of change and patterns of adjustment is in itself enough to make our era distinct.

The political system is among those sectors of society that could be most affected by the impact of technology. If technology were to affect detrimentally our ability to maintain a democratic political system, we would certainly be paying a high cost for material gains. A cause for caution in the pursuit of technological change is the fact that we do not yet fully understand the internal structure and operations of the democratic system. Tinkering with a few variables could alter significantly democracy as we know it. The trade-offs, then, between democracy and technological change, if they do exist, should be clearly stated, and examined before we commit ourselves irrevocably or totally to moving in any one direction. Moreover, because government is the prime source of support for research and development expenditures in the United States, we are in fact studying the engine of change when we study the relationship between technology and the political system.

Democracy in the United States has meant the deconcentration of political power. Citizens by and large have the opportunity to participate in a significant way in the processes of government. Elites, persons who control disproportionate shares of politically valued resources, are present, but they are specialized and competing and, thus, not dominating. The institutions of government are

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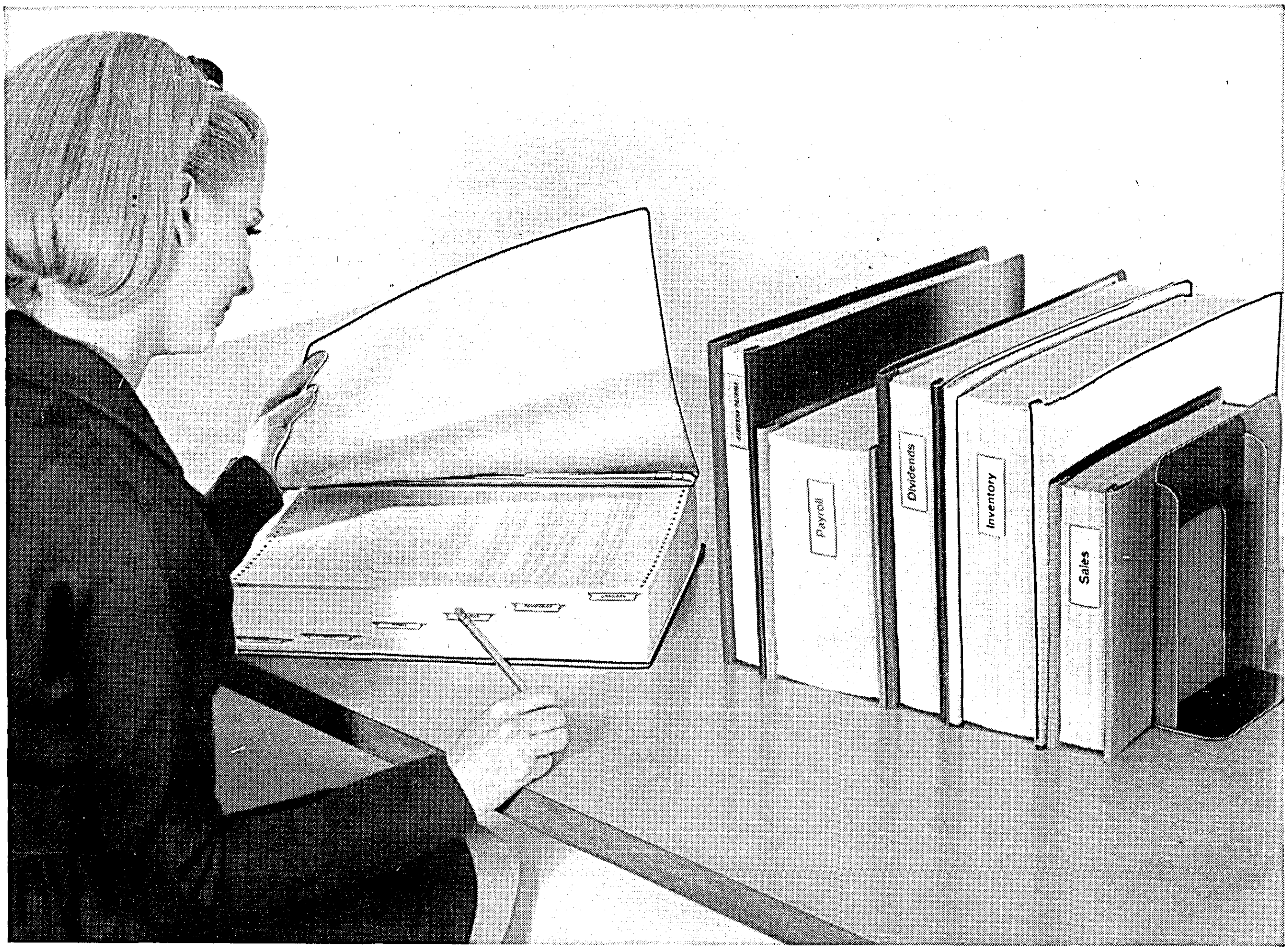

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designed and operate in such a way as to check and to supplement one another. Even the normal functioning of government requires the cooperation and consent of several independent political and administrative units. Non-governmental organizations and institutions, such as voluntary associations, business firms, and universities, have roles in governmental activities, but they also have a guaranteed independence from governmental control. Dispersed power can be assembled, but only on a limited *ad hoc* basis and only for widely shared objectives.

The constitutional framework of the democratic system has shown both flexibility and stability. Fashioned for a small, homogeneous, agricultural population, the Constitution has been able to adjust to serve the needs of a large, heterogeneous, industrial population. As important as its flexibility, however, is its continuity of purpose, a concern for individual liberty and individual development. Such a framework permits social change, but prevents social revolution.

changing relationships

In the first years of our nation the growth of science and technology and the growth of democracy were thought to be intertwined. The founding fathers, many of them scientists or technologists as well as politicians, were children of the Enlightenment, the philosophy that held science, technology, and democracy to be inseparable partners in the progress of man. Science and technology, by undermining religious dogma, would help to destroy the power of absolutist theories of government and would open the way for the democratization of society. Democracy, in turn, by encouraging the spread of education and by relying on reasoned discussion for the formulation of public policies, would guarantee the progress of science and technology.

As the nation developed, technological progress took precedence over scientific progress, but the link to democracy was maintained. Material progress, it was thought, insured the growth of an independent and economically secure citizenry, while political freedom guaranteed that the inventive and entrepreneurial genius of the entire society would be nurtured, thus increasing production. America, becoming at nearly the same time both the world's largest democracy and the world's most technologically advanced nation, confirmed for many that the relationship between technology and democracy is auspicious.

Today, while we can have no doubt that technological progress and government are interdependent, we are no longer certain that technology and democracy are partners in the progress of man. We have seen that technology can advance in nondemocratic societies. We have also seen that a democracy can receive impetus for technological development from international competition: It is someone else's nuclear weapons and space vehicles, as much as the internal encouragement of democracy, that keeps us moving technologically. Moreover, the forces of technological change may be particularly threatening to democracy for they may increase the pace of social change beyond the point at which democratic institutions can effectively respond. Fear of unemployment caused by a loss of confidence within the financial community has been replaced by fear of unemployment caused by the growth of unlimited confidence among technologists. The close and necessary tie between technology and government cannot simply be assumed to be beneficial for democracy. Many believe that it is, in fact, harmful, for, in their view, it leads to structural centralization and limitations on citizen participation in political decisions.

The relationship between two such complex and dynamic systems as technology and democracy cannot easily be clarified. Concentrated research in this area is just beginning; only the grossest dimensions of the central issues are at present discernible. We hope here to arouse the interest of technologists in the potential consequences of their work.

To assess the impact of technological changes on democracy, I believe it is useful to consider the effects of technological changes at three levels—the individual, the institutional, and the communal or societal levels. At the individual level we are concerned with the effects of technological change on the processes by which the citizen forms political opinions and expresses political judgments, whether through direct participation in policy formation or through communication with representatives. At the institutional level we are concerned with the effects on the structural framework of political action, on the relative position and independence of organizations and institutions, and on the relationships among these organizations and institutions. And at the communal or societal level we are concerned with the effects on national goals and on political values.

the contradictions of change

Technological changes appear to have contradictory effects on the role of the citizen in political processes, inhibiting as well as facilitating participation. The democratic ideal has the citizen forming independent political judgments and participating directly in public affairs. It was probably romantic to believe that the ideal could ever have been attained; it can be argued that technological changes have effectively prevented even a near approximation of the ideal. The complexity of public decisions requires that scientific experts and technological specialists take a larger role in policy formation. The citizen, and even his representatives, find themselves increasingly dependent upon expert advice and increasingly forced to weigh expert opinion in order to form political judgments. The contention of some, that these trends must necessarily lead to a form of elitist rule, is questionable. The political problems of the future, if they are at all similar to those of the present, are likely to contain a large value element and there are no recognized experts on values. Nevertheless, we must be concerned with discovering the means to keep public issues comprehensible and political decisions responsible.

The effectiveness of citizen participation in public affairs depends in part on the efficiency of communication networks, the methods for the dissemination of political information and the gathering of opinions and judgments. It can be argued that advances in communication technologies (TV, for example) promote democracy because they improve the amount and timeliness of information available to the public. Moreover, dramatic improvements in opinion gathering methods have been forecast (electronic referendum devices) that would allow the citizen to react to and perhaps affect political events as they occur.

Changes in communications technologies, however, may hold more costs than benefits for democracy as they could render the population more easily mobilizable and manipulable. Instantaneous and direct communication between the mass of citizens and top decision makers, for

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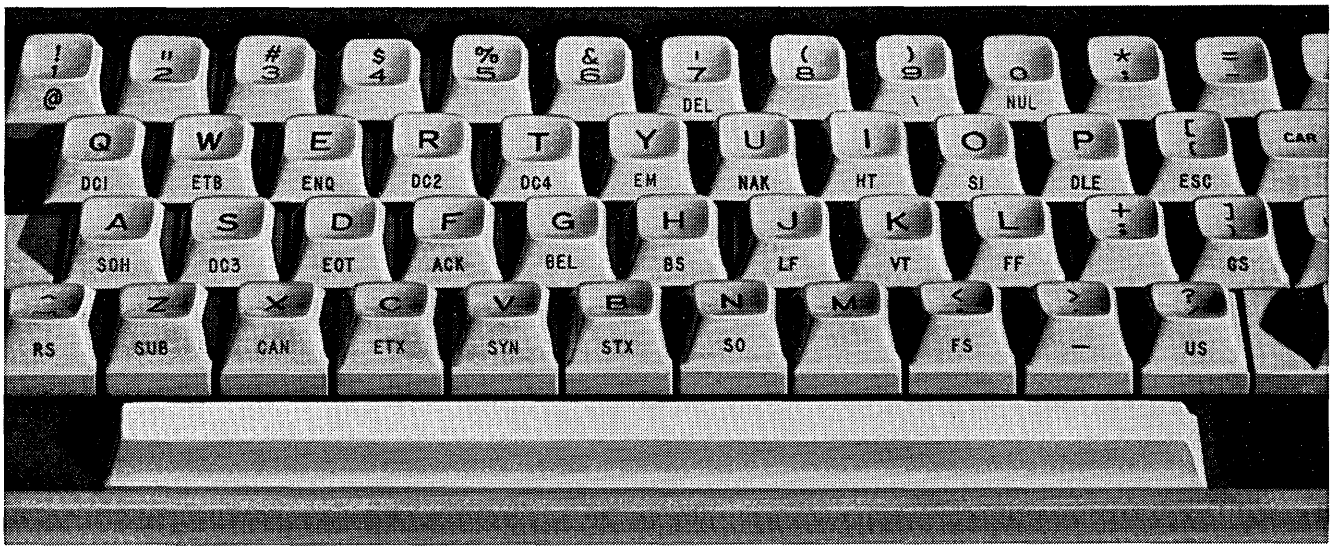

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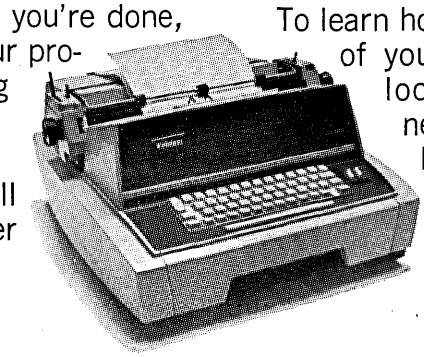

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example, could destroy important opportunities for delay and reflection by undermining the tempering and interpretative roles of what we may call political intermediaries—voluntary associations, political parties, legislators, and civic leaders. The rapid dissemination of election results or publicized computer predictions of election outcomes before the polls close may affect in unknown ways the voters' decisions on candidates, issues, and the exercise of the franchise itself. Considering both changes in communications and the role of experts, it can be argued that the preservation of the democratic political system requires methods to restrict citizen participation as well as methods to guarantee opportunities for participation.

effects of technology on institutions

The impact of technological changes on institutional arrangements, particularly those relating to governmental organization, is the subject of considerable debate. Some argue that technological change may destroy democracy since it increases the concentration of political power. Society, seeking to mobilize technology for its defense, becomes its victim. According to this view, the interests of scientists, technologists, and the military have fused, forming a cohesive and dominant elite. Within the government, power is said to have shifted from the Congress to the Executive Branch and within the Executive Branch from the politically responsible officials to experts who are neither known nor responsible to the public. The federal system, once a guarantee against the concentration of political power, becomes inoperative; state and local government seem unable or unwilling to cope with the problems of technological change, forfeiting jurisdictions to the federal government. Federal funds, once of minor importance and widely distributed throughout the economy, are now of vital importance to economic health and are highly concentrated, benefiting only a few firms, a few industries, a few universities, and a few states. Non-governmental organizations and institutions important to the maintenance of democracy have lost their financial independence and are now tied closely to governmental power.

Others argue that technology affects democracy in a directly opposite way. Technology, rather than causing an increased concentration of political power, exacerbates an inherent weakness of democracy by causing a further deconcentration of political power. Many governmental agencies have long been noted for their intimate ties to pressure groups and legislative committees which give them a protected independence from central policy making bodies. When the jurisdiction over the development and promotion of particular technologies is placed in governmental agencies without providing for a compensating increase in the expertise and authority of central policy units, technology can be said to contribute to the fragmentation of political power.

Moreover, technology, according to this view, is being presented to the public as the quick and easy solution to some of society's most difficult problems, thus increasing the demand for the establishment of technology promoting agencies. We are warned that there is an increasing danger that a large number of expensive and uncoordinated "Apollo"-like projects will be initiated by and later themselves sustain powerful pressure groups. Change, instead of being slow and understandable, becomes rapid and disruptive when agencies have as their prime mission the promotion of technology. The government, instead of becoming centralized, becomes more decentralized and unmanageable when the power of operating units is strengthened relative to the power of coordinating units.

On closer examination, one is likely to find that both views exaggerate aspects of the real relationship between technology and democracy. At the institutional level, it can be argued that attempts to apply technology in order to solve certain problems (many of which are at least partially induced by technology such as national security, education, environmental pollution) lead to greater federal intervention in the operations of society, rendering some forms of private enterprise and local government obsolete. The increased role of the federal government, however, creates new difficulties for democracy, since within the federal government there exists no effective or democratic means to coordinate and to assess the efforts of the organizations established for implementation of technological approaches to current problems.

The impact of technological changes on the political community has yet to be carefully explored. It is clear that advances in science and technology have permitted society to approach the achievement of many of its basic aspirations. Widespread, if not universal, material prosperity seems possible, and life expectancy has increased considerably. Moreover, recent advances in technology have permitted society to consider new goals—the exploration of space and the utilization of the ocean's resources. Serving and expanding the aspirations of the political community is, of course, a positive contribution to democracy.

It can be argued, however, that the expanded aspirations of the political community conflict with democratic values because these aspirations can only be obtained at the cost of increased restrictions on the individual. The democratic society seeks to promote equality and to protect minority rights. Central information banks containing a complete data profile on each individual, for example, may increase the efficiency of government, but only at the cost of individual liberty and privacy. As lawyers are aware, knowledge of an individual's past transgressions can prevent a reasoned consideration of the facts of any current situation. With centralized storage and multiple agency access to such data, an individual's past errors, expiated or unexpiated, can be used to deny new opportunities and to control future behavior. Similarly, electronic devices useful in protecting society from its enemies can, if employed indiscriminately, destroy the citizen's right to free expression by destroying the confidentiality of private communications. Democracy may depend upon the ignorance of officials as well as upon the enlightenment of citizens.

Given these potential costs and benefits, the technologist as a responsible citizen clearly has a vital interest in a clarification of the relationship between technology and the political system. The technologist as a technologist also has a vital, if somewhat less obvious, interest in a clarification of the relationship between technology and the political system.

With its financial support of research and development activities, the public has the opportunity to control the direction of technological progress. The technologist must be aware that the public will base its allocation decisions, in part, upon values other than rapid technological development alone. Provided with a clear explication of the relationship between technology and the maintenance of democratic society, the public will have a basis for the intelligent exercise of its control. ■

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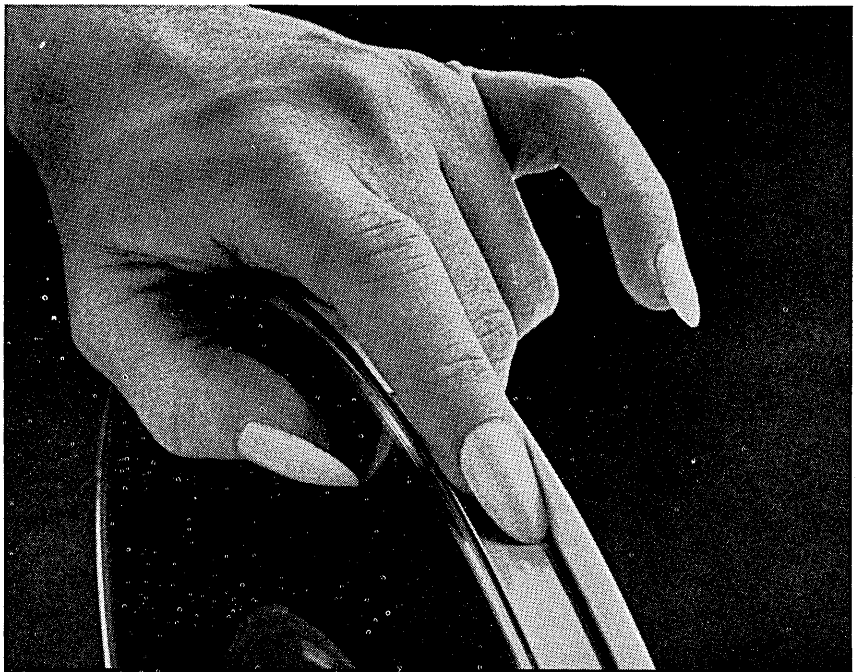

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SYSTEMS AND THEIR COMPUTERS

"The Computer as a System Component" was subject of Session 16 at the WESCON convention in San Francisco in August.

In his opening remarks, session chairman Pete England of Scientific Data Systems in Santa Monica, California, pointed out that until now systems engineers have had to adapt their systems designs to the available computers. Today, however, they must focus their attention on the task of defining the problem the computer system must solve. With that completed, a versatile third-generation computer can then be selected to fulfill all requirements. According to England, today's systems engineers are also mainly concerned with the need to design a system that can be properly and efficiently programmed with available software. This task is more difficult than defining the problem or selecting the hardware.

In discussing the impact of third-generation computers on systems design, David L. Stein of SDS differentiated between component generations, structural generations, and functional generations. The evolution of functional generations, for example, can be traced from simple machines based on the von Neumann concept—with closely integrated arithmetic, memory, control, and I/O units—through synchronous I/O machines with more separated structural units; asynchronous I/O machines with multiple bus organization and coupled systems in which two computers communicate with each other through data paths via I/O modules to what is considered third-generation machine technology, which is characterized by free interplay among the various modules.

In Stein's opinion, software capability has not kept pace with hardware advances. Attempts must be made to optimize scheduling. New strategies, he said, can increase the flexibility and scope of system operation, but these more complex systems must be better understood to get maximum benefits.

The hardware building-block approach permits add-ons to be made as the system needs change. Wider band width, more I/O, more memory, etc., can be added after a system is in operation, according to Stein. This approach means that certain wrong "guesses" as to hardware requirements can be corrected. With increasing system complexity, however, a more scientific approach is necessary based on operations research techniques in which simulation and modelling are applied to hardware and software configuration control. Stein emphasized that economic optimization is the main objective of the new approaches to system design. Intuition, or heuristic algorithms, can reduce the cost of a system and improve scheduling. More efficient scheduling, he added, could be achieved by utilizing linear programming techniques to dynamically allocate system resources.

Dr. John V. Kane of Michigan State Univ. described the Sigma 7 computer system that was installed in MSU's cyclotron laboratory in January 1967. The computer is monitoring and controlling experiments in nuclear physics, performing real-time and general-purpose computations concurrently. At MSU, the computer is now being used with standard FORTRAN to control machine tools, oscilloscope displays, and laboratory devices. A general-purpose interface handles communication between the computer and a variety of laboratory instruments and sensing devices. It also provides the path through which the computer controls cyclotron energy levels, beam focusing, and related functions.

Software for the MSU installation is divided into four categories: (1) monitor code package, (2) FORTRAN run-time code module, 3) a real-time code module, and (4) real-time interrupt processing routines. The real-time code, which requires only 400 hexadecimal locations, directs all interactions with the outside world, as well as setting up real-time tasks.

Bob L. Ryle of Planning Research Corp. discussed software as a component in computerized systems. He pointed out that "systems" include computers, communications, special-purpose devices, terminals, and many other elements. He limited his presentation to include only those systems in which the computer and software together usually comprise nom-

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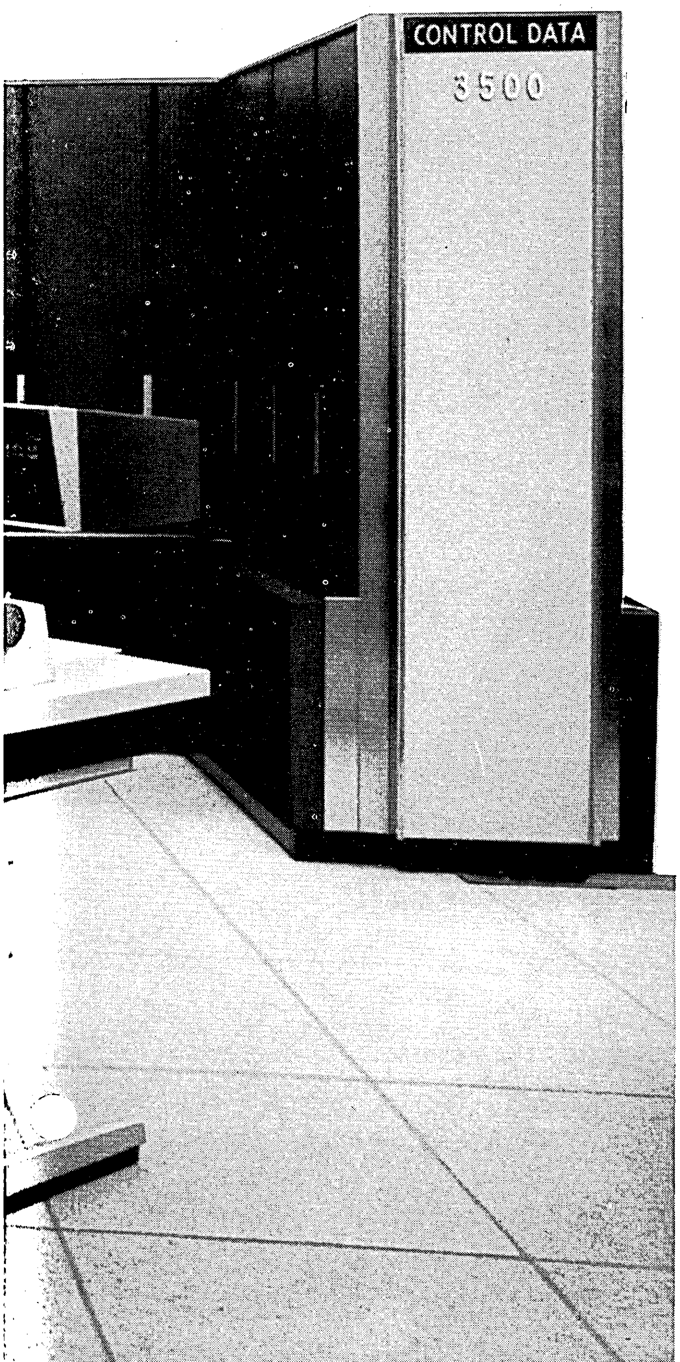

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inally less than 50% of the total cost. Many examples can be found in aerospace, process control, and other application areas.

In many systems, software is either ignored or treated as a "caulking compound" that bridges the gap between what the hardware can do and what needs to be done. Advances in hardware, systems management technology, and software are forcing changes in these attitudes, according to Ryle.

Because of recent hardware advances, system designers can make meaningful trade-offs between hardware and software approaches to problem solving. Advances in systems management technology have increased the credibility in software development schedules and cost figures. But software technology, itself, has failed to keep pace, Ryle said. Progress is still required in real-time control, operating systems, testing, compilers, and programming aids. Time-sharing is not yet a reality in the sense that all terminals can have full use of all system resources.

Two aspects of software technology need particular emphasis: reliability engineering and maintainability engineering. Reliability is basically the minimizing of the number of errors in a system and their impact on system performance. Though errors are inevitable as hardware ages, software errors tend to diminish, both in magnitude and in their effect on the system, with time and system use. In other words, intrinsic errors introduced during program preparation do not tend to recur sporadically after a program has been checked out and used.

A program can assume a number of "states" of reliability. An "experience factor," based on the number of states the program has assumed, helps determine program reliability. Further, software can enhance system reliability by detecting and correcting noise, errors, etc. Although software should be easy to change, every change can introduce new intrinsic errors and reduce software reliability unless software maintainability receives equal attention during the development phase.

The effectiveness of software can be increased by testing, and the reliability of a program can be made to approach "1," according to Ryle. Independent organizational elements must assume responsibility for conducting test operations. Although techniques for testing hardware are relatively advanced, little has been done to formalize software testing. Reliability can only be assured when the industry develops standardized and calibrated testing tools for software as well as hardware, he added.

To achieve maintainability engineering, software must be designed for ease of detecting and correcting errors and verifying corrections.

Large-scale integration and other hardware advances may increase software reliability. The LSI-generation systems may accommodate hardwired programs. Higher-order languages can help bridge the communications gap between engineers and programmers, thus reducing errors during program preparation.

Ryle contends that software should become "just another element in the system." System designers can then actually make valid trade-offs between hardware and software approaches to problem solving. He concluded by pointing out that, ideally, programming should be no more of an "art form" than logic design, circuit design, or any other technical activity.

In his paper entitled "On-Line Computers and Patient Care," Dr. Shannon Brunjes of the Univ. of Southern California Medical School described the system his group is implementing at Los Angeles County General Hospital. He described the application of computers to medical paperwork and people-to-people communication, specifically with respect to the ordering of drugs in a hospital. The on-line system is used to process labels for prescriptions. While it generates the labels, it also captures information for hospital files. In addition, it can process medical calculations in the background.

Dr. Brunjes' group is writing software for the system in two sections, both of which are modular and are maintained in assembly language. This software consists of programs for the special on-line terminals and batch programs for processing data. The modules are designed to be reentrant, and the coding is independent of the number of terminals. The system operates in 14K bytes of the 64K byte IBM 360/30 system with a two-second response time. Entry terminals used by the individual pharmacists are IBM 2260 cathode ray tube display devices.

To use the system, the pharmacist enters the prescription as a variable-length field, including the doctor's name, patient information, a short code for the drug and quantity, and another code for the "sig" (physician's instructions for application). Because the system produces labels faster, the pharmacist can spend more time verifying ambiguous prescriptions or unusual dosages. For the hospital, the system offers a means of collecting information that will eventually eliminate overlapping administration of closely related drugs by different doctors as well as detection of over-use of prescribed drugs.

One of the major problems was expected to be acceptance by the hospital's pharmacists. However, as the system has come into use, it has been welcomed by members of the pharmacy staff, which prepares over 700,000 prescriptions per year. The two terminals (a third will be added in the near future) are now in almost constant use. Dr. Brunjes feels that this acceptance resulted because the design objective was to optimize the system for the user rather than for the computer.

—Nancy S. Foy

the acm historical session

COMPUTING'S EARLY YEARS

"I recall in 1937 I built a little binary computer which had two relays . . . model K for Kitchen table. I took it to Bell Labs to show some of my colleagues. General agreement among them was that the binary adder would never supplant the decimal machine . . ." related Dr. George R. Stibitz, professor of physiology at Dartmouth Medical School, who with Sam Williams, was responsible for some of the early relay computers.

Dr. John Mauchly: "I did fool with American Can adding machines in my basement when I was a high school kid . . . Before I got to the Moore School, I'll have to confess that I built an analog computer, which is not widely known, a harmonic analyser . . . I also invented a digital computer, but a very special kind for ciphers . . . the first place I know of where memory or storage features of neon tubes or gas tubes was used for a digital computer . . . Those were the '30's, the early days . . ." The conviction that weather forecasting was possible only if he could compute his equations faster was what initially led Dr. Mauchly from these beginnings to the co-invention of the first electronic digital computer, ENIAC.

Between 1938 and '42 at Iowa State College, Dr. John V. Atanosoff and Dr. Clifford Berry developed a 300-tube computer which had a drum memory and could compute 30 simultaneous algebraic functions with 30 unknowns—and was intended to solve agricultural problems.

In the '30's Wallace Eckert was developing punched card computing for use in problems of astronomy.

Oh, and sometimes during that era there was a relay computer called the TOTE, used for parimutuel computations at the race track.

divergent paths

The roads that ultimately led to the development of digital computing were, to say the least, divergent. And many of the people from the various disciplines who became responsible for the start of this multi-billion-dollar enterprise were present at the hallmark 20th Anniversary Conference of ACM (Washington, D.C., Aug. 23-25) to reminisce about "In the Beginning" during a nostalgic three-hour session. More interesting is that in an industry that will soon rival the oil and automobile industries in size and effect, most of these creators and pioneers continue to contribute to computing.

With Mauchly and Stibitz on the panel were Richard Bloch, Samuel Alexander, Edward Cannon, Herman Goldstine, Maurice Wilkes, Grace Hopper, Jay Forrester, Arnold Cohen, and moderator Isaac Auerbach. And 15-20 more major contributors lined the front rows to tell their anecdotes.

The session, which promises to be just Part I of many such ACM sessions, began by honoring Samuel N. Alexander with the Harry Goode Memorial award from the American Federation of Information Processing Societies. In 22 years with the National Bureau of Standards, Dr. Alexander has been involved in the establishment of numerous computer facilities. This includes the procurement of the first three Univacs and the design and development of the first operational electronic stored program computer—SEAC—and the first portable computer, DYSEAC.

in the beginning

Then the historical musing began. The first digital computer, the Harvard Mark I, was demonstrated in 1944.

"I was fully prepared to become a navigator and thought that would be a thrilling way to end my career." But Dr. Richard Bloch, now vice president of Auerbach, was soon on his way to Harvard, instead, as "I had met Prof. Howard Aiken, then commander of the Naval Research Laboratory, who had told me in late '43 about the wondrous behemoth that was developing under his guidance."

Bloch became a programmer, designer, and later director of the Mark I project. "One of the problems we faced, and of course that doesn't exist today," he said, was that of determining which had precedence, hardware or software. "It came to be a stalemate, because as . . . Grace Hopper will attest, I had the nasty habit of making changes to the machine on a daily basis . . . I think Grace was the first person who programmed successively different machines on successive days." (After Mark I, Bloch went to Raytheon to develop RAYDAC, which went to Point Mugu in 1951 and was used for Navy data reduction operations for many years. He also developed the Datamatic 1000 under the Raytheon-Honeywell firm, Datamatic, and the Honeywell 800 and 400 series.)

After Mark I, which was full of the punched card devices IBM had developed in the '30's, came the first general purpose electronic system, ENIAC. John Mauchly, after those early experiences with his own special purpose computers, surveyed more powerful methods of computering—none of them fast enough. When he visited the Atanosoff-Berry effort, he found it was "clever, but not working." At a math meeting, he toyed with a remote Teletype terminal. "I was putting problems through it, thinking this was wonderful. I still thought it could be speeded up with vacuum tubes. Another man I didn't know, sort of small and interesting fellow, kept telling me computers were great and this was the beginning of some thing that would turn out to be revolutionary. 'Don't you think I'm right,' said Norbert Weiner."

Then at the Moore School of Engineering, Mauchly, with J. Presper Eckert, incorporated vacuum tubes as the high-speed storage element into ENIAC built by 1945 under government contract. Also adopted were the important subroutine facility, lacking originally in the Mark I, he noted, and later the mercury storage tank, which made practical the storage program concept.

The dissemination of knowledge on computing was vital at this time, and an intensive summer study course, given at the Moore School in 1946 by Eckert and Mauchly and colleagues was credited by several of the panelists for giving the field a "great boost." And other lectures and efforts by the pair, as well as by von Neumann and Goldstine, turned the Whirlwind I and MADDIDA (at Northrup) computers from analog to digital projects.

Dr. Herman H. Goldstine, now director of scientific development at IBM's DP Division, represented the triumvirate that contends with Eckert and Mauchly for credit as inventors of stored programming. Collaborating with John von Neumann and Arthur Burks, Goldstine was involved in the design and development of the IAS computers at the Institute for Advanced Studies in Princeton. The beginning of this was at the Aberdeen Proving Grounds, where Goldstine went in 1942. "The thing that made ENIAC and all the subsequent computers possible was . . . Gen. Leslie Simon. The group that Simon assembled at Aberdeen was really a very remarkable one. Among other things he had a scientific advisory committee, the like of which I don't think we're going to see in the near future. Among others, it had a very nice young Hungarian mathematician named Johnnie von Neumann. . . ."

lionizing

Von Neumann, much deified by the panel, had his interest in computing triggered by all the problems he wanted to solve. He was interested in economics, hydrodynamics, weather calculations . . . "enormously many things," recalled Goldstine. And it was a tool and not a final authority, that the computer was to be used, von Neumann taught.

Among the many anecdotes offered on von Neumann was one that happened at Aberdeen, where a "bright mathematician" was stymied by a problem involving the parameter n. He had taken a "computing machine" home and spent half the night solving the first five cases. Von Neumann came in the next day and looked at the problem, unaware that the mathematician had any solutions. Attacking the problem numerically, "von Neumann threw back his head," Goldstine related, "and said, 'for n equals one,' and he would talk to himself, and about one minute later he said, '17.53! Fine!' And he said, 'Now let's see what n equals two is like.' After several minutes for each case, von Neumann had knocked off n equals 2, 3, 4. Then he got to n equals 5. And this was the thing that had kept the mathematician up until 4:30, so he was really out for blood. He watched carefully as von Neumann was going through this mumbling, and when he got to a number that this chap recognized, the fellow immediately said 67.51. Von Neumann's mouth dropped open, and he said 'What?' '67.51.' Von Neumann's head went back again and the calculation went much faster now. Half a minute later von Neumann said 67.51, that's right. This fellow ran out of the

At right is Dr. Richard Bloch. Chairman: I. L. Auerbach.

Unidentified at right is MIT Prof. Jay W. Forrester.

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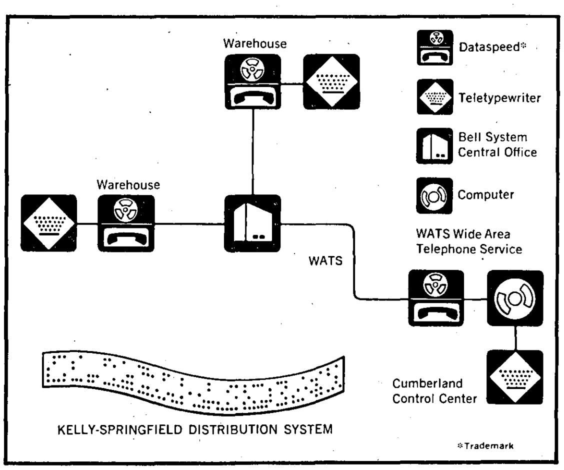

BELL SYSTEM AT&T and Associated Companies room . . von Neumann was pacing back and forth in the room jiggling the keys in his pocket. You could hear him saying to himself, 'How could the guy have done this?' "

the mongrel

After ENIAC and an unsuccessful BINAC, the government authorized the building of three UNIVACS. And that was why SEAC came to be, related Sam Alexander. It was certainly a "mongrel dog . . . with more intellectual parents than any device ever built." The UNIVAC contract came with the proviso that if Eckert and Mauchly went broke in the process, NBS laboratories was to claim all the government-owned equipment and finish it—a stimulus for NBS to learn all there was to know about computing, he said. It became clear that the UNIVAC inventors and Raytheon, doing component development, were overextending themselves. Harry Huskey, coming to NBS from National Physical Laboratories, pushed NBS to build SEAC as an interim machine, and as the UNIVACS' delivery became even later, the completion of SEAC was authorized. It later became a productive tool with an operative acoustic memory and experimental Williams tube storage memory—a total of 1000 words.

"The first digital computer excursion in a serious way into command and control systems," was Whirlwind I, built at MIT, 1946-50. The exercise led to the beginning in 1951 of the first computer-controlled aircraft interception system, and to subsequent Lincoln Labs work on SAGE. Prof. Jay Forrester, now at MIT, who was responsible for Whirlwind I's design and development, noted, "I came into the field at such time when some of the early ideas in the field with respect to logic and binary arithmetic had been pretty well thought through by a number of people . . . We aimed at higher speed and higher reliability necessary in this area of command and control systems." The detailed block diagram of Whirlwind I published in 1947 had some traceable influence on machines up to today. The project also marked many beginnings in human interaction with the computer—with the oscilloscope display and the light pen, which gave the operator the power to intervene. And the use of the Sylvania 7AK7 vacuum tube brought reliability up 1000-fold.

Across the sea, Dr. Maurice Wilkes, professor of computing technology at Cambridge University, London, began the design in 1947 of EDSAC—after he had attended the Moore School course. His particular remembrance, in addition to those in his opening session Turing lecture at the conference, was that in connection with the "first substantial programming I did . . . I discovered debugging . . . It was somewhat of a shock that I realized that I was going to spend a good part of my life finding mistakes I had made myself in programming."

Dr. Grace Hopper, beaming at being back in Navy uniform because of a temporary recall to active duty to do COBOL programming, traced some of her programming experience with Mark I, II, III, Eckert and Mauchly Corp., and now with UNIVAC. "My primary purpose in life has not been in making programs, not in designing languages, not in running computers, but rather in making it easier to use computers. And it was that that led me into the whole field of trying to store libraries of subroutines. Here I had acquired the first hint from Dr. Wilkes in the first book on programming, and in Aiken's desire for a library of routines . . . and in Eckert and Mauchly's encouragement that we try to use the computer to help us make our programs. But there was frustration because we insulted the programmers when we would treat their programs as if they were data, and let the computer manipulate them . . . We went to languages to try and simplify things and the mathematicians resented it when we let the data processing people say 'add' instead of writing a plus sign."

Relating several anecdotes, Dr. Hopper had a "vivid picture of coming in early one morning and finding the BINAC surrounded by Coke bottles, and sitting in front of it, slightly unshaven, John Mauchly, and both John Mauchly and BINAC singing 'Merrily We Roll Along.' "

Needless to say, the session would not have been complete without a complaint from Dr. Herbert Grosch, now director of the NBS Center for Computer Sciences & Technology. "We have a great scarcity of westerners (on the panel), although about half of the early work and a much larger proportion of the later work has been done west of the Rockies. There is no representation of business data processing to speak of and very few applications people . . . and above all we don't have very much representation from a rather well known company in the field (IBM)." This is a void for the next ACM historical session to fill.—ANGELINE PANTAGES

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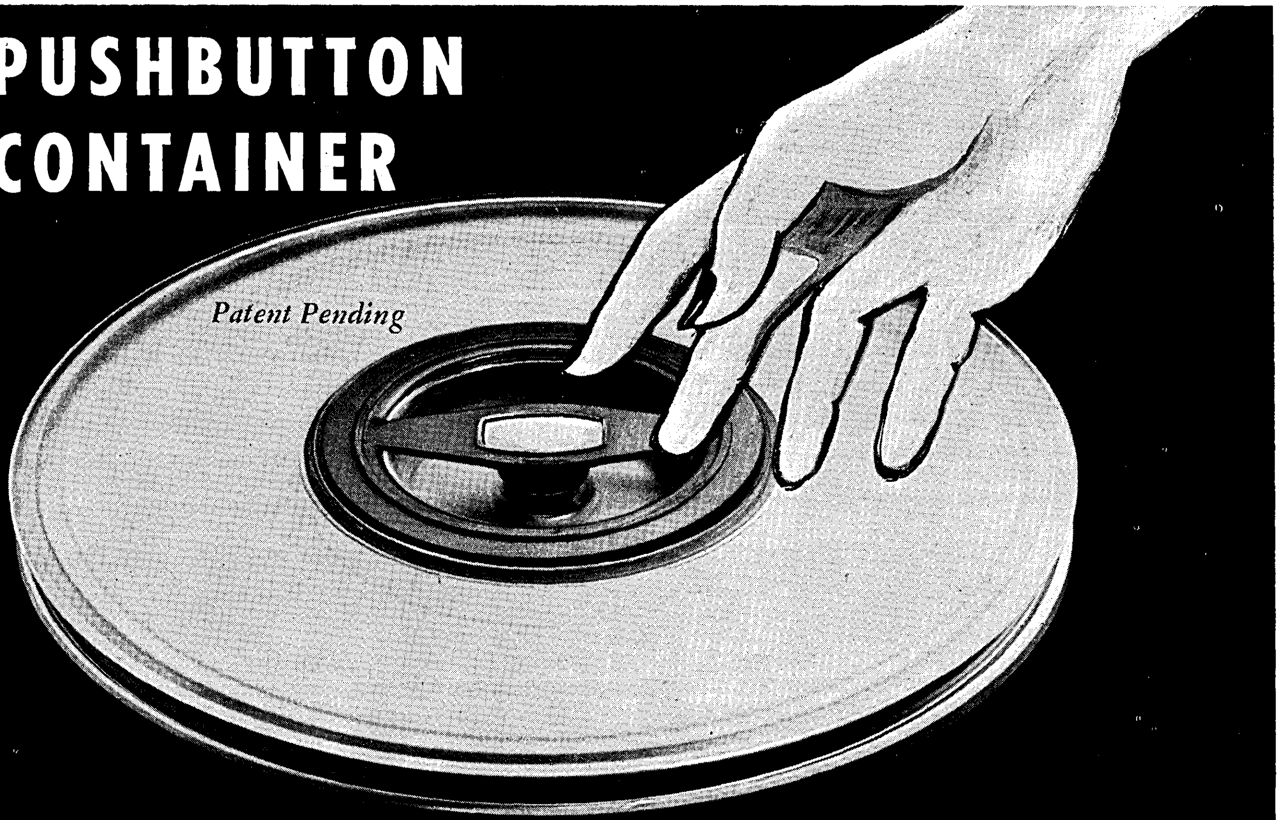

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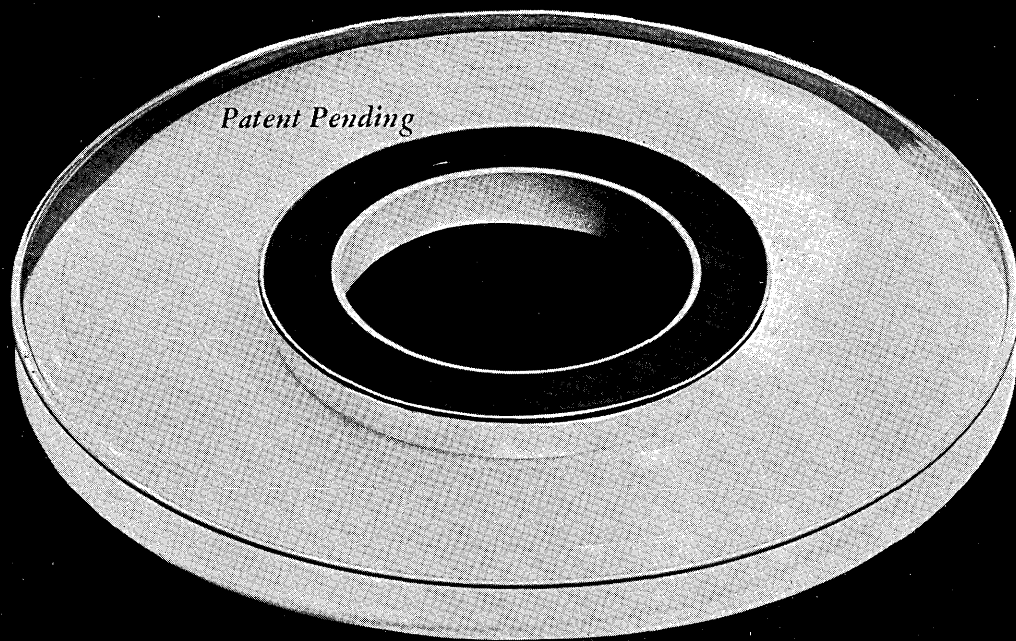

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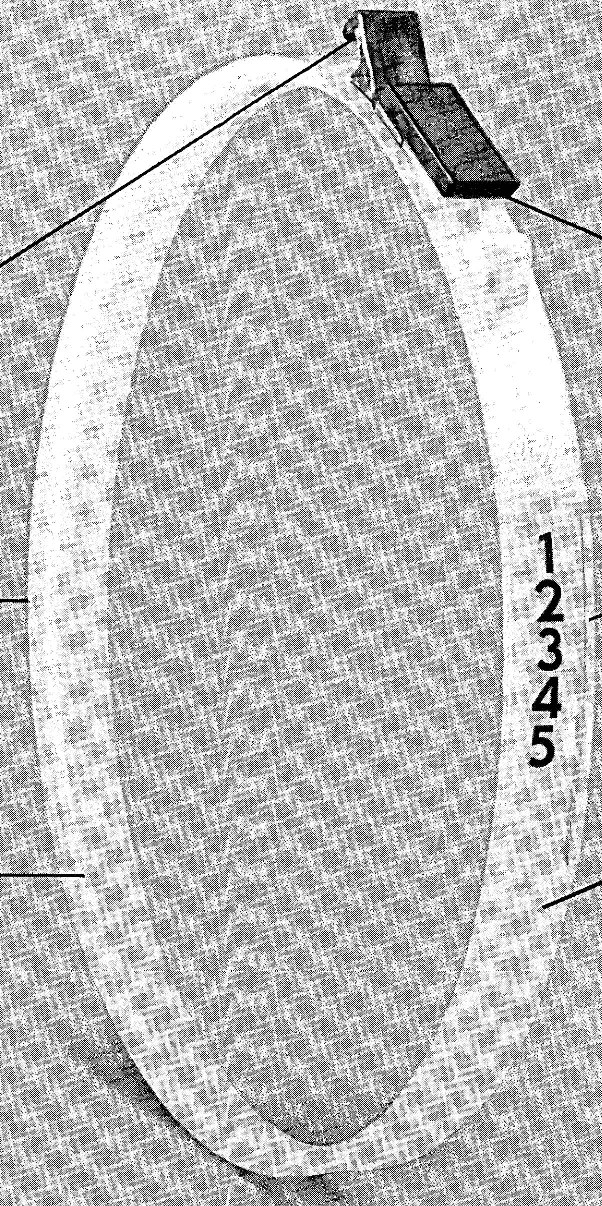

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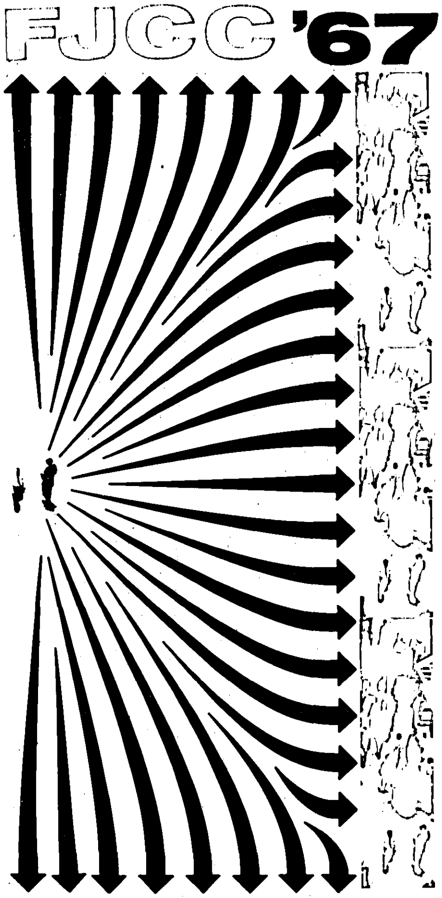
by L. C. HOBBS



Welcome to the 1967 Fall Joint Computer Conference! Since this will be the first Joint Computer Conference held in the Los Angeles area since 1961, the conference committee has made every effort to assure that it is an outstanding one. In the final analysis, you will be the judge of whether we have succeeded.

The exhibit space sold for the conference is approximately 50% larger than that for any previous JCC, representing 140 exhibitors. We expect approximately 6,000 registrants for technical sessions, and 9,000 exhibit registrants and guests. The technical program committee has screened 280 papers to select 70 for the 16 formal sessions which will be supplemented by 14 panel and discussion sessions. However, numbers and statistics cannot convey the intentions and goals of the conference committee. Major emphasis has been placed on the technical content of the program, with quality and value the major goals.

In keeping with the traditions established by previous FJCC's, several innovations have been planned for this conference to facilitate the interchange of technical information and to improve the image of computers in the eyes of other segments of the community. These innovations include:

1. A one-day workshop led by a professional expert in effective discussion practices was held for the chairmen of panel and discussion sessions.
2. An expert in oral presentations made a two-week tour of the country, holding one-day training sessions in several major cities for those presenting papers at the conference to help improve the presentations.
3. A community relations committee to organize presentations and tours of the exhibits for "opinion forming groups" in the community, to help give a better idea of the role that computers will play in community, government, and industrial affairs.
4. An education program has been planned for superintendents of secondary schools to help them better understand the role computers will play in school systems and the education process.
5. The usual keynote session and keynote speaker have been omitted to provide more time for technical sessions while holding the maximum number of parallel sessions to four.

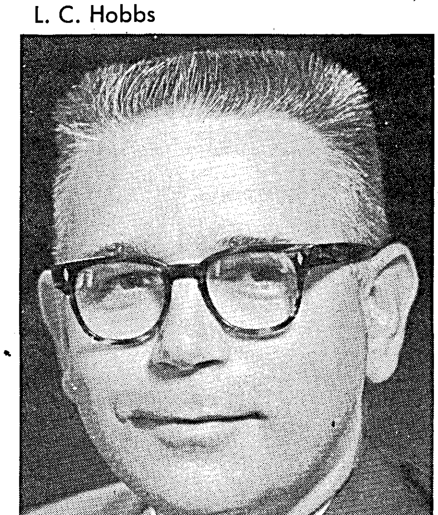
Perhaps the greatest, and most questionable, innovation is holding the conference in a location where the number of housing accommodations for attendees is marginal. There were many long discussions and careful deliberations over whether to hold this conference in Las Vegas again, or to make every effort to return it to the Los Angeles area. Since opinion among those involved was split on which would be the better course of action, the general chairman of the conference assumes full responsibility for the final decision to hold the conference in Anaheim. Although we recognized that holding the conference in a new city, where the hotel and motel facilities are limited, would greatly increase the problems for our local arrangements committee, and would cause inconveniences for some attendees, it was finally decided that the advantages of the Anaheim site outweigh those difficulties. These advantages include:

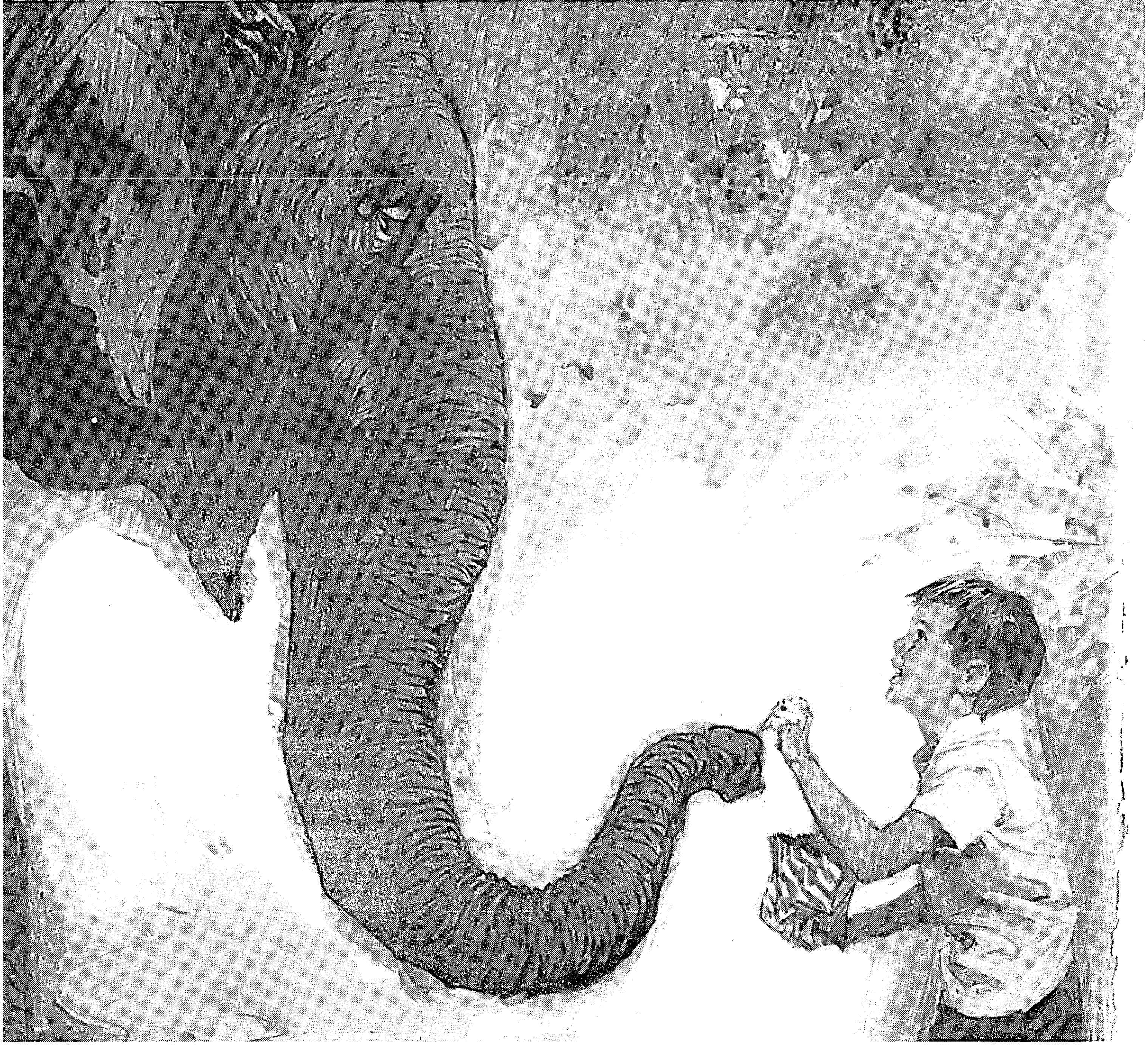
1. The better physical facilities for technical sessions and exhibits in the new Anaheim Convention Center.
2. The greater availability of the conference to the large segment of sponsoring society members and local industry in the southern California area.
3. The ability to hold a meaningful community relations program.
4. The ability to reach a large number of educators and school officials for the education program.

We hope that the attendees to the conference will agree that these advantages produce a better and more meaningful conference and that they will bear with us in accepting any personal inconveniences that may occur in some cases. Adequate housing is available for all attendees, but some of the motels and hotels are a few miles from the Convention Center. In addition to the traditional ladies' activities program, the conference has planned an entertainment program for all attendees which will prove that Anaheim is really not like Cucamonga. The highlight of this entertainment program is an FJCC night at Disneyland.

We look forward to seeing you in Anaheim. ■

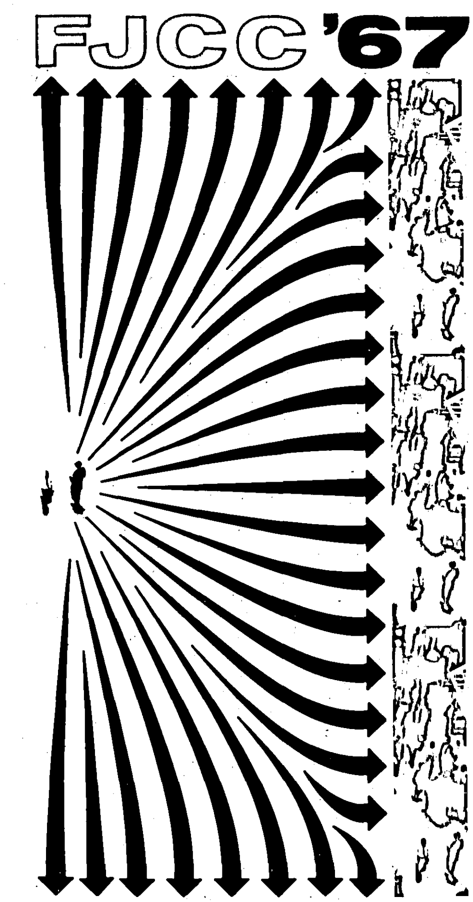
L. C. Hobbs





"and with the right system the computer can be made to eat out of your hand"

CONFERENCE PARTICULARS



Last spring, the campy decadence of Atlantic City; this fall, the progressive decadence of Anaheim. *Anaheim?* If you can figure out where it begins and ends in the swarm of humanity that is sinking southern California into the sea, you will find a city with a small cap and a few large feathers: notably, Disneyland, Knott's Berry Farm and the expatriated Los Angeles Angels. And then, it's located in Orange County, which happens to be one of the fastest growing areas in the world. The orange groves, of course, have been razed into tracts, and the land that once held glossy citrus trees now carries billboards demanding the impeachment of various government officials.

The 1967 Fall Joint Computer Conference, sponsored by American Federation of Information Processing Societies (American Documentation Institute, Assn. for Computing Machinery, Assn. for Machine Translation and Computational Linguistics, Simulation Councils Inc., and the IEEE Computing Group), and headquartered in the Disneyland Hotel, will meet at the new Convention Center on November 14-16.

More exhibitors than ever—about 140—are expected to compete for the attendees' attention, although they may be a little more subdued than before—the frown of AFIPS lingered on the go-go-booths. The exhibits will be open on Tuesday from 11 a.m.-6 p.m.; Wednesday, 11 a.m.-9 p.m.; and Thursday, 10 a.m.-5 p.m.

Registration for the conference will be at the Convention Center Monday, 5-9 p.m.; Tuesday, 8:30 a.m.-6 p.m.; Wednesday, 8:30 a.m.-9 p.m.; and Thursday, 8:30 a.m.-5 p.m. Registration fees for three days (with a copy of the *Proceedings* included) are $20 for an AFIPS member; $30 for a non-member; $3 for a full-time student. One-day fees are $10/member and $15/non-member. A non-member who joins one of the sponsoring societies during the conference, or within 90 days after the conference, is eligible for a $10 refund.

The technical program is boasting 30 sessions, including panel discussions, and about 70 papers (written by some 115 authors). The emphasis of the program is on hardware architecture, effective software, usefulness of programming languages. A few glamorous subjects (computing in the humanities, intelligence of robots) will also be included, as well as applications discussions (in law enforcement, medicine).

Arrangements have been made to have follow-up discussions on sessions that provoke great interest. For morning sessions, afternoon follow-ups are scheduled; afternoon sessions may meet again in the evening.

The formal keynote session has been eliminated from the '67 program; instead, science fiction writer Ray Bradbury will speak at the Wednesday luncheon on "Unthinking Man and His Thinking Machines."

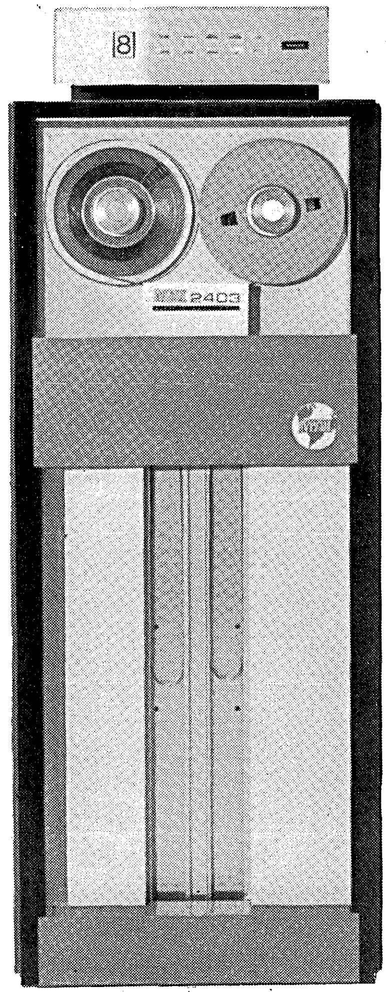
Two "by invitation only" sessions will be featured this year, each an experiment in the introduction of data processing to the non-edp professional. Dr. Gloria Silvern, of Education and Training Consultants, will lead an all-day discussion and tutorial session on "What School Superintendents Should Know About the Use of Computers in Education," before a group of school administrators and trustees. Basic orientation lectures will be supplemented by panel discussions on current applications, an overview on CAI, and a tour of the exhibits.

A Community Relations Committee, headed by Bob Forest of DATAMATION, will attempt to present a brief, intensive tutorial session, including a visit to the exhibits, to a group of invited dignitaries.

As in past years, computer movies will be shown throughout the conference.

The conference committee has arranged entertainment activities with fervor, to eradicate any disappointment among conferees that the Las Vegas site was scrubbed. Wine tasting parties, tours of southern California night clubs (by bus), and an FJCC night at Disneyland have all been scheduled.

The ladies' program will include a tour of a movie studio and luncheon at the beach. ■



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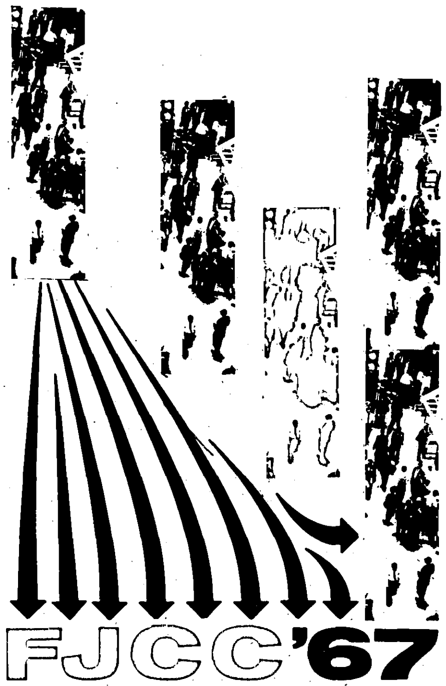

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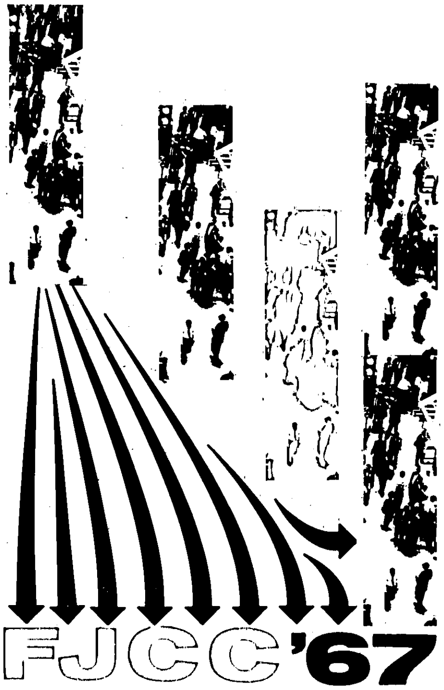


A PRODUCT PREVIEW

ADAGE, INC.
Boston, Massachusetts

The AGT models 10, 100, and 1000 2-D and 3-D graphics terminal systems require only voice-grade communication and no CRT buffer. The complete system includes the Ambilog 200 hybrid computer with 4, 8 or 16K (30-bit) memory; CRT's with more than 1000 lines/inch resolution; a communications interface between the AGT system and a remote CPU; disc files; light pen; keyboard input; analog tablet; and a graphics recorder for hardcopy output of the image.

CIRCLE 124 ON READER CARD

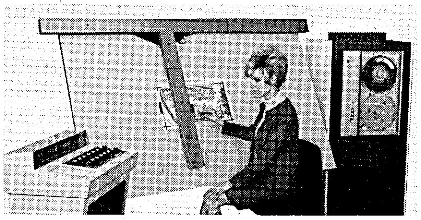
ANELEX CORP.
Boston, Massachusetts

The 6511 printer interfaces with the System/360, and is capable of providing the extra-large characters used on labels and other forms for the packaging industry.

CIRCLE 125 ON READER CARD

AUTO-TROL CORP.
Arvada, Colorado

Company will exhibit an *x-y* coordinate digitizing system that uses a



ruled glass scale. Measurements are taken from maps, drawings, etc., and are recorded in computer compatible formats onto punched cards, paper or mag tape, typewriter or IBM document writing systems. On-line interfaces are offered for the 1050 terminal. Unit also features grid recognition for printed circuit layout and a third coordinate, *z*, for measurements in photogrammetry.

CIRCLE 126 ON READER CARD

CALMA CO.
Santa Clara, California

Three digital incremental mag tape recorders will be introduced; all capture sporadic digital data, a character at a time, on tape. Model 800 writes 800 bpi, 9-channel output tapes at a rate of 0-500 cps; model 600 writes 556 bpi, 7-channel tapes at 0-500 cps; model 200 writes 200 bpi, 7-channel tapes at 0-300 cps. All are equipped with company's constant bit density control feature that keeps character spacing from varying less than 2% under any operating conditions.

CIRCLE 127 ON READER CARD

CHESHIRE, INC.
Mundelein, Illinois

A division of Xerox, this company will be displaying the model 514 labeling machine which can apply 7,500 edp-addressed labels an hour to pieces of mail.

CIRCLE 128 ON READER CARD

COMPUTER TEST CORPORATION
Cherry Hill, New Jersey

The Delta 400 memory test system consists of a modularly structured magnetics test terminal, an SDS Sigma 2 computer and a basic library of test programs. Test parameters (pulse current pattern, rise and fall times, etc.) can be remotely programmed in absolute decimal increments. Test results can be stored within the memory and used to construct output voltage, switching time or peaking time histograms. Programs are written in TOOL (Test Oriented Operator Language).

CIRCLE 129 ON READER CARD

CONCORD CONTROL, INC.
Boston, Massachusetts

The Mark 8 universal graphics processor consists of a precision table joined to a gp computer. Unit can be operated as an input tracing digitizer, as an output digital plotter, or as both an input and output system simultaneously. The computer has a memory capacity of 4,096 (12-bit) words, provides on-line computation and acts as a buffer interface to other equipment. Complete software is provided, including a standard utility package and programs for point-recording, line-tracing, plotting and executive control.

CIRCLE 130 ON READER CARD

CONRAC CORP.
Covina, California

Being marketed to original equipment manufacturers is the data display terminal. This CRT-keyboard unit has self-contained electronics, refresh memory and character generator. It uses the Selectric's keyboard, has a 64-character set and a keyboard-controlled blinking cursor. The CRT's 8½ x 7½" usable area displays 37 characters/line and 16 lines with the starburst character font, or 24 lines with the 5 x 7 dot matrix font.

CIRCLE 131 ON READER CARD

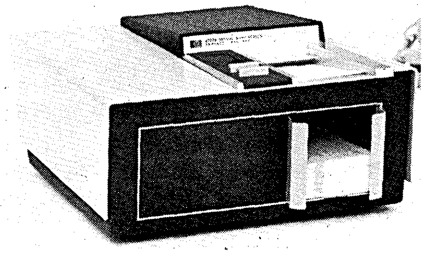
CYBETRONICS, INC.
Waltham, Massachusetts

The model CT-100 mag tape cleaner/tester has forward cleaning and reverse testing pass; complete operation takes 10 minutes on a 2400-foot reel. Basic machine tests for dropouts on 7-channel (556 or 800 bpi) tapes. Options increase testing to include write skips and skew errors on 9-channel (800 or 3200 bpi) and full surface tapes.

CIRCLE 132 ON READER CARD

DYMEC DIV.
HEWLETT-PACKARD
Palo Alto, California

Company will display a desk-top optical mark reader that reads cards which have been punched and/or marked with regular soft lead pencil. The standard tabulating card has preprinted marking boxes which will accept 39 characters of alphanumeric



information. The unit, model 2760A, plugs into a standard telephone data set, and can be used in simple data communications applications. It operates in temperatures from 0° - 55°C and 95% humidity at 45°C. MTBF is 2000 hours at 25°C. A prototype of this model was displayed by the Datamec Corp. over a year ago, but did not perform to the company's satisfaction; now improved, it is being reintroduced.

CIRCLE 133 ON READER CARD

GENERAL KINETICS, INC.
Arlington, Virginia

The 680 magnetic tape cleaner can service ½", ¾" and 1" tapes on standard reels up to 14" diameter. The unit has automatic forward and reverse pass cycle, and can clean a 2400' reel of ½" tape in 4.8 minutes. The model has self-sharpening blades, and a winding action that automatically resets the guide positions.

CIRCLE 134 ON READER CARD

LINK GROUP
GENERAL PRECISION, INC.
Sunnyvale, California

Incremental plotter has a basic resolution of 4000 x 4000 raster elements. Steps can be made in 1, 2, 4, or 8 raster elements with automatic corresponding adjustment of line width. Plotting speed is 100,000 points per sec. The system can be interfaced with a computer or an off-line tape unit. Output is on 35mm roll film.

CIRCLE 135 ON READER CARD

GERBER SCIENTIFIC INSTRUMENT CO.
Hartford, Connecticut

The 1500 graphic display control is a stored program system for use with the company's automatic drafting machines; the system features a 16-bit gp computer with 4096 words of core, an I/O teletypewriter, and a 500-cps input paper tape reader that accepts either EIA or ASCII codes.

CIRCLE 136 ON READER CARD

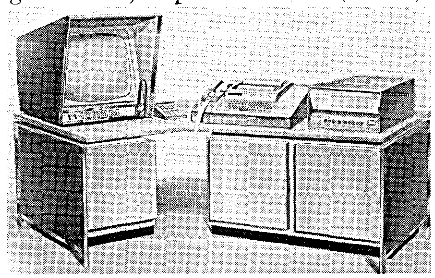
INFORMATION CONTROL CORP.
El Segundo, California

Solid-state light pen, the LP-301, has below 300 nsec response time, and will resolve light pulses at a maximum rate of 100 KC (or 10 msec minimum spacing). Company will also exhibit the Mil Rac 100 military random access core memory. Unit has 8192 (24-bit) words, and a 1.5 usec full cycle time. Designed in accordance with MIL-E-4158C, the memory has an MTBF of over 4,000 hours.

CIRCLE 137 ON READER CARD

INFORMATION DISPLAYS, INC.
Mount Vernon, New York

IDIIOM is a buffered graphic CRT console with a self-contained, programmable, expandable 4K (16-bit)



random access memory. Input devices include light pen, A/N keyboard and function keys. Output is on a rectangular 21" CRT screen.

CIRCLE 138 ON READER CARD

LOCKHEED ELECTRONICS CO.
Los Angeles, California

Being displayed is the CD-50 500-nsec core memory system that features 2½D packaging and is available in 8-65K words, sizes of 18 to 144 bits.

CIRCLE 139 ON READER CARD

MEMOREX CORP.
Santa Clara, California

The Mark I disc packs are designed for operation on disc storage drives such as the IBM 1311 and 2311. An assembly of six discs, the unit provides 10 recording surfaces, and is enclosed in a dust-proof container.

CIRCLE 140 ON READER CARD

MOHAWK DATA SCIENCES CORP.
Herkimer, New York

The 1320 buffered line printer provides line printout from mag tape in the company's Data-Recorders without the use of a computer. The unit will print up to 132 characters a line at a speed of 300 lines a minute. It can print 6 or 8 lines an inch, and can handle forms from 4" to 20" in width and 22" in length. Printer also has a logic system of controlling form advance and spacing within a print line.

CIRCLE 141 ON READER CARD

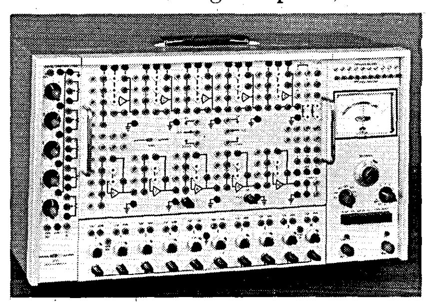
POTTER INSTRUMENT CO.
Plainview, New York

The SC-1131 militarized tape transport system is to be displayed. A single-capstan digital system, the unit can operate at bidirectional speeds up to 37.5 ips at standard packing densities of 200, 556 and 800 bpi, with no program restrictions. SC-1131 is 7- or 9-channel IBM compatible, and can be used with new USASCII format, including 1600 bpi phase-modulation recording.

CIRCLE 142 ON READER CARD

SYSTRON-DONNER CORP.
Concord, California

Being displayed for the first time will be the 3300 analog computer, a desk-



top model that is expandable up to 10 amplifiers and 15 coefficient potentiometers. The unit has ±100 V design, REP-OP mode control, and a null reference system.

CIRCLE 143 ON READER CARD

VARIAN DATA MACHINES
Newport Beach, California

The VersaSTORE II core memory system operates asynchronously at 1.7 usec with 750 nsec access time, is available in increments to 4,096 (36-bit) words, and can also be obtained as an 8K (18-bit) word memory. Party Line feature is optional: it enables the basic unit to be used in multiples.

CIRCLE 144 ON READER CARD

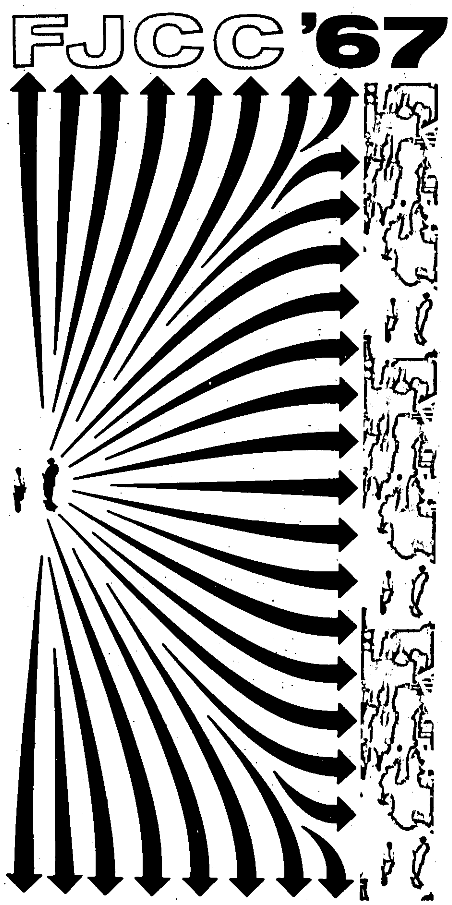
XEROX CORP.
Rochester, New York

Exhibit will feature the 2400-IV duplicating device; when used with computers, it copies and reduces page size directly from the printout. Complete copies are collated and ready for binding. In 30 minutes, 15 x 11" continuous forms are converted into collated sets of 60 pages on 8½ x 11" sheets.

CIRCLE 145 ON READER CARD

THE TECHNICAL PROGRAM

by HARRY T. LARSON



Why have a Joint Computer Conference? To bring together the diverse professional design specialists and users of computer technology. Our profession seriously needs this—it is important.

Why have a conference? To communicate significant advances, and to discuss important issues.

These two simple, important goals are easy to identify, but difficult to achieve, especially when we add another important goal, high quality. These are the foundations of the technical program for the 1967 FJCC.

All of the member societies of AFIPS have their own regular national conferences, so the dominant reason for a Joint Computer Conference has to be that it is interdisciplinary and broad. In designing the program, we have kept in mind the interest of the members of the AFIPS societies, and have attempted to provide subject matter of interest to all of them. Thus, there are sessions on hardware, software, applications, and analog/hybrid matters. In addition, a number of sessions have been specifically designed to be interdisciplinary in nature, where specialists from several facets of our business will be focusing on important developments or issues.

Perhaps one of the greatest weaknesses in the computer profession as a whole is the sharply separate development of hardware and software people. Few people are truly ingrained with both specialties, or are fully cognizant of the trade-offs. A few men with over-all system design responsibility are motivated to attack the trade-off between hardware and software, but their attempts to bring the two groups together and achieve a balanced design have usually been unsatisfactory (by their own measure). So there exists a crucial need for interdisciplinary conferring, listening, arguing. At this conference, we urge you to attend the session of "the other guy."

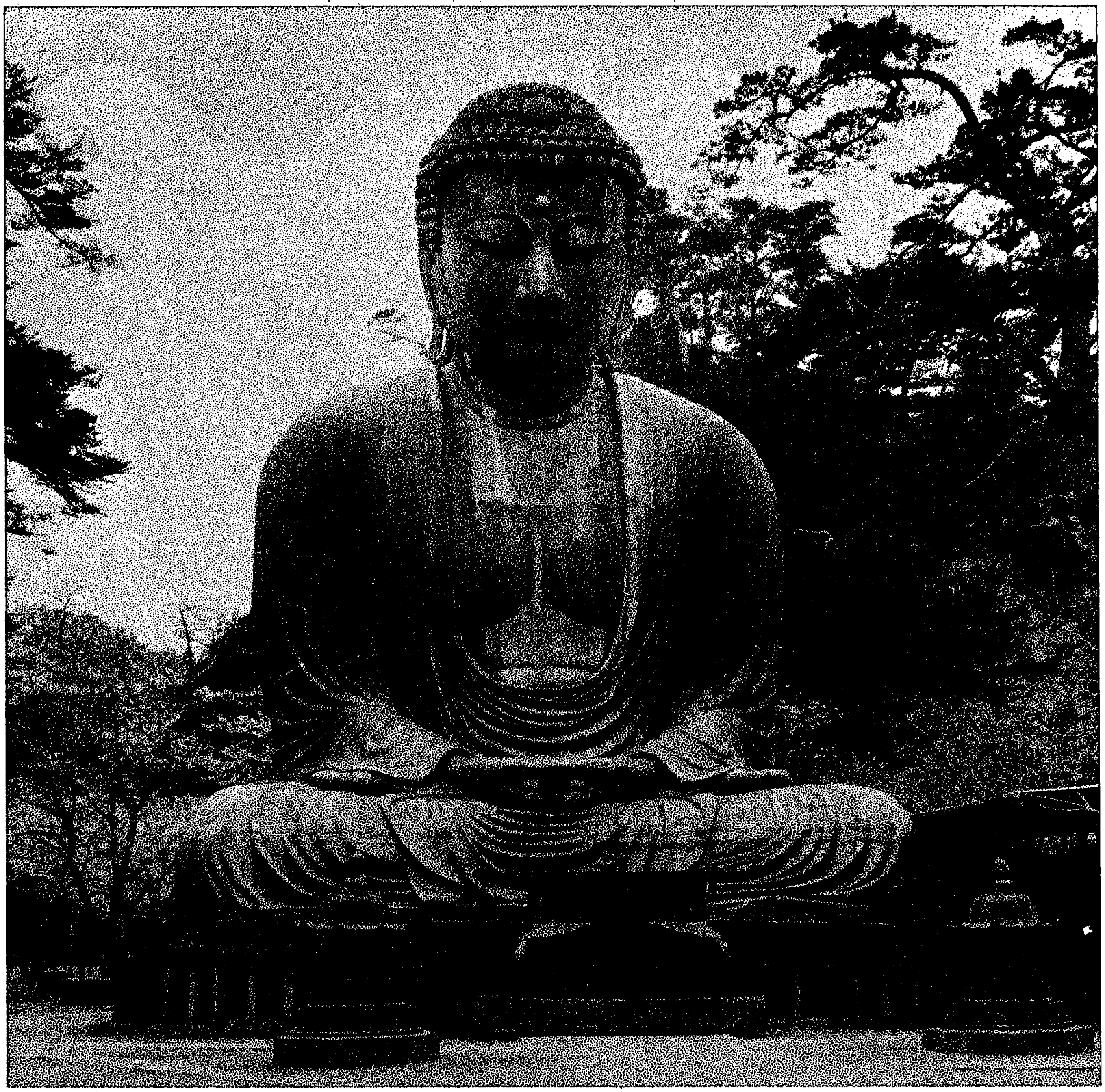
Rather than await the results produced by author's response to the general call for papers, we have identified important subjects and have waged an active campaign to seek out and attract the best in the country. We have not covered all the important matters by any means because of limitations of available program time, and, more important, because we concluded in many cases that insufficient real substance or insufficient quality existed to justify a first-class session. The survivors constitute a solid and exciting program.

Two major types of sessions are scheduled. About half of the 30 sessions are the normal "expository" sessions where formal paper presentations are made. Unfortunately, these sessions must be fully prepared far in advance of the conference, in order to obtain the papers early enough to publish at conference time. To report on more recent developments, to provide a forum for discussion of important issues, and to achieve another important type of communication, we have scheduled panel sessions for the other half of the program. This is the highest percentage of "non-formal" sessions yet produced in a Joint Computer Conference.

In most cases, these panel sessions will open the proceedings to the audience. We look forward to your active participation at this point. There is something about a big room, a big audience, and a formally organized session that inhibits free and easy questions, gutty exchange, and discussion. Therefore, many of our session chairmen plan small "follow-on" sessions after the main session, for those of you who wish to pursue matters further with the speakers or panelists. A different but important kind of communication takes place in these more intimate surroundings.

Quality of subject matter, and quality of presentation of the subject matter, are the key goals. On the former, program design, competent and constructive review, and active

Harry T. Larson



FJCC '67

TECH PROGRAM . . .

panel session development, are the keys—all tough to accomplish with some 400 volunteer people involved, all over the country, busy doing other things.

It's a shame to have good subject matter wrecked by poor presentation. So we've attacked this problem in two ways this year. For the panel session leaders, we've planned a seminar on the subject matter and have assembled a handbook of techniques. For the authors making formal presentations, we've developed a six-hour hard-hitting seminar crammed with principles and facts about the oral/visual presentation of technical papers. We're making a tour of the country, staging one-day stands in cities at the centers of author concentration. We hope to convince the authors to throw away their published version and start over when preparing the oral/visual presentation. By these efforts, we hope to make the whole thing more interesting, achieve better communication, and do more justice to the author and his work.

The reason for all this is to make the technical program a worthwhile investment of your time. We hope you can attend. ■

THE SESSIONS . . .

Tues., Nov. 14

9:30-11:30

Garden Grove Room

Hybrid Facility Performance Improvements

Chairman:

Paul E. Parisot

Monsanto Co.

St. Louis, Missouri

Although the specific demands of particular applications still furnish a major stimulus to effort directed towards hybrid computer performance improvements, a strong impetus now exists for general improvement of facility utilization.

Digital hardware is representing a larger and larger share of the facility cost and its frequently low utilization rate is being closely examined. Many of the same proposals for making pure digital facilities more productive and accessible are also being advanced for hybrid facilities, i.e. multiprogramming, multiprocessing, remote access, etc. However, the hybrid facility undoubtedly presents a greater challenge than the pure digital facility because of critical timing and scheduling problems associated with real-time simulation work. The problem is further compounded by needed improvements in closer communication and integrated control of digital and analog hardware, particularly if we are attempting to increase utilization by increasing hybrid problem throughput.

The presentations of this session deal with some of these problems from a hybrid point of view that takes a stand in neither the digital nor analog world but rather in both.

Multiprogramming for Hybrid Computation, by M. S. Fineberg and O. Serlin.

The IADIC: A Hybrid Computing Element, by Morris J. Bodoia and James I. Crawford.

PHENO—A New Concept of Hybrid Computing Elements, by Wolfgang Giloi and Heinz Sommer.

9:30-11:30

Anaheim Room

Advanced Computer Generated Graphics

Chairman:

Eric G. Vesely

Mobility Systems

San Jose, California

This session explores the improvements made in generating graphic images by computer. It is principally devoted to software actually implemented with emphasis on practical industrial applications.

The four papers will describe programming solutions to problems encountered in graphic generation. These problems range from eliminating hidden surfaces in perspective projections of three dimensional objects to overcoming the inherent jitter associated with data plotting in a motion picture environment.

The paper on holographic displays explains the massive computational problem involved in calculation of the integrals of Kirchoff's diffraction theory in constructing large holograms. The authors will demonstrate how a newly developed finite Fourier transform algorithm has reduced the computational requirements substantially, thereby permitting economical generation of holograms. The authors have produced holograms having 4×10^5 resolution elements from numerically defined objects having 10^5 resolution elements on photographic film.

The paper on textile graphics presents the application of graphics to the production of printed multicolored textile designs. A survey of current methods for obtaining color separation is given. The authors continue by explaining a computer-aided technique they have developed for expediting production of color separation design control information.

Input to the computer includes tracing on an on-line digitizing tablet; free hand drawing with a light pen on a CRT screen; and use of a keyboard with special function keys that request specific computer actions. The software is able to enlarge, reduce, erase, translate, or repeat designs. It can also incorporate "standard" shapes into a design. Output is "long films" produced by an on-line high speed photographic plotter.

The authors of the paper on half-tone perspective drawing describe an algorithm for creating two dimensional half-tone pictures of perspective projections of three-dimensional objects. The algorithm erases hidden surfaces, thereby displaying only visual surfaces. Half-tone shading was incorporated to provide viewers with object illumination for greater visual perception of three-dimensionality. The technique of using small finite triangles to describe objects is also discussed.

VISTA, the subject of the fourth paper, is a programming system developed by the authors for producing a motion picture which is a true representation of a spacecraft orbiting about a central body. The paper discusses two subsystems. The first subsystem creates the dynamic orthographic projection of the bodies in motion including erasing hidden lines. The second subsystem provides title frames, selected overlay information,

MAGNETIC TAPE RECORDING

For thirty years, CEC has been the pioneer and recognized leader in data instrumentation. The analog and digital magnetic tape recorders described here, plus accessories, represent the most complete tape line available today and are the latest reasons why CEC continues to dominate the field.

VR-3700—New from CEC, this recorder has special magnetic heads which extend its frequency range to 2.0 MHz—plus 500 KHz for FM—at the traditional cost of a 1.5 MHz unit. The first and only 2.0 MHz laboratory recorder that combines versatility and reliability at a budget price.

- Magnetic recording heads guaranteed to exceed 1000 hours. CEC's unique, solid metal pole-tip design has eliminated the inherent deficiencies of lamination and rotary head design.
- Failsafe DC Capstan Drive assures dramatically-improved flutter and TDE performance.
- All-Electric Tension Control. Solid-state amplifiers for improved linear tension control and greater reliability.
- 15-inch reel capacity.
- Automatic 8-speed transport with electrically selectable electronics.
- Phase-lock capstan control electronics included for improved speed accuracy.
- Convertible from mid to wideband recording. New plug-in heads offer easy interchange of headstacks up to 42-channel capacity.

VR-3400—Identical in specifications to the VR-3700 transport but with midband electronics. However, should eventual data handling requirements call for a 2.0 MHz response, the VR-3400 may be *converted* to a VR-3700 by a simple exchange of heads and electronics. This modestly-priced recorder will readily meet the vast majority of laboratory requirements.

VR-3300—Unmatched for applications where ruggedness and mobility must be combined with outstanding performance.

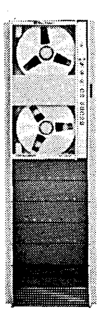
- 100 cps to 300 KHz direct frequency response; dc to 20 KHz FM frequency response.
- Dual capstan drive system provides closed-loop speed and tension control equal to standard laboratory systems.
- Interchangeable record and reproduce electronics and heads with CEC's VL-2810 Continuous Loop Recorder/Reproducer.
- Six-speed record/reproduce system.

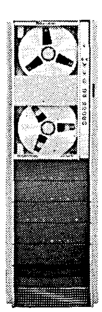
DR-3000—CEC's "universal" digital recorder now offers another *first*—plug-to-plug compatibility with IBM 729 and 2400 Series tape handlers. Result: state-of-the-art performance at approximately half the cost of comparable digital tape systems.

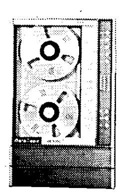
- Fully IBM compatible with full plug-to-plug compatibility at all speeds and densities, 7 or 9 channels.
- Only low-cost transport with straight-line loading for rapid, easy tape handling.
- Unique, all-metal-front-surface heads are guaranteed for a minimum of 2500 hours of tape passing.
- Dual capstans 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.
- Compact, rugged design with unique tape buffering provides the only high-speed system mountable in a 19″ or 24″ rack.

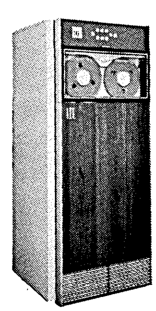
VR-2600 PCM—Features the most advanced electronic circuitry of any PCM recorder. Due to internal clock correction and skew correction circuitry, no delay lines are required. This eliminates the necessity for frequent readjustment and a pulse display unit. Once the VR-2600 has been set up, it may be operated for extremely long periods with no readjustment whatsoever.

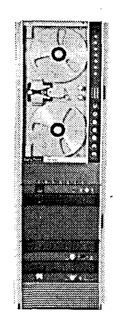
- All solid-state electronics, pushbutton controlled for operation without readjustment at six electrically selectable tape speeds from 120 to 3¾ ips.
- Packing density 1000 bpi.
- Individual speed accuracy ±0.20%.
- Accessories include edge track voice recording/reproducing, shuttle control and monitoring equipment, including both meter and oscilloscope presentation.


VR-3700


VR-3400


VR-3300


DR-3000


VR-2600 PCM

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	VR-3700	VR-3400	VR-2600 PCM	VR-3300	VL-2810	DR-3000	VR-5000
TAPE SPEEDS	8 speeds to 240 ips	8 speeds to 240 ips	7 speeds to 120 ips (in two ranges)	6 speeds to 60 ips	6 speeds to 60 ips	up to 75 ips	8 speeds to 240 ips
TAPE SPEED ACCURACY	±.02% Phase-Lock Servo	±.02% Phase-Lock Servo	±0.2%	±0.25%	±0.20%	±0.3%	±.05%
REEL SIZE MAXIMUM	15 inch	15 inch	14 inch	10½ inch	Loop	IBM	16 inch
DIRECT FREQUENCY RESPONSE	400 Hz 2.0 MHz	300 Hz 600 KHz	1000 BPI	100 Hz 300 KHz	100 Hz 300 KHz	—	400 Hz 2.0 MHz
FM FREQUENCY RESPONSE	dc 500 KHz	dc 40 KHz	—	dc 20 KHz	dc 20 KHz	—	dc 500 KHz

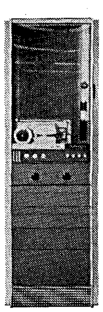
VL-2810—Specifically designed for data reduction or data monitoring and storage where machine work-load is heavy.

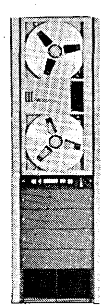
■ Accommodate tape loop runs from 2 to 75 feet at six tape speeds from 1⅞ to 60 ips.

■ VL-2810 handles data in the range from dc to 20 KHz via FM techniques, and from 100 cps to 300 KHz employing direct techniques.

■ Utilizes ½" tape for up to 7 channels, or 1" tape for up to 14 channels, using IRIG geometry.

■ Accessories include selective erase equipment providing erasure of any combination of 7 to 14 tracks, without removal of the tape loop from the machine. Bulk erase equipment also available.


VL-2810


VR-5000

VR-5000—CEC's finest new recorder, the advanced VR-5000 2.0 MHz System has a flutter correction capability five times more effective than any other instrumentation recorder known today. The unique Dual Inertia* (DATALOCK™) tape drive provides the low flutter introduction advantages of high mass recording coupled with the flutter correction and low TDE (±0.4 μsec./120 ips) advantages of low mass reproduce under wideband servo control. Consequently, the VR-5000 is the only recorder capable of translating the ideal system concept into a working reality—*high mass recording and low mass reproduce.*

■ A 3% flutter component at 50 Hz will be reduced at least 20 db; a 1% flutter component at 200 Hz at least 16 db. Thus flutter components from dc to beyond 200 Hz are, for all practical purposes, effectively eliminated.

■ Capstan servo phase-lock capture range is sufficient to lock on a ±30% recorded speed error occurring at a 5.0 Hz rate or a quasi-static speed error of +50%–100%.

■ Longer tape life, fewer "drop-outs", and better amplitude stability are assured by the VR-5000's unequaled servo system, which holds tape tension variations to such a low value they cannot be measured with gages presently available.

■ Positive air pressure tape buffering (patent pending) prevents recording errors due to reel perturbations, while solving the contamination and "sticktion" problems normally associated with vacuum systems. This system, combined with closed loop reel servos, provides 40db of reel to head area isolation.

■ A high inertia flywheel is inserted into the drive system during the record mode to achieve an absolute minimum of recorded flutter components.

■ Tape speed accuracy of ±.05% with tape servo, machine-to-machine.

*PATENT PENDING

CEC DataTape® Accessories

The Monitor Oscilloscope is used with tape recorder/reproducers, or any multichannel instrumentation system to provide visual display of electrical signals ranging in frequency from dc to 3,000,000 cps. Unique features of this unit include up to 500 KHz sweep rate and modular construction.

The Type TD-2903 Automatic Tape Degausser is designed to erase data signals from magnetic tape wound on reels up to 14" in diameter and tape widths from ½" to 2". A reel of 1"-wide instrumentation tape recorded at saturation level is erased to a nominal 90 db below normal level.

The Dynamic Tape Tension Gage permits accurate tension measurements directly while the recorder is in operation ...helps keep your recorder in proper operating condition through routine maintenance adjustment.

CEC Computer & Analog Tapes

All CEC Computer Tapes are well within allowable tolerances of the reference tape used by the computer industry—and all are certified "drop-out free" for the first pass, and remain so for many more. Because of CEC's nation-wide field force and warehousing facilities, tape generally can be delivered within 24 hours. CEC Analog Tape is available in all frequency bandwidths, meets or exceeds the most critical specifications, and offers the same delivery advantages.

For complete information about any of these products, call your nearest CEC Field Office, or write Consolidated Electrodynamics, Pasadena, California 91109. A subsidiary of Bell & Howell. Bulletin Kit 320-X 1.

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and the elimination of data plotting jitters.

Holographic Display of Digital Images, by P. M. Hirsch, L. B. Lesem and J. A. Jordan, Jr.

Textile Graphics Applied to Textile Printing, by J. R. Lourie and J. J. Lorenzo.

Half-Tone Perspective Drawing by Computer, by G. Romney, D. C. Evans, C. Wylie and A. Erdahl.

VISTA—Computer Motion Pictures for Space Research, by G. A. Chapman.

9:30-11:30

Santa Ana Room

Advances In Computer Circuits

Chairman:

Theodore H. Bonn

Honeywell EDP

Waltham, Massachusetts

Progress in semiconductor technology has been explosive. During the past few years we have witnessed a decrease in the cost of individual silicon transistors by almost two orders of magnitude. Functional integrated circuits which contain 5-50 transistors and the associated circuit components are now in large scale production. Devices ten times more complex are being made experimentally in various semiconductor laboratories.

The ability to batch fabricate increasing numbers of circuits on silicon wafers poses some sticky questions: What is the state of the art? How will it be used? What will the digital computer designer have to do to use large chunks of logic on one chip? What are the economics? What is the impact on analog computation? What will be the role of the semiconductor manufacturer?

Panelists:

Thomas A. Longo, Transitron Electronic Corp.

Robert H. Norman, Consultant.

Donald E. Farina, Philco-Ford, Microelectronics Div.

Papers:

Current Status of Large Scale Integration Technology, by Richard L. Petritz.

Large-Scale Integration from the User's Point of View, by M. G. Smith and W. A. Notz.

A Family of Linear Integrated Circuits for Data Systems, by M. B. Rudin, R. L. O'Day and R. T. Jenkins.

9:30-11:30

Arena

Whither Programming Languages?

Chairman:

Thomas B. Steel, Jr.

System Development Corp.

Santa Monica, California

An attempt at prophecy will be made as the panelists predict what the future will yield in the programming language field. In addition, the panel will express its views on what programming language development *ought* to generate in the years to come. It is not at all clear that these two pictures will appear similar.

Among the topics to be considered will be the potential of languages of broad applicability (such as PL/I), the rôle of the so-called "problem-oriented languages," and the future, if any, of machine-level languages. The concept of self-extendability of programming languages, both in the conventional manner through the use of macro-instructions and also in more general and less well-known fashions, will be given thorough treatment.

Another subject certain to receive considerable discussion is that of employing "natural language" as a programming language. With respect to this point it should be noted that "natural language" and "ordinary English" are not synonymous. The "natural" language for many problems may well be highly stylized and symbolic, as is mathematical notation, for example. Clearly there is a relationship between "natural languages" and the previously mentioned topic of problem-oriented languages.

In addition to a discussion of programming languages *qua* languages, the future of compiler technology will be given consideration. It is obviously futile to speculate on ideal programming languages that are unimplementable. Related to this topic is the relationship between programming languages and operating systems, as well as the influence of new hardware developments such as read-only-storage on the prospects for programming language developments.

Panelists:

P. H. Dorn, Union Carbide.

R. McClure, Consultant.

J. E. Sammet, IBM Corp.

F. V. Wagner, Informatics, Inc.

1:00-3:00

Garden Grove Room

Hybrid Computation—Several Applications

Chairman:

Arthur I. Rubin

Martin Marietta Corp.

Orlando, Florida

The most general application concerns the use of hybrid computers for obtaining the solutions of integral equations. The remaining application papers deal with problems arising in the aerospace industry. However, the presentations include lengthy discussions of topics of general interest to the hybrid computer field.

These topics include 1) the use of masses of the relatively new Multiplying Digital to Analog Converters (MDAC) for extremely fast hybrid function generation for a large number of functions of two and three variables, 2) the discovery of the need for a variable compensation for digital computation delay in a hybrid loop when the simulated system exhibits variable damping, and 3) a rather general discussion of problems encountered and techniques used for their solution in an Apollo docking simulation.

Flight Simulation of a Six-Degree of Freedom, Man-in-the-Loop Lifting Reentry Vehicle, by Paul F. Bohn.

The Solution of Integral Equations by Hybrid Computation, by G. A. Bekey, R. Tomovic and J. C. Maloney.

The Effect of Digital Compensation, for Computation Delay in a Hybrid Loop, on the Roots of a Simulated System, by E. E. L. Mitchell.

Hybrid Apollo Docking Simulation, by B. B. Johnson and S. Weiner.

1:00-3:00

Santa Ana Room

Display Systems & Equipment

Chairman:

S. Sherr

Sperry Gyroscope Co.

Great Neck, New York

The paper on console displays gives a thorough discussion of significant performance characteristics and capabilities of CRT display systems. It describes the basic functional elements which make up such systems as character generation, deflection amplifiers, and CRT's, and presents the range of performance achieved in available equipment, as well as trends which indicate significant improvements in speed, accuracy and other parameters. By combining achieved performance with expected improvements, it serves both as introduction to, and detailed review of, the existing and anticipated capabilities of this type of display equipment.

The area of large screen displays is given a similarly comprehensive treatment based on present and contemplated developments in the field. It includes application information and describes the limits of performance in a number of systems. Also mentioned are some new approaches under study for future development, such as lasers, solid state light valves, and novel film processing techniques. The need is for faster response and more reliability, and some of the new approaches appear promising.

The two additional papers offer examples of specific items of equipment which are treated in a much more extensive fashion than is possible in the two general papers.

Graphic CRT Terminals—Characteristics of Commercially Available Equipment, by C. Machover.

How Do We Stand on the Big Board?, by M. Kesselman.

The Display Subsystem of the IBM 1500, by R. H. Terlet.

Conic Display Generator Using Multiplying Digital/Analog Decoders, by H. Blatt.

1:00-5:30

Anaheim Room

Impact of LSI on Future Computer Systems

Chairman:

Rex Rice

Fairchild Semiconductor

Palo Alto, California

At the present time it is not clear whether LSI will, or will not, help solve programming. In fact, one can seriously question whether LSI alone will do anything for us. Several items of major significance which have evolved from the discussions to date are itemized below:

1. LSI will disturb the old balance of work assignments between device, circuit, logic and systems designers.

2. LSI will disturb the present relationship between component suppliers and system manufacturers.

3. System architecture must be changed if the maximum low cost potential of LSI is to be realized. The number of interconnection pads is now far more important then the number of circuits required for a given amount of logic.

4. Invention is needed in architecture using large quantities of low cost logic if any inroads on programming difficulties are to be realized.

The promised low cost feature of LSI can only be realized through a new type of system architecture. Miiller will present a dramatic reduction in interconnection pad requirements, even effective in arrays as small as a few dozen gates. The implications of proper functional partitioning of both data path and control structures has far reaching hardware and architectural significance.

The rapidly increasing interest in time-sharing systems is producing an expanding market for logical hardware in peripheral equipment. In a brief discussion, Low will emphasize the very large market for LSI in peripherals and comment on how increased logic may reduce programming problems.

The status of integrated circuits from high volume production circuits through newly introduced lines to research array circuits will be illustrated.

Evans has done extensive research exploring how different, improved and increased amounts of logic may be used to reduce programming difficulties.

Creech will discuss how computer hardware resources that allocate themselves will aid in reducing system programming problems.

Next, four panelists will present their views on the role LSI can play in either reducing cost for the same performance or in greatly enhancing performance at present costs.

Part II will be an audience participation discussion with the panel.

Paper:

System Architecture for Large Scale Integration, by H. R. Beelitz, R. J. Linhardt, and H. S. Miiller.

Panelists

Paul Low, IBM Components Div.

Wendell Sander, Fairchild Semiconductor, R&D Laboratory.

David Evans, University of Utah.

Bob Creech, Burroughs Corp.

1:00-5:30

Arena

Executive Control Programs

Chairman:

Joel D. Erdwinn

Computer Sciences Corp.

El Segundo, Calif.

The major problem facing a designer of a real-time or time-shared system lies in the specification of the control program. Choices must be made as to the most appropriate techniques for scheduling the system's various activities, for insuring protection against program and equipment failure, and for providing suitable man-machine interaction environment. This session contains five papers which address these problems as encountered in a variety of circumstances. The systems presented are concerned with both large and small equipment configurations, with stringent and modest response time requirements, and with penalty for system failure from mild inconvenience to loss of life. All papers deal with systems now functional.

Management of Periodic Operations in a Real-Time Computation System, by H. Wile and Gerald J. Burnett.

A Generalized Supervisor for a Time-Shared Operating System, by T. C. Wood.

A Real Time Executive System for Manned Spaceflight, by J. L. Johnstone.

Executive Programs for the LACONIQ Time-Shared Retrieval Monitor, by D. B. J. Bridges.

An Executive System for On-Line Programming on a Small Scale System, by L. V. Moberg.

3:30-5:30

Garden Grove Room

Input/Output Techniques

Chairman:

Irving L. Wieselman

Data Products Corp.

Culver City, California

This session deals with four areas of I/O equipment, each employing


SEL
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several disciplines. The first area relates to the external storage problem, stressing the current state and future potential of magnetic recording technology. The second area relates to the output printing problem where a novel thermal technique provides an attractive solution. The third and fourth areas relate to the general problems of hybrid systems. One approach transforms synchro information to digital and eliminates electromechanical servos by using digital techniques. The other approach converts transducer information to digital by processing phase-encoded information utilizing a new digital technique.

The first paper reviews the current status of mass storage compared with predictions made by the author five years ago. The first significant solution to mass storage was the continuous magnetic tape. Today, devices exist using magnetic discs, drums, strip and cards as well as tape. The principal advantage of these devices is their direct access capabilities as opposed to sequential access. The online availability of significant amounts of data has profoundly affected programming, systems design, time-sharing and general data processing techniques.

The second paper, which discusses high-speed thermal printing, presents a unique design approach to the printing problem. This approach uses a print head comprising an array of resistors which can be electrically heated in a manner to produce thermal images. Printing is accomplished by utilizing a thermal-sensitive paper which is held in contact with the print heads. The special paper can then be used to print multiple copies on plain paper by simply pressing the paper together.

The third paper deals with a technique for converting synchro information, in the form of an AC analog signal, to a digital form. The conventional technique uses electromagnetic and electromechanical equipment in the conversion process. In the proposed device, the signals are processed as analog signals and then converted to a digital form by digital servo techniques using differential analyzer modules. This mechanization accounts for scale factors and tends to eliminate errors normally introduced by analog equipment. The digital output provides the required angular values as well as the sine and cosine functions. This versatile conversion technique will minimize electromechanical equipment and place the conversion process closer to the digital domain.

The fourth paper discusses a new high speed input-output mechanism which transforms analog signals in the form of phase modulated information to a digital form. The method utilizes a phase-locked loop with a countdown counter which serves as an electronic servo to keep the digital output at the required binary phase angle.

Mass Storage Revisited, by A. S. Hoagland.

High-Speed Thermal Printing, by Richard D. Joyce and Stanley Homa, Jr.

Solid State Synchro-to-Digital Converter, by G. P. Hyatt.

A New High-Speed General Purpose I/O with Real-Time Computing Capability, by Kenneth Fertig and Duncan B. Cox, Jr.

3:30-5:30

Santa Ana Room

Management Information Systems

Chairman:

A. J. Critchlow

Mobility Systems, Inc.

San Jose, California

Currently, management information systems are being increasingly accepted as essential tools for modern management. There is still much potential, however, for improvement and growth to meet the ideals proposed by management information enthusiasts.

This session will examine some of the problems—technical, economic, political and psychological—which have slowed the full utilization of the projected benefits of management information systems.

The ideal management information system would have:

1. A data base consisting of all information valuable to management.
2. A communication system capable of gathering and transmitting the required information to all parts of an industrial complex or government entity.
3. Means for organizing the data into useful, preferably predictive, form.
4. Means for displaying information rapidly and accurately.

Sounds like a set of patent claims, doesn't it? The question is: How do we get from the present condition to the future one?

A paper in this session by Benner describes a typical data base and the problems of organizing it in a useful way. Data is not usually arranged in a file in such a way as to meet the current need. He describes one way to set up files to prepare for a large number of contingencies. Not all, but a good subset.

Woodgate, from London, describes a way of using data to take the *next step* beyond PERT and CPM to provide management with useful means for resource allocation, cost planning and project profitability assessment. This approach results in meaningful prediction of expected future results based on knowledge of the present and past. Data of this type can be of great aid in management decisions.

These are examples of technology and methods which will be used as a start for the discussion period. Included in the assumed basic background of technology and methodology will be all the new software approaches described at the FJCC. Also the availability of large disc memories and the trend toward high quality graphic displays will be pointed to as partial proof that technology is available to do the tasks required in management information systems.

Papers:

Design Considerations and Techniques for Direct Access File Records, by F. H. Benner.

The Planning Network as a Basis for Resource Allocation, Cost Planning and Project Profitability Assessment, by H. S. Woodgate.

Panelists:

Robert V. Head, Software Resources Corp.

V. A. Van Pragg, Consultant.

F. H. Benner, Bell Telephone Co.

Franklin Afferton III, C-E-I-R, Inc.

J. J. Pariser, Hughes Aircraft Corp.

D. A. Forman, Chrysler Corp.

H. S. Woodgate, International Computers & Tabulators, Ltd.

Wed., Nov. 15

9:00-11:30

Garden Grove Room

Computing in the Social Sciences and Humanities

Chairman:

Joseph Raben

Queens College

Announcing the Bryant CPhD: 7.25 million bit capacity, no bigger than a breadbox.

No kidding. The new low-priced Bryant 10″ drum packs 192 data tracks with Read, Write, and Select Electronics. And an average positioning time of 40 milliseconds. Just right for small and medium-size data processing applications. How do we do it? With Series 9000 integrated electronics—our new monolithic circuitry that's also more reliable and economical than conventional circuits. And more flexible. The mini-giant can be interfaced to nearly any computer system (new or only a gleam in somebody's eye), with either the Bryant XLO-1000 plug-in Controller or your own controller. Sound too good to be true? Contact your local Bryant sales office or write Ex-Cell-O Corp., Bryant Computer Products, 850 Ladd Rd., Walled Lake, Michigan 48088. You'll be a "Bryant Believer" before you know it.

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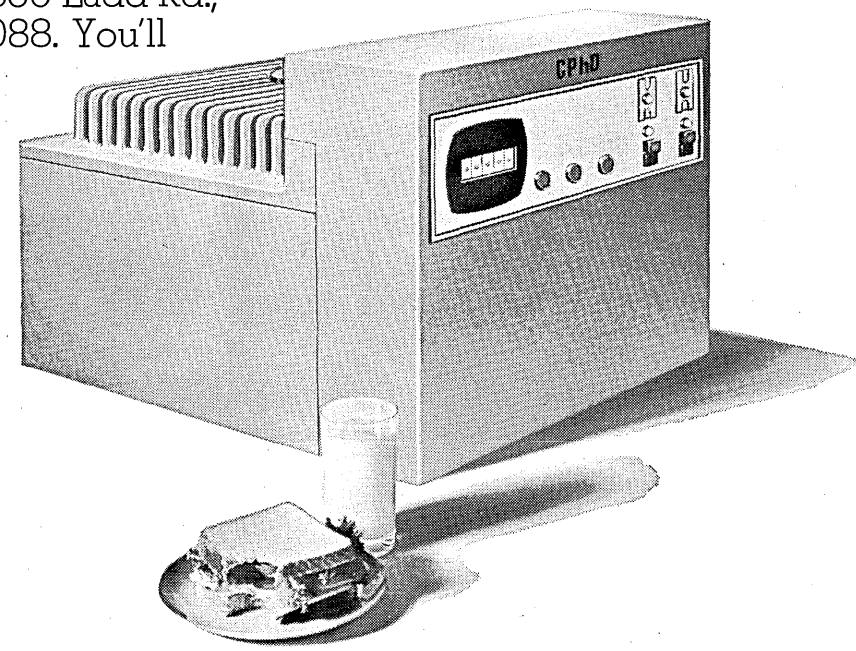


SEE US AT THE FALL JOINT COMPUTER CONFERENCE, BOOTH 1302.

CIRCLE 57 ON READER CARD

THE SESSIONS . . .

Flushing, New York

This session will consist of four papers—on political science, archaeology, literature, and music. In each of these disciplines, the problem has been, first, to reduce the qualitative concepts to quantifiable data, and, second, to manipulate simultaneously the many variables that must be measured. Among the present successes in all these fields has been relatively simple information-retrieval operations, like the compilation of bibliographies and concordances. Beyond this, the social scientists, who are accustomed to some method of measuring, have generally been able to adapt computer techniques which have been perfected elsewhere. Those humanists, however, who wish to solve problems traditional to their studies without introducing such historically alien methods as statistics are finding greater difficulty.

There is, nonetheless, a slow but increasing recognition of the computer's role in analysis as well as information retrieval. These four papers record workshops, publications, groups projects, and other evidences of growing acceptance among social scientists and humanists of machine applications. While some scholars warn of the twin dangers that their colleagues will either reshape their thinking to suit the capacities of the computer or be seduced into following only those projects which the computer has made simple, a small band of forward-looking researchers is seeking new ways to expand and deepen their knowledge of their subjects.

Computer Applications in Political Science, by Kenneth Janda.

Computer Applications in Archaeology, by George L. Cowgill.

Winged Words: Varieties of Computer Application to Literature, by Louis T. Milic.

Music and Computing: The Present Situation, by Allen Forte.

9:00-11:30

Arena

Memory System Technology

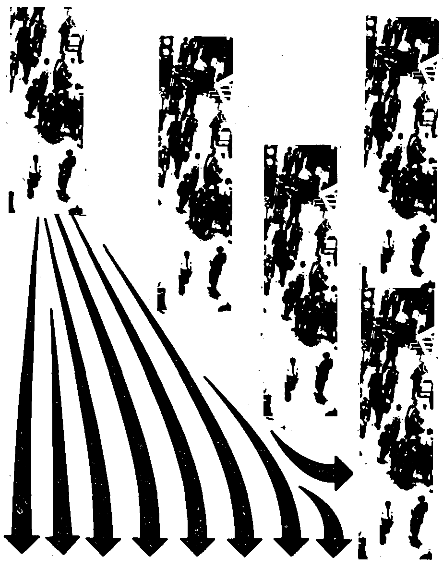
Chairman:

L. M. Spandorfer

Univac

Philadelphia, Pennsylvania

The papers in this session range from mature designs which are currently being placed, or close to being placed, into large scale service, to those developments in the category of being highly promising for future systems. Magnetic flat thin film and extended core are in the former category, and mass plated wire, MOS, and holographic semipermanent memory are in the latter. The planar film memory paper has considerable design emphasis on economy. The



2½D extended core paper describes a new economical bit access technique. The third paper reports on progress toward the attainment of low cost mass plated wire. The semiconductor memory paper describes a fully populated MOS stack/bipolar driver memory. The last paper describes a significant new holographic technique for potentially achieving a semi-permanent memory with inexpensive removable media.

The B8500 Half-Microsecond Thin-Film Memory, by Richard I. Jones and Eric E. Bittman.

Bit Access Problems in 2½D x 2-Wire Memories, by Philip A. Harding and Michael W. Rolund.

Engineering Design of a Mass Random Access Plated Wire Memory, by C. F. Chong, R. Mosenkis and D. K. Hanson.

Low Power Computer Memory System, by D. Brewer, S. Nissim and G. Podraza.

A Technique For Removable Media Read-Only Memories, by Robert E. Chapman and Matthew Fisher.

9:00-11:30

Anaheim Room

Software for Hardware Types

Chairman:

R. R. Johnson

Burroughs Corp.

Detroit, Michigan

Three aspects of programming and how it has influenced and should influence hardware design are presented. In the first paper the characteristics of compilers and corresponding language considerations affecting hardware design are poignantly pictured. Significant improvements can and have been made in system throughput and/or in programming efficiency by designing hardware completely around programming system considerations.

The nature of executive routines and how they have influenced and should influence hardware designs as well presented in the second paper. The author shows what functions have been included in operating systems and covers why and how the hardware has been changed in response to the needs of these programs.

The third paper discusses diagnostic programs, their nature, and the hardware designs stemming from the need to fix and recover from computer failures.

The speakers describe what a compiler, an executive control program and a diagnostic program is; they show how these three different programming considerations have affected hardware design; and finally in various hopefully provocative ways, they say what's needed in the hardware as seen through a programmer's eyes.

Language Directed Computer Design, by W. M. McKeeman.

The Ever Widening Moat Between a User Program and the Hardware, by A. Tonik.

System Recovery from Main Frame Errors, by R. Armstrong, H. Conrad, P. Ferraiolo and P. Webb.

9:00-11:30

Santa Ana Room

Digital Simulation Languages and Systems

Chairman:

Philip J. Kiviat

The RAND Corp.

Santa Monica, California

Digital computer simulations of the discrete-event type were first applied in the early 1950's to the analysis of military and industrial systems. During the past few years, simulation has become a working tool in the computer industry, being used extensively for computer hardware design and for the evaluation of computer system configurations. A number of recent projects have applied simulation techniques to software and combined hardware-software systems; unfortunately, many of them have not met with great success.

Most of the software simulation failures have been blamed on the complexity of the systems considered. People have had difficulty defining software systems properly; few have been able to balance model abstraction and realism so that operating models fit into available memories and execute in reasonable amounts of time. Claims have been made that these simulations are somehow "different" from the industrial and military systems we are most familiar with and know most about.

As a result of these systems being different, or at least being treated as different, the special simulation programming languages developed over the past 10 years are not being used. While it is true that the experience that went into these languages was with systems of a different kind, they have had such a large impact on the simulation field that it seems reasonable to ask why so little of their technique is being transferred. The primary goal of this session is the exploration of this and related questions.

The session is organized around four papers, each presenting a different aspect of software or hardware-software simulation.

An Approach to the Simulation of a Time-Sharing System, by N. Nielsen.

SODAS and a Methodology for System Design, by D. L. Parnas and J. A. Darringer.

Design, Through Simulation, of a Multiple-Access Information System, L. R. Glinka, R. M. Brush and A. J. Ungar.

Experiments in Software Modeling, by D. Fox and J. L. Kessler.

2:30-6:00

Garden Grove Room

Achievements in Medical Data Processing

Chairman:
Lee D. Cady, Jr., M.D.
Univ. of Texas
M. D. Anderson Hospital
Houston, Texas

This session is planned to examine the goals and requirements for the application of computer systems to the problems of medical centers. Recent achievements in this area include shared hospital dp centers that accomplish business and accounting functions; the automation of chemical laboratory functions; the acceleration of medical research by the availability of special-purpose hardware and statistical packages combined with interactive displays; and the development of generalized medical information systems for patient care and hospital management.

Hardware features necessary to the hospital management information system will be discussed in terms of systems currently available. The problems of available software and personnel are difficult, and discussion will be presented as to how these problems can be lessened by new philosophies of medical data collection, special-purpose hardware for multiprogramming systems, and development of analytic aids. The solution of individual problems will be considered relative to their importance as building blocks to a useable, integrated system.

A Cooperative Data Processing Service to Minnesota Hospitals, by John P. Bodkin and John H. Anderson.

Use of Displays with Packaged Statistical Programs, by W. J. Dixon.

MEDATA — A New Concept in Medical Records Management, by Caroline Horton, T. M. Minckler and L. D. Cady.

Requirements for a Data Processing System for Hospital Laboratories, by Irwin Etter.

An Advanced Computer System for Medical Research, by William J. Sanders, D. Cummins, R. Flexer, K. Holtz, J. Miller and G. Wiederhold.

2:30-6:00

Santa Ana Room

Main Frame Memory Technology

Chairman:
Tudor Finch
Bell Labs
Murray Hill, N. J.

Soon after its invention, the ferrite core became firmly established as the only technology used for main frame memory. Many times since then, as other technologies with allegedly superior qualities emerged from research laboratories, the demise of the ferrite core was confidently predicted. But in the meantime, the core has improved, too, and has yielded no ground to the would-be challengers. With the advent of third-generation computers, however, it appears the situation is finally changing; magnetic planar thin films and plated wires have been committed to main frame memory applications.

The third generation has also seen the introduction of small semiconductor scratchpad memories, and claims have been heard that semiconductors will extend their domain to include main memories in the next generation.

The purpose of this session is to debate what technology will be used in *main memories* in the next generation of computers. The scope of the debate is purposely limited to main memories, to avoid getting trapped in the side issues involving the best technology for mass files and special-purpose memories (e.g., buffers, control memories). Questions for debate are:

Will next-generation main frame memory technology be magnetic or semiconductor?

If it is magnetic, will it be planar magnetic film or plated wire?

If it is semiconductor, will it be MOS or bipolar?

Panelists:

R. J. Petschauer, Fabri-Tek, Inc.

Q. W. Simkins, IBM Corp.

G. A. Fedde, Univac.

Sam Nissim, Bunker-Ramo.

Roger S. Dunn, Texas Instruments.

Wendell Sander, Fairchild Semiconductor.

2:30-6:00

Arena

Information Sciences and Computer Utilities

Chairman:

E. M. Grabbe

TRW Systems

Redondo Beach, California

Important factors in the future commercial development of such services are the availability and cost of communication circuits and terminal equipment. Interest has recently been focused on these areas by the Federal Communications Commission notice of its inquiry into the "regulatory and policy problems presented by the interdependence of computers and communications service facilities."

Three of the six panel members will give short position presentations, followed by discussion among the panel members and questions and discussion from the floor. The goals of the panel will be to clarify the interdisciplinary problems and relationships between computers and communications which, as one panel member stated, "have placed the computer and communication industries on a collision course." Specific areas of information services to be reviewed in relation to communications are: experience in operating hardware and software systems, interface requirements, system economics, communication costs, future developments in communication circuits and public policy.

Some of the positions taken and questions raised by panel members are:

—The real success of the common carrier business has been its ability to anticipate the future, to introduce new services even before users have requested them.

—If common carriers feel that they cannot announce service they are not prepared to make generally available, then the customer should have the right to run the risk of using faster devices without the common carrier's guarantee.

—Is the public benefited by restrictions on the nature of data sent down a line purchased from a common carrier?

—On the broadest and most philosophical level there is a problem in the basic environment of a highly regulated utility, especially in the face of rapidly changing technology.

—Does the asymmetrical relationship between the computer and communications industries effectively bar market entry to major candidates who wish to offer computer utility services, particularly if those firms reside in the non-regulated sector of the economy?

—Are only two options open to the computer services, competition or regulation, or are there other choices?

—Are the ground rules for market entry at stake in the current FCC investigation?

—New dataphone sets for transmitting 3600 bits per second over dial telephones and 7200 bits per second over private lines will be available in the near future. A 50 kilobit per second dataphone is now being offered on a trial basis in one locality.

—Would not a new digital transmission system which some computer users want duplicate facilities which already exist?

Panelists:

James D. Babcock, Allen-Babcock Computing, Inc.

Guy H. Dobbs, H. H. Isaacs Research and Consulting, Inc.

E. H. Gibbons, Western Union.

Manley R. Irwin, Federal Communications Commission.

W. B. Quirk, American Telephone and Telegraph.

W. E. Simonson, CEIR.

2:30-6:00

Anaheim Room

New Developments in Programming Languages and Language Processors

Chairman:

Joseph Smith

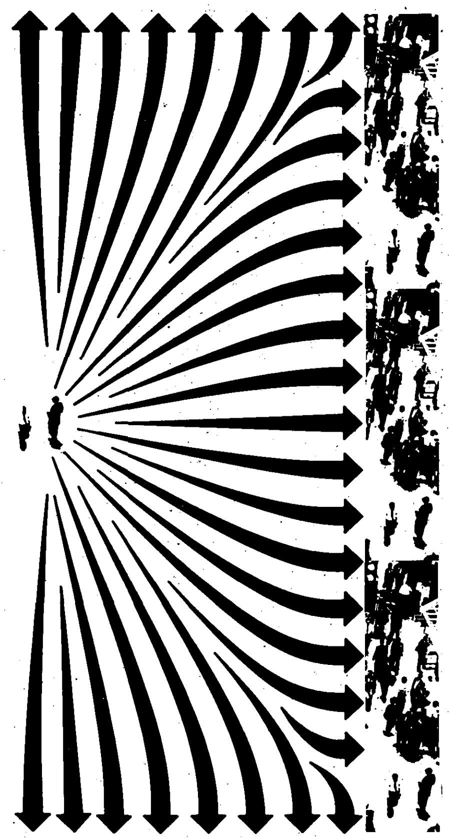
The RAND Corp.

Santa Monica, California

Many techniques for defining languages and language processors are, by now, included in the repertoire of most programmers, so that the business of implementing special-purpose and ad-hoc systems and languages has been able to flourish. In fact, the activity is so widespread that much of the work undoubtedly remains unreported. Work in this area properly treats languages and language processors as integral components of systems designed for specific purposes, with correspondingly well-defined measures of performance. Two of the papers to be presented reflect this point of view and also indicate the growing interest in on-line, interactive systems wherein the old choice between interpretation and compilation must be made on the basis of the intent of the system and of its desired performance: Feingold describes a language and an interactive system for the construction, testing and modification of classes of programs designed for interactive service; Balzer describes a representation-independent adjunct to PL/I as an integral part of an interactive system for program composition and debugging.

The pervasive problems of defining and representing data and of integrating data with program are treated by two papers: Mealy offers precise explications for the notions of data structure and data definition, and proposes a marriage of procedure and data definition to achieve representation-independent programming; Balzer, on the other hand, proposes divorcing program definition from data descriptions to achieve the same end.

The formal definition of languages



and language processors remains a vital area of interest, much of the work being directed toward techniques for handling richer, less stylized languages than the current crop. In this area, Donovan and Ledgard describe a new formalism for specifying syntax and translation schema for context-sensitive languages, with some emphasis on the handling of declarations; Jonas introduced the linguistic theory of transformational grammars to the field of programming languages.

The difficult problem of generating efficient running programs is not treated at all in this session. As in the construction of special-purpose processors, much of the work in this area undoubtedly remains unreported, and

There's a cycle at work in the steel industry. It begins the moment a customer places an order.

When it ends is critical, because today quality in the steel industry is universally high. Prices are competitive. The big difference is customer service. The crucial question is: how fast can you deliver? The answer depends chiefly on how fast work begins on the customer's order.

Before computers came onto the scene, the order cycle took three weeks. (Often, time was lost just determining if and when room could be found for the customer's order.)

Today the sales division of one of the world's giants in the steel industry relies on a UNIVAC® 490 to shorten this cycle.

Now, in 85% of the cases, the three week wait has shrunk to a maximum of 48 hours.

Now data (and lots more data) can be accessible to remote locations on request. And when the requirements of a customer's order change, a lot of people who need to know about it will know about it simultaneously.

A hypothetical case: A customer needs his order of steel cable sooner than expected because progress on

Next time you order a

The crucial question in the steel industry is: how fast can you deliver?

the bridge he's building has been accelerated by a warm weather spell.

This means a shift in scheduling which affects plant availabilities, cost factors, date of shipment, and ultimately, invoicing.

The new data is fed into the UNIVAC 490, a real-time system. Information from then on is revised to be up-to-the-minute. Any outlying plant with a terminal device can have that information instantaneously.

This particular 490 has been in operation for 3½ years. It has been used twenty hours a day, five days a week and 16 hours on Saturday. During all that time the machine has been "down" only once.

UNIVAC systems are at work at the major steel companies and throughout the entire metals industry.

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bridge you'll get it faster.

The answer depends chiefly on how fast work begins on the customer's order.

the lack of papers specifically directed toward this critical area is probably more indicative of the complexity of the problem than of any lack of interest.

Another Look at Data, by G. H. Mealy.

Dataless Programming, by R. M. Balzer.

PLANIT: A Flexible Language Designed for Computer-Human Interaction, by S. L. Feingold.

A Formal System for the Specification of the Syntax and Translation of Computer Languages, by J. Donovan and H. F. Ledgard.

Generalized Translation of Programming Languages, by R. W. Jones.

8:00 P.M.-10:00 P.M.

Anaheim Room

Proprietary Protection of Computer Programs

Chairman:

Thomas C. Rowan

The RAND Corp.

Santa Monica, California

As software has begun to account for a proportionately larger share of systems costs, and as more sophisticated and special purpose programs are being developed, attempts are being made to protect software investment.

The history, current practices and existing and proposed legislation for protection by patent, copyright, licenses, and trade secrets will be outlined. For example, the term "computer program" does not appear in the classification of copyrightable works in the Copyright Law, and the question of whether or not computer programs are appropriate for copyright protection at all will be considered. A patent is intended to protect an "invention" for 17 years; a copyright is intended to protect an author's order of words for 28 years. Do either of these concepts of protection apply to computer programs? Perhaps the practice of considering a computer program as a trade secret would afford the most protection. The criminal laws regarding theft of trade secrets, particularly the implications of the new California law, will be discussed.

The relatively recent decision on the part of the Copyright Office to permit registration of computer programs, if certain requirements are met, has pointed up the difficulties involved in physically marking a computer program with a visible notice of copyright, since the notice must appear on any representation of the program, whether on hard copy printout, punched cards, magnetic tape or disc. Even if all the technical problems were solved, the question of just how much protection is afforded remains.

The panel will discuss such questions as: If proprietary rights are violated, what remedy does the "proprietor" have? What are the penalties for patent and copyright infringement, breach of contract, or violation of laws for theft of trade secrets? How should proprietary computer programs be marketed? Should it be by agreements, licenses, outright sale? How can rights be preserved or lost?

Finally, the impact of proprietary protection on the growth of information processing and the future of the software industry will be discussed.

Panelists:

Jerome Priest, Computer Resources Corp.

Reed C. Lawlor, Patent Attorney.

Kenneth Poovey, Gibson Dunn and Crutcher.

Richard C. Jones, Applied Data Research.

8:00-10:00 P.M.

Garden Grove Room

Digital Computers In Process Control

Chairman:

Rowland Lex, Jr.

Leeds & Northrup Co.

North Wales, Pa.

The panel members will review the present state-of-the-art of digital computers in process control systems, paying particular attention to the rapidly developing field of direct digital control. The session will consist of four tutorial presentations, followed by a discussion period during which audience participation is invited.

The Interrelationship of Plant Applications and Computer System Configurations, by T. J. Williams.

Characteristics of Control Computers and I/O Equipment, by G. W. Markham.

Control Algorithms, by K. W. Goff.

Programming Methods for Process Control Computers, by E. C. McIrvine.

8:00 P.M.-10:00 P.M.

Santa Ana Room

Problems of Intelligence For Robots

Chairman:

Joseph K. Hawkins

Philco-Ford Corporation

Newport Beach, California

A panel of experts in the fields of robots and artificial intelligence will discuss problems of intelligence for robots.

Robots, for purposes of this session, are defined as stored-program automata. Excluded from the discussion are man-controlled vehicles or manipulators, fixed-cycle mechanisms, and fixed-program automation systems.

Memory and data processing are the crucial features which distinguish the new breed of robots from their more prosaic predecessors.

Robots presently available on the commercial market include stationary automatic transfer—materials handling—machines, and mobile, programmable-path vehicles. They are currently finding application in such industrial tasks as paint spraying, brick loading, glass and ceramic handling, and warehousing.

Research currently under way on robot systems is aimed at increasing the capabilities of robots to sense their environment and maneuver within it. Optical image sensors and pattern recognition logic for dealing with complex visual scenes are under investigation at one institution. Methods for automatic path-finding in an environment cluttered with obstacles are being studied at another. The government is supporting these projects with substantial funding.

The challenge for the computer industry in this expanding field lies in three areas: cost, reliability, and performance. In the interests of cost, robots presently on the market incorporate only rudimentary program memory stores. Manufacturers are anxious to enlist the aid of the computer industry in increasing the size and flexibility of robot memories while maintaining costs within economic limits.

Visual, tactile, and other sensors are expected to allow industrial robots to perform more complex tasks, with less detailed setup and programming.

Panelists:

Ruth M. Davis, National Library of

Medicine.

J. F. Engelberger, Unimation, Inc.

Joseph K. Hawkins, Philco-Ford Corp.

Marvin Minsky, Massachusetts Institute of Technology.

Nils J. Nilsson, Stanford Research Institute.

Richard C. Simon, AMF Versatran.

8:00 P.M.-10:00 P.M.

Arena

Techniques to Facilitate Conversion

Chairman:

R. M. Franklin

Chrysler Corp.

Detroit, Michigan

This panel discussion session provides a platform for specialists in the data management field to present solution philosophies to the problem of systems conversion. The four members of the panel will present five-minute statements describing their experience and approach to major management conversions. At the conclusion of the position presentations the panel will discuss the merits of each approach and will solicit questions from the attendees. Specific attention will be paid to standardized language as an aid to conversion ease, the pro's and con's of language simulation and language synthesis versus hardware emulations in the context of ease of use and cost performance. Both users and manufacturers are represented on the panel thereby providing a platform for exposing, opposing, and divergent philosophies.

Two position papers will be published in the conference proceedings and will lay the background for a give and take discussion. One paper will describe Lockheed's experience and hopes to date for self-compiler and decompilers. Another paper displays the relative benefits of a fundamental management policy of planned continuous computer change. The panel will be concerned with identification of emerging trends and software design criteria which would materially reduce management system conversion costs.

Panelists:

Stanley R. Erdreich, Univac.

W. Barkley Fritz, Westinghouse Electric Corp.

Maurice H. Halstead, Lockheed Missile and Space Div.

Clarence B. Poland, IBM Corp.

Thurs., Nov. 16

9:00-11:30

Garden Grove Room

The Impact of New Technology on the Analog/Hybrid Art—I

Chairman:

George A. Bekey

Univ. of Southern California

Los Angeles, California

The major emphasis of this session will be on new developments and new problems in software for hybrid computer systems. The first attempts at creating useful combined analog-digital computers were faced with a multitude of hardware problems associated with connecting a discrete, sequential machine to a continuous parallel machine.

The current problems in hybrid software are directed toward improving the efficiency of man-machine communication, toward improving reliability, and toward achieving efficient system simulation languages.

This panel will concentrate on the most important of these problems. The first paper will discuss the development of problem control routines and efficient execution of hybrid problems. The second paper will review diagnostic software—an area long neglected in purely analog systems but of great importance in the efficient use of hybrid computers. The third paper will trace the software development, the operating system and the final integrated software-hardware package in the new Lockheed hybrid system, which involves four large analog computers tied into a large digital computer. The final paper will discuss the development of the Continuous System Simulation Language (CSSL) and its possible effect on the hybrid computer field.

Hybrid Executive and Problem Control Software, by E. Hartsfield.

Diagnostic Software for Operation and Maintenance of Hybrid Computers, by R. E. Lord.

A Large Multi-Console System for Hybrid Computations: Software and Operation, by C. K. Bedient.

Simulation Languages and the Analog/Hybrid Field, by J. C. Strauss.

9:00-11:30

Santa Ana Room

Computers and the Future of Law Enforcement

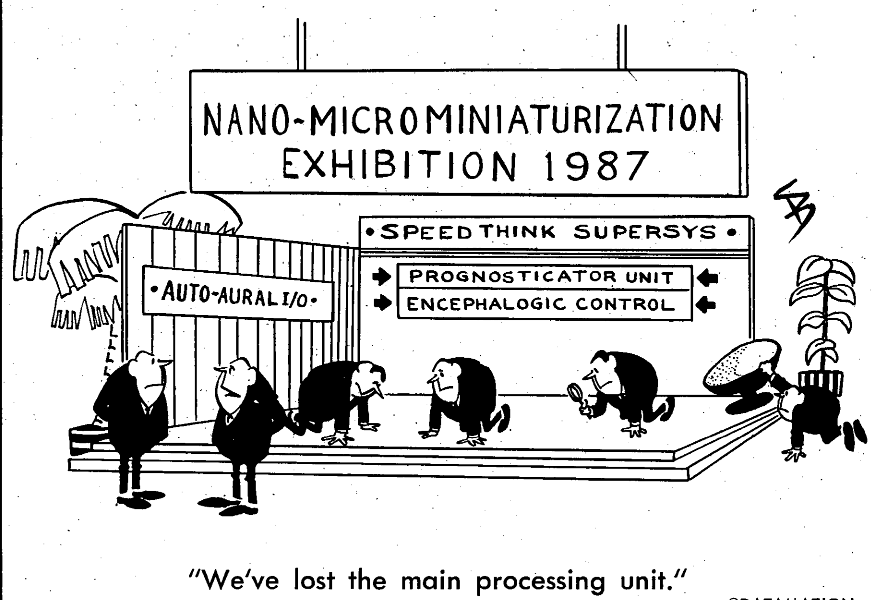
Chairman:

William Herrmann

System Development Corp.

Santa Monica, California

There is ample documentation attesting to the fact that much of this world—including urban areas within the United States—is in the throes of significant and uneven social, political and economic change. Similarly, there is ample documentation of the fact



"We've lost the main processing unit."

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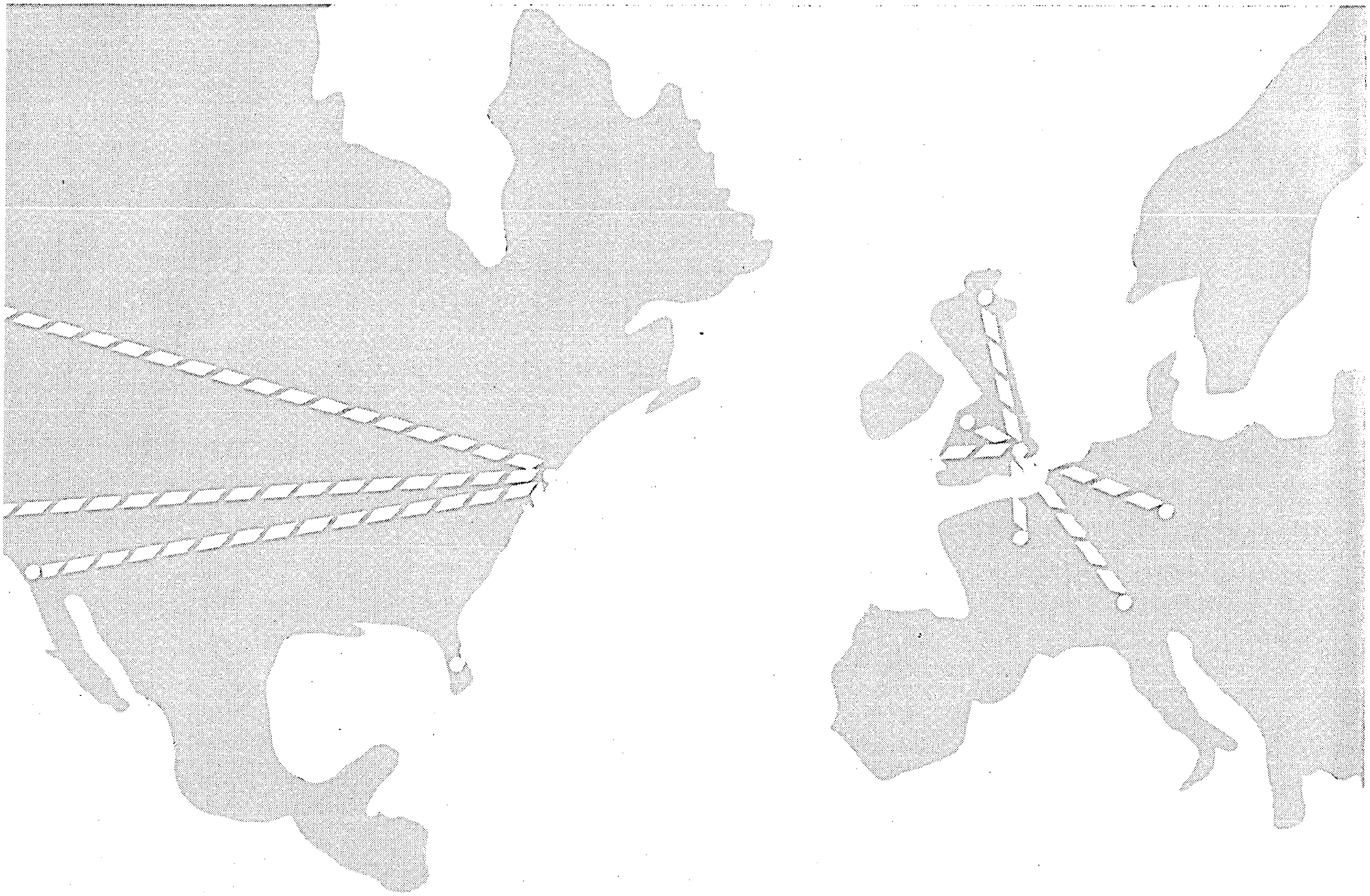


at one of the more noteworthy ef-
cts of this instability is an environ-
ent that is conducive to the incep-
n, if not the actual manipulation,
activities prejudicial to public or-
r. These activities have been mani-
sted, at least in part, by what
pears to be significant increases in
e incidence of criminal activities in
neral, and activities associated with
olence of the type referred to in this
untry variously as riots, public dis-
der and, of somewhat more recent
igin, "insurrection."

The suggestion that science and
chnology be applied to the prob-
ms associated with those functions
government presently identified
ith the term "administration of jus-
ce" is receiving an increasing
nount of attention from practi-
oners, citizens, scientists and tech-
icians.

There seems to be a growing una-
imity of opinion that reflects an
nquestioned acceptance of the belief
iat such an application of science
nd technology is, in fact, a worth-
hile goal. There is also an implied
romise of enhanced—although as
et not too well defined—benefits,
long with reduced costs.

It is something of a paradox that
his belief—attractive though it may
e—should be accepted so readily in
he absence of demonstrated validity.
t is, in and of itself, somewhat anti-
hetical to the basic tenets of the very
cience that is presumed to offer such
great promise.

Science deals with ways of know-
ng; technology with ways of doing.
Science will not tell us too much
bout how man and other things in
our universe *ought* to behave, but
science can tell us how they *do*
behave. Neither science nor tech-
nology can relieve man of his ultimate
responsibility for deciding among al-
ternative objectives and the appropri-
ate systems for achieving these objec-
tives.

It is definitely not the intended
purpose of this paper to refute the
idea that science and/or technology
can be of assistance to the achieve-
ment of the objectives implicit within
the concepts embodied in the phrase
"administration of justice." It is, how-
ver, the purpose of this session to
cuss some of the more apparent
ifications inherent in what might
ed to as a systems approach
mediate problems involved
ting to apply science and
to the statement and reso-
roblems implicit in achiev-
ing and maintaining public order in a free society.

Panelists:

Alfred Blumstein, Institute for Defense Analyses.

Edward V. Comber, California Criminal Justice Information System.

Thomas Reddin, Chief of Police, Los Angeles.

Stan Rothman, TRW Systems.

Dan Skoler, Office of Law Enforcement Assistance, U. S. Dept. of Justice.

9:00-11:30

Arena

Computer Organization—I

Chairman:

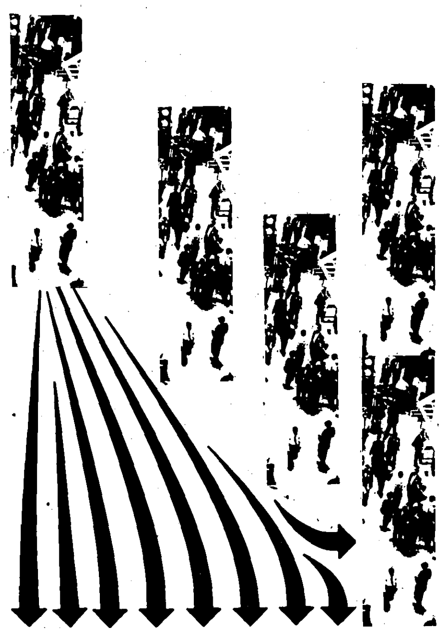
Gerald Estrin

University of California

Los Angeles, California

The main trends in organization of computer systems are focussed upon:

1. How to bring together system components so that they interact effectively in the context of the ever-increasing complexity of software systems.
2. Developing models and measures which can predict when one computer system will be better than another.



3. Devising methods for the design of systems which utilize the changes in current and forthcoming device technologies.
4. Discovering radical new approaches to devices or to methods for using existing devices.
5. Meeting the requirements for long-term mission reliability of computer systems.
6. Finding economic approaches to increasing the computing capacity of systems through multiprocessing.

Bulk Core in a 360/67 Time Sharing System, by Hugh C. Lauer.

Modular Computer Design with Picoprogrammed Control, by J. G. Valassis.

Intercommunication of Processors and Memory, by Melvin W. Pirtle.

Stochastic Computing Elements and Systems, by W. J. Poppelbaum, Jc W. Esch and C. Afuso.

9:00-11:30

Anaheim Room

Quality Papers of General Interest—I

Chairman:

M. Phister, Jr.

Scientific Data Systems

Santa Monica, California

The AUTOSACE automatic checkout system described in the first paper is a general purpose computer system used to check out system components of the Poseidon missile at the factory, at the test range, and at a field depot. Each checkout system consists of:

1. A central processor, which does computations, assembles programs, stores test routines and test results, and lists test programs and results.
2. A number of general purpose computer substations communicating with the central processing unit over several hundred feet of cable, and providing a link between the central processor and various test stations.
3. A number of test stations (for each substation processor), each of which contains special equipment tailored to the particular test being carried out.

The paper discusses system design characteristics, describes processors and test stations, and reviews a programming language which makes it easy for a test procedure designer to describe his requirements and to get them automatically converted into a suitable test program by the central processing unit.

The second paper will describe a

The sloop on the left is Kialoa II; on the right, Baruna. For quality reproductions of this photograph, write us at Memorex.

THE TWO GREAT TAI

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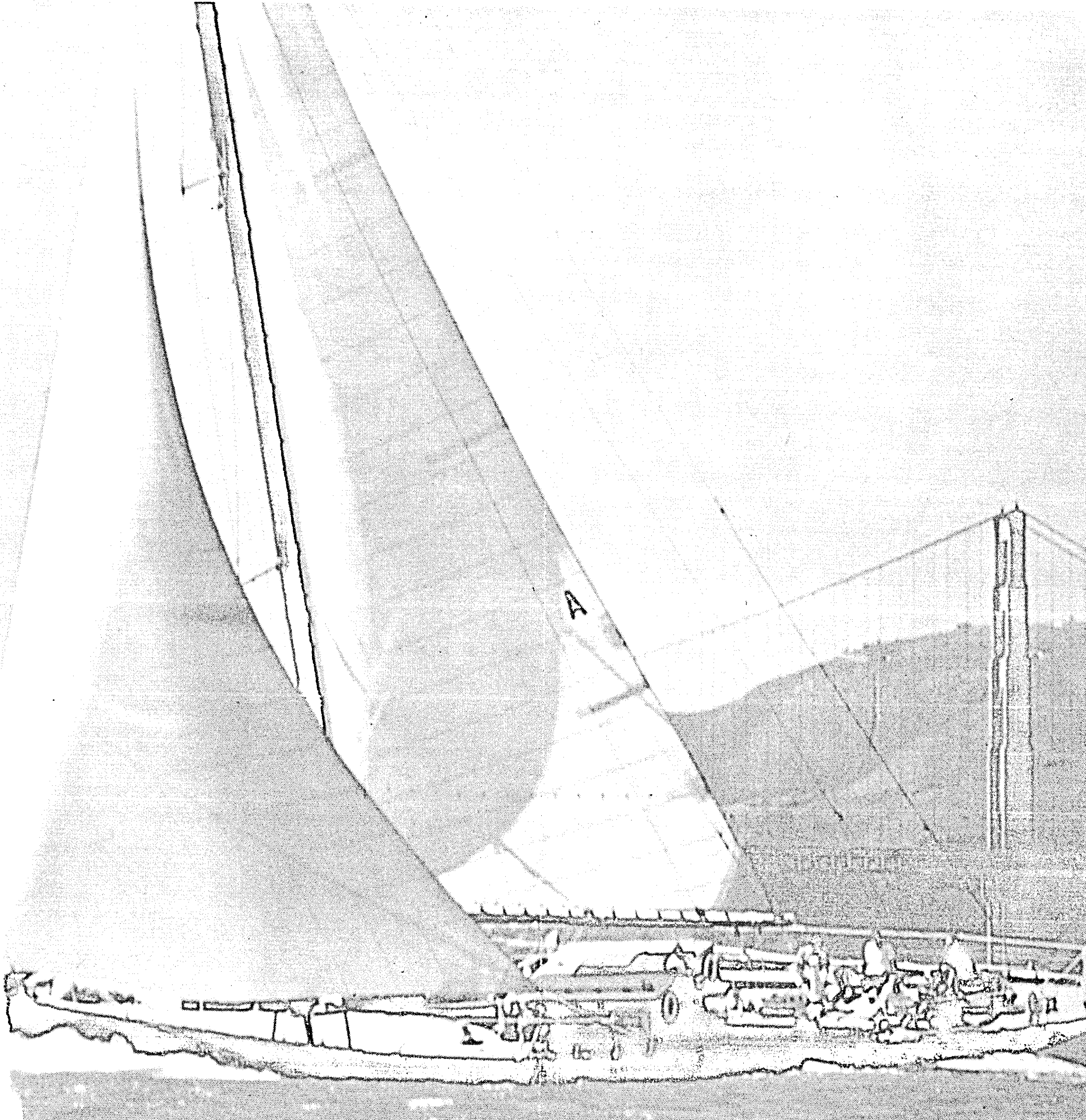

:E THE TWO GREAT SLOOPS, ARE NOT IDENTICAL.

st glance, Kialoa II and Baruna seem
y much alike.

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:ul crafting. Fast and incredibly responsive, they can
:he paint off anybody in their class. But race them
nst each other, and they won't necessarily finish in a
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been fastidiously manufactured to make pass after
pass without a drop-out, long after other tapes have failed.
But compare one with the other, and they won't necessarily perform exactly the same.

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system employing an SDS 930 computer to carry out a spectral analysis of experimental data in real-time.

The third paper describes an analytical method for selecting the best integration technique for solving a set of differential equations. The method does not make use of graphical procedures, and the mathematical analysis (based on Lyapunov's second method) is fairly simple to apply. More important, the relative advantages of two different integration schemes may be compared for a broad class of nonlinear systems. The paper develops and describes the method in some detail, illustrates it with appropriate examples, and considers noise and round-off errors.

The last paper describes a programming system which accepts format and editing information prepared on a typewriter keyboard, and revises a text according to the information so received.

AUTOSACE, Automatic Checkout for Poseidon, by G. W. Schultz and J. M. Colebank.

Real-Time Spectral Analysis on a Small General-Purpose Computer, by A. G. Larson and R. C. Singleton.

A Practical Method for Comparing Numerical Integration Techniques, by P. P. Shipley.

Further Advances in Two-Dimensional Input-Output by Typewriter Terminals, by M. Klerer and F. Grossman.

1:00-3:30

Garden Grove Room

The Impact of the New Technology on the Analog/Hybrid Art—II

Chairman:

Roger C. Wood

Univ. of Calif.

Santa Barbara, California

The presentation will open with a discussion of the hardware aspects of relevant digital devices, both as they currently exist and, within limitation of proprietary interest, of what can be expected in the future. Among the considerations is the effect of input/-output devices such as the RAND tablet, the "Magic Wand," and many online display devices, on the ease and convenience of pure digital simulation, and therefore, on its suitability as an alternative to hybrid operations.

Next, the question of communicating with the computer will be examined from a systems standpoint, taking cognizance of both software and hardware innovations. This second panelist will draw on his experience as a developer of one of the mathematical and scientific uses and will consider how this combination of man, machine and program package can be extended and exploited to cover the simulation problems which form the backbone of hybrid applications.

Concluding the formal presentation will be two speculations, from current analog/hybrid practitioners, as to the future of their art. The first of these panelists, once a confirmed hybrid advocate, will discuss the extent to which his views have been modified by his years of hybrid experience. Among the problems which he will consider, in addition to those mentioned above, are the costs of operating a hybrid computer facility. These include high maintenance requirements, the relatively poor reliability compared to digital computers, and the requirements for professional level operating personnel. Additional problems are the poor turnaround time which derives from both manual setup and the inevitable trouble shooting and complex check-out which results. The last panelist, who brings a viewpoint derived from a long and varied analog/hybrid career, will examine these questions from a somewhat different perspective. From the discussions which follow, the panel, drawing also upon the collective experience of the audience, will attempt to shed more light than heat upon these problems. It is to be hoped that some delineation of the relative future of digital and analog/hybrid simulation, along with an anticipated time table for any significant changes, will result from our efforts.

A Look at New Digital Input/Output Hardware, by Roland Bryan.

Communicating with Computers—A Systems Viewpoint, by Glen S. Culler.

The Future of Hybrid Computers—Some Second Thoughts, by Bruce B. Johnson.

The Future of Analog/Hybrid—An Analog Viewpoint, by Robert M. Howe.

1:00-3:30

Santa Ana Room

The Role of the Graphic Processor in Programming Systems

Chairman:

Morton I. Bernstein

System Development Corp.

Santa Monica, California

The concept of on-line interactive graphic communication between man and computer is no longer a laboratory curiosity or an esoteric topic of interest to a select few. The tools and techniques of interactive graphic input/output are being used productively by designers, engineers, and scientists in a number of areas today. As with the computer itself, it is expected that the use of these new techniques will grow exponentially.

Until recently, most interactive graphic programs required dedication of an entire computer, because of both hardware and software system limitations. Despite this requirement, many interesting and worthwhile graphic systems have been developed and a great deal of progress has been made, at both the experimental and practical levels. Techniques have been developed for structuring and manipulating complex two- and three-dimensional entities. Great strides have been made in specialized application areas, such as that of computer-aided design. But these advances have been made at the cost of slowing the computer down to human speed during much of the problem solution time.

Concurrent with the development of interactive graphic techniques, time-sharing systems were being created for the specific purpose of making it economical for a user to communicate interactively with a computer for extended periods of time. It is not surprising, then, that there should be a marriage between on-line interactive graphics and time-sharing systems. It is precisely here, however, that the challenge lies for the graphic system designers and implementers, for it is much more difficult to provide certain essential features to time-shared graphic terminal users than it is to provide the same feature to users of dedicated, stand-alone systems. These features include real-time response, a flicker-free image, and a general feeling that the computer is giving the user its full attention.

Although the problems are difficult, they appear to be solvable. This session will include four papers, each of which deals directly with a major aspect of implementing real-time on-line graphics in a shared environment. These papers are not concerned with hypothetical propositions, but rather descriptions of systems that are currently being implemented. These systems have one very interesting aspect in common: each one depends in some way on having a peripheral processor available for graphic console operation. These peripheral processors carry the major load of closing the real-time loop with the user, although they differ both in the kind of peripheral processor used and the specific applications.

A Graphic Tablet Display Console for Time-Shared Use, by L. Gallenson.

Multi-Function Graphics for a Large Computer System, by C. Christensen and E. Pinson.

Reactive Displays: Improving Man-Machine Graphical Communications, by J. D. Joyce and M. J. Gianciolo.

Graphic Language Translation with a Language-Independent Processor, by R. O. Morrison.

1:00-3:30

Arena

Computer Organization—II

Chairman:

Melvin A. Breuer

Univ. of Southern Calif.

Los Angeles, California

The main problem that must be dealt with when trying to substantially increase the reliability of a digital computer, is how to carry out useful computation under the conditions that one or more components have failed. A number of techniques for solving this problem are currently being investigated. For example, one technique used in many applications, such as in the telephone industry, is to use duplicate systems. For this technique, a diagnostic system must be available to determine which of the two machines is at fault under the conditions that they produce different responses to the same problem. This requires component failure detection routines. If the fault is to be corrected, then failure diagnostic or location routines are required. These routines are quite difficult to construct, and are not always 100% effective in detecting failures. The first paper develops some important relationships between the effectiveness of the fault detecting system and the increase in reliability achieved by having redundant systems.

A second common approach to increasing system reliability is to employ triple modular redundancy with vote takers. In such a system, the fault is said to be masked since any single component failure in a triplicate module does not cause a computational error.

Another technique is to code the information being processed in some redundant manner, and to employ special error checking circuitry. This includes such well known techniques as parity checks, Hamming codes and

the use of residue number systems for arithmetic operations.

Most of the proposed new systems use a certain amount of duplicate modules which are automatically switched into use as other modules fail.

Design of Fault-Tolerant Computers, by A. Avizienis.

Some Relationships between Failure Detection Probability and Computer System Reliability, by H. Wyle and G. J. Burnett.

A Distributed Processing System for General Purpose Computing, by G. J. Burnett, L. J. Koczela and R. A. Hokom.

1:00-3:30

Anaheim Room

Quality Papers of General Interest—II

Chairman:

Lowell Amdahl

COMPATA, Inc.

Tarzana, California

A call for papers for a computer conference inevitably yields a number of contributions that are not easily assigned to specialized systems. As the name implies, this session accommodates the better papers in this category.

The first paper presents a variety of data on RAND's JOSS system. This statistical use summary of a major time-sharing facility should be of great interest to others who are using or designing such systems. Overhead, file requirements, and console usage are among the factors that are considered. A breakdown for typical interpretation time for JOSS statements is given.

The second paper is a fresh look at the problem of planning and specifying software. As a preliminary, the authors classify the users of software packages in rather amusing terms. The general viewpoint of the paper is that of a computer manufacturer who contracts for product support software from vendors. FORTRAN is chosen as the vehicle for describing some of the problems with which a good specification must deal.

The next paper discusses the organization of the CPU of high-performance computers. Limitations of look-ahead as a design technique are cited. The author goes on to discuss array processors which utilize instructions whose operands are arrays of data. The possibility of multiple control units time-shared among functional units is described. Some comments are also made on programming languages and on design trade-offs.

The last paper of the session is concerned with a chess-playing program that is an honorary member of the U.S. Chess Federation. The design approach to the program is "focused and pragmatic," involving modules such as a plausible move generator. Facets of the logical organization of the program are described in considerable detail. Some statistics are provided on the performance of the chess-playing program in competition with tournament chess players.

JOSS: 20,000 Hours at the Console—A Statistical Summary, by G. Edward Bryan.

How to Write Software Specifications, by Philip Hartman, David Owens, Sol Zasloff, and Nancy Foy.

Observations on High Performance Machines, by D. N. Senzig.

The Greenblatt Chess Program, R. B. Greenblatt, Donald E. Eastlake, and Stephen D. Crocker. ■

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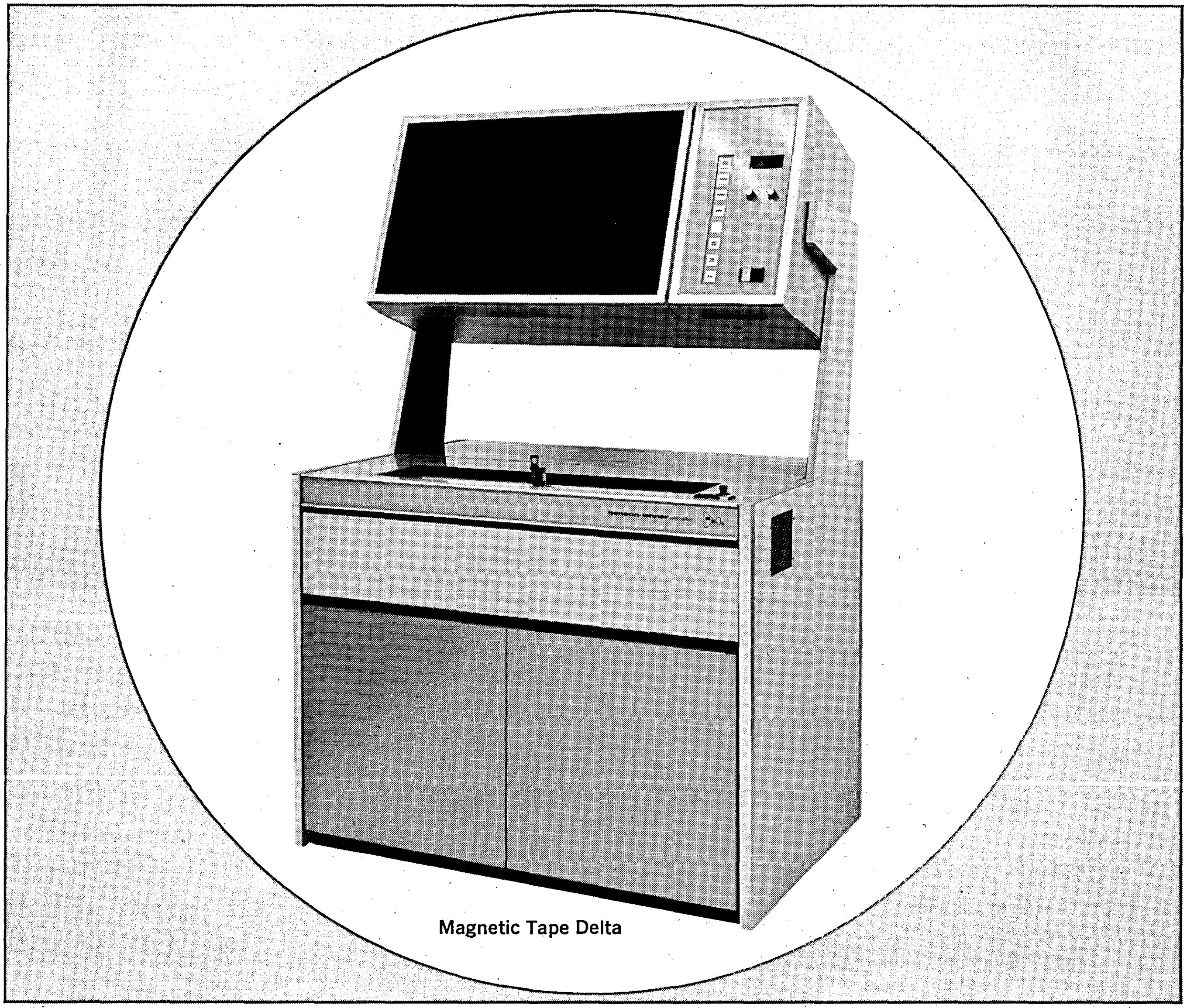
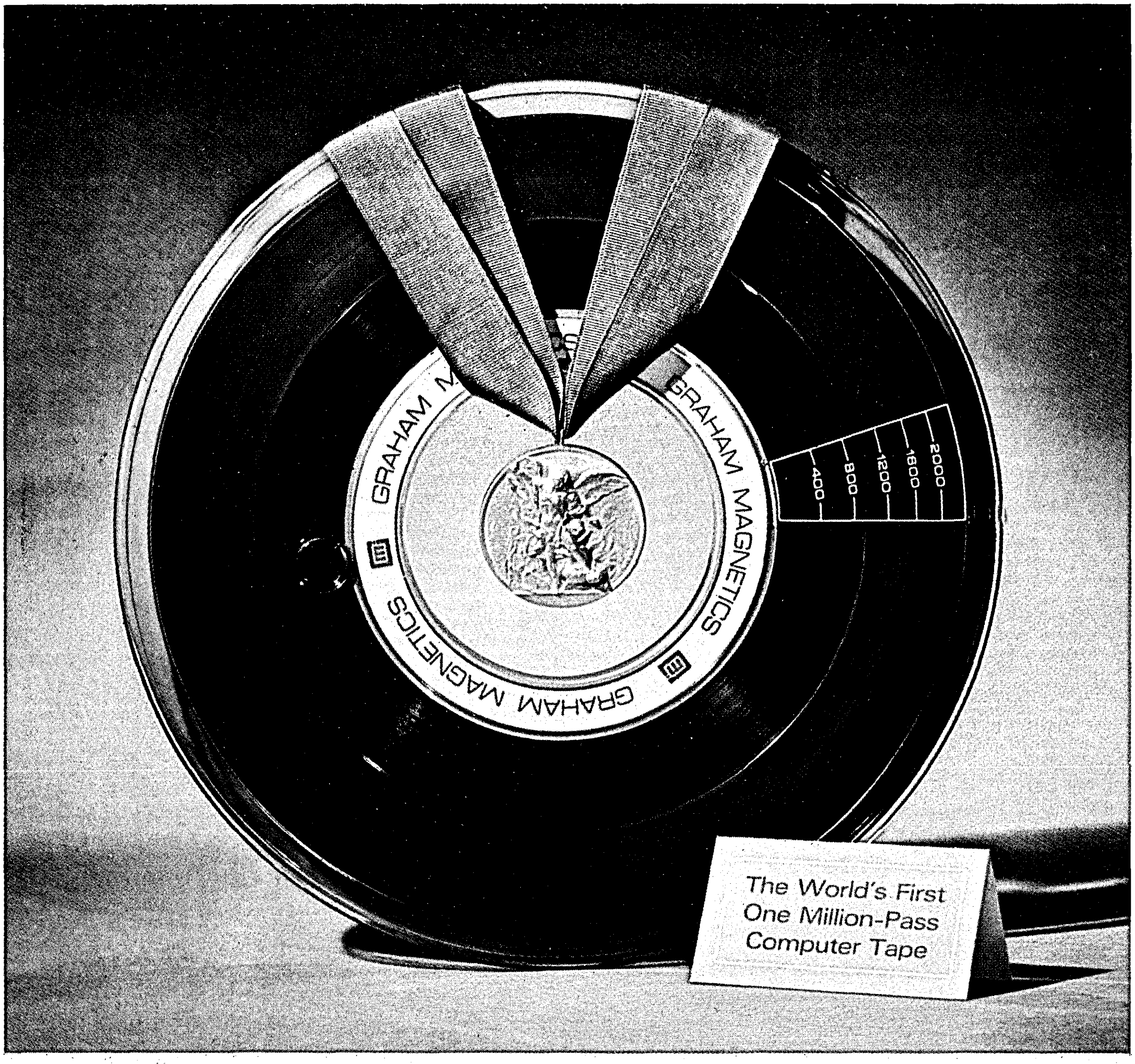


Magnetic Tape Delta



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CIRCLE 62 ON READER CARD

news briefs

PANELS FEATURE OF FIRST IEEE COMPUTER CONFERENCE

About 450 people registered for the First Annual IEEE Computer Group conference in Chicago, which offered in addition to panel discussions, sessions on reliability, new computer organizations, design automation, pattern recognition, computer-aided circuits and device design, computer memories and new computer elements.

Five well-known electrical engineers turned computer expert cautiously explored the introspective question of the role of the EE in computer science at one panel discussion.

Dimly visible in the large room, the panelists—Ted Bonn, Arnold Cohen, Charlie Hobbs, Cal Johnson, and Sam Levine—seemed to concur the EE's role is dwindling.

Those technologies most likely to change the role of the EE in the industry which were most often mentioned were Large Scale Integration (LSI) and electro-optics. In answer to a question from the floor, however, Honeywell's Bonn estimated that it would be 5-10 years before optical devices (such as lasers) would be in common use.

Several of the panelists sensed that new specialists—especially in materials—would play a more important role in designing systems in the future, and the EE would become sort of a middleman or interface between such specialists and the programmers.

The fireworks that moderator Dick Tanaka hoped for on the touchy subject of the relationship between hardware and software (and their human representatives) didn't come off. At one point Johnson said, "Software is a mess and it's getting worse." But nobody deigned to answer a question later from the floor: "Is hardware any better?" Stanford's George Forsythe, a non-EE and ex-president of the software-oriented ACM, took the audience mike at one point to complain that users of computers spend a lot of time trying to overcome bad hardware design. They'd like the hardware man to understand applications. But hardware expert Charlie Hobbs pointed out that it's frustrating trying to get users to tell the hardware designer exactly what it is they want to do.

One man in the audience wondered how the panel felt about "the aggressiveness of programmers," but the panel was asleep or not worried. In the darkness it was hard to tell.

At another panel discussion, six university people got together to discuss "Computer Science in Electrical Engineering Curricula." This turned out to be mostly a debate about whether computer sciences should exist as a separate department or as part of the electrical engineering dept.

South Carolina's Tom Jones affably led the discussion by Dave Evans (Utah), George Forsythe (Stanford), Gordon Murphy (Northwestern), Alan Perlis (Carnegie Mellon . . . it used to be called Carnegie Tech), M. E. Van Valkenburg (Princeton), and Gerard Weeg (Iowa).

Predictably, the group broke down into two forces, with math-, software- and computer-oriented proponents of the computer science department ably and articulately represented by Forsythe, Perlis and Weeg. The others, all EE-oriented, thought that computer sciences belong in EE, although not necessarily exclusively.

Forsythe offered a well-organized description of what computer science departments ought to do, and how they should be organized. Perlis read parts of an interesting letter to be published in *Science* which defined computer sciences and offered answers to those objections to the claim that it is a science. It should be read by all serious computer professionals.

Probably the strongest and wittiest attack on the computer science camp came from Van Valkenburg, who said he had been told in Russia that *the* drink was "Vodka and"; Vodka alone, he was told, is colorless, odorless and tasteless. Taken with something else—caviar, for instance—it becomes exciting. So it is with computer science, which, alone, is colorless, odorless, tasteless. With EE it becomes palatable.

Forsythe saw differences between computer and EE types as evidence that the two are separate entities. He noted that few females were to be found at the conference, and said that EE repelled women, while women were attracted to computing. He found no beards at the conference. All of the attendants wore suits and ties, and the inference is that computer people are nonconformists and that EE's are conformists. And he feels that more people drift into computing from EE than the other way around.

Probably the best summary of the debates is in Forsythe's observation that the question of where computer science belongs in the university curriculum is not an intellectually exciting one, although it is important.

The conference was planned to fill what was felt to be a void in confer-

Conferring on a computer data bank project are Uri Yechiali of Israel (left), a Ph.D. candidate in operations research at Columbia Univ., and Kees Heyning, M. A. candidate in physics at Leiden Univ. in the Netherlands. Both were invited to participate with 51 other foreign students as summer trainees with the IBM World Trade Corp.

ences for hardware specialists, and the initial reaction was evidently favorable enough to persuade IEEE Computer Group officials to conduct another. It will be held in Los Angeles next June and will focus on LSI.

TOUCHTONES GET TEST IN SHOP ENVIRONMENT

An on-line system for keeping track of work in progress on the factory floor, and using Touchtone telephones for input/output, is under development at the Rohr Corp., Chula Vista, Calif. There currently are more than 120 of the new terminals on-line to dual switchable 360/50's. Running in both the on-line and batch modes, the system provides an audio response, batch process, and a spool printout. They also have 1.75 million records in data cells, answering inquiries from CRT terminals while running batch and spool jobs. The ability to update the file from the CRT's is now being added.

ON-LINE DOCUMENT RETRIEVAL GAINING IN FAVOR

Some 30 Selectriever systems, Mosler's random access document storage-retrieval unit, have been sold and installations have begun. Nassau County, N.Y., is using it for land title records, Westinghouse for engineering drawings, and World Savings & Loan Assn., Lynwood, Calif., will store depositors' signature cards. From remote sites, users will gain access to documents in the form of CRT images, hard copies, or duplicates of the stored aperture cards.

Based on this capability, a new outfit in Chicago, Telebiblios, has been formed to supply published documents to medical researchers. Plans are to enable on-line users to interrogate a file, narrow their search criteria, and get copies of usable documents.

UTILITY CONCEPT GETS ACM AIRING

The giant computer utility is not an immediate threat because too many large-scale users already have their own systems, and aren't about to junk them. Smaller users, although theoretically a more likely market, really aren't. Hardware and software tailored to their needs are available, or soon will be, at prices low enough to permit individual acquisition. Also, the communication carriers most likely to develop centralized data bases lack the application expertise to sell to small-scale dp users.

These were the major points made by Ronald F. Denz, vp of Telemax Corp., East Orange, N.J., in arguing "The Case Against the Computer Utility" at the recent ACM conference. His company operates a computerized travel reservation service for motels, car rental agencies, and assorted other enterprises.

Denz's paper was one of three presented at a panel discussion entitled "Computer Information Systems Utilities." The others came from Univac's Dr. Gastone Chingari, who discussed numerical control information utility applications, and from Dr. R. D. Jones, of the Univ. of Missouri. He explained how the utility concept could expedite public planning.

Although confident that relatively small, independent service bureaus could compete successfully against giant utilities, Denz complained that FCC policy is making the struggle unnecessarily difficult by giving the carriers too much control. He advised the commission to adopt "a policy which says, in effect, 'what the facilities are capable of handling will be allowed.'" Such a policy would lead to more liberal provisions for line sharing and message switching, would permit channel subdivision and use of foreign terminal attachments, and would open the door to low-cost microwave telecommunications, he predicted.

Denz indicated one way the industry could help achieve this goal when he mentioned ADAPSO's recommendation to FCC for a sweeping change in telecommunication rates. Under this proposal, announced at the conference, the user of any dial-up data service would be charged for transmission time but not transmission distance.

On the same day that Denz read his paper, FCC hearing examiner Chester Naumowicz issued a recommendation in the Carterphone case. If the commission goes along with the recommendation, Denz may join that small, select group of conference speakers whose podium predictions actually come true.

Both of the other papers suggested piggybacking specialized data processing jobs onto the workloads of general information utilities to cut costs and improve service. Government planners and numerical control users have a large and growing demand for computer capability, it was added.

There are about 25,000 machine shops in the U.S., reported Dr. Chingari, and about 2 million metal-removing and metal-forming machine tools. Currently, numerically controlled units comprise 20% of all machine tool sales, and by 1970, this figure is expected to be 75%. He presented other figures indicating that a machine shop operator who employed two full-time programmers to set up N/C production runs could get the same service from a time-shared computer for about $250/week plus terminal and transmission charges.

Dr. Jones' paper explained how additional data and users are being grafted onto computerized planning systems, but contended that a public or private utility would be much more effective. Dr. Jones briefly described several established planning systems — computerized and noncomputerized — which he considered expandable into facilities of much greater scope. His list included two private services — the California land bank and R. L. Polk's urban information system; either, said Dr. Jones, "could furnish a number of cities with software, data, and data processing."

TRANSAMERICA RESEARCH OFFERS COMPUTER SERVICES

Two computer program packages, offered on a service basis, have been developed by Transamerica Research Corp., a market analysis subsidiary of Transamerica Corp. Both programs grew from work done for the parent company that proved to have varied applications.

One is called TEMPO—for Transamerica Electronic Market Planning Operations. Using a data bank built up on a county basis, which includes Census Bureau statistics, the program can produce market projections for areas of interest to a given company. As an example of the range of decisions that might be simplified by the service, the program can help establish sales quotas by territory, establish dollar allocation of advertising, or determine priorities in establishing branch offices. It is used for this last purpose in setting up Pacific Finance offices and would be applicable to other types of financial institutions. The program runs on larger configurations of 360/30's, but the company sells it as a service because of the need to tailor input/output for each specific case. It's now in use by two big outside companies, one a national manufacturer and distributor of food products, and the other a retailer of lumber and building material supplies. The service is of interest to national or large regional companies.

The second program is TEST—Transamerica Electronic Scoring Technique. This is a method for evaluating various kinds of business risks, such as credit and underwriting. It is also used within the Transamerica empire and in credit departments of retailers, oil companies, and public utilities. Here again the company wants to handle the whole project, using the

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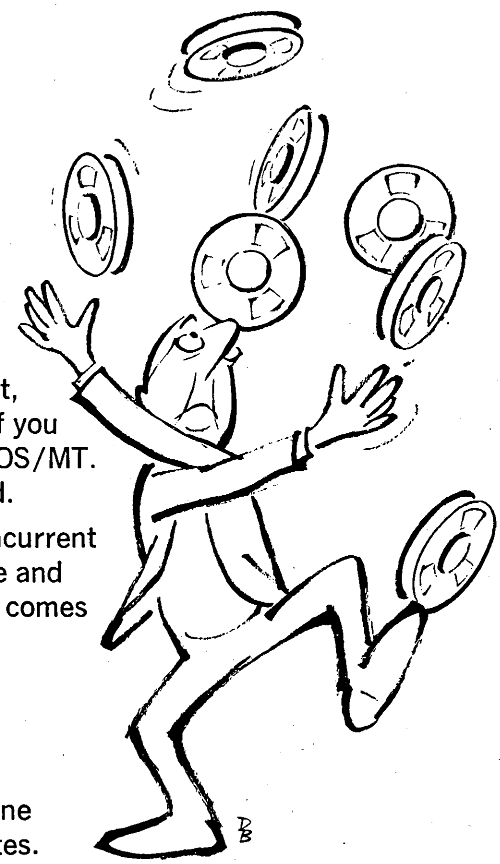

Just announced: General Electric's new GE-400 Extended Operating System (EOS/MT.)

It can probably increase your throughput by at least 25 percent, since most programs don't use the processor's full potential. If you have a GE-400, you can shift easily from uniprogramming to EOS/MT. Your existing computer work will not have to be reprogrammed.

EOS/MT lets you run up to six media conversion programs concurrent with your main program. It uses existing input/output software and resides totally in-core. A variety of media conversion programs comes with the system.

Three recent examples prove the value of EOS/MT.

* A large western bank has cut their two-shift operation down to 1½ shifts.
* A trucking company using EOS/MT ran three programs in nine minutes where running the programs in serial took 25 minutes.
* Another demonstration showed that two programs under EOS/MT could be completed in the time it took to run one before.

For more information on EOS/MT and the growing list of other GE-400 developments, contact your General Electric Information Systems Sales Representative. Or write General Electric, Room 912, 2721 N. Central, Phoenix, Arizona 85004.

290-07

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TECHNOLOGY ADVANCE IS NEW GOVERNMENT CONCERN

Senator Howard Baker's address to ACM's Wednesday luncheon contained few surprises but was significant nevertheless. His subject — galloping technology and how computerization might control it — is a hot topic on the Hill these days. At least half a dozen House and Senate committees are considering the problem, and substantive activity is imminent.

The Senate Government Operations Committee reportedly is on the verge of approving establishment of a Select Committee on Technology and the Human Environment. This idea was developed by committee chairman Ed Muskie. He was the speaker originally chosen to address the ACM luncheon but at the last minute was diverted to election-day duty in Viet Nam by the President.

A related bill, authored by Representative Emilio Q. Daddario, of Connecticut, would establish a Technology Assessment Board to monitor socio-technological problems and recommend ways of alleviating them. On Sept. 21-22, the House Science and Astronautics Committee held a two-day seminar at which likely problems and approaches were discussed by 11 of the country's leading intellects — including Harvard's Dr. Emmanuel Mesthene, who gave the ACM keynote address.

Senator Baker, when he addressed the ACM, emphasized that legislators are poorly equipped to cope with the problems generated by modern technology. If anyone in the audience had any doubts on this point, they were resolved by the end of the speech; the Senator spent most of his time repeating that technological change can have both good and bad effects, and advocating prompt corrective action.

Suggestions regarding the kind of corrective action required were offered by the House Government Operations Committee in a report released concurrently with, but independently of, the ACM conference. Entitled "Federal Research and Development Programs: The Decision Making Process," the report contains four committee recommendations for improving federal R&D planning. Comments by the Budget Bureau and National Academy of Sciences on each recommendation were included.

The committee proposed that the Executive Office use a cost-benefit approach in evaluating major R&D proposals, hire outside analysts on a regular basis, further centralize R&D planning, and publish an annual "Science and Technology Report," similar to the Economic Report.

The only strong objection to these recommendations came from NAS, which doubted that cost-benefit analyses could benefit R&D planning or most other federal programs. Goals have to be agreed upon first, the agency argued.

SDS SIGMA 7 KEEPS WATCH OVER UCLA'S OTHER MACHINES

The Univ. of California at Los Angeles' Digital Technology Research Laboratories, with support from ARPA, has installed a computer to check the efficiency of the other computers currently installed on the campus. The machine, a 16K (32-bit) SDS Sigma 7 with a rapid access data file storing 1.5 million (8-bit) bytes, will monitor, analyze and evaluate the performance of the other systems, and provide data useful in comparing performance and developing new designs. This application will also permit studies on the percentage of storage capacity used, the times each subsystem is used, and the instruction types most frequently used. The monitoring procedure permits the object computer's activities to be observed without interference, interruption or modification of the program.

A concurrent development for S/-360 time-sharing evaluation is a performance recorder that gathers material and measures 256 operating conditions at a time. The computer monitor in the recorder provides electronic "stopwatches" that check millions of operations a second, and gives information on such things as the storing of information into a memory address, passing of control from one program to another, time spent under the control of a program, execution of a specific instruction, clearing and contents of a register, and information transfer. This system was described in "Hardware Measurement Device for IBM System/360 Time Sharing Evaluation," a paper by Franklin D. Schulman given at the recent ACM conference in Washington.

ITT DATA CENTER STAYS IN PARAMUS

Last month, DATAMATION erroneously stated that the ITT data center at Paramus, N.J., would be moving out when the New York Stock Exchange moves its computer complex there. It's actually ITT's Federal Laboratories that moves out to consolidate its facilities elsewhere.

The ITT data center, with its 360/-65 and a 7094, and another mod 65 due this fall, will be next door to the NYSE dp center. It continues to serve the some 250 regular customers who have access to the computers through satellite centers in Princeton, N.J., Garden City, N.Y., and in midtown Manhattan.

NEW PERIPHERAL MAKER RESULTS FROM MERGER

A new manufacturer of peripheral equipment named Datel Inc. has been formed. It is a combination of an old firm, Wyoming Electrodata Inc. of Riverton, Wyoming, and a new one, Data Communications Devices Inc. of Palo Alto, Calif. The first product of the combined companies is a data terminal consisting of an IBM mod 73 Selectric typewriter (see New Products). With the electronics mounted behind the typewriter, all it requires is an acoustic coupler.

The terminal is actually a product of DCD, which was incorporated last February. It was headed by Helmut Falk, formerly associated with Dura Business Machines. Falk is the board

chairman of Datel, which is headquartered in Palo Alto. The president is William C. Bennett, who previously was vp of Precision Instrument Co. and a director of Wyoming Electrodata (WE). Bennett has also been with Bunker-Ramo, G.M. Giannini, and AC Spark Plug.

The former president of WE, Raymond B. Larsen, is vp for advanced R&D of Datel. One of the founders of Uptime Corp., he established Electric Information Co. in 1962 and its successor firm, WE, two years later. Larsen, an alumnus of Univac, Ramo Wooldridge, Alwac, and Auto-Trol, stays in Riverton, where Datel will have its R&D and manufacturing facilities in a plant expanded by 40,000 square feet to handle this.

BERKELEY GROUP PLANS TIME-SHARING PROJECT

In a program reminiscent of the successful development of the SDS 940 from the original 930, Project Genie at UC Berkeley is planning another time-sharing machine using hardware from Scientific Control Corp. of Dallas.

There are important differences between the two projects, however, al-

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- **48 bit floating point number** — gives you 11-plus digits of precision — the four additional you really need.
- **Engineering software** — basic math routines plus a wide range of application systems are available now.

So you see the GE-400's don't *just* mean business. They now offer you the broadest capabilities available today on a medium scale information system — all the way from everyday business runs to complex scientific problems.

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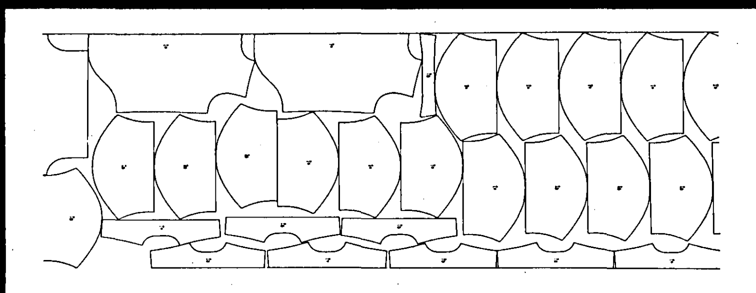
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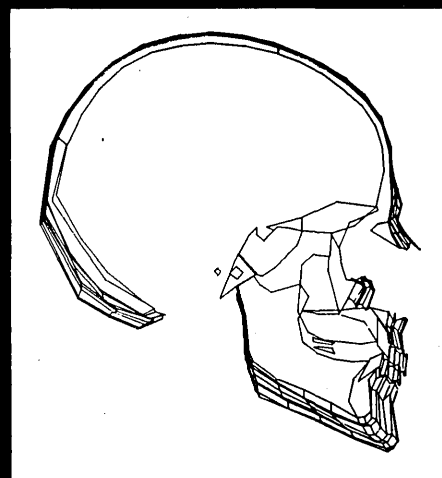
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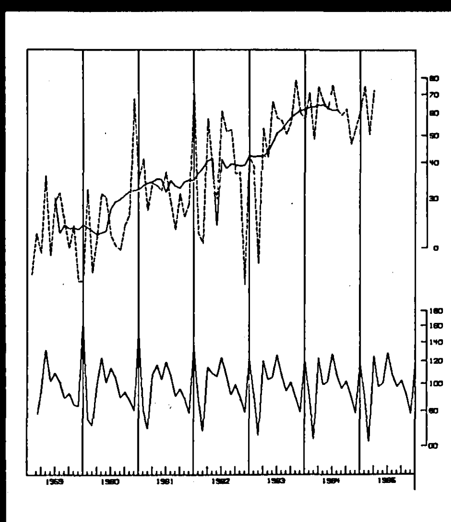
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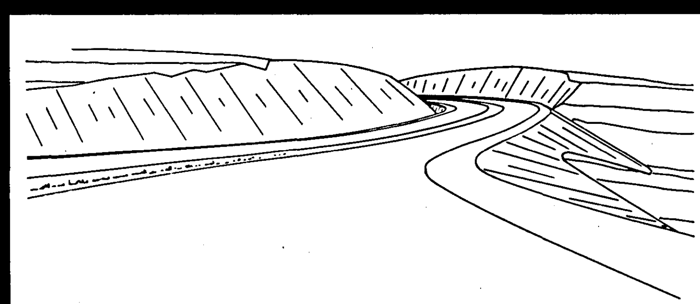
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though both have been supported financially by ARPA.

In the SDS case, Berkeley took the 930 and designed hardware modifications as well as the time-sharing software. These changes were sent to SDS in detailed form—such as wire lists.

For the SCC project, on the other hand, Berkeley has a management contract to develop jointly with the company the specifications for the machine. (It will not, incidentally, be the same machine as that announced by SCC a few months ago.) It is expected that Berkeley will then order the main frame from the company. The rest of it—memory, input/-output, etc.—will be ordered separately from various manufacturers and assembled by the group at Berkeley.

The software will also be a joint venture. It will be an improved, and somewhat different, version of that designed for the 940.

As for the timing on the project, if the specifications are mutually agreeable the order was expected to be placed about Oct. 1. Delivery would then be scheduled for mid-summer next year.

It may be worth noting, in this connection, how the SDS 940 has fared since its introduction. In a recent news release, SDS says that seven cities now have time-sharing centers using 940's and that three more will open by the end of the year. The various firms using the machines charge customers from $10 to $25 per hour for machine time. The company also points out that six language packages are available, all suitable for conversational use.

Besides these commercial time-sharing outfits, several other organizations use the 940's for internal time-sharing purposes. Given successful development of the new 6700, then, Scientific Control Corp. might see a pleasant future.

SENATE REPORT SUPPORTS ELECTION PROSECUTIONS

A Senate Commerce subcommittee "is satisfied that the networks and broadcasters will take appropriate steps to clearly label voting projections and predictions in a manner that (assures) the public will not be misled."

This is the chief conclusion of a report the subcommittee published recently after looking into the use of computerized election projections by broadcasters. Basically, the senators wanted to know whether use of East Coast returns to project trends and predict winning presidential candidates changed the minds of voters on the West Coast, many of whom—in recent elections—heard or saw the projections and predictions before casting their own ballots.

Testimony was collected from governors, from the FCC, and from network representatives; all of them were against limiting the use of computers on election night. Some support was expressed for a bill introduced by Senator Javits, which would open all polling places at 9 a.m. EST and close them 24 hours later. But the subcommittee saw "no immediate emergency" and suggested shelving this idea.

IRS TESTING GE SYSTEM FOR TAX DATA INPUT

Internal Revenue Service officials who recently pilot-tested a new GE source data automation system say it is capable of speeding up data entry 20%. They anticipate a 30% saving in labor costs. Other major benefits: a "substantial" reduction in residual errors—those not caught during data entry and verification—and a reduction of about 50% in the amount of data that must be re-entered to be verified.

The test has aroused interest among non-government data processors, who hope for like savings. But the IRS system can't verify alpha data automatically, so the relative payoff would be far less in most other applications. The pilot test equipment configuration—which included 24 Datanet 760 terminals, a GE/PAC 4060 processor, mag tape, disc, and drum storage, plus other peripheral gear—rents for $15K/month, suggesting another limit. A smaller, less-expensive processor could handle 24 terminals, but isn't commercially available today, IRS officials said.

The new system includes four separate verification routines. First, when the original entry operator enters data through the Datanet keyboard, the information is displayed on an adjacent crt. If she sees a mistake, she corrects it by backspacing and entering the right character or characters.

After a section of data—184 characters—is input, displayed and visually checked, it is dumped onto a 128K drum via the GE/PAC, which performs a sequence and validity check that detects some additional errors. When an entire income tax document has reached the drum, the processor automatically verifies all data that can be arithmetically balanced. The output is then transferred to a disc.

Subsequently, each disc-stored document is displayed, section by section, on a Datanet crt while a verification operator gives the information a final check. She corrects any errors uncovered in previous steps (these are listed on the crt), and re-enters all data that couldn't be zero-balanced. The cpu compares the re-entries with the original input and reports discrepancies. The operator, after checking the original document, makes the appropriate correction through the keyboard.

The pilot test was conducted at the IRS's Chamblee service center, near Atlanta. An operational system, including 400 terminals and two GE/PAC 4020's, is scheduled to go into operation there next summer. Three more like systems are to be installed by the end of calendar '68, and all seven IRS regional service centers are expected to be equipped by December '69.

NINE CITIES START COMPUTER SHARE PROJECT

A jointly operated municipal computer system is forming in the San Gabriel Valley of California, with nine founding cities—San Dimas, Ontario, Monterey Park, Arcadia, Claremont, Montclair, Covina, Pomona and Monrovia—to begin November 1 with automated water billing. The program for this shared effort was written by Herbert H. Isaacs Research and Consulting in Los Angeles.

This beginning interim program is part of a larger idea—as many as 20 cities that would share a data center and programs covering all facets of city government. The feasibility study concluded, full implementation of the project—which is dependent on ratification of a corporation charter this winter—would not be completed until at least 1970.

Meanwhile, the earlier application will concentrate on two areas: water billing and appropriation (budget) accounting. Terminals connected to the Allen-Babcock computer in Los Angeles will be located in each City Hall. Now being installed are IBM 2741 typewriter terminals, but the possible use of paper tape with the teletype may effect a later change to mod 35 or 37 terminals.

More efficient means of meter reading are also being considered by the planners (led by Gifford Miller, city manager of Monrovia). Three possibilities are the use of Portapunch cards or mark sensing devices, or the more elaborate method of a two-channel recording device carried by the meter reader. Such a device would have one channel with spoken cues to announce the address of the home, and a second channel for the reader to record the information found on the meter. Back at the office, the recorder would be re-

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sm

If you think the *ADVANCE* 6130 computer from EMR is just another "little" computer, take a closer look. You could be fooled by the price—low enough to compete with any small machine—or by the 16-bit word length, characteristic of small-scale systems. But that's where the comparison ends.

Analyze the 6130 and you'll realize it's the most productive system available. The instruction repertoire and internal architecture put it in a class by itself. We have a number of comparisons made by 6130 customers and prospects which we would be glad to send to you. They'll make you think twice about thinking small.

Principally, there are two classes of customers we wish to address ourselves to—the small-scale area and the high-productivity applications with limited budget funds.

SMALL SCALE

To the potential buyer of a small-scale computer, there are a number of capable machines which are available to "do the job." However, aren't you looking for a system that can "do the job—plus"? The plus being able to expand to accommodate your next requirement. Many of the small-scale computers (under $35,000) that are being sold cannot provide the user with any realistic approach to expansion.

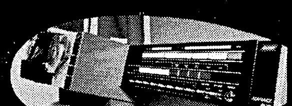
The 6130 is in a different class, it is designed for expansion. Taking the already powerful computer, additional input/output channels, memory, and peripheral units can be attached, but most of our competition can do the same. With the 6130, however, you can add a second processor easily, with no operational software problems. This additional processing power is relatively inexpensive when compared to installing larger systems.

This built-in capability for growth insures that you won't be looking for another new system next year and have to face the re-programming problem.

HIGH PRODUCTIVITY

Next, how about the buyer who has a problem that actually requires a large-scale machine, but does not have the funds? The 6130 has a

6130 computer all



capability that stretches into this high-productivity market.

Historically in the computer field, the user's main problem is to justify a large financial investment to his management. Most of our competitors in this area offer their large general purpose computer as a starter. They rely on the approach that, as the load increases, the solution is to add smaller and less capable satellite processors to handle input/output and some pre-processing. By offering a somewhat reversed approach EMR allows the user to start with a significantly lower initial investment and build from there. Once the computer is installed, and the user can demonstrate to management what can be accomplished, he can build a good argument for expansion. The expansion is normally in the way of adding more peripheral equipment and additional core memory. This is further indicative that, with the large-scale approach, the user has started out with more "computer-power" than needed—and is paying for features that he cannot use or can do without. As the load increases, a point is reached where he has all of the options that use the software to the limit, but by that time, he runs out of "computer-power."

In the case of the *ADVANCE* 6130, the high-productivity user may run out of computer-power sooner but would be in a position to add another 6130 processor to immediately increase his computer power at a small financial addition. One 6130 can handle background processing while the second handles preprocessing and input/output. If this would not be an acceptable approach, a more powerful processor could be added and the 6130 retained as a satellite.

The 6130 alone can successfully offer this approach as competitive small computers are just not powerful enough to handle the general purpose requirements.

ADVANCE 6130 FEATURES

- Here are only a few of the powerful features of EMR's *ADVANCE* 6130 computer.
- 16-bit data word with parity check and memory protect.
- 750 nanosecond memory cycle time as standard.
- Exceptionally large repertoire of more than 100 instructions.
- 1.5 microsecond add time.
- Three hardware index registers with indirect address.
- Relocation register with double indexing allowed is standard.
- 128 interrupt priority levels.
- Multiple processing hardware as standard feature.
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EMR *COMPUTER DIVISION*

news briefs

played and the data entered in batch mode on a terminal, in an arrangement similar to a dictaphone.

10,000 BPI RECORDER IS DEMONSTRATED

A new recording technique that produces 10-20 times current densities has been developed by the controls div. of Leach Corp., Azusa, Calif. The high-density digital recording system makes use of analog recording principles, taking the signal apart and putting it back together to achieve digital format. Result is densities of 10K bpi and more with error rates of one in 100 million. First applications are expected to be in aerospace, but the possibilities of computer use are obvious. Data transfer rates, for example, could be increased by a factor of 10.

GROUPS SEEK RIGHT TO USE OWN MODEMS

Data set and computer manufacturers, plus at least one major dp industry trade association, are charting a major attack on Ma Bell's foreign attachment restriction within the next few months. The field of battle will be the FCC computer utility inquiry. Basic goal is a ruling which would require all communication carriers to allow the use of foreign terminal attachments in dial-up service whenever the equipment met specified performance standards.

Carter Electronics Corp. has won the first two rounds of its battle with Bell on a basically identical issue, and these victories have encouraged the dp industry. The first approval came Oct. 4th from the FCC Common Carrier Bureau. Significantly, that recommendation advised the commissioners to state "clearly and affirmatively . . . that customer-provided equipment may be attached . . . for any purpose that is privately beneficial and not publicly detrimental." Such a ruling would permit use of any technically satisfactory foreign attachment needed by users, not just the Carterphone, which is a voice-only device.

On Aug. 31st, hearing examiner Chester Naumowicz also recommended ending the Carterphone ban. Regarding foreign attachments in general, he was "struck with the inherent unfairness of a system which permits the telephone companies to bar the use of equipment . . . which competes with their own," but recommended against granting unrestricted access immediately. "Possibly," he added, "the time has come to consider establishment of a process whereby (suppliers) of attachments . . . might submit them to the telephone companies for expeditious approval or disapproval under . . . objective standards."

The ball is now in the commissioners' court; a knowledgeable source expects them to go along with Naumowicz while rejecting the more sweeping rule suggested by the Common Carrier Bureau.

Proposed machinery for developing foreign attachment standards and for certifying the equipment of individual suppliers will be spelled out by the dp organizations who are filing statements with FCC. Overall, the system would be modeled after those already operating abroad. Suppliers want to participate with the carriers in setting standards, and will ask FCC to act as final arbiter when conflicts arise over the acceptability of specific gear. "It should take a year or two to hash out the details," estimates our source.

If and when the foreign sets, now largely a Western Electric monopoly, become competitive, leading to improved maintenance and quicker equipment deliveries, users will be able to cut costs by using one terminal complex for private, backup, and/or public message needs. The dial-up system's present data transmission speed limit—about 2000 bps—will be raised to as much as 4800 bps by improved data set equipment, enabling many private line customers to use the public system.

Since nearly all city government is administered in similar—if not identical—fashion, the programs being developed would be adaptable to most communities. Participants in the San Gabriel Valley project say that several cities along the southern California coast have also shown interest, and the number of cities sharing the proposed data center could grow to as many as 40.

ACM SYMPOSIUM ON COMPUTERS & CITIES

Computer use in a broad range of urban problems—from air pollution, transportation, and desegregation to urban planning and municipal data banks—will be covered in the second annual ACM symposium on "The Application of Computers to the Problems of Urban Society" to be held Nov. 10 in New York. Headlined speakers will be Under Secretary of the Department of Housing and Urban Development, Robert C. Wood; air pollution control expert, NYC Commissioner Austin Heller; Professors Russell Ackoff (operations research) and Britton Harris (urban planning) of Univ. of Pennsylvania; and Dr. Edward F. R. Hearle of Booz, Allen & Hamilton (urban data banks). More than 500 attendees are expected at the meeting, which is sponsored by the regional ACM chapters in the New York area.

Leading off the session with a talk on information systems in a "New York urban observatory" will be Dr. E. S. Savas, ex-IBMer recently appointed Deputy City Administrator for management sciences and information systems. The afternoon of the one-day meeting will have three parallel sessions of five general and technical papers each. These will include such topics as the "Design of a Planning Model for an Urban School District," "An Operations Research Approach to Racial Desegregation and School Systems," "Urban Data Banks and the Rights of Individuals," "Retrieval of Geographically Organized Data," and "Simulation of Urban Transportation Transfer Points."

IC MASK DESIGNING SPEEDED BY SOFTWARE

A program to aid the design and fabrication of masking arrangements for integrated circuits has been developed by Northern Electric Laboratories in Ottawa, Canada. The program, CALM (Computer Aided Layout of Masks), runs on a dual Control Data 3300 computer, and requires 30K (24-bit) words of core.

CALM accepts a systematic description of the circuit element geometries and processes their interconnections into various geometrical shapes. The geometries can then be operated on by the programs that generate a mask layout compatible with the interconnection and other constraints. (The designer can modify the procedure at any point.)

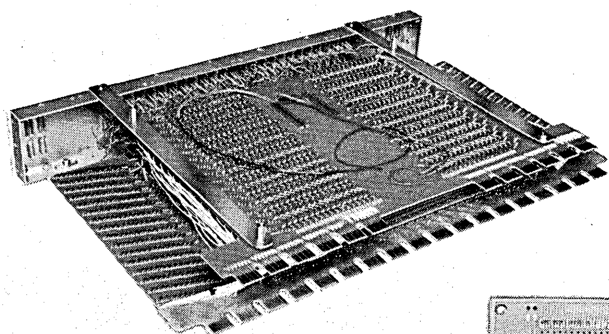
The performance of the mask design is then simulated by the program, compared with initial requirements, and made ready for approval. After this series of transformations, the program will generate a mag tape containing mask coordinates to drive a light table for producing the masks.

Successfully tested in its experimental runs, CALM will soon be in operation at Northern Electric.

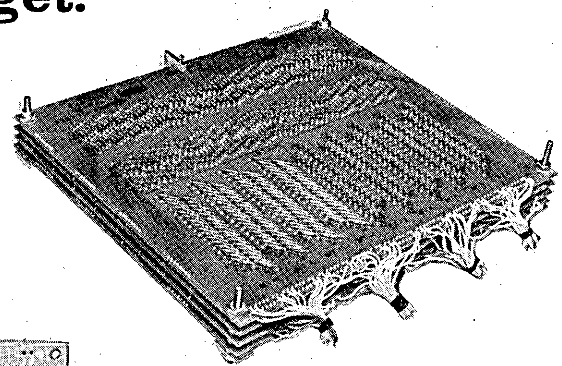
MIS GETS BOOST FROM NEW SCHOOL

To the list of management aids in development—I/O models of the economy so firms can determine their marketing strengths, of management information systems and grandiose

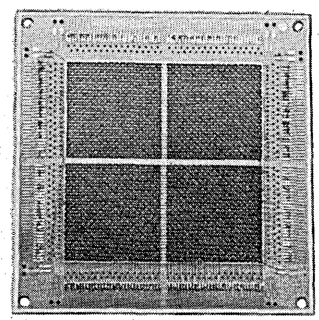
That's what G. E., SDS, Interstate Electronics, Litton Industries, Northrop and others get.



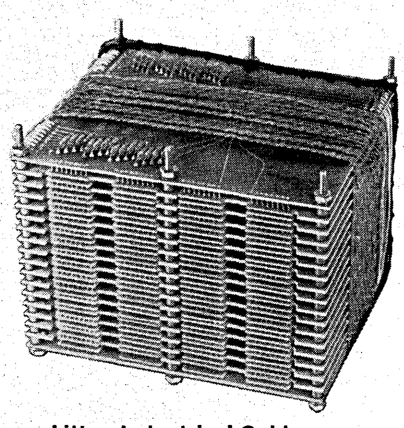
General Electric — GE/PAC* 4020 16K x 25 (modular increments of 4K); 1.6 microseconds; 30 mil cores; 2½ D; heated stacks.



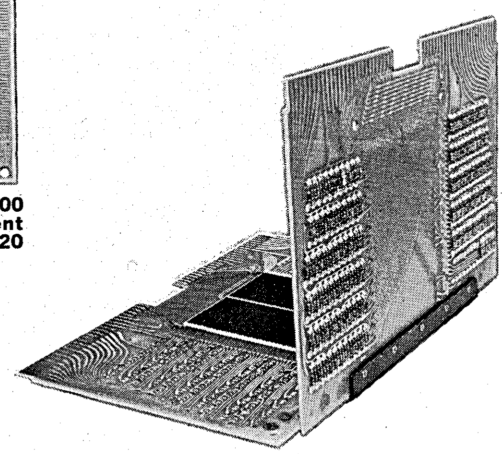
Interstate Electronics — IEC 1010 8K x 18; 1 microsecond; 20 mil cores; 2½D.



Northrop Nortronics—NDC 1000 Series Computer Development 16K x 14; 2 microseconds; 20 mil cores; 3 wire; 3 D.



Litton Industries' Guidance and Control Systems Division —CORCT LCM-710 memory series; LCM-728 computer series 4K x 32; 2 microseconds; 30 mil and 80 mil cores; 3 D.



Scientific Data Systems — Sigma 2, 5 and 7 Computers 4K x 9 (opened); Sigma 2 900 nanoseconds; Sigma 5 and 7 850 nanoseconds; 23 mil cores; 2½D.

*Reg. T.M. of General Electric Company

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FABRI-TEK LEADS IN MEMORY TECHNOLOGY

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"control centers" with video and CRT displays—add Manager Learning Center of the American Foundation for Management Research. For $5,000/week, a company team can come to the Center's new headquarters at Hamilton, N.Y., to try to formulate plans in such areas as long-range planning, manpower planning, and management control. At each team's disposal is a staff for each "Substance Center" (now established or being formed for the three areas listed above) and a microfilmed bank of documents. These cover such topics as histories and forecasts of industry growth patterns and changes in market segments, trends, etc.; and case histories, plans, manuals, job descriptions, etc., of companies of various sizes and industries. About 20,000 such documents, 70% unpublished, are now on file, using a Recordak system for retrieval and printout. The Center hopes to have at least 70-100,000 such documents. A Houston Fearless CARD microfiche system, which stores 74,000 8½ x 11 pages, is on order. It is planned that ultimately some of the data, perhaps indexes and abstracts, will be computerized, and that displays for the microfilmed documents will be installed in the Center.

After the first week a team will spend usually about six months back at the office gathering data and formulating plans, which are then submitted to the Center staff for analysis and comparison with environmental data. A 360/50 at IBM in N.Y. is used by the Center to perform a linear regression analysis of this data. This output of average values and trends is then compared with the projections of the company. (Ultimately the Center hopes to have programs to perform the more sophisticated linear correlations.) After these analyses, the team may return for a second week to develop a definite action program.

ON-LINE TICKET SALES SLATED FOR L.A.

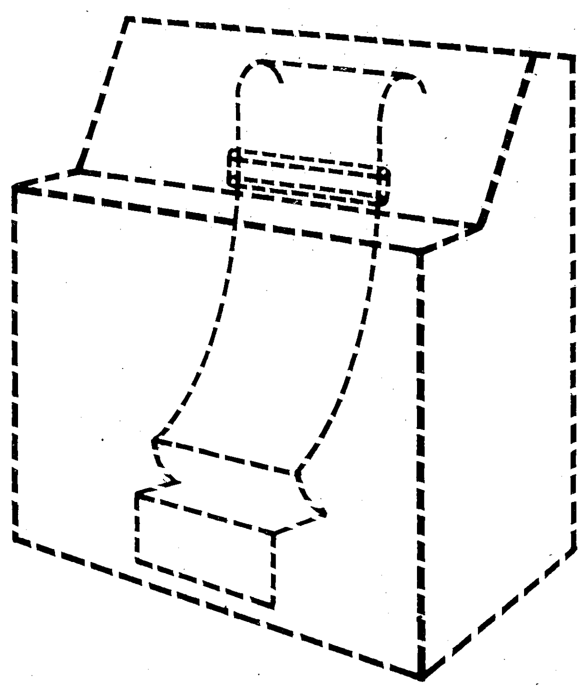
Ticket Reservation Systems, Inc., first to go operational with the on-line sale of tickets via remote terminals, has announced that this service, successfully tested in a pilot program this summer, will be available to the Los Angeles area by the end of this year.

The pilot project, conducted in New York City (see Aug., p. 73) on specially designed Control Data terminals located in department stores, and linked to a CDC 1700 computer, sold tickets to seven attractions (ball games, movies, concerts). This trial run worked, and experienced no problems with the software, according to president John Quinn, Jr., who emphasized that the software is more complex than airline reservation systems because it books a customer for a particular seat, and prints out the ticket at the point of sale. The New York system will begin full-scale (250 attractions) this month.

The operation in Los Angeles will initially be connected (via leased lines) to the 1700 in NYC; a west coast data center will be added later if things go well. In addition to local events, residents in Southern California will be able to purchase tickets to New York shows (at first, only a selected few).

After its success with the pilot in two NYC department stores, TRS hopes to place terminals in similar LA business locations. Where? For one, the May Co. is "very interested," Quinn said.

Tickets are sold to the consumer at box office prices. The action at the terminal is in two phases: when a consumer shows interest, and indicates time and location he prefers for an event, the inventory is queried for the availability of tickets. The resulting information, printed out as a



verification of the order, later serves as an audit trail. If the consumer then decides to buy (he has 40 seconds to make a decision before the "frozen" tickets are returned to the inventory), the BUY button is pushed and the tickets are printed out.

A few snags in the system are caused by the under-the-table trade usually associated with ticket sales. Thus, TRS agrees to handle only events that relinquish 80% of their inventory to the system.

Interesting competition for TRS in the Los Angeles area will be Computer Sciences' Computicket (see May, p. 79). Also scheduled to begin this winter, they plan to have terminals located in over 50 Ralph's markets, possibly expanding then to New York.

CDC HAS GROWING INTEREST IN CONTROL SYSTEMS

Although GE and IBM have won all the headlines lately for their activities in process and industrial control, Control Data is also in there pitching with a total of about 50 installations now in operation. They got started by taking over the Control Systems Div. of Daystrom near La Jolla, Calif., in 1963. Daystrom was well established in the control business and, in fact, was the first company to install a system for computer control of a power plant—in 1957.

Adcomp Corp. was then acquired, in 1964, and later merged into the La Jolla operation. Now the whole thing has the cumbersome, if descriptive, name of the Control Data Analog-Digital Systems Div. It's managed by Nate Dickinson, who has recently added Jerry Tasto to the staff as director of product management (which means marketing).

The division now has about 500 people and produces systems for industrial and process control; data acquisition, including biomedical monitoring systems; hybrid computers; and a product line of test, measurement, and control instrumentation. Altogether, they turn out some 40 varieties of analog/digital gear to hook into CDC 160's, 1700's, and 3000 series machines. The division supplies all corporate requirements for this sort of equipment, which takes about 20% of production, and almost all the rest goes into their own systems; outside sales are just beginning.

Although the division is strong in power plant installations, they are now concentrating on chemicals, glass and steel makers. At present, process and industrial control accounts for about half the systems business; the other half is in data systems, such as those for seismic and telemetry applications.

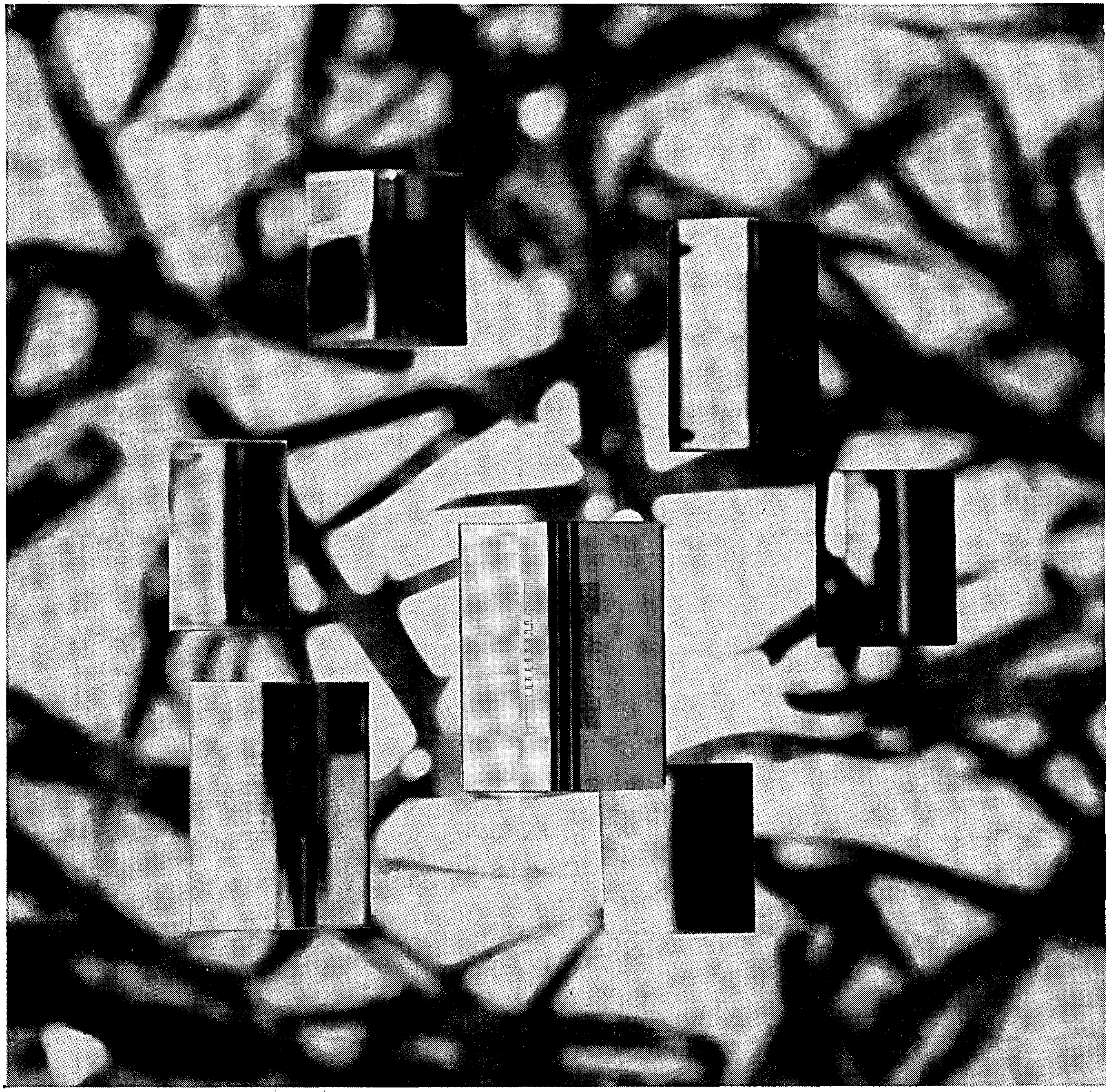
As with everyone else in the computer business these days, the company's main problems are getting, keeping, and directing programmers to develop useful software. But this company should be luckier than most at keeping them happy; La Jolla is one of the country's more pleasant places to live.

ACM SCHEDULES TRAVELLING SEMINARS

The active Professional Development Committee of the Assn. for Computing Machinery (ACM) is sponsoring half-day, one-day, and two-day seminars this fall in many cities of the U.S. Two are being held in conjunction with the Anaheim FJCC.

These will be held in Anaheim on Friday and Saturday following the conference, and again on the following Monday and Tuesday in Chicago. The topics: "Information: Its Storage, Retrieval and Management," and "Computer Systems Analysis Techniques." Fee for ACM members is $75.

Other seminars are on time-sharing, computer graphics, and file structures for on-line systems. For more information, contact your local chapter or



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James M. Adams, Jr., Director of Education, ACM, 211 E. 43rd St., New York, N.Y. 10017.

L.A. COUNTY TO GET IBM VOTING SYSTEM

Los Angeles County, which has over 3 million registered voters (40% of voters in California) but still uses paper ballots and hand-counting methods, last month agreed to buy $5.6-million worth of IBM Votomatics. That's 33,000 punched-card vote recorders plus 7,000 demonstrator units, said to be the largest order for an electronic voting system. Others bidding for this job were Coleman Engineering Co. Inc., Santa Ana, Calif.; Seiscor Div. of Seismograph Service Corp., Tulsa, Okla.; Cubic Corp., San Diego, Calif.; AVM Corp., Jamestown, N.Y.; and Shoup Voting Machine Co. Delivery is to be made in time for the '68 state presidential primary.

The IBM system, currently in use in 10 California counties, is a six-pound table-top unit that accepts a punched card on which voters record their selections. The names of candidates and issues are printed on pages bound into the Votomatic, and a stylus is used to punch the holes. There's room for 235 positions; write-in votes are written on an envelope given each voter, and in which the ballot is placed. After polls close, tabulation is to be performed at two IBM data centers.

The selection of IBM was made by the county, following the recommendation of a commission that studied competitive systems for 14 months. By using Votomatics, the county over a 10-year period reportedly would save $4.4 million, with the final count completed by 2:30 a.m. after the close of polling places. Included in this computation is a savings of $13.9 million by consolidating precincts, and payments to IBM. By contrast, all the other systems would have cost the county from $2.8 to $24 million, and the final count wouldn't be in until 7 a.m., the county said.

CDC INTENDS TO ACQUIRE CEIR THROUGH STOCK SWAP

Control Data Corp. and CEIR have reached agreement in principle for acquisition of the latter by exchanging one share of CDC common for six CEIR shares. Negotiations are not yet completed; the deal requires approval of both companies' shareholders and boards of directors.

The initial agreement, however, raises lots of questions. The most basic one: why does CDC want the company? CEIR's sales were down slightly for the latest nine-month reporting period, from $17.4 million the preceding year to $16.5 million, and net profit dropped to 6 cents a share from 33 cents.

TOSHIBA UNIT READS HANDWRITTEN NUMBERS

A journal tape reader capable of reading at 2000 cps and 1200 lpm and a mail sorter that reads handwritten numbers have been developed by Tokyo Shibaura Electric Co. Ltd. (Toshiba) of Japan. No marketing plans are announced for the tape reader, which was developed under 1965 subsidy from Japan's Ministry of International Trade and Industry; the mail sorter was developed for the government's Ministry of Postal Services.

The journal tape reader has character-recognition logic which needs no adjustment to read such numerical

fonts as ISO-A and -B, IBM, NCR, Farrington 12 F and the Toshiba Stylized Font. Characters are recognized by their geometric features rather than stroke, thickness, or position. Main components are a paper-feeding mechanism, photoelectric scanning device, and i.c. recognition logic. Width of the journal tapes can range from 56 to 100 mm.

In testing, the reader-sorter, whose OCR unit uses the feature-detection method developed for the tape reader above, achieved 95% accuracy in recognizing and sorting samples of numbers handwritten with a variety of instruments. The system will sort letters into pre-assigned stackers at five pieces a second. A character is analyzed and compared to a dictionary of recognition logic compiled from a "tremendous variety" of handwritten numerical characters. If an unpredicted character appears, the logic is improved by the addition of this number to the dictionary. Also for the post office, Toshiba has developed a claimed world's first facer-canceller that, in addition to facing and postmarking mail, automatically distinguishes and sorts special delivery mail from ordinary mail by recognizing the color and shape of the postage stamps. The machine does not require that any special chemicals, designs or printing methods be used in the stamps—as conventional machines do—but instead detects the color contrasts at the edges of stamps. "High accuracy" is claimed, such as not confusing the color on post cards with the color on stamps.

GOLD-PLATED CRT IS BR'S 10,000TH

Bunker Ramo, pioneer in on-line systems for such fields as banking and airline reservations, has chalked up some more firsts. Last month, the firm celebrated the 10,000th installation of its Telequote III stock quotation unit—a gold-plated CRT terminal at the Portland office of Hornblower & Weeks-Hemphill, Noyes. Since the first unit went into service in 1964, Telequote III has been installed in nearly 1400 brokerages in the country.

And while several major airlines have trumpeted the ordering of mammoth new systems with thousands of CRT reservations sets, Braniff this summer became the first to install displays for this function—30 BR mod 204 units at various Braniff offices as well as those of three airlines it serves, Southern, Trans-Texas, and Central. Two BR-335 computers are presently used, although IBM 360's will ultimately replace them. United, which has ordered Univac CRT's and computers, in the meantime is supplementing its 1100 Bunker Ramo keyboard sets with 300 new BR units using nixie tubes. BR has over 4400 keyboard sets (mostly TE1's with lamp displays) in the airline industry.

In another area, New Jersey Bell Telephone in July became the first Bell company to put CRT's into operation for updating and record retrieval and plant and equipment records. These are 34 Bunker Ramo 200 series units. Illinois Bell is using 36 series 200's in another application—operator retrieval of information on an intercepted (changed, disconnected, etc.) number.

SANDERS ENTERS HOSPITAL SYSTEMS FIELD

Sanders Assoc., moving steadily into the commercial market place with its 720 CRT displays, has now declared itself a total system supplier for on-line hospital patient record systems. Its first contract in this field, for $500K, is with Kaiser Foundation Hospital in San Francisco, where next April Sanders will install 20 CRT/keyboard/card reader terminals, two computers—a DDP-416 and 516—and several Kleinschmidt mod 311 printers.

The displays will be installed at stations around the hospital for input and retrieval of patient records and computer-stored medical forms. This Kaiser hospital handles 18,000 in-patients per year. To enter instructions, a doctor, nurse, or clerk can call up a form on the CRT, enter patient data on to it by inserting an i-d card (like credit card) into an attached reader, check off tests to be done and other functions with a photo pen, and key in any narrative of from 75 to a few hundred words. The DDP-416 and 516 will be used to temporarily store such records in a Data Disc F-6 disc system (6.5 megabits) and to send and receive data from the central Kaiser IBM 360/50 located in Oakland, Calif.

Sanders intends to offer hospitals its CRT with computers and other I/O equipment of any make, along with an operational package of programs for the terminal communications portion of a hospital information system. The CRT's for this function use part of the 720 components, but the 720's delay line refresh memory has been replaced by a core memory for a character generation refresh multiplexer. This results in a speed of 1/10th of a second to fill a page of data on the screen, which can hold 1000 characters, versus 3 seconds for the 720.

ANELEX, MOHAWK TO FORM $30-MILLION COMPANY

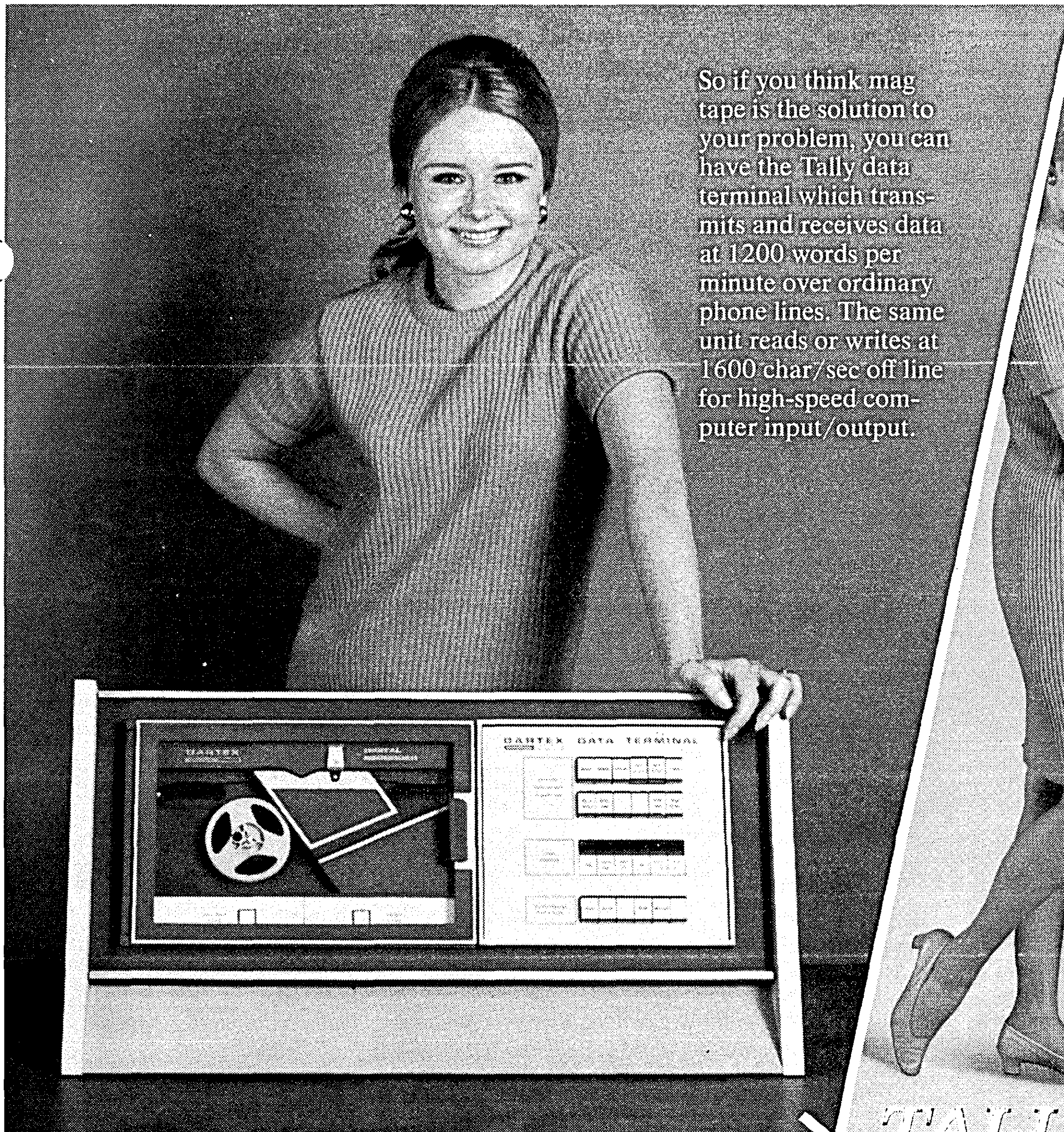
The Mohawk Data Sciences merger with supplier Anelex, which will be a wholly owned subsidiary, should result in a neat complement of products, marketing and service emphasis and facilities, and engineering skills. At the same time, the two firms, both in the black for 1967 after '66 losses, combine for $30 million in assets.

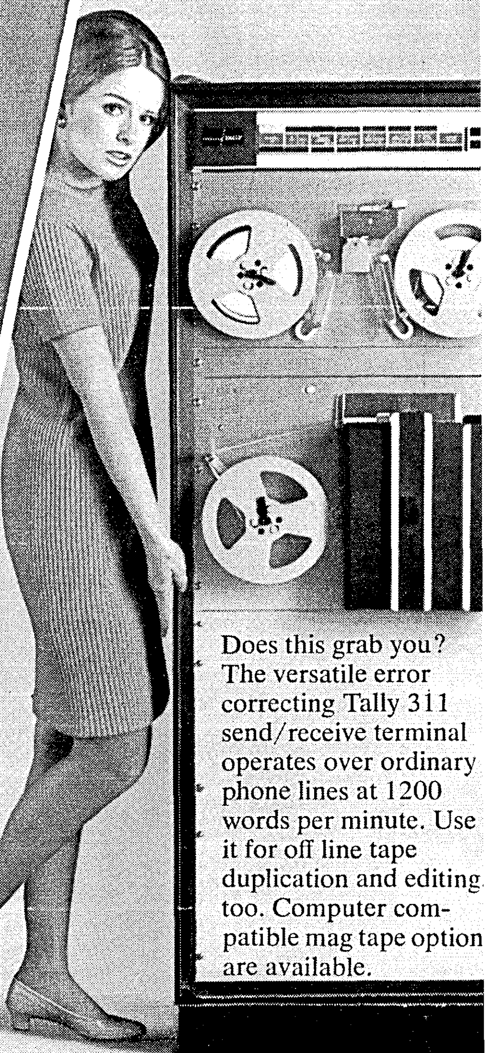
Mohawk, which has been nipping away at IBM's keypunch business with its Data Recorder (source data to mag tape conversion) series, is primarily an end user supplier. (However, one OEM, NCR, does market the units under its label.) Anelex's major customers for its 4000 and 5000 series printers (300-1250 lpm range) and other products are OEM's, primarily GE and RCA. But it is planning to increase end user market penetration with print stations and printers, which will include new models at the high and low end.

Thus, Anelex, with a 40-50 man marketing and support force operating now mostly out of Boston, will have available the sales and service facilities of Mohawk: 49 U.S. offices, 11 offices or dealers in Canada and Europe, 63 salesmen and 110 customer engineers. In turn Mohawk expects that the Anelex force will be helpful in marketing its recorders to OEM's.

The most natural reason for the merger is that Anelex, starting this year, became a supplier of series 4000 printers to Mohawk for use in their 1320 system—a combination of the Data Recorder and printer. About 235 are now on order. It was expected that Anelex shipments here would amount to over $1 million a year. Too, utilizing the mechanical engineering talents at Anelex and electronic knowhow of MDS, other printer/recorder products should result.

MDS, which sprang from Univac in 1964 and shook off a Sperry Rand suit over the origin of the recorder, has grown into a 600-man firm with 16 Data Recorder models. Over 5000 should be installed by year end and production will jump from 100 units/week to 150-200. Backlog is now 2400. A year ago, MDS was reporting 1000 installations and a fiscal '66 loss of $828,799; in fiscal 1967, with rentals pouring in and





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sales increasing, the firm showed a $9.33 million gross and $1.1 million profit after taxes.

Anelex has over 1000 people employed in its total operation, which also includes subsidiaries Franklin Electronics Inc. (strip printers); Mark Steel Stamp Corp. (engraving group—print wheels, etc.); Unicraft Corp. (precision machine shop); Anco Technical Service Inc. (technical writing); and Anelex Ltd. in London and Anelex NV in Amsterdam (both sales and service groups). Anelex took a $5 million loss in fiscal '66. But for the 9-month period ending June 1967 the firm showed $13 million in sales and a $550K profit after taxes (49¢/share).

The agreement, which should be approved by stockholders this month, involves exchange of one share of MDS common stock for each three shares of Anelex common. Anelex stock, 1,145,709 shares outstanding, trades on the American Exchange. MDS, with 2,023,425 shares, is on the over-the-counter market, although it will apply to Amex soon.

ACM EXHIBITS AREA GETS BIGGER, BETTER

A combination of location and event —the 20th anniversary conference held in Washington, D.C.—led to new records for the ACM national meeting. About 2700 registered and over 3000 more attended the exhibits, which had more than 30 manufacturers showing wares. And the ACM meeting has never before been noted for its large exhibits.

It looked like an AFIPS conference, with sleek showmen giving pitches at exhibits, like AT&T's. Control Data provided a computerized message handling system, consisting of 12 CDC 211 keyboard CRT terminals so that you could go over, type your name in, and find out there was "no information on file." (Sometimes there was a message, if you were popular.)

IBM had a demonstration of RAX (Remote Access Computing System) on hand, along with the 17th century Pascal calculator, the first true calculating machine, several other antique devices, and some of IBM's early equipment (1925-46).

Computing Technology Inc. of Paramus, N.J., has approached the government with its computerized automatic dictionary for Vietnamese-English translation, and proved it works with a demonstration at the conference. A time-shared RCA 70/45 in Cherry Hill was used in the showing. The computer performed word-for-word and, in some cases, phrase-for-phrase look-up in the stored dictionary and output the English equivalent. The dictionary matching procedure makes use of a longest-match technique so that whole phrases may be translated.

CTI also demonstrated its ballistics identification system, BALID. It uses an electromechanical scanner to track the grooves on a spent bullet. The analog signal produced is converted to 10-bit ordinates. These ordinates are then read directly into a PDP-8/S, which reduces them to indices of scanned surface. The program matches the search bullet against mechanical bullet files kept on mag tape. The system is reportedly being tested by several state and city law enforcement agencies.

Other showings included Computer Applications Inc., which has a demonstration of Ticket Reservations Service Inc.'s Control Data terminal for making on-line reservations and issuing tickets to entertainment events. Applied Data Research touted its Autoflow program, first software to win an *Industrial Research* magazine

award. And Informatics touted fifth-generation software, terrifying those still struggling with the third generation. ■

KWIC DETAILS REFERENCES IN SECURITY CLASSIFICATION

A new application of Key Word In Context (KWIC) indexing is proving itself to be a useful tool in the management of national security classification. A KWIC index of the complete text of a classification guide has been found to greatly facilitate use of the document. The guide, a detailed reference book which assigns appropriate security classification levels to specific information, is the basic security text. The ability of the KWIC technique to produce a detailed, yet easily revised, index makes it ideally suited to this job.

This technique has been successfully applied at Atomic Energy Commission labs at Rocky Flats Plant, operated by the Dow Chemical Co., and the Los Alamos Scientific Laboratory, operated by the University of California. KWIC indexing of classification guides has focused attention on the potential of complete text indexing for other technical documents. It is interesting to note that the humanities have been the first academic discipline to fully exploit this computer technique with the widespread production of literary concordances. It is expected that KWIC indexes to technical procedure manuals, proposals and other such technical documents will become popular.

Further information on this application can be found in a recent article in *Classification Management,* Vol. 3, No. 1, pp. 7-11.

GRUENBERGER FILM REVIEWED AT ACM

Fred Gruenberger, a senior member of the staff at Informatics, Inc., and an associate professor of mathematics at San Fernanco Valley State College, premiéred his 14th film on the computing industry at a recent Los Angeles ACM meeting.

Produced with financial assistance from AFIPS, "It's Your Move," is based on a data processing course given before a selected group of mathematics teachers from the Los Angeles City Schools. The film illustrates the successful attempt to "teach teachers to teach computing": The group of 30 met on Saturday mornings for three months and progressed from lectures on basic principles to hands-on a 1620; witnessed time-sharing demonstrations, and were introduced to concepts in advanced logic.

The movie centers on a group of six unusually outstanding teachers who were chosen from the main group to participate in a casual discussion of the course for the camera. The comments and insights from these six are complemented by flashbacks to the lectures and discussions of the classroom.

"It's Your Move," is a lively, professional film, greatly aided by an intriguing original score by Glenn Grossman and Hal Willard's art and animation.

The personalities of the representative teachers reveal another degree of professionalism; they are an outspoken, thoughtful enthusiastic cross-section of educators that recall the dignity of academic careers.

Now available from AFIPS, the film is an enlightening and entertaining way to spend 29 minutes.

MEDICAL LIBRARIES OPEN COMMUNICATION NETWORK

A computerized library system, the SUNY Biomedical Communication Network, has been developed by the State Univ. of New York Upstate Medical Center in Syracuse. An on-line real-time system, the network, scheduled to go on the air in September '68, will link three SUNY (Buffalo, Syracuse and Brooklyn) medical libraries and the Univ. of Rochester Medical Center library.

The system will list approximately 1 million books and journal articles on biomedicine published in the last five years; the books will be indexed by chapter. Terminals located in the participating libraries may be used by students and faculty to research material; when a particular book or article is desired, the user may request a status report (where the book is located; is it available). If the material is in another library, the system will automatically arrange an inter-library loan, and provide the user with the approximate delivery date.

Another library communications system, based on inventory control of over 8 million books, is now in operation in 23 cities and four universities in Indiana. Centralized at the Fort Wayne public library, teletypewriter equipment (from General Telephone Co. of Indiana) allows rapid distribution of books in request from participating cities. Over 100 small towns can query the system by telephone.

● "Info 68," the ninth national symposium of the Society for Information Display, has issued a call for papers in preparation for their May 22-24, 1968, meeting at the Ambassador Hotel in Los Angeles. Five areas to be covered at the conference include the use of displays in the civil, medical, military, education and entertainment fields. Definitive abstracts should be sent by November 3 to Erwin A. Ulbrich, Jr., Information Systems Subdiv., Douglas Space Center, 5301 Bolsa Avenue, Huntington Beach, Calif. 92646.

shortlines . . .

A plan for enabling users to replace obsolete equipment has been announced by U.S. Leasing Corp., San Francisco. Convertalease allows a company to transfer its lease from one computer to a newer model . . . A study of source data practices in the federal government shows that not enough is being done to standardize the data forms from which computer input is derived. In its report, Auerbach Corp. refers to House Report No. 2197, which says the government uses 360,000 different forms, prepared in 15 billion copies; in 1966, an estimated $53 million was spent to print forms, another 20 times that amount for clerks who use them; some 255,000 federal employees spend most of their time filing records; and $550 million a year is spent preparing machine input from record language. . .

The British affiliate of GE, De La Rue Bull Ltd., announces the first commercially available time-sharing system in Europe. It's a GE 265 system . . . A similar system purchased from Dartmouth College is being operated by Graphic Controls Corp. in Buffalo, N.Y. A bank and a private secondary school are among the users . . . Raytheon has lowered the memory cycle time of the 703 computer, the new integrated circuit model, from 2 usec to 1.75 usec . . . Matrix Corp. has installed an IBM 360/65-40 ASP system in its El Segundo, Calif., facility . . . Using the CEIR time-sharing system, the National Biomedical Research Foundation in Silver Spring, Md., is storing information on 200 poisons and their antidotes to speed treatment of accidental poisoning patients. Interrogation of files is from Teletypes. Now in experimental stages, a complete system reportedly would hold up to 10,000 poison elements and information on toxicity, ingredients and symptoms .

Your memory need improvement? Ampex makes cores, planes, stacks, transports and complete memory systems. Check this list for your needs.

a A data system or computer is only as good as its memory, so it pays to get the most reliable memory components and systems. Here are some examples—from a company which is a leader in the development of core and tape memories and has the technology and experience to improve your system's memory—Ampex.

Core Memories

b **START WITH FERRITE CORES...** We offer a full line of ferrite cores ranging in size from 18 to 80 mils (outside diameter). If your application involves a wide temperature range, we can supply you with lithium ferrite cores in 18- to 30-mil sizes. Chart "B" shows typical switching times.

For more information on Ampex cores, circle number 15 on Reader Card.

c **OR WITH ARRAYS OR STACKS...** We have a full line of commercial and military arrays for memory designers, and we're glad to take on design assignments for special stacks and arrays.

Our 2½D stack family has expanded and now includes 18-, 22-, and 30-mil cores. Ruggedized stacks for military applications are designed to satisfy such requirements as MIL-E-5400 and MIL-E-16400 in both 3-wire 3D and 4-wire 3D configurations.

More stack or array info? Circle 16 on Reader Card.

d **OR BUY THE COMPLETE MEMORY!** We design and build all kinds of core memory systems for commercial and military use. They begin with our widely known and used RF series, and range in size up to 20 million bits. Here is a brief view of our core memory line.

RF series is a modular family of reliable memories which offer large ranges of "store" sizes and options. Integrated circuits and "Master Board" construction cut their size and cost, increase reliability. All feature high MTBF, easy maintenance, non-destructive power shutdown.

RF-1, RF-2, RF-3 give you 1.5 microsecond cycle time. Capacities from 512 to 16,384 words, in word lengths from 4 to 72 bits. Each includes power supply. Over 4000 hours MTBF for 4K x 12 RF-1; proportional for RF-2 and RF-3.

New RF-4 memory has faster cycle time of 1 microsecond. Capacity: up to 4K x 20. Available with or without power supply.

RS memory system is a large capacity (up to 32K x 80) -microsecond system with a variety of options that let you tailor it to your exact needs.

For more core memory details, circle 17 on Reader Card.

e **MASS MEMORY** consists of 4 modular stacks of 5 megabits each. Cycle time is 2.7 microseconds, but unique 4-way interleafed operation with two-port entry into the four stacks results in *effective cycle time of 675 nanoseconds.*

For more core memory details, circle 17 on Reader Card.

NEW! RG MEMORY

Our brand-newest system, the RG memory packs big capacity into very small size by using integrated circuits throughout. Some features:

- 900 nanosecond full cycle
- modular (16K x 40 max. per 5¼" panel unit), can expand to 32K x 80
- operating temperature 0 to 50°C
- standard TTL positive true logic interface levels
- uses advanced IC's throughout
- low cost yet reliable and simple to maintain
- options: data parity generation and check, built-in tester, indicator panel, zone transfer; many other options

For more core memory details, circle 17 on Reader Card.

Single Capstan Tape Transports

Our tape transports meet all your requirements with data transfer rates up to 120 kHz. All offer at least 2,000 hours MTBF, at least ONE BILLION start/stop operations before replacement parts may be needed in the drive mechanism. All units are interface interchangeable. Write and read IBM compatible 7- or 9-track formats. All contain the Ampex patented single capstan electronic servo control.

f **NEW! TM-16 TRANSPORT** is the newest member of the Ampex single capstan family. It is a direct plug-compatible replacement for any IBM 729 or 2400 series transport. Besides offering higher data reliability at high speeds (60-150 ips), the TM-16 features a number of human design improvements: push-button power window for faster access and easier loading; straight-line threading for operator convenience and faster loading; optional automatic threading; and a modular design that makes maintenance simple.

For additional data circle 18 on Reader Card.

TM-7, -9, -11, -12 transports are the original single capstan transports specifically designed for digital data transfer. Over 1,000 of these Ampex tape drives are now in use around the world.

For complete and up-to-date information on transports, circle 18 on Reader Card.

g **BUFFERED TAPE MEMORIES (BTM SERIES)** incorporate an Ampex single capstan tape memory, an RF core memory and integrated circuit control logic to achieve a highly flexible digital data recording system. A functionally integrated, easy-to-use unit, the BTM buffered tape memory, can accept asynchronous digital data over a wide range of character rates, format the incoming information and record the data in blocked and gapped form on computer-compatible magnetic tape.

For more core memory details, circle 19 on Reader Card.

h **SHARED TAPE MEMORY SYSTEMS** let you save both money and floor space. They time-share the 7- or 9-track data (read/write) electronics between up to four TM-series single capstan tape transports.

TAPE CONTROL UNITS FOR COMPUTERS

The convenience and low cost of digital magnetic tape recording can now be inexpensively obtained for various medium and small size digital computers. By combining an Ampex TM-series single capstan digital tape memory with our Ampex-designed tape control unit (TCU) you have a versatile, compact, low price magnetic tape system. The TCU plugs directly into a computer's input/output interface and decodes standard magnetic tape unit program instructions for tape transport selection and data transfer control.

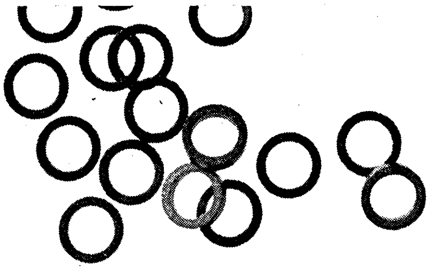
Sound interesting? Circle 19 on Reader Card for tape memory info.

i **HOSTILE ENVIRONMENT DIGITAL TAPE MEMORY SYSTEMS** Our ATM-13 and GTM-14 memories are designed and constructed to take the extremes of pressure, humidity, temperature, shock and vibration found in airborne, shipborne, geophysical and ground mobile applications.

The ATM-13 high performance memory system is IBM-compatible to 75 ips (60 kHz character transfer rate at 800 cpi). Continuous (gapless) to 112.5 ips. Fast start/stop times of 6 milliseconds maximum at 75 ips. Can operate continuously at maximum program rates up to 160 start/stop cycles per second. Environmental Class: MIL-E-5400-G, Class 1A; RFI: MIL-1-6181D; Source Power: MIL-STD-704. Weight: less than 150 lbs.

NEW! GTM-14 memory is IBM-compatible to 45 ips. Continuous (gapless) to 105 ips. Weighs less than 150 pounds. Low power requirements. Will operate on battery power. Capable of operation within the environment of MIL-E-5400, Class 1A.

If you're especially interested in this tough breed of memory, circle 20 on Reader Card.



a

AMPEX

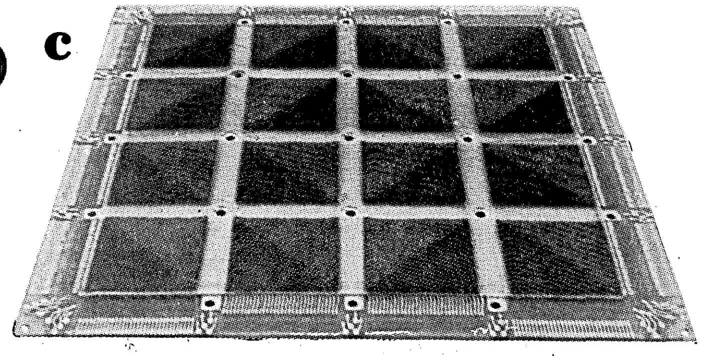
Typical switching times for Ampex Ferrite Cores

b

Core #	Switching time
184-06*	175 nanoseconds
204-06*	230 nanoseconds
303-03	360 nanoseconds
304-07*	380 nanoseconds
304-06*	440 nanoseconds
501-10	850 nanoseconds
504-10	1300 nanoseconds
506-15	1500 nanoseconds
802-40	3000 nanoseconds

*Wide temperature range

c



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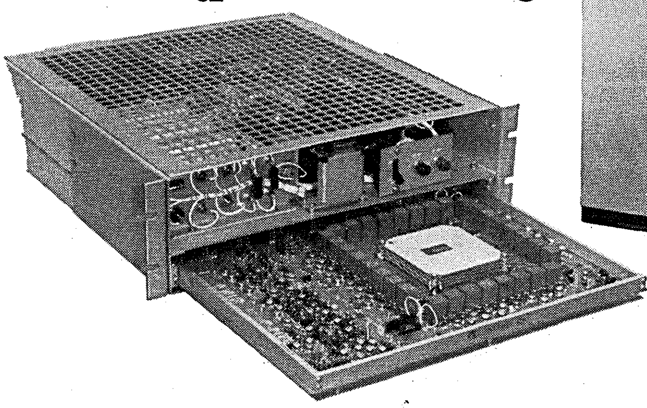

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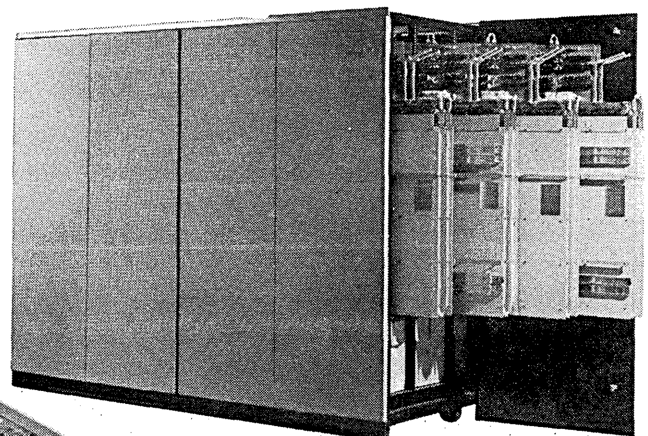

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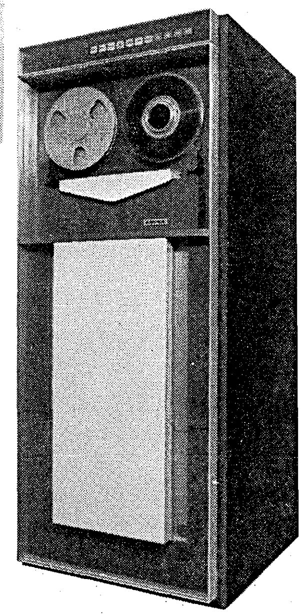

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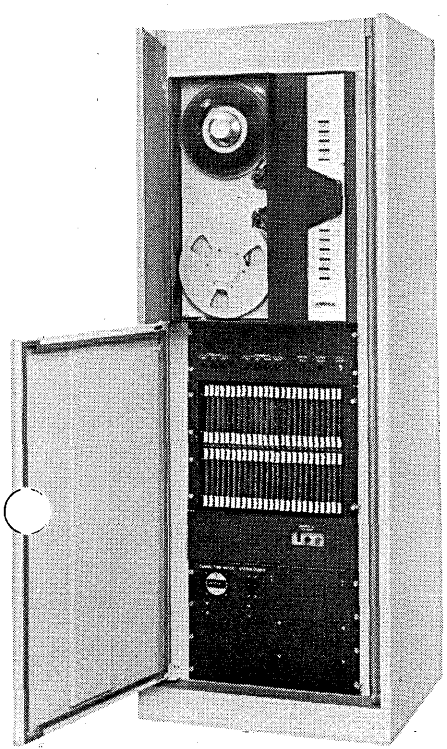

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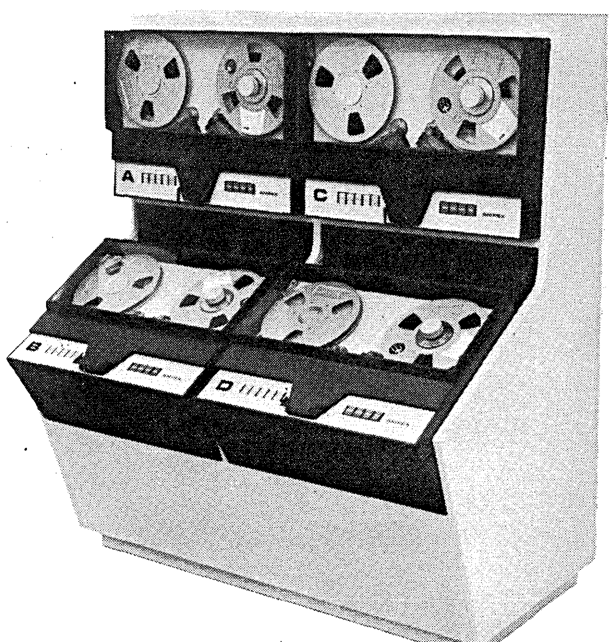

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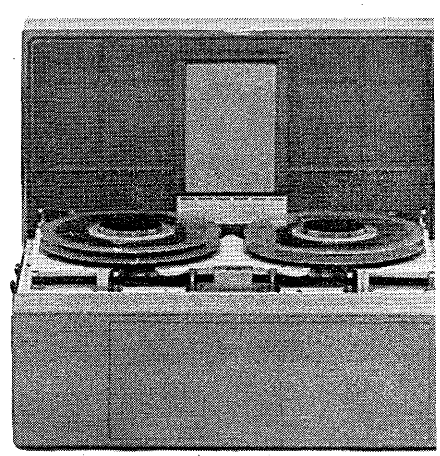
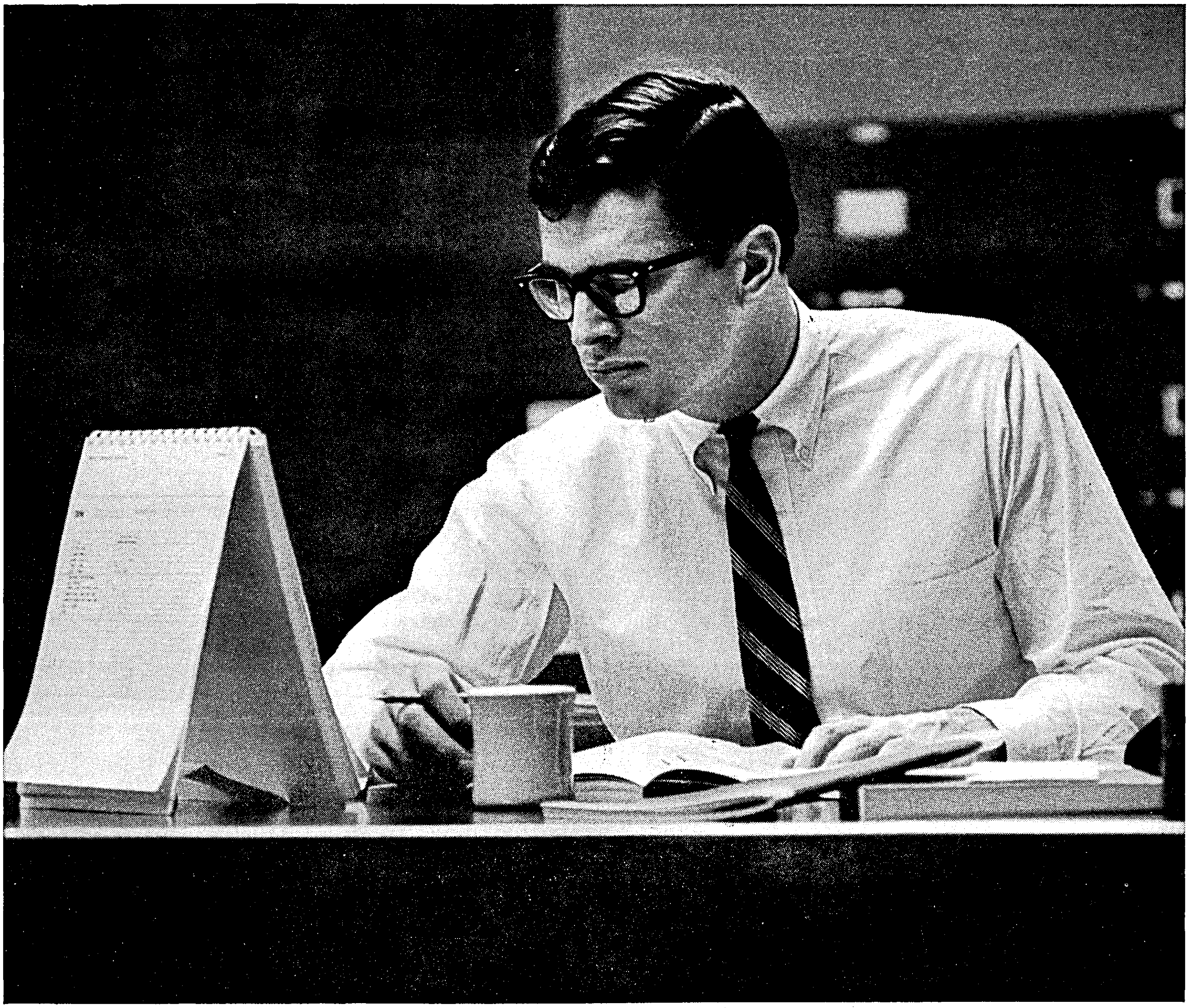


See many of these components and systems in our Booth "G" at FJCC, Anaheim, Nov. 14-16. You can't miss us—we're in the center of the hall.



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®

SENATE BILL SLATES PROCUREMENT REVIEW BOARD

"There must be a better way (of selecting dp equipment)," said a GovOps committee staffer when asked to explain S2430. This bill, introduced last month by Senator Montoya sets up a presidentially-appointed board, consisting of five members "from private life" to review all federal dp selections, needs and utilization. The board would have access to all dp procurement and selection paperwork.

The Brooks bill, "doesn't go far enough," the staffer explained. "With so much money involved, bidders must be wining and dining procurement officers." Asked for details, the staffer said he "wasn't talking about GSA." He admitted the AF Phase II selection was one reason for drafting S2430.

A House source says the Montoya bill is "ridiculous" and will never be enacted.

GSA SERVICE BUREAU BOWS AT HUNTSVILLE

CSC is the likely operator of GSA-financed service bureau scheduled to begin operating this winter in Huntsville. Users—federal agencies and contractors --reportedly will pay "the world's lowest rates" for 7094 and 1401 time. GSA hopes the bureau will be the prototype of a nationwide network. NASA supplied the hardware and will be the prime user while phasing in three 1108s. Univac is giving NASA one 1108 free as recompense for not delivering Exec VIII software last June. The new delivery date is Jan. 1st.

WESTINGHOUSE QUESTIONED ON CAI CONTRACT

A House GovOps subcommittee is frustrating Westinghouse Electric's plans to break into the public school CAI market. The subcommittee says Lou Bright, research director of the Office of Education, violated the federal conflict of interest law when he ok'd Westinghouse as a supplier of a $2.7 million CAI project in Shawano, Wis. Bright, formerly associate research director at Westinghouse, insists his heart was pure. The subcommittee appears unconvinced; it's likely to write a critical report and alert the Justice Department.

Shawano's proposed configuration includes a sophisticated student-operated terminal, to be built for $2K, way below the prices of available terminals.

CHANNEL DERIVATION GEAR: CAN CUSTOMER SUPPLY?

Western Union International has asked FCC to allow use of customer-supplied channel derivation equipment on international voice-grade circuits. Three telegraph-grade channels would be derivable for alternate or simultaneous voice-record communications.

IN-HOUSE MAINTENANCE RECOMMENDED BY GAO

A GAO study scheduled for release before Christmas says federal agencies should establish more in-house dp maintenance programs. Contractors, by implication, are told to cut their rates. GAO describes a number of agencies which cut maintenance costs 30-40% by replacing contractors with in-house maintenance. The report suggests that like results are attainable at a substantial percentage of federal installations, possibly half the total.

THIRD-GENERATION FOR ARMY'S 3S

An RFP seeking third-generation gear for the 3S System probably will be issued by Army next spring. 3S encompasses Army's Pacific Theater supply network, and at least five installations are planned. Later next year, Army's Strategy, Tactics, and Analysis Group should be in the market for a computerized war gaming system featuring sophisticated graphics. Specs for both buys are now being written.

The President's "State of The Western Union" Message.

Members of the board, fellow shareholders, Ladies and Gentlemen:

As President of Western Union, I needn't tell you of the effort on my part to write this message in fifteen words or less. Nor do I have to tell you—it was an impossible task. Yet it is the very wordiness of the speech, I think, that speaks most eloquently of Western Union's expansion into virtually every avenue of communications, computer programming and data transmission. Fifty years ago an entire report of this sort could indeed have fit on the face of a telegram in a very economical five words: WESTERN UNION IN TELEGRAM BUSINESS period... pardon me, I meant STOP.

Today, however, our faithful old bikes, I'm afraid, haven't the facility for such rapid and complex data and record traffic systems as are employed by the Department of Defense, for example. So, Western Union designed AUTODIN, the world's largest digital data system, to do that job, and it's doing it well by processing over 17 million messages per month.

A.R.S., our ADVANCED RECORD SYSTEM for the General Services Administration, is currently in the employ of over thirty civilian agencies of the Federal Government. Moreover, Western Union's communications circuitry, teleprinter and allied control equipment now serves the F.B.I.'s National Crime Information Center. Thereby replacing the bicycle and catching bicycle thieves at the same time.

Then there's SICOM, the shared transmission and computer switching service, conceived and devised especially for the securities business. SICOM can endow any adolescent-size firm with the wherewithal to behave like the big boys without incurring the heavy capital investments required for in-house facilities.

Lest those not connected with securities feel like a stepchild, there's INFO-COM, the daddy of SICOM, that can be tailored to meet the specific communication requirements of any industry.

TELEX, our broadly based teleprinter exchange service, grows 25% yearly. As of the moment, it has a waiting line of better than 1,500.

The HOT/LINE, our no-dial intercity private-line, allows you to merely lift the receiver and have your party on the line before you get it to your ear. You can place a person-to-person call up to 3,000 miles away for as little as 5¢.

And that, Ladies and Gentlemen, should give you some idea of how our organization has fared, and of the highly complex, highly advanced and *highly reasonable* service Western Union is and means to keep supplying. You must admit, a young fellow peddling his bicycle all the way from New York to Indiana to deliver a message for $1.65 is pretty darn fair. I thank you for your kind attention.

See us at FJCC Booth 1309-1310

world report

BRITISH, FRENCH STAGE MERGER RACE

Something of a race has developed between Britain and France in the establishment of a state-sponsored National Computer Corp. for manufacturing and marketing. Both countries entered autumn in a strong atmosphere of government-prompted mergers, following earlier plans for concentrating resources.

In France, Thomson-Houston has taken over Compagnie Francaise de Telegraphie San Files, the dominant corporation among the firms slated to receive state monies in the $120 million Plan Calcul. CFTSF has a one-third holding in the newly formed Compagnie Internationale pour l'Informatique, which has been chosen the main-frame producer of Plan Calcul computers. Thomson-Houston gets a smaller amount through its subsidiary Sperac, which specialises in peripherals. Combined turnover of the two merged groups is about $550 million a year.

In the UK, an even bigger get-together between English Electric and ICT is under discussion. Such a merger would give English Electric a much bigger marketing force in addition to the overseas outlets it sorely needs. Unfortunately, EE has just run into teething troubles on its new System 4, bucking delays of up to three months across the product range. The company, with an order book of around $70 million, says the trouble-spot is in peripheral development and comes with an underestimation of the work for transferring from prototypes to production.

Technically, the two companies have been separated by some very different attitudes. When both were considering their new product ranges about three years ago, English opted to wait and patiently develop micro-electronics. ICT, with a cash crisis on its hands, jumped in with discrete component logic in the form of the 1900. This has taken them to a near $300 million sales in Europe's most successful marketing campaign yet. If ICT is to keep up the momentum, it will have to contend with other competitive pressures from Europe, as well as the U.S.

Giant Dutch Philips, three times the capital value size of merged English Electric and Elliott Automation, is carefully planning and picking its time for entry in the market, with a latest maneuver to buy up the marketing agents of Germany's Siemag. Philips took controlling interest in Siemag last year, when it also bought an interest in Computer Sciences International, Brussels. Ready-made software for Philips-specified machines is expected for delivery in the first quarter of '68.

SIMULA 2 CRACKS LANGUAGE CURTAIN

For the first time, the East and West will use a common language for computerized demographic planning. This will occur with the implementation of Simula 2, the Algol-based simulation language developed by Dr. K. Nygaard of Norway's Regnecentralen. Already operating on Univac and Control Data machines, Simula is to be used on the Soviet's latest Ural systems

(Continued on page 139)

Do you plan to buy your own data transmission system?

Because of recent changes in communications regulations, it is now possible for you to buy your own data subset, lease a voice circuit, and send as much data over the line as you require.

The question is: *whose* system do you buy?

We say Lenkurt. Why? Lenkurt specializes in communications transmission systems. We know the *entire* communications problem—know it from beginning to end. We have been selling data, as well as voice and video transmission systems, to all types of communications users for over 20 years.

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 down-line 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.

LENKURT ELECTRIC

SUBSIDIARY OF GENERAL TELEPHONE & ELECTRONICS GT&E

Lenkurt Electric Co., Inc., Old County Road, San Carlos, California 94070

Please send me more information on: ☐ 25A (Low Speed Data Transmission Set) ☐ 26C (High Speed Data Transmission Set)

Name ____________________

Address ____________________

Firm ____________________

City ____________ State ____________ Zip ____________

CIRCLE 78 ON READER CARD

and the scientific number-cruncher BESM 6. An IBM user's group and other U.S. manufacturers are evaluating the language.

SOFTWARE STARS AT BRITAIN'S DATAFAIR

Dominating the computer scene in September was the British Computer Society's Datafair at Southampton Univ. The biggest event of its kind for Europe (6,500 attended), it marked two events: the final take-over of the computer professional from the office machine selling gangs, and the acceptance of software houses as an industry within the UK.

In a week's joint conference-exhibition, the software houses were given equal opportunity for paper presentations with the manufacturers and university men. The drift of skilled manpower toward the software houses obviously has accentuated the software difficulties of the main frame houses. This drift is not too difficult to understand when, as at Datafair, a director of Europe's biggest software house, CAP, was dangling a salary carrot of up to 2½ times running rates among manufacturers. Perhaps it was in self-defence on two counts that ICT presented a paper on models and simulation in marketing, describing the way ICT was tackling the job of short- and long-term planning, and implying that the think-group at ICT House has got the financial future of the company well in hand. The second count was to sell big machines for model building.

SCHLUMBERGER-SOLARTRON SELLS SEISMIC SYSTEM

Newcomer into the European computer market is the Schlumberger group, pushing its interests derived from subsidiary Electro Mechanical Research. The EMR AS6000 series is being sold in Europe through a subsidiary, the Solartron Electronic Co., in Britain. First customer has been British Petroleum, the state-owned oil company taking a 6040 for seismic exploration.

BITS & PIECES

Control Data has gained permission to build a plant in France at Ferney-Voltaire. Gallic craft appears bent on setting up a rival group to balance the power of GE and IBM. . . . IBM has completed its task of giving the UK holding company a thoroughly British look by bringing in three of the Big Barons onto the board. The latest is former governor of the Bank of England, the ex-dollar game-keeper, Lord Cromer, who replaces A. K. Watson as chairman of the board. In dressing themselves up behind the Union Jack, IBM's best performance is its underdog look in the banking market: in straight commercial competition, IBM has lost three successive multi-million dollar rounds to Burroughs, English Electric and ICT. . . . The Japan Electronics Assn. will suggest to the government that the Information Science Institution be founded at Kyoto and Tohuku Universities, which have, respectively, FACOM 230/60 and NEC 2200/700 computers. Research on IR (pattern and sound recognition, etc.) is to be emphasized. . . . Nippon Electric has developed an automatic keyword index system, JAKIS, the first such system in Japanese. . . . Ministry of Trade and Industry is planning to found an Information Industry Research Organization in order to devise a general long-run plan for development of the Japanese dp industry.

Need a CRT Display to fit your system?

See the flexible one . . .
the new TEC CRT Display,
Booth 503-4, FJCC

TEC CRT Display . . . the <u>one</u> that bends to fit your needs!

- **Broadest interface capabilities**
- **Styling and mounting especially for your design**

See how comfortably the TEC CRT Display System can be incorporated into computer input/output systems, Dataphone and teletype. TEC CRT is also compatible with TEC Electronic Keyboard Systems. ■ Standard interface codes include ASCII, IBM and EBCDIC, or other codes up to 8 levels. Its compact screen displays up to 128 alpha numeric characters—3/8" high, 8 rows, 16 flicker-free characters per row. Signal levels are compatible with 5 volt current sink integrated circuit logic. ■ It's ready now! Floyd Raasch (photo), Director of TEC's Systems Research, which developed this display, is always ready to help tailor the TEC CRT to your special needs. Check the flexible one—write today for complete information.

TEC LITE ®

INFORMATION DISPLAY AND CONTROL DEVICES

TRANSISTOR ELECTRONICS CORPORATION

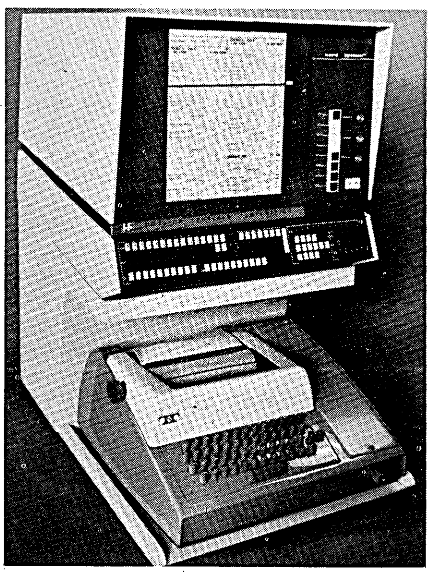
Box 6191 • Minneapolis, Minnesota 55424 • Phone (612) 941-1100

CIRCLE 79 ON READER CARD

new products

microfilm retrieval

Available in two models, the CARD (Compact Automatic Retrieval Display) system can contain 73,500 pages of information in micro-image form on 750 microfiches. A page can be selected and displayed in full size within 4 seconds. Selection may be



through a computer command, or manual through a keyboard. Depressed keys of the system may be input to a computer, triggering a programmed function or modifying computer stored information. Pictured is Model TA-CP, a peripheral device. Model II, Type I is a stand-alone model. HOUSTON FEARLESS CORP., Culver City, Calif. For information:

CIRCLE 161 ON READER CARD

optical scanner

Model 3040 journal tape reader can read up to 4,000 lines/minute, or over 15,000 cps. Fonts read include Farrington 12F and 12L, NCR National Optical Font, IBM 1428, and USA Standards A and B. The system converts data onto mag tape, although a modified version is available to transfer optically read data directly into a computer. In the latter, data is stored in the reader's core memory in unit records up to 40 characters in length; total capacity is 1,024 characters. Characters being read are displayed on a video screen to provide operator control for error correction and deletions. Symbols may be printed on the mag tape at up to 10 characters/inch. FARRINGTON MANUFACTURING CO., N.Y., N.Y. For information:

CIRCLE 162 ON READER CARD

typewriter terminal

The Series Thirty is a data terminal consisting of an IBM mod 73 Selectric typewriter with electronics housed in a box in the back. It thus would operate over telephone lines through an acoustic coupler at speeds up to 15 cps. Different models can generate such codes as USASCII, BCD. It features full duplex operation, allowing the keyboard and printer to be decoupled and operated independently and/or simultaneously. A non-print feature enables the operator to key and transmit information, such as addresses and command routines, without causing a printout. DATEL INC., Palo Alto, Calif. For information:

CIRCLE 163 ON READER CARD

x-y plotter

The 1140 x-y Variplotter has full scale static accuracy of ±.075% and slewing speed of 30″/second on each axis. Repeatability is 0.05%. Reference capabilities include internal zener reference supplies for each axis and switch-selectable external computer reference. External reference has dual provisions for ±10 and ±100 volts. Input impedance is 50K ohms/volt full scale through 1 volt/inch; all other ranges are 1 megohm constant. ELECTRONIC ASSOCIATES INC., West Long Branch, N.J. For information:

CIRCLE 164 ON READER CARD

data acquisition system

The Miniverter data acquisition system is a combination 16-channel multiplexer, sample-and-hold amplifier and 10-bit, 100 kHz, A/D converter. Made up to 10 cards on a 10-connector block, the unit is pre-wired and can be expanded to a larger number of channels. Basic system would include 256-channel Miniverter and 85 additional logic modules in a single 5¼″ drawer. Price is $1750. RAYTHEON COMPUTER, Santa Ana, Calif. For information:

CIRCLE 165 ON READER CARD

incremental recorder

Incremental digital magnetic recorder requires only 7″ of vertical panel space. Recording at 200 cpi on 7-channel tape, stepping rates are asynchronous to 150 cps. Lateral parity generation and inter-record gap are automatic; reel drive system is full servo. DELTA-CORDERS INC., Burbank, Calif. For information:

CIRCLE 166 ON READER CARD

mass storage devices

Two mass storage devices have been added to the line of peripheral options for the DDP-124, -416 and -516 computers. The first, model 4600, is a disc pack available in either 100- or 200-track configurations, has a maximum storage capacity of 115.2 million or 230.4 million bits. Basic capacities are 28.8 million and 57.6 million bits. The unit uses single-head assembly for each recording surface;

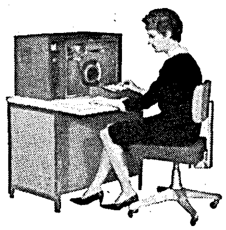
PRODUCT OF THE MONTH

Four desk-top CRT terminals can display alphanumerics only or both characters and graphics, and include black & white and color units. Each has a keyboard, CRT, and associated electronics for generating and storing messages.

The model D-20 is a color unit with alphanumerics capability only. Mod D-21 is the same in black & white, and D-22 is a color system with special electronics for the airline industry, displaying flight arrival and departure information to customers. Also having color capability is mod D-30, which can generate both alphanumerics and simple graphics, such as line drawings and schematics.

The first products of the Philco Houston operation, no mention is made of interfaces for these terminals or accompanying software packages. First deliveries are expected early in '68, except for the D-21, which requires only a three-month wait. PHILCO-FORD CORP., Philadelphia, Pa. For information:

CIRCLE 167 ON READER CARD



OK, so it's a MOHAWK!

If you can't lick 'em, join 'em... we say. We called it a DATA-RECORDER. You call it a MOHAWK. So be it, it's a MOHAWK.

MDS is engaged solely in the manufacture and international marketing of MOHAWKS for computer input preparation. Our entire organization is "input minded."

In a variety of multi-function models, MOHAWKS basically provide an exclusive, fast, economical medium for transcribing data from source documents direct to computer-compatible magnetic tape... and verifying on the same machine.

We don't care whether you call for Data-Recorders or for MOHAWKS. *Just call us, we'll know what you need.*

We'll be at the BEMA Show, Oct. 23-27, New York Coliseum. You're cordially invited to visit our MOHAWK display and demonstrations.

We'll be at the Fall Joint Computer Conference, Nov. 14-16, Anaheim Convention Center (Booths 204-206-208-303-305-307), Anaheim, Calif. You're cordially invited to visit our MOHAWK display and demonstrations.

MOHAWK
DATA SCIENCES CORPORATION
P.O. BOX 630, PALISADE ST., HERKIMER, NEW YORK 13350
Exclusive Manufacturers of MOHAWKS

CIRCLE 80 ON READER CARD

new products

each head may read or write data in a defined cylinder containing 10 tracks. Model 4400 uses head-per-track technique, and has an average access time of 8.5 msec. The option will store from a minimum 1.5 million bits to a maximum 24 million bits using two units. Each of the models has a different drive/control/electronics unit. Model 4600 is mechanically compatible with IBM disc packs. First delivery on these units is scheduled for November 1. HONEYWELL COMPUTER CONTROL DIV., Framingham, Mass. For information:

CIRCLE 168 ON READER CARD

data translator

The Comput-A-Phone data translator converts a Touch-Tone phone into a computer input device by converting the sound pitches into impulses. A die-cut template with printed instructions is placed over the telephone keys, providing a specially designed keyboard for a particular application. COMPUTER TELEPHONE CORP., Washington, D.C. For information:

CIRCLE 169 ON READER CARD

core memory

The ICM-42 core memory is available in capacities of 2,048 and 1,024 (12-bit) words. It has a cycle time of 1.5 usec, an access time of 700 nsec, and an operating range of 0-50°C. The memory, for use in communications, telemetry, machine tool control and digital buffer applications, includes address and information registers, internal timing and control and a cooling unit. HONEYWELL COMPUTER CONTROL DIV., Framingham, Mass. For information:

CIRCLE 170 ON READER CARD

continuous tax forms

Treasury Dept.-approved continuous no-carbon 1099 forms consist of three parts: IRS copy, payer's record and payee's copy. The payee's copy is a ready-to-mail envelope. Available in stock sizes for all dp printers. SHELBY BUSINESS FORMS, Shelby, Ohio. For information:

CIRCLE 171 ON READER CARD

graphic console

The 274 Digigraphics system is for use with small-scale computers, specifically the CDC 1700. Consisting of an operator's console, CRT display and a light pen, the unit has a controller with 4,096 word buffer memory (expandable to 8,192 words). The display screen is capable of displaying 2,000 inches of curves or the equivalent, or up to 1,800 characters of variable size and font. A function control software package is provided with the system; integration of user-oriented programs is accomplished via FORTRAN IV CALLS. CONTROL DATA CORP., Minneapolis, Minn. For information:

CIRCLE 172 ON READER CARD

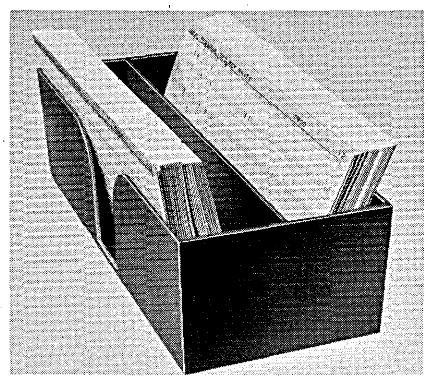
optical encoder

The Super OPTECON is an optical encoder with up to 1 MC pulse rate performance and can be used in applications including machine tools, process control, and digital instrumentation. The basic unit transforms input shaft motion into electrical waveforms 10V (50KC square wave, 200KC with pulse logic). Absolute accuracy is ± 4 arc minutes. DATA TECHNOLOGY INC., Watertown, Mass. For information:

CIRCLE 173 ON READER CARD

programming tray

Programming tray for tabulating cards will hold 300 cards, and has



center divided to facilitate sorting. BEEMAK PLASTICS, Los Angeles, Calif. For information:

CIRCLE 174 ON READER CARD

disc drive

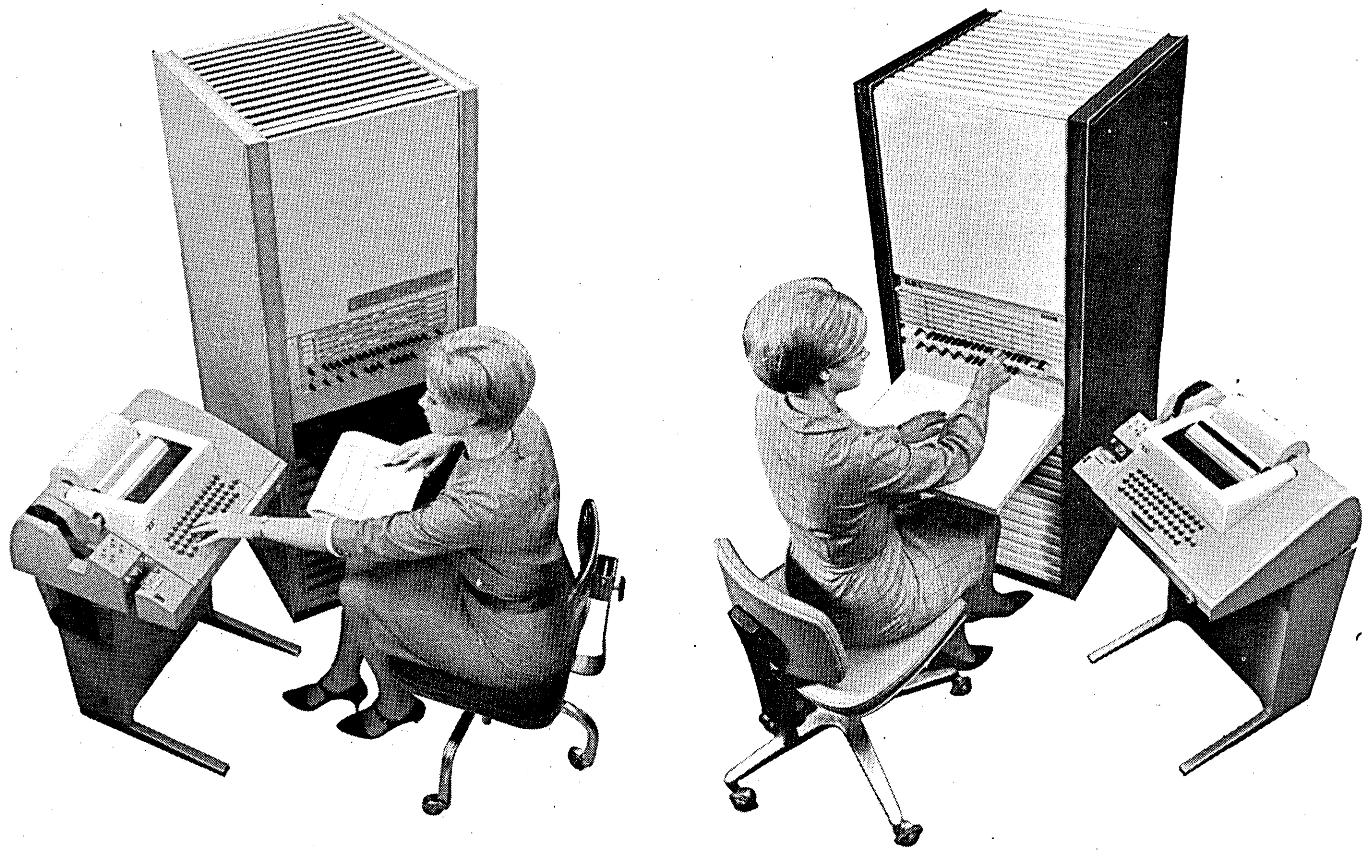
The 630 series OEM disc drive is compatible with IBM 2311 disc drive units. A separate read/write head with tunnel erase is provided for each of the ten recording surfaces (200 tracks per surface). MEMOREX CORP., Santa Clara, Calif. For information:

CIRCLE 175 ON READER CARD

electronic accounting system

The E 3500 electronic accounting system has four-function arithmetic, magnetic striped ledger which can store up to 48 numeric digits and related signs, and a core memory of 30 words expandable to 50, 80 or 100 words. The pre-programmed unit also

Anything the 810A can do, the new 810B can do twice as fast.



Over 50 SEL 810A, 16-bit computers have been supplied for data acquisition and control. Now meet the SEL 810B, with twice the speed of the A. Yet only about 20% more in price. Same great features: all integrated circuits, 2 levels of priority interrupt, memory expandable to 32K, I/O typewriter, high-speed hardware multiply and divide, and real-time I/O structure. And the software package of the 810B has been proven in the A.

Fixed point execution times of the B are: add/subtract—1.58 microseconds; multiply—4.74 microseconds; divide—6.32 microseconds; cycle time—790 nanoseconds. If you don't need the speed of the SEL 810B, buy the A. For either, call or write: Systems Engineering Laboratories, 6901 West Sunrise Blvd., Fort Lauderdale, Fla. 33310. Area Code 305 587-2900.

Systems Engineering Laboratories

See the 810B at FJCC Booth D1-2-3-4.

CIRCLE 82 ON READER CARD

includes program control center with operator's console, automated forms handling, alphanumeric input and A/N output in paper tape or punched cards. Optional peripherals are ledger card readers and a card or tape punch. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 176 ON READER CARD

decision table preprocessor

DETAP/IMI is a decision table preprocessor which handles extended entry and allows continuation of conditions, actions and rules on to additional lines and pages. The end product is an efficient COBOL source code. INFORMATION MANAGEMENT INC., San Francisco, Calif. For information:

CIRCLE 177 ON READER CARD

pedestals

Pedestals for use with IBM 029 and 059 punches and verifiers slide under tops of units and provide storage space for cards, manuals, etc. They

are available in three- and four-drawer models; also with modification for a S/360 console. SYSTEMS MANUFACTURING CORP., Binghamton, N.Y. For information:

CIRCLE 178 ON READER CARD

compiler-compiler

The GENESIS compiler-compiler is an integrated system consisting of two phases: the program proper which interprets a given language spec and constructs syntax tables for the use of the compiler; and the compiler modeling program which uses the syntax tables and incorporates pragmatic functions for the desired compiler. Speeds of GENESIS-produced compilers on a 360/65 are over 500 cards per minute. In addition to ALGOL language already implemented, GENESIS will later offer specs for JOVIAL, FORTRAN, COBOL and PL/I. The system can handle tasks other than the production of compilers: translation from one compiler language to another, implementation of command and query languages, dynamic and discrete simulators. System now runs on a Univac 1107 and will soon be bootstrapped to a S/360. Automatic documentation of the language compiled is provided. COMPUTER SCIENCES CORP., El Segundo, Calif. For information:

CIRCLE 179 ON READER CARD

customized keyboards

Assembled keyboards have solid-state encoding and dry reed switch input, have customized appearance options, and are ready to interface to any equipment. Optional features include an electronic interlock and electronic strobe to delay the read cycle until it is stabilized. MICRO SWITCH DIV., HONEYWELL CORP., Freeport, Ill. For information:

CIRCLE 180 ON READER CARD

tape splicer

The Tape-Stor splices either Mylar or paper tape through a compressed electrical fusion process. Ends are sealed in lateral alignment. Unit can also be used for mending tears, inserting new information and making corrections. It operates on 100/200 VAC-60 cycle and takes 100 watts. HELPS CO., Minneapolis, Minn. For information:

CIRCLE 181 ON READER CARD

accounting software

An accounting software package for the PDS 1020 computer accepts input transactions from punched tape and prints a transaction report with customer number, reference number, code number, and date and amount. It also updates the accounts receivable master file and applies payments to the outstanding balances. PACIFIC DATA SYSTEMS INC., Santa Ana, Calif. For information:

CIRCLE 182 ON READER CARD

adaptive recognition system

SOCRATES is an adaptive recognition system that uses linear or piece-wise linear separation modes and has digital logic, 35 mm transparency inputs. It can be operated independently or as a sorter on a gp computer. A selector switch programs the unit to have between 2 and 504 classes or subclasses. SOCRATES is able to learn

The Memorex 630 Series Disc Drive For Your System

2311 COMPATIBILITY

The Memorex 630 Series Disc Drive is fully compatible with IBM 2311 disc drive units. It will read/write Memorex Mark I or IBM 1316 disc packs. A separate read/write head with tunnel erase is provided for each of the ten recording surfaces to assure you of total interchangeability. We can also supply the 630 Series Disc Drive with the exact interface *for your system.*

PERFORMANCE

Total performance of the Memorex 630 Series Disc Drive is unmatched by any other competitive machine. The head load/unload is new—for higher data throughput. The positioner is new—for better access time—the best in the industry. These and other Memorex designed performance features guarantee competitive advantages *for your system.*

RELIABILITY

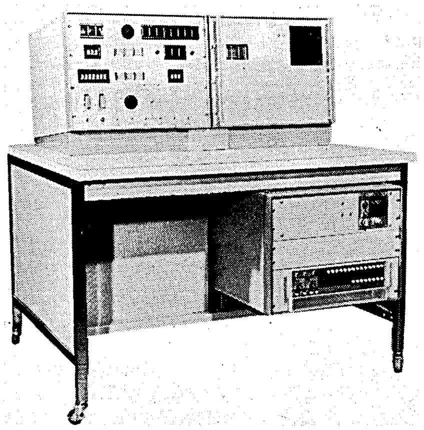
The Memorex 630 Series Disc Drive offers superior reliability. Over 75,000 head load/unload operations without error verify reliability and repeatability. The advanced positioning mechanism has fifty fewer moving parts than competitive devices. These and other technical advances guarantee a truly dependable disc drive *for your system.*

For further information about the Memorex 630 Series Disc Drive for your system, contact Peripheral Systems Corporation, 292 Commercial Street, Sunnyvale, California 94086.

Peripheral Systems Corporation
A Subsidiary of Memorex Corporation

MEMOREX SERIES 630

new products



and recognize 16,000 nonrelated or randomly selected 400-element patterns. SCOPE, INC., Falls Church, Va. For information:

CIRCLE 183 ON READER CARD

tape splicer

The SC-2 tape splicer has floating self-sharpening rotary knife and stationary lower blade, slotted nylon roller for sealing, and two rows of feed hole pins. Splicing patch can be read by optical units, and is available in 5-, 7- and 8-channel tape. DONAULD INC., Ridgewood, N.J. For information:

CIRCLE 184 ON READER CARD

light pen

Model LP-301 solid-state light pen is sensitive to brightness changes of 10^{-6} with the system; integration of user-nsec response time. Acceptance area is ⅛" and is defined by an illuminated solid finder circle which is projected on the CRT phosphor. INFORMATION CONTROL CORP., El Segundo, Calif. For information:

CIRCLE 185 ON READER CARD

cobol translator

COTRAN, a third-generation COBOL translator, converts source language statements for older machines into S/360 E level COBOL. Packages are also provided for IBM 1410/7010, 7040/7044, 7070/7074, 7080 and 7090/7094 equipment. COTRAN will run on a 32K 360/30. SOFTWARE RESOURCES CORP., Los Angeles, Calif. For information:

CIRCLE 186 ON READER CARD

keyboard

The Keycode KN-10 data entry keyboard is assembled and wired to a single printed circuit edge for a mating connector or for hardwiring to external circuitry. Buttons are spaced on ⅝″ centers. Unit is rated at 5 million cycles at 100 mil., 6 v. dc. for computer data entry applications. NUTRONICS, Paramus, N.J. For information:

CIRCLE 187 ON READER CARD

in-file card sorter

Randomatic in-file card sorter houses punched cards, film, or 5″ × 8″ control cards in file trays. Cards are in random order, or grouped randomly by status, such as "paid" and "unpaid." A keyboard selects single items or groups as requested in two seconds and code-notches the cards. Several models are available to fit the size of the system. RANDOMATIC DATA SYSTEMS, INC., Trenton, N.J. For information:

CIRCLE 188 ON READER CARD

card reader

The CR-5 reads 100 80-column cards a minute from a 430-card hopper. Control of data skipping is done either under computer control or under control of an interchangeable control disc within the reader. CLARY DATACOMP SYSTEMS, San Gabriel, Calif. For information:

CIRCLE 189 ON READER CARD

payroll program

A payroll program for use with the PDS 1020 computer accepts employee number and hours worked from paper tape and computes gross to net, prints checks and updates master file. In addition to withholding tax, the program prints quarterly W-2 and 941 statements. PACIFIC DATA SYSTEMS INC., Santa Ana, Calif. For information:

CIRCLE 190 ON READER CARD

2D core memory

A 2D core memory offers an access time of less than 400 nsec and cycle time of one usec. Storage capacities range from 64 to 4,096 words, with bits/word ranging from four to 32 in increments of one. Maximum bit storage is 32,768. TTL integrated circuits are used, and all components are mounted on printed circuit boards. The memory is available as a random access, sequential access or sequential-interlace access unit. All models have full cycle clear/write and read/restore and half cycle read and write operations. Random and sequential access models also have read/write/modify operation. DATACRAFT CORP., Ft. Lauderdale, Fla. For information:

CIRCLE 191 ON READER CARD

CIRCLE 88 ON READER CARD

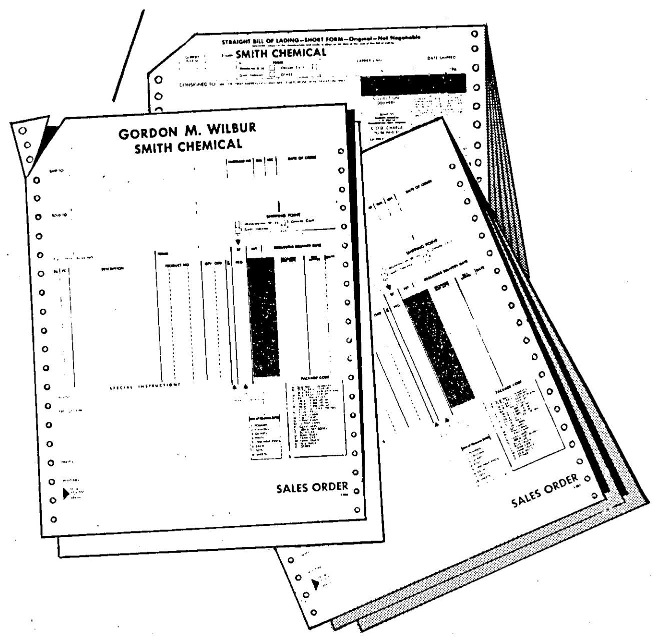
All-in-one

Moore forms work harder for you— that's because Moore can supply you with many 'all-in-one' constructions that multiply system uses. The Moore Man can show you how a unique construction or a different approach to your system need builds additional functions into Moore forms.

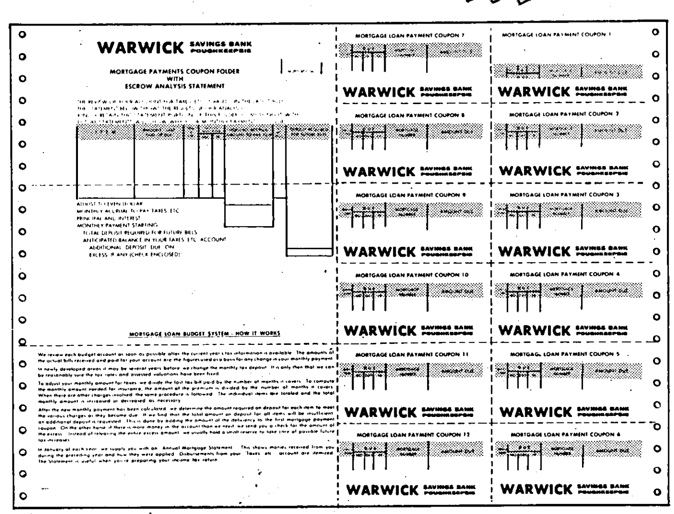
Idea: Incorporating sequential numbered tags for job or part identification along with production and billing forms. Idea: Predated coupons incorporated in statements for easier monthly remittance returns. Idea: Source documents or special instructions carried along with 'working papers' by pasted pockets in the set. The Moore Man can suggest many 'function adding' features to make your Moore forms work harder for you!

And—he'll add Moore Total Value: Quality materials and precision manufacture. Service before and after you buy. Make-good guarantee. Prompt delivery from over 35 plants.

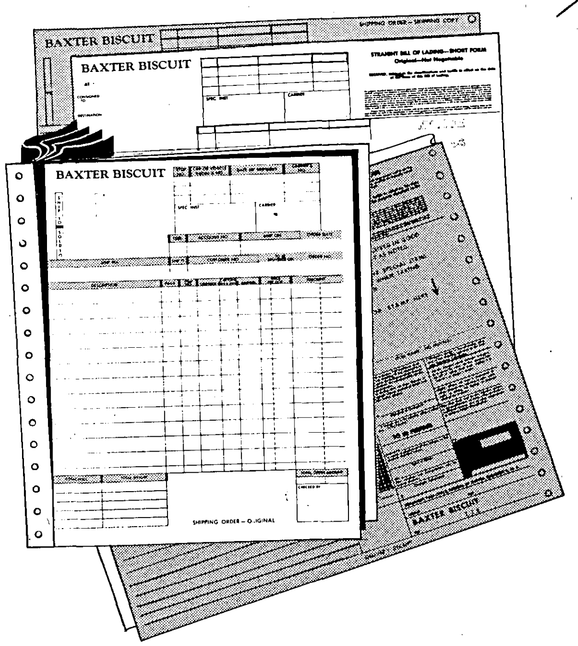
Teletype® Sales Order A 12-part continuous form incorporating pasted pocket, factory copies and shipping papers. The form separates sectionally for later handling. (Example: parts 1 and 2 form a pasted pocket to store tape, part 3 becomes plant copy.) Shipping inserts data on parts 4, 5, 6; parts 7-12 form Bill of Lading set, to be extended and distributed.



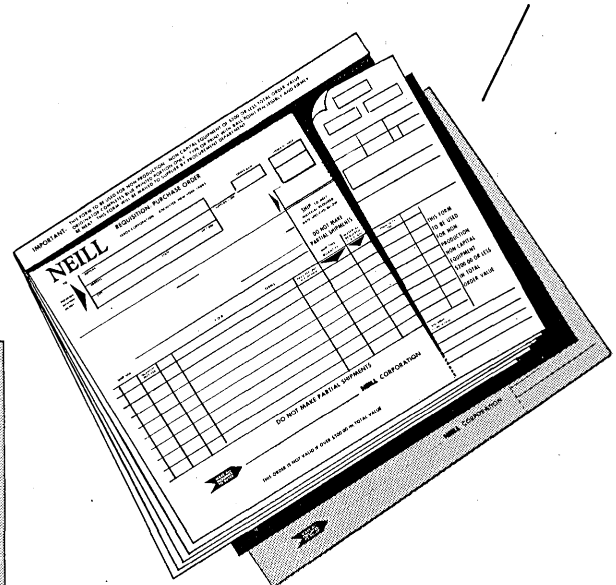
Payment Coupons A 2-part continuous Speediflo form consisting of a mortgage statement and 12 payment coupons. From previous year's tax bills, the bank estimates and prints monthly payments on coupons. Sends to homeowner who detaches the coupon when due and sends to bank with payment. Part 2 of the form is a control.

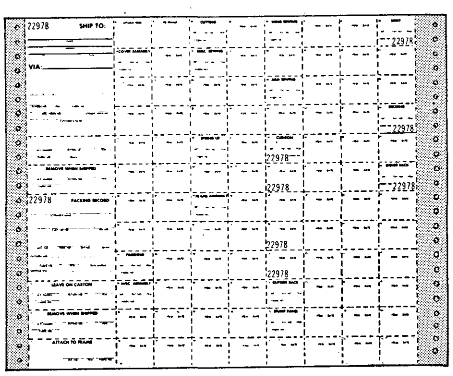


Shipping Order/Bill of Lading A 6-part continuous form with wide and narrow parts for economical copy control. After printout, shipping adds data and holds part 6. Parts 3, 4, 5 are a B/L set; 1 is used to prepare the invoice. Features: 2-color printing; 2-color screening; reverse printing; colored paper for B/L copies.



Requisition/Purchase Order A complete 6-part system to systematize and control procedures, eliminate extra writings, save time and money. Parts cover requisitioning, purchasing, receiving accounts payable, follow-up. A perforated strip from vendor copy (part 1) notifies requisitioner order has been placed. Parts in color; 2-color coding to expedite preparation.





Production Tickets For fast, accurate production-sequencing, an entire system in a 1-part continuous form on card stock, made up of 103 perforated numbered tags. After the computer printout, the perforated sections provide a ticket for every operation on the production line (with Nos. 1-7 used for shipping).

MOORE® BUSINESS FORMS INC

CIRCLE 90 ON READER CARD

new literature

DOS FOR S/360: Programmer's handbook developed to acquaint the inexperienced programmer with the scope of DOS and to provide a convenient reference to DOS techniques and control card formats. Cost: $1.50; bulk rates available. COMPUTER USAGE DEVELOPMENT CORP., 344 Main Street, Mt. Kisco, N.Y.

ELECTROLUMINESCENT DISPLAYS: 78-page report describes the work performed at Wright-Patterson Air Force Base, Ohio, by Lear Siegler in development, characterization, and human-factors evaluation of high visibility electroluminescent displays to improve their readability. AD-652 496. Cost: $3; microfiche, $.65. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

GP COMPUTER: Eight-page brochure describes the DDP-124 computer and lists hardware and software characteristics, options, and user services for the system. Also features three applications with diagrams. The DDP-124 is designed for real-time control systems and for general scientific and engineering applications. HONEYWELL COMPUTER CONTROL DIV., Framingham, Mass. For copy:

CIRCLE 146 ON READER CARD

MODULAR DISPLAY ASSEMBLY: Complete product specifications and how-to-order information on the Tec-Lite Data-Line display system, an in-line modular display and control assembly, are contained in six-page bulletin. TRANSISTOR ELECTRONICS CORP., Minneapolis, Minn. For copy:

CIRCLE 147 ON READER CARD

INSTRUMENTATION TAPES: Four-page bulletin explains in simple terms the various instrumentation tapes available from major manufacturers which are used in aerospace and computer technology and in medical and military applications. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 148 ON READER CARD

BILL OF MATERIAL PROCESSING: Ten-page brochure features card-in, card-out bill of material explosion with Series 500 computer. Includes flow charts, equipment configurations, and sample reports with representative entries. THE NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:

CIRCLE 149 ON READER CARD

TELEMETRY DP SYSTEMS: Eight-page brochure discusses company's capabilities to design and produce computer-based systems for processing telemetry data and describes its telemetry hardware and software, Sigma central processors, system organization, and typical applications. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For copy:

CIRCLE 150 ON READER CARD

AUTOMATIC FEEDING UNIT: Fact sheet describes the operating and control features of the Auto-Feeder, which was designed to increase the flexibility of the company's Auto-Sorter, a 100-station automatic sorting machine. THOMAS COLLATORS, SUBSIDIARY OF PITNEY-BOWES, Stamford, Conn. For copy:

CIRCLE 151 ON READER CARD

STORAGE DRUM: Data sheet describes C-105A magnetic Utility Storage Drum, a unit capable of storing 426,000 bits of information and designed for various educational, laboratory and commercial data processing applications. Physical and electrical specifications, as well as the recording and playback characteristics, are explained. BRYANT COMPUTER PRODUCTS, Walled Lake, Mich. For copy:

CIRCLE 152 ON READER CARD

SUCCEED IN COBOL: Eight-page brochure offers 14 methods to increase performance and lower costs of business data processing. Introduced by leading contributors to COBOL, the new capability concepts are said to save between 30% and 50% of machine time needed for COBOL applications. Also discussed are eight efficiency aids and six proprietary programs which enable reduced manpower, improved hardware/software efficiency, tighter management control, and better coordination of dp with overall organizational objectives. INFORMATION MANAGEMENT INC., San Francisco, Calif. For copy:

CIRCLE 153 ON READER CARD

DETERMINE WIRE SIZES: Two-page application note describes how optimum wire sizes for a given ferrite core can be readily determined. ELECTRONIC MEMORIES, Hawthorne, Calif. For copy:

CIRCLE 154 ON READER CARD

SOFTWARE EVALUATION: 13-page RAND Corp. paper discusses software evaluation and systems evaluation as a whole from an installation manager's point of view. AD-651 812. Cost: $3; microfiche, $.65. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

EVALUATE MAG TAPE PERFORMANCE: Fifth monograph in series of problem-solving literature explains the testing philosophy for wear resistance, describes tests used to evaluate dropout incidence, and details some of the more significant variables which affect accuracy and reliability of digital magnetic tape. MEMOREX CORP., Santa Clara, Calif. For copy:

CIRCLE 155 ON READER CARD

HOSPITAL APPLICATION: Four-page illustrated brochure describes the in- and out-patient application utilized by Parkview Memorial Hospital in Ft. Wayne, Ind., and cites advantages of computerizing other administrative data processing tasks with the small-scale GE-115 computer. GENERAL ELECTRIC INFORMATION SYSTEMS DIV., Phoenix, Ariz. For copy:

CIRCLE 156 ON READER CARD

POSITIONING SYSTEM: Four-page bulletin describes the NCS-100 numerical control system which performs positioning control, precision position measurement, and position display of up to seven digits (plus sign) per axis. Features include full-range zero offset, time-shared arithmetic, and hybrid optical encoders (designed for industrial use) as position sensors. Bulletin describes the electronic control console, display unit, and the hybrid optical encoders. Options, special features, and the performance specifications are detailed. DATEX DIV., CONRAC CORP., Duarte, Calif. For copy:

CIRCLE 157 ON READER CARD

STANDARDIZATION OF SYSTEMS: 22-page report examines the relationship of program compatibility to the evolutionary modernization of computer installations. AD-651 861. Cost: $3; microfiche, $.65. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Md. 22151.

SHAFT ENCODERS: 20-page brochure describes these devices which translate shaft rotation (or linear motion) into digital form. Applications in fire-control systems, gyro systems, inertial-guidance systems, numerical machine-tool control, navigation computers, radar antenna-position indication, and steel mill processing. LIBRASCOPE GROUP, GENERAL PRECISION, Glendale, Calif. For copy:

CIRCLE 158 ON READER CARD

SPEECH GENERATION: Six-page brochure describes the technical aspects and uses of Speechmaker 670 series of automatic speech generation equipment with applications in areas such as telephone rate, route and intercept; banking; credit inventory control and management information. Words or phrases are stored on a photographic-film memory drum and replayed in any sequence specified by computer or manual command through standard telephone or audio equipment. Both units in the series include binary decoding matrices and logic for digital message selection and have an unlimited multiplexing capability. COGNITRONICS CORP., Mt. Kisco, N.Y. For copy:

CIRCLE 159 ON READER CARD

AEROSPACE DIGITAL COMPUTERS: 24-page catalog describes nine different aerospace digital computers and their variations. Contains descriptive text, pictures, and other features, and details a variety of general-purpose and special-purpose navigation and guidance computers designed for more than 25 different applications aboard aircraft, missiles, boosters, and spacecraft. KEARFOTT GROUP, GENERAL PRECISION SYSTEMS, Little Falls, N.J. For copy:

CIRCLE 160 ON READER CARD

The key word about PDP-10 General Purpose Time-Sharing is Simultaneous

PDP-10 General Purpose Time-Sharing (GPTS) is an advanced software system which can handle multiple unrelated:

- Real-time simulation and control jobs
- Conversational jobs
- Batch-processing jobs

All at once!

For example, a system that's been operating nearly two years interfaces a Digital Equipment Corp. computer with three analog computers forming a hybrid system. The GPTS system is configured to handle the three real-time simulations *simultaneously*.

At the same time the real-time programs are running, individual programmers have direct access to the central processor and its associated peripheral equipment from teletype consoles. From these teletype stations, programmers may write, debug, edit and run their own programs. This feature makes it possible for a user to debug application programs for real-time systems without costly and inconvenient shutdown of the real-time systems.

Using the PDP-10 time-shared batch-processing system, individual users can initiate their own batch stacks or submit jobs to a system background stack which is available to all users. Jobs are placed in the system batch stack through a simple Teletype command. Batch control programs run as ordinary time-shared jobs at the same time as real-time and conversational jobs.

DEC's time-sharing software has been field-proven at numerous installations throughout the world. *True* GPTS is available today with the surprisingly low-priced PDP-10. Why settle for less in your installation?

digital
MODULES · COMPUTERS

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

CIRCLE 95 ON READE

Keyed to multiplant control

This Teletype Model 35 ASR (automatic send-receive) set gives management timely control of data flow. Keeps data moving quickly, accurately between the home office and the company's many diversified operations.

keyed to keep data moving

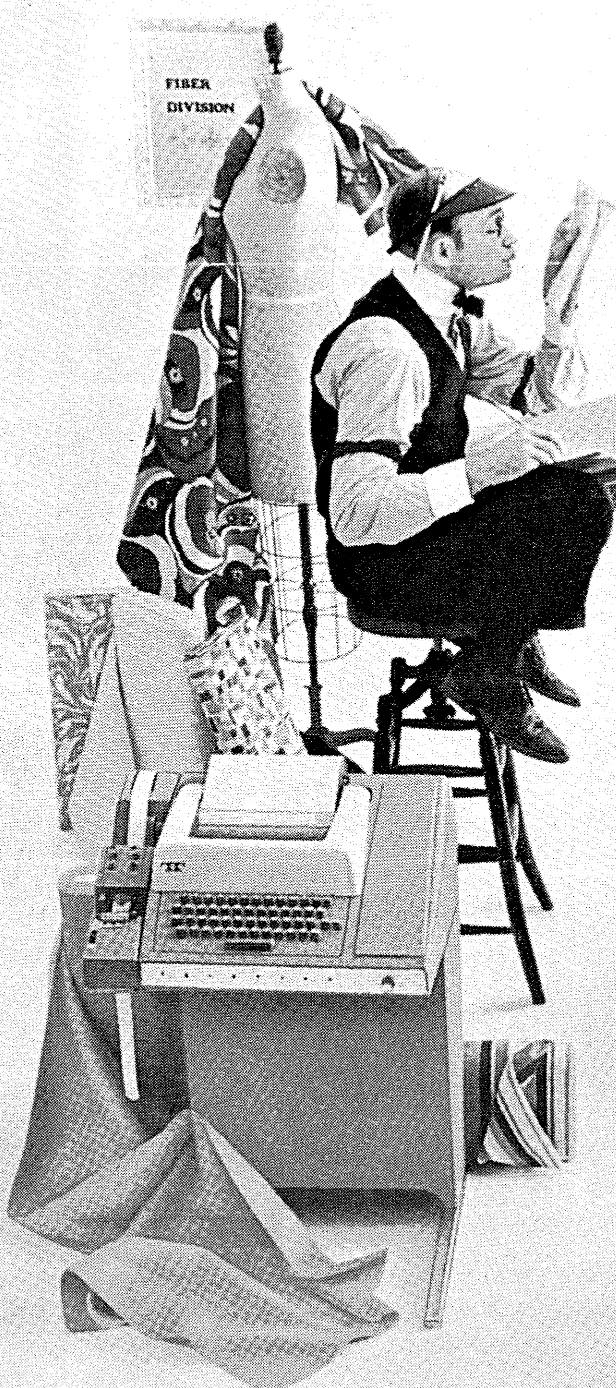
Timely data is essential for profitable multiplant management. Teletype terminal equipment offers the simplest, most reliable method of collecting, integrating, and distributing data. Teletype machines put your data processing system on-line. Keep all of the pertinent facts and figures of divisional operations moving to the right place at the right time. Teletype machines not only link division and corporate management, but tie in departments, plants, warehouses, and field offices. Make planning and operations easier all down the line. Teletype equipment is keyed to fast accurate data communications. Keyed to keep data moving.

The capabilities of Teletype equipment are more fully described through actual applications in the brochure, "HOW TELETYPE EQUIPMENT MOVES DATA FOR YOUR BUSINESS OR INDUSTRY." To obtain a copy, contact: Teletype Corporation, Dept. 81K. 5555 Touhy Avenue, Skokie, Illinois 60076.

Keyed to improve market planning

Up-to-the-minute sales data and current marketing trends are being received on a Teletype Model 33 KSR (keyboard send-receive) set. Gives the division a competitive edge in their day-to-day marketing activities.

CIRCLE 96 ON READER CARD



Keyed to simplify cost accounting

This Teletype Model 33 ASR (automatic send-receive) set is linked to the company's data processing center to simplify the handling of cost accounting, invoicing, accounts receivable, credit ratings, and other accounting data. Helps management to secure accurate, up-to-date accounting records.

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machines that make data move

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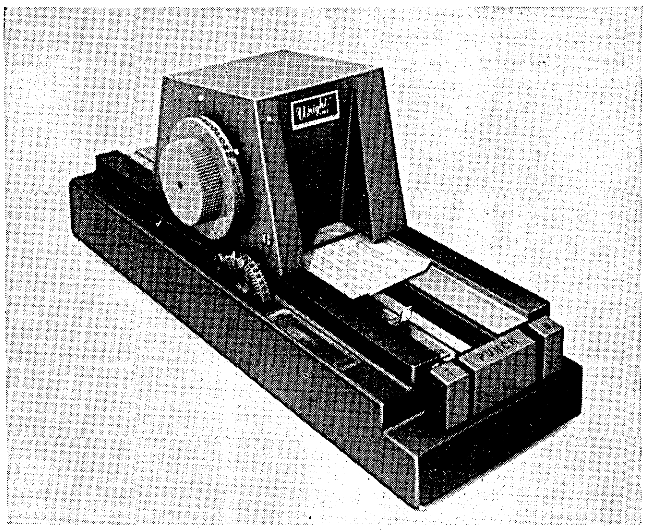

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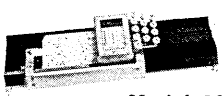

Model 2600

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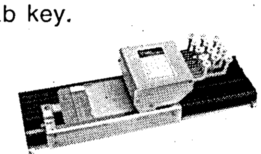

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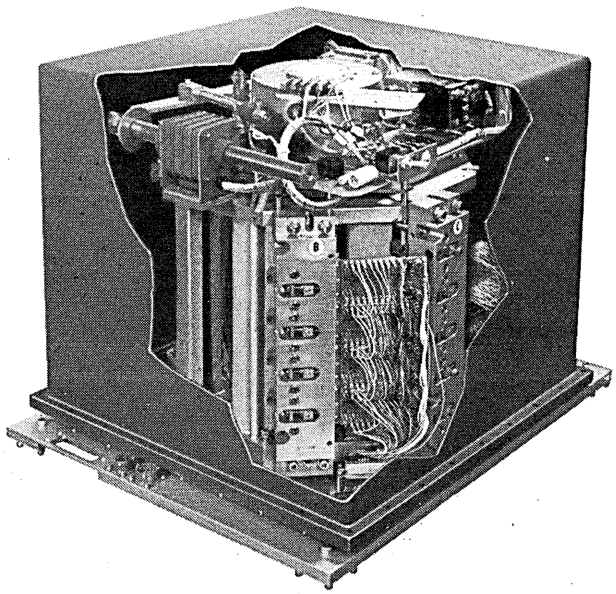

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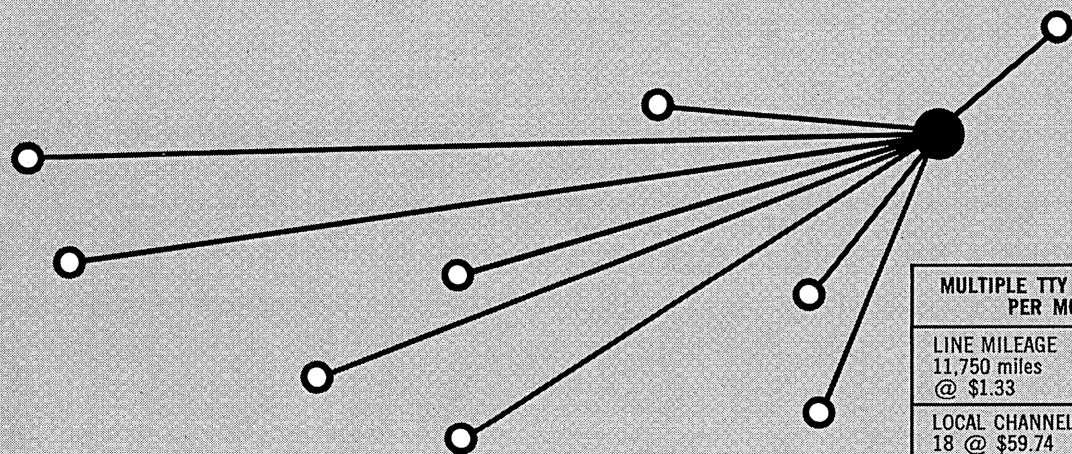

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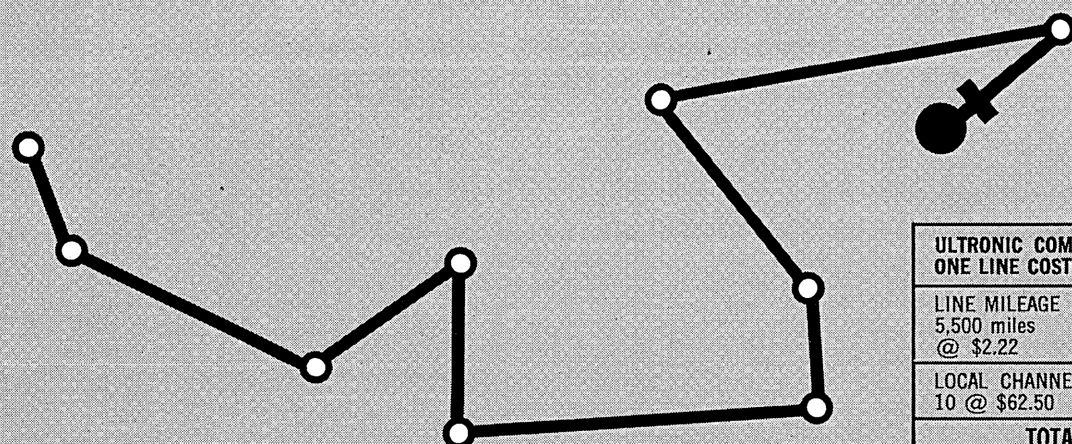

ULTRONIC COMMUNICATIONS ONE LINE COSTS PER MONTH	
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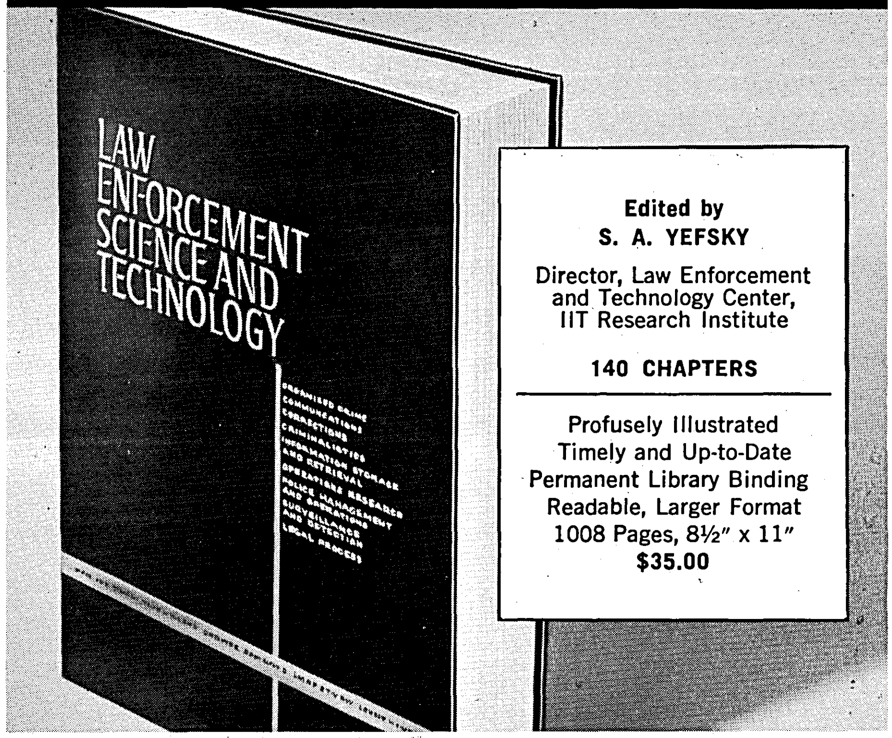

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COMMUNICATIONS

Frequency allocations in law enforcement for more efficient transmission techniques and spectrum utilization. Future requirements in data transmission to patrol operations. Because of communications loss when patrol officer leaves his vehicle, two separate solutions to providing personal communications are described: satellite station repeater approach; vehicle repeater approach.

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CIRCLE 104 ON READER CARD

books

Computers on Campus, by J. Caffrey and C. J. Mosmann, American Council on Education, Washington, D.C., 1967. $3.

In the spring of this year several hundred representatives of a smaller number of colleges and universities convened in Albuquerque, New Mexico, as the *Twelfth* College and University Machine Records Conference. In the summer of the same year the Association for Computing Machinery, among whose founding members as well as its leaders through the years are to be found the names of distinguished academicians as well as academies, celebrated its twentieth anniversary in conference assembled. The senior author of the book *Computers on Campus* created, more than six years ago, literally by the force of his own character, the organization that is known today as the California Educational Data Processing Association. He was also a prime mover in the formation of the Nationwide Association for Educational Data Systems.

I have cited all of these instances to bolster my view of wonderment that *Computers on Campus* needed to be written. Is it really possible, in the United States, in 1967, that the "principal administrators of colleges and universities"—to whom the book is primarily addressed, according to its foreword—of any significant number of such institutions are unaware of the fundamentals that comprise the messages that are this book? Can it really be the case that these principal administrators are insensitive to the existence of the digital computer, its nature, and the roles it has played, is playing and, very likely, will play on their myriad campuses?

And then I weaken my case for wonderment by trying to construct an impressive list of the nation's colleges and universities, each possessed of a school—preferably graduate—of public, industrial or business administration with a faculty "administrative advisory council." To salve these wounds I would augment my list with institutions whose principal administrators hire their own faculty as consultants. It is hopeless: I cannot create a list that is significant in the positive sense I intend.

So I am compelled to conclude that there is an audience for the messages that comprise *Computers on Campus*. And I am sympathetic to the premise that such messages are better received if they are cast in the language and the context of their intended audience. For having sponsored the study that resulted in the book, the American Council on Education and the College Entrance Examination Board are to be commended: they and the authors will have accomplished a worthwhile service if the messages are heeded by any large fraction of its readers. Let me quote two of these messages here:

It is extremely important for the administrator to understand the proposition: *The computer never makes decisions. It carries them out.* The decisions are made when the system is designed. . . .

This message is accompanied by a warning that the administrator must not abdicate to a system analyst his responsibility for specifying *what* information is to be provided by an administrative information system. The second message:

Even a small college can rarely afford *not* to hire a *full-time* director [for its computer center]. If he shares his time between the computer center and an academic appointment, one post or the other will suffer. If his true interest is his teaching and research, he will run the center with his left hand and eventually the center will be left to run itself. It is usually true that an organization that runs itself runs down.

Computers on Campus is marred by a few flaws. One of them is the slighting of the role that is possible for the computer in what is called computer-assisted instruction: "The future-oriented administration wisely encourages such interest when it appears but does not try to force history to happen." Perhaps this attitude is merely a reflection of a matter of taste, but I prefer to believe that not all leading is simply a matter of following. A second flaw is the careless assertion "*any* process which can be described in precise terms can be carried out or executed by the computer." A third one notes that the computer performs its tasks "at speeds approaching that of light;" it is a poor analogy at best. And, finally, Hamming's deathless aphorism about computing, insight and numbers is neither attributed to him nor properly quoted.

In sum, let me encourage the widespread reading of this book by those for whom it was written. It can even be read, out of context, by other administrators or managers who may be coming to the computer for the first time or who may seek a summary of important factors affecting the successful use of the computer.

Finally, let me note that *Computers on Campus* is amusingly illustrated by Robert Osborn. His drawings in this instance, as in so many others, add just the right touch to the messages.

—Robert M. Gordon

book briefs

(For further information on the books listed below, please write directly to the publishing company.)

The Computer in American Education, **edited by Don D. Bushnell and Dwight W. Allen. John Wiley & Sons, Inc., New York, N.Y. 1967. 300 pp. $5.95.**

A series of articles written by educators and practitioners in data processing for non-technically oriented instructors. The authors (the editors themselves, as well as such notables at Patrick Suppes) examine current applications in management and planning, relate the potentialities of the field, and suggest guidelines. Includes thoughtful foreword by I. A. Richards.

Selecting the Computer System: Step by Step, **by D. N. Chorafas. Gee & Co., Ltd., London, England. 1967. 336 pp. 75/6d (overseas).**

A guide for executives responsible for choosing dp equipment, and graduate students in information management. Chapters cover how to start, keeping pace with change, identifying the limits of cost expansion, and evaluating profitability.

Advances in Computers, **Vol. 8, edited by Franz L. Alt and Morris Rubinoff. Academic Press, New York, N.Y. 1967. 345 pp. $14.50.**

The eighth volume in a continuing series contains sections on time-shared systems, formula manipulation, standards, syntactic analysis of natural language, programming languages and incremental computation.

Systems Engineering Methods, **by Harold Chestnut. John Wiley & Sons, Inc., New York, N.Y. 1967. 392 pp. $11.95.**

Material is presented from the point of view of a systems engineer, and shows how the factors of technical, economic, material, information and human resources are treated from the initial system phase through development, design and production phases. Emphasis is placed on practical methods and cost evaluation.

IBM 360: Programming and Computing, **by James T. Golden and Richard M. Leichus. Prentice-Hall, Inc., Englewood Cliffs, N.J. 1967. 342 pp. $5.50.**

Written as an introduction to programming and operating systems, the text may be used as a self-teaching device. Content is supplemented by the inclusion of worked examples, and general concepts are elucidated by direct reference to System/360 Disc Operating System.

An Introduction to Business Data Processing and Computer Programming, **by Robert W. Swanson. Dickenson Publishing Co., Inc., Belmont, Calif. 1967. 238 pp. $10.60.**

The book is directed to the student, and covers the essential characteristics of edp in business in three fundamental areas: the machine itself, the programming, and the applications. An introduction to COBOL and a glossary of terms are also included.

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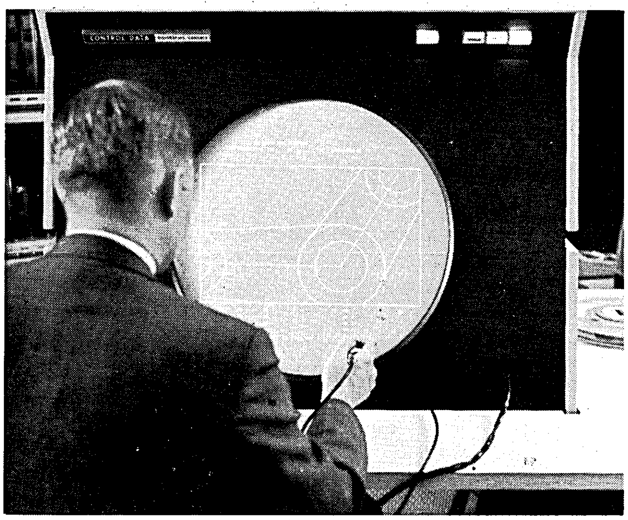

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CIRCLE 306 ON READER CARD

people

■ Dr. Samuel N. Alexander, senior research fellow in engineering at the National Bureau of Standards and who "probably influenced more than any other individual the introduction and development of adp techniques and systems into the operations of the federal government," was awarded the '67 Harry Goode Memorial Award.

■ Ex-Cell-O Corp. has announced the promotion of Robert O. Wilson to vp and general manager of the company's Bryant Computer Products Div.

■ Carl L. Byham has been named vp in charge of Data Systems Div. of the American Stock Exchange. Formerly he was vp of Data Systems Activity for the Assn. of American Railroads, Washington, D.C.

■ Dr. Allen V. Astin, director of the National Bureau of Standards, has been named acting Assistant Secretary of Commerce for Science and Technology and will return to his NBS post pending permanent appointment of an assistant secretary.

■ John W. Haanstra, formerly vp of IBM's Federal Systems Div. and general manager of its Federal Systems Center in Gaithersburg, Md., has joined GE as a consultant to its Information Systems Div. Another ex-IBMer, Jean-Pierre Brule of IBM-France, has been named manager of operations for Bull-GE.

■ William Kehl has been appointed director, campus computing network, at UCLA. He was formerly associate director of computation and electrical engineering at MIT.

■ Wesley H. Harker has been appointed manager-systems and processors advanced development for General Electric's Advanced Systems Technology Operation. He will be responsible for development of advanced computer systems; processor and central system organization and logic; and systems, language and application programming.

■ Col. Robert W. Dickerson is the new deputy for communications systems at the Electronic Systems Div. of the Air Force Systems Command, Bedford, Mass.

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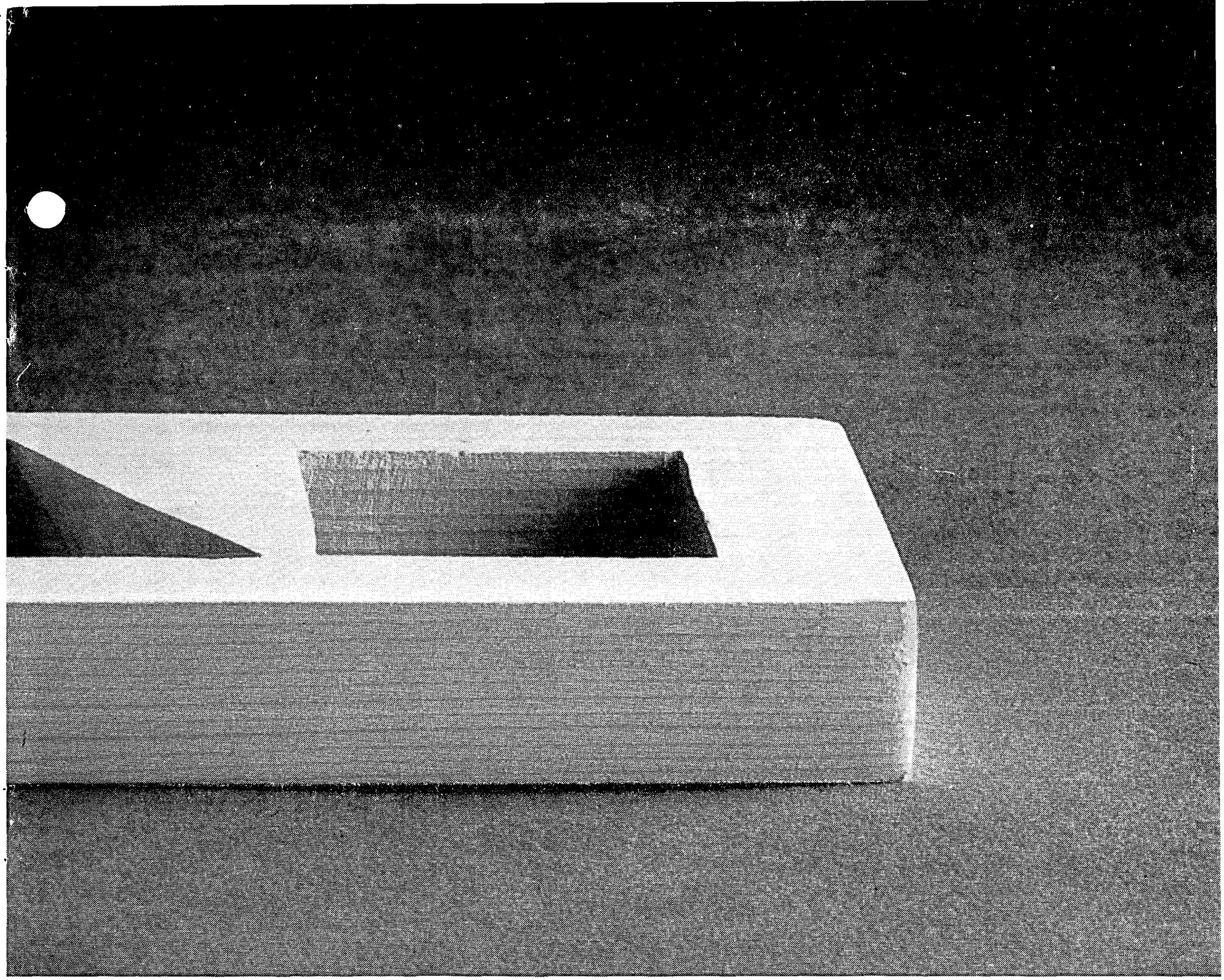

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NEW TRANSLATOR FROM COMRESS

COMRESS, which now counts some 135 users of its SCERT system used to evaluate computers, is about to announce its next big proprietary program: TRANSIM. This one is a program translator and has been under development for about three years. The prototype, expected to be finished this month, will convert 1410 and 7010 programs for use by the 360 and, like SCERT, will be a proprietary package available on lease. Input is object programs; output is in 360 assembly language.

PL/I ROUNDUP

Universities, tired of manufacturer-provided compilers not fast enough for their special loads — thousands of short, one-time student programs — are developing their own swifties. Out of Canada's U. of Waterloo came Watfor, a 360 Fortran compiler compatible with IBM's G level, which has compiled 11K statements/min., or up to 10 times as fast as IBM's.

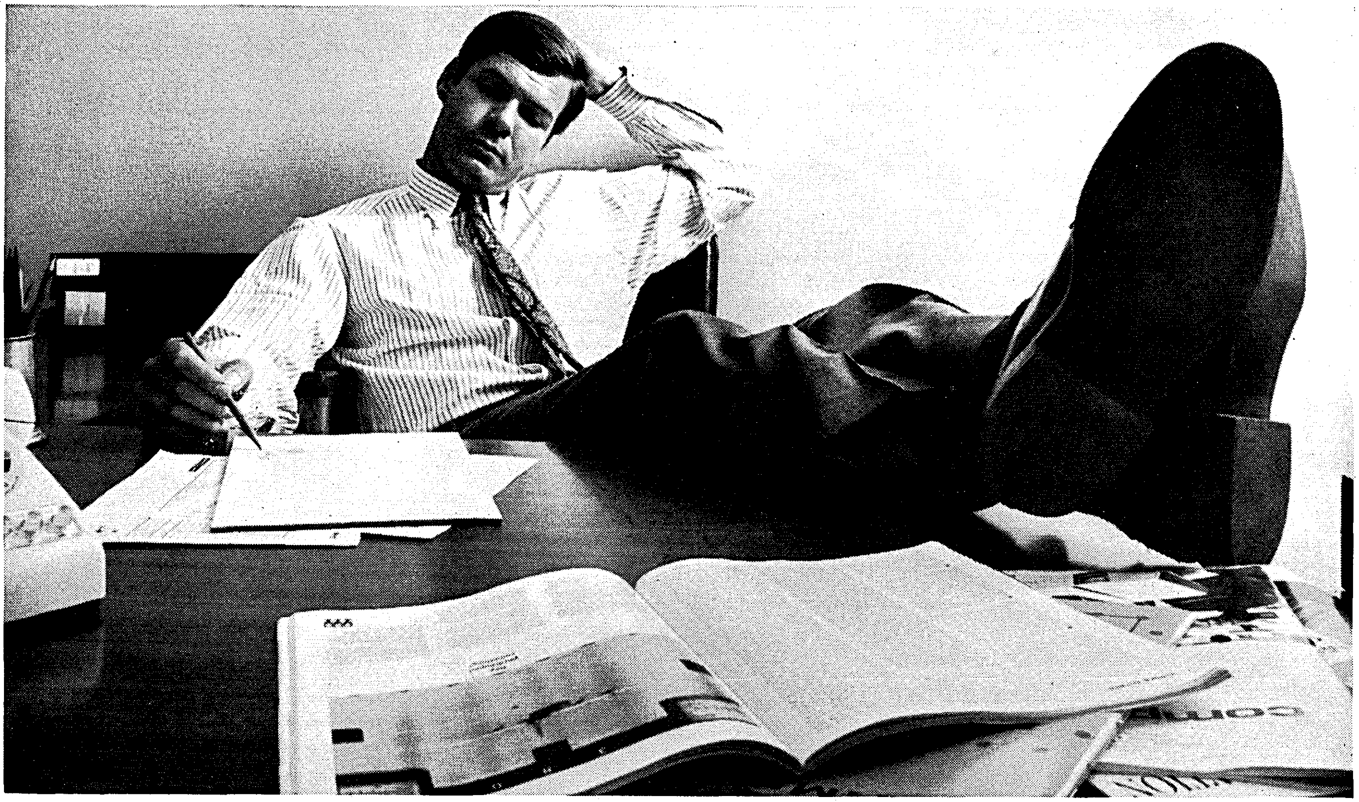
Now Stanford's Dr. McKeeman is developing a PL/I subset compiler which he hopes will be to that language what Watfor is to Fortran, but not as fast.

Back at IBM, PL/I seems to be making progress. We hear that version 3 compiles 25% faster, produces 20% better code density than its predecessor. H level is probably dead for good, but there may still be something larger than F. Smaller PL/I compilers are also allegedly in the works.

Meanwhile, the other major manufacturers are holding off PL/I software development until they see sufficient justification, which, according to one, "is decreasing."

RUMORS AND RAW RANDOM DATA

IBM marketing types are reportedly having a hard time deciding whether or not to go ahead with the 360/85. ...Potential users of the Census Bureau county/city data bank summary tapes should beware: some New York counties are out of sequence and the code list supplied doesn't always correspond to what's on the tapes. ...15-month-old Standard Memories moves into the black this month, has a $1.8 million backlog. ...Look for Photon to bring out a new typesetting system. ...TWA, evidently concerned about the effect of power failures on its reservation system, has ordered two 750 kw gas turbine generators from Solar Div. of International Harvester. The gas turbines are said to be more accurate, reliable and expensive than reciprocating engines. ...We hear NCR is conducting merger talks with retail tag maker Monarch. ...Applied Data Systems says its Adpac is now running under full OS/360 on models 30 and up, uses standard job control and IBM's I/O, allows mixed streams of Fortran, Cobol, Adpac. ...ElectroData alumni will meet at the FJCC. For more info, contact Datamation editor Bob Forest. ...The ABA has accepted the social security no. as their personal identification number. The action clears the decks for more rapid progress toward a checkless society. ...Univac, encouraged by the sale of 135 1108's, is reportedly planning an 1109, to be running by '71. By '70 Univac expects to have 375-400 1108's installed. Also in the works, a third generation of equipment which will have names instead of numbers. ...A joint committee of the Savings & Loan League and the Nat'l. Assoc. of Mutual Savings Banks has released to IBM, Bunker-Ramo, Burroughs, NCR and RCA specs for on-line teller terminals which could reduce remote costs from around $11K to $7500 or less. The potential market: 27,000 terminals.



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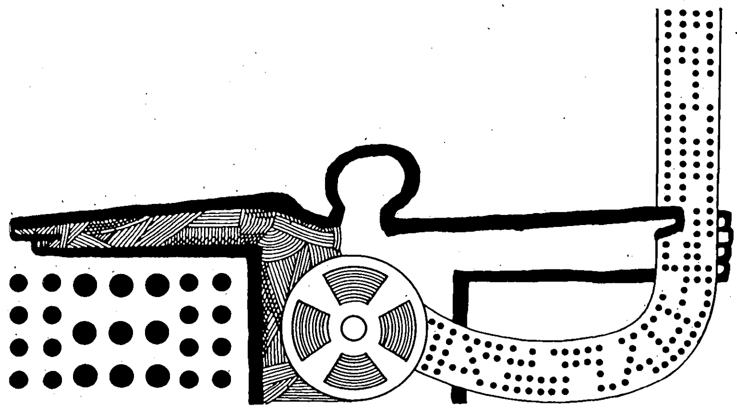

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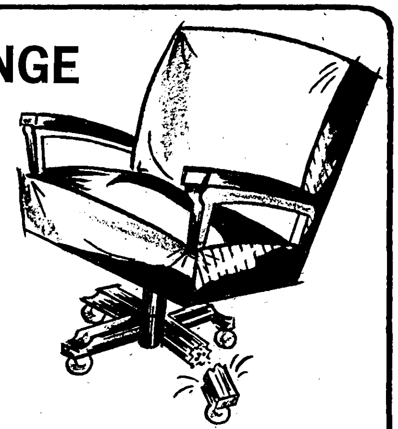

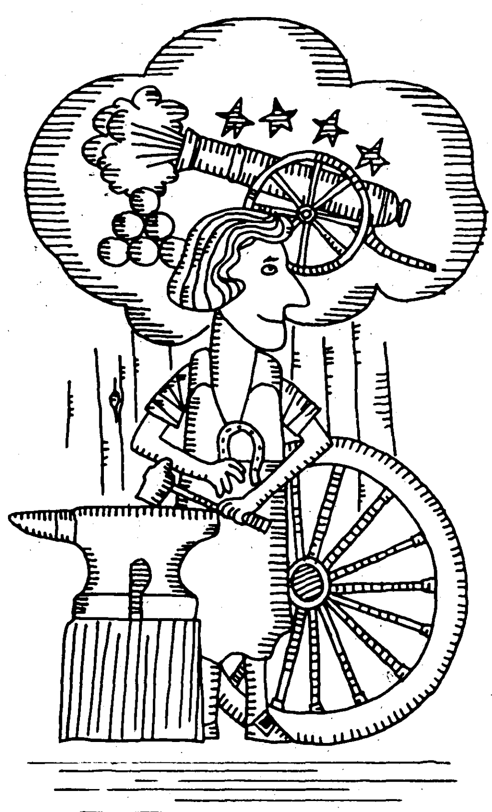

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In spite of the impressive growth, wide acceptance, and financial maturity of the computer industry, there are significant stresses apparent in current attempts to get full and proper use of computers. Many of the problems are the problems of growth, but some appear to be fundamental, with potentially adverse consequences which may seriously limit the growth of the industry and its contributions to the rest of society.

Third-generation hardware has fallen behind schedule in achieving its potential level of performance and utility. Many of the current difficulties will be eliminated in time, but delays in making full use of the capabilities of this new hardware not only postpone the solution of problems for which these machines are intended, but also waste the financial and technical resources of our economy.

Whether symptom or cause, one of the prime areas of concern is represented by the shortage of capable programmers. While estimates vary widely, it appears reasonable to accept the view that there are approximately 100,000 programmers in the United States currently engaged in making computers usable, but that there is a requirement for as many as 50,000 more. This is an impressive relationship between supply and demand.

A shortage of this magnitude has profound implications, not only for the computer industry as it is now, but for how it can be in the future.

Predictions for the number of computer installations uniformly agree on some form of exponential growth. There were approximately 14,000 computer installations in 1962. It is estimated that there are now 47,000 installations, and the prediction for 1970 is for as many as 85,000 computer installations. The corresponding prediction for the number of programmers required in 1970 ranges from 200,000 to 650,000!

The exact numbers are not as important as the conclusion that the shortage of programmers is not one which is likely to be alleviated in the near future.

In spite of constructive measures such as financial inducements to attract additional talent to the field, training to upgrade skills, improvements in hardware to ease the programming burden, and the possible wide acceptance of techniques where programming loads are transferred to users, it is difficult to see where enough will be done to alleviate the shortage.

While the consequences of a continuing shortage can vary widely from trivial to disastrous, it appears mandatory for the computer industry itself to initiate actions now to minimize the adverse effects of this shortage. Otherwise, growing financial burdens and external disenchantment may impose solutions which will affect the computer industry in undesirable and perhaps unnecessary ways.

Except for ambitious goals placed on the software itself—and these are to be encouraged—the foundations for the software problem (or the programmer shortage) are more economic than technical. And, therefore, the solutions must have economic relevance.

Of the several ways by which software is financially supported, the major realistic choices are made from four possibilities: 1) software supplied by the computer manufacturers, 2) programs obtained, generally at no cost, from other installations or from users' groups, 3) custom-made programs, whether done in-house or by contract, and 4) the purchase or lease of proprietary program packages. The first two alternatives provide programs which may not meet the specific requirements of the recipient; usually, additional work is needed to adapt programs obtained in this manner. By definition, while not always the case, the third alternative provides suitable programs. The fourth choice would appear to require adaptation by the user, but there are other factors which can affect the specifications of these programs.

We believe that the industry must place increased reliance on the least popular of the four—the purchase or lease of proprietary packages. Well-designed proprietary packages can multiply the efforts of good programmers manyfold, these packages can be made available at costs far less than those for custom-tailored programs, and, most important of all, increased acceptance of such packages can eliminate significant portions of the duplication of effort, to free programmers to take on new and important tasks not yet properly handled by computer techniques.

The quality of proprietary program packages will, in general, be better than those of custom-tailored programs, since extra time and care can be committed. It is even conceivable that they would be more relevant for the purposes intended, since custom programs often start with ill-formed objectives. The supplier of proprietary packages must be extremely careful in specifying the characteristics of his work and in considering the validity of his judgment. No other prevailing practice carries this degree of relevant reward and punishment.

It is not suggested that proprietary packages alone will solve the programmer shortage, but proper operation of marketplace pressures and correction can do much to collapse artificial demand.

Two major obstacles face the supplier of proprietary programming packages. First, legal protection is currently difficult to obtain or to define. Protection can come from patents, copyrights, trade secrets, or legal contract between supplier and receiver. Each technique is being used currently with varying degrees of success, but no clear and assured practice has been established.

Perhaps more important, however, is a second kind of obstacle, related to existing attitudes and practices. Many take the view that software has no economic worth, and that there exist the right to receive, and the obligation to distribute, software to all at no charge.

We suggest that the attitude of the programmer and his manager represents the major obstacle towards the acceptance of ready-made packages, and may be providing an inadvertent stimulant for some of the programming work in the industry. The attitude may be based on any of several possibilities: fears for job security; the honest technical view that a brand-new program would do the same job better; the desire to increase efficiency of computer usage; or habit. If any significant part of the programming work now being done does not need to be done, and if constructive steps are taken to isolate and eliminate this part, then clearly, some of the pressures will be alleviated. These constructive steps can be painful, and will require the reshaping of habits and the acceptance of some standardization in procedures and programs.

But the alternatives can be even more painful. And it is clear that there will still be more to do than can comfortably be done. It is important, therefore, to try to ensure that the resources and talents of the computer field are applied to new areas, rather than to the re-doing of the old.

—RICHARD I. TANAKA

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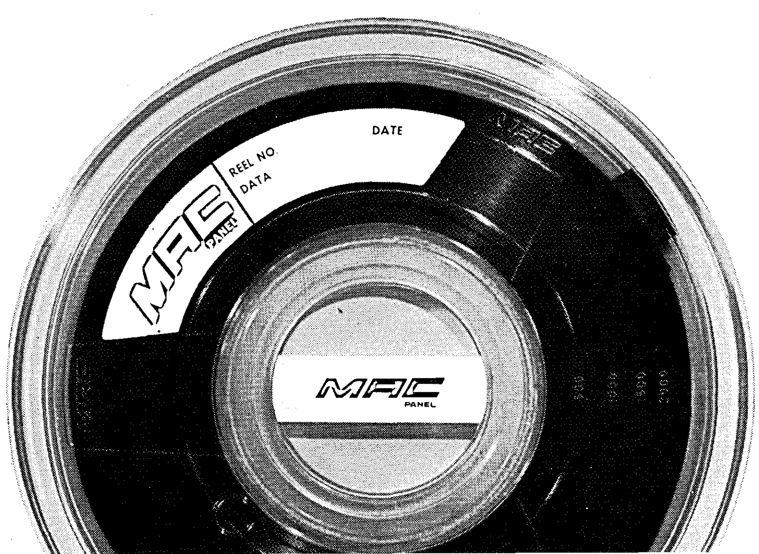

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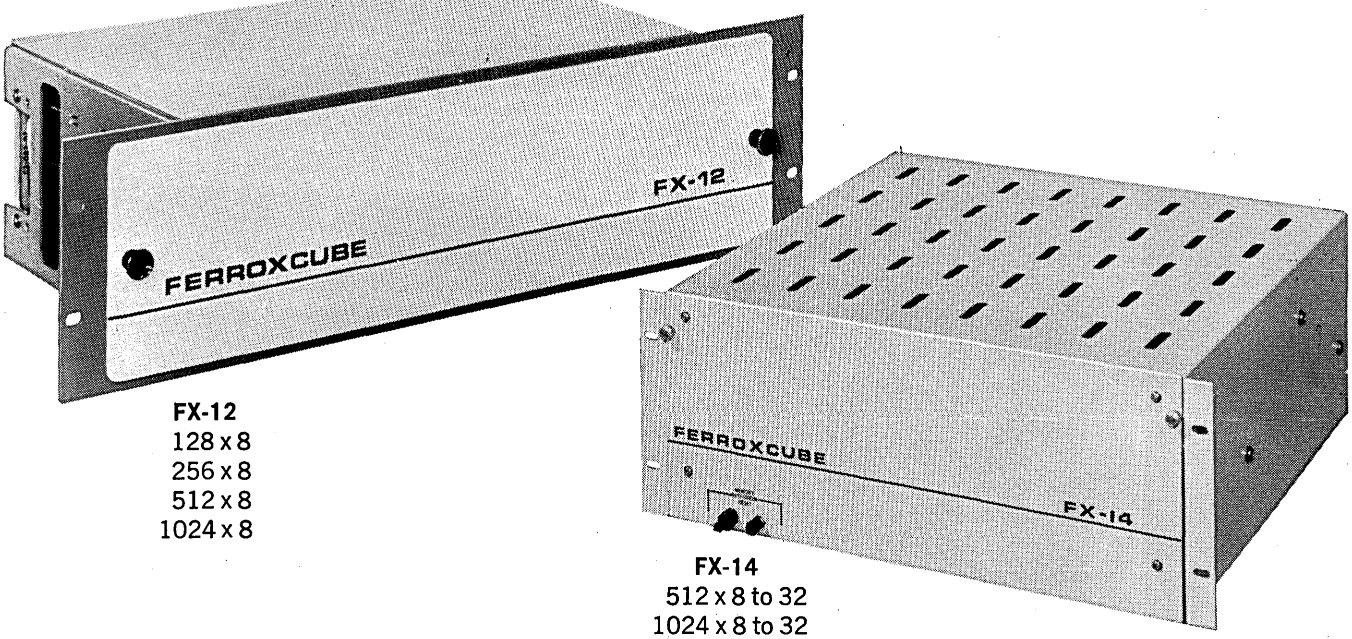
You've got it made because these are core memories with all the advantages of core storage over electromechanical techniques: speed, random access, non-dissipative, non-volatile... to name a few. And, because they're mass produced, reliability is higher than core storage systems built on a onesy-twosy basis.

You've even got it made on cost. Remember, all the engineering is done. You specify; we produce and ship. That alone narrows the cost between Ferroxcube core memories and less versatile types. Example: you can buy a Ferroxcube 1024 x 8 FX-12 system complete with stack electronics and timing for $1,990.

But that's not all. With so many models to choose from, interfacing is flexible: buy what you need to interface with what you have and save some more money.

For details on all this performance and economy, write for Bulletin MS670, "Ferroxcube Catalog-Standard Coincident-Current Memory Systems." It describes 513 ready-to-go models—with prices. Not so incidentally, we're the only manufacturer to publish a price list on memory systems. Reason: production experience; we know our costs in advance. You will too.

Ferroxcube
Systems Division Englewood, Colorado



FX-12
128 x 8
256 x 8
512 x 8
1024 x 8

FX-14
512 x 8 to 32
1024 x 8 to 32
2048 x 8 to 32
4096 x 8 to 32
8192 x 8 to 16
16,384 x 4 to 8

See us at the FJCC—Anaheim, Booth No. 104

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CIRCLE 3 ON READER CARD