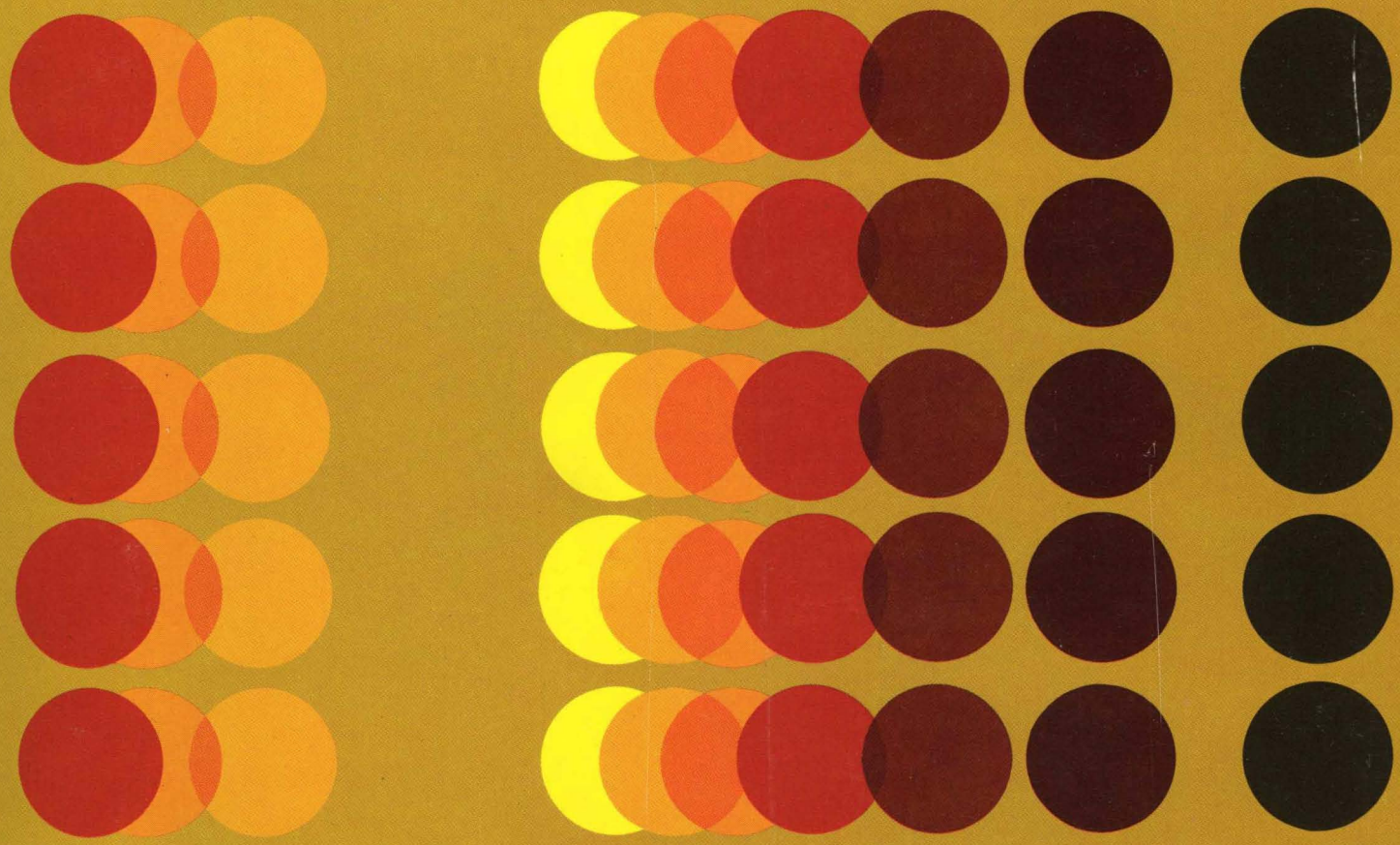
DATAMATION 70®

September 1



MIS: is there communications?

Take a close look at the big three in small computers.

At Varian, we consider the 620 series as a kind of computer molecule, bonded by the same standard software: FORTRAN IV, MOS, BASIC, RPG, and others. This 620 family also offers the largest line of peripherals available in the industry.

620/i: one of the most popular ever built — over 1300 sold worldwide — this systems-oriented digital computer features ease of interface and programing, full array of options required in today's multi-application environment and up to 32,768 words of memory, 16- or 18-bits.

R-620/i: a ruggedized version of the 620/i, it's a general-purpose computer that's designed to withstand environmental extremes. For truck, shipboard, or other military/industrial applications. The 620/i's large software library works with the R-620/i.

620/f: latest in the series, the 620/f has a 750-nsec cycle time, meaning it executes 2½ times faster than the 620/i. It is 100% upward compatible from the 620/i. And, this new computer also uses the 620/i's field-proven software.

The 620 series gives you three more good reasons for talking to the big company in small computers.

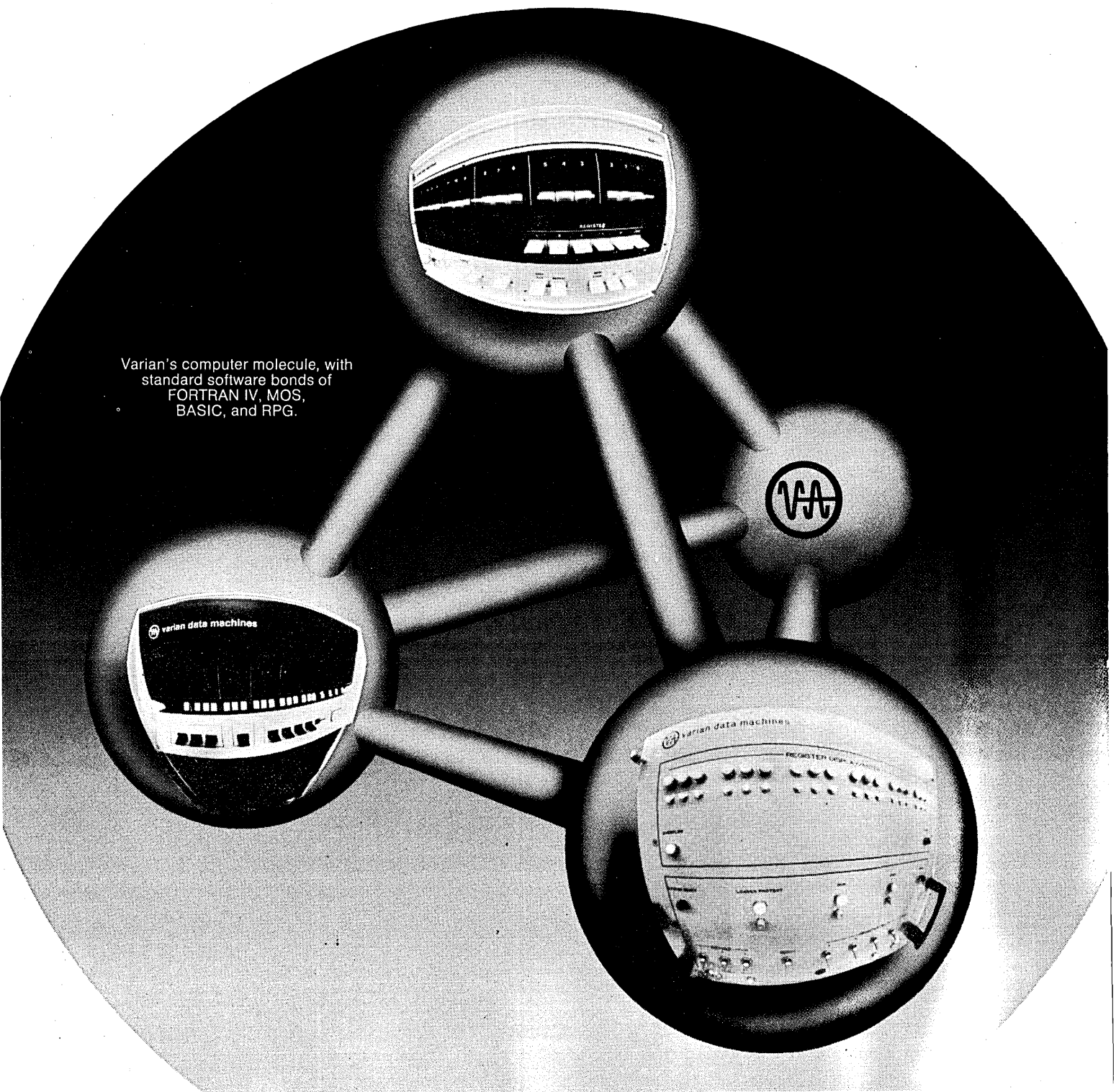
U. S. Sales Offices: Downey, San Diego, San Francisco, Calif.; Washington, D.C.; Atlanta, Ga.; Chicago, Ill.; Waltham, Mass.; Ann Arbor, Mich.; Albuquerque, N. Mex.; New Rochelle, Syracuse, N.Y.; Fort Washington, Pa.; Dallas, Houston, Tex. Other offices worldwide.

Varian Data Machines, a Varian subsidiary, 2722 Michelson Dr., Irvine, Calif. 92664. Telephone 714/833-2400.

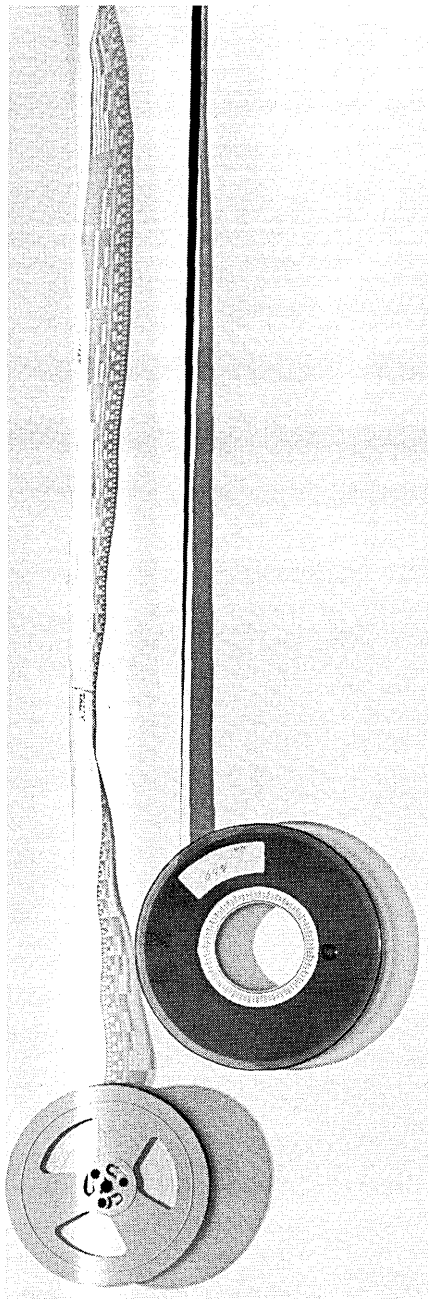
varian data machines

The Big Company in Small Computers

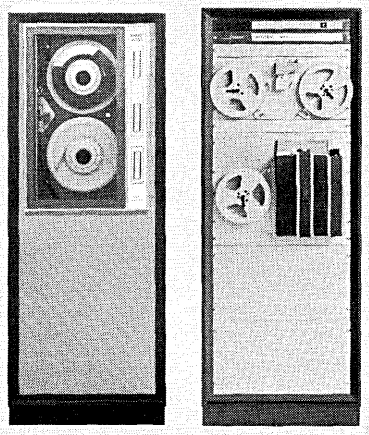
CIRCLE 1 ON READER CARD



Varian's computer molecule, with standard software bonds of FORTRAN IV, MOS, BASIC, and RPG.



Computer compatibility, a hang-up we understand



To move bits by the billions between your offices, Tally's computer communicators are your answer.

To gather remote batch data and put it into your CPU in the easiest way imaginable, consider the Tally System 4031. This efficient magnetic tape data terminal receives your incoming data on computer compatible ½" tape, 9 track or 7 track. Full error control routines during transmission are standard.

To increase the efficiency of your system, the 4031 offers you code conversion between terminals during transmission. Now, the 4031 can help you solve your 2400 or 4800 Baud requirements too. If your CPU likes paper tape input, the Tally System 311 is the most versatile perforated tape data station ever offered. Standard features include automatic error control, unattended answer capability, and off-line tape editing or duplication.

So if you are responsible for the movement of bits by the billions, we invite your inquiry. The informed Tallyman from your nearest regional office will be glad to help you.

Please address Tally Corporation, 8301 South 180th Street, Kent, Washington 98031. Phone (206) 251-5500.

Regional offices:

Atlanta: 3785 Northeast Expressway, Atlanta, Georgia 30340. (404) 457-1624.

Chicago: 33 North Addison Road, Addison, Illinois 60101. (312) 279-9200.

Los Angeles: 501 N. Golden Circle Drive, Santa Ana, Calif. 92705. (714) 542-1196.

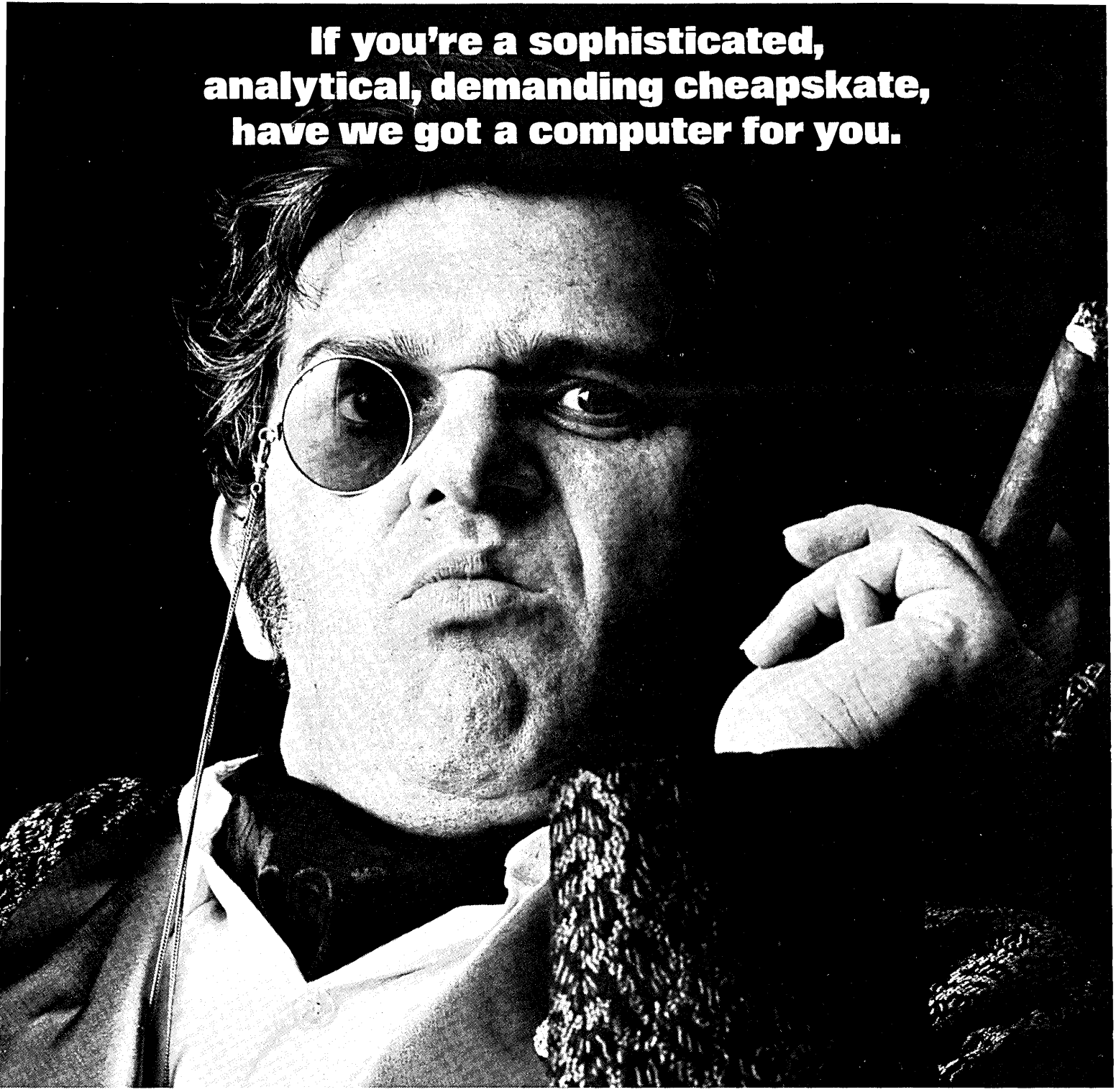
New York: 45 North Village Avenue, Rockville Centre, Long Island, N.Y. 11570. (516) 678-4220.

San Francisco: 420 Market Street, 94111. (415) 989-5375.

England: Tally, Ltd., Tally House, 7 Cremyll Road, Reading RG1 8NQ, Berkshire. Reading 580-142.

TALLY®

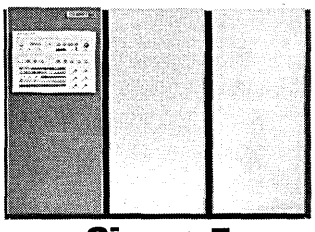
If you're a sophisticated, analytical, demanding cheapskate, have we got a computer for you.



It would be nice to sell a Sigma 5 sometime without having to undergo a rigorous analysis by a hard-nosed customer who knows exactly what he wants and what he wants to pay for it.

No such luck. When we install a Sigma 5 it's invariably because all the elements of the system — hardware, software, service — combine to give superior price/performance in a difficult, sophisticated application.

Most of these applications involve routine batch processing concurrently with critical foreground tasks. Like interactive time-sharing. Or real-time process control. Or store-forward message switching. Or remote data collection and concentration. Or nuclear reactor monitoring and experiment analysis. Or on-line telemetry data conversion, compression and display. Or multiphasic health screening and hospital patient monitoring.



Sigma 5

It's not just Sigma 5's foreground/background architecture, its flexible I/O system, and its tremendous throughput capacity that make it so cost efficient in areas like these. It's also the wide range of powerful, proven software that comes with the machine.

Bit for bit, Sigma 5 hardware isn't the cheapest around. But in the environments it was designed for, Sigma 5 almost always delivers far more performance per dollar than anybody else can.

No sophisticated, analytical, demanding cheapskate should be without one.

XDS

Xerox Data Systems
El Segundo, California

DATAMATION®

SEPTEMBER 1, 1970
volume 16 number 10

MANAGEMENT

TECHNICAL

GENERAL

COMMENTARY

About the Cover

Somewhere between the dark of systems design and the light of successful management, the communications necessary to bring the two together becomes operable. The elements are there; the relationships are complex. Our design is by Cleve Marie Boutell.

departments

DATAMATION®

SEPTEMBER 1, 1970
volume 16 number 10

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New Autoflow® beats out its closest competitor: old Autoflow

Old Autoflow is not so old. It was introduced in 1967. It's installed in over 1,100 computer systems.

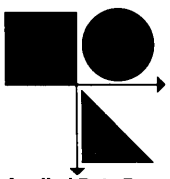
But we continually change and improve it. The first Autoflow, for instance, had one language and 5 listings. Today, 14 languages and 12 listings are incorporated.

In all, the 1970/360 system is three times more comprehensive than the original.

Right now Autoflow is at work in more computer systems than any comparable software system. By far.

For one simple reason: Autoflow does more. It flowcharts. Debugs. Documents. Cross references. Helps in desk checking and training. Saves time and money in program development, corrections, and maintenance.

If you haven't seen Autoflow in a while, call us. We'll arrange for a demonstration.



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data bits from Teletype

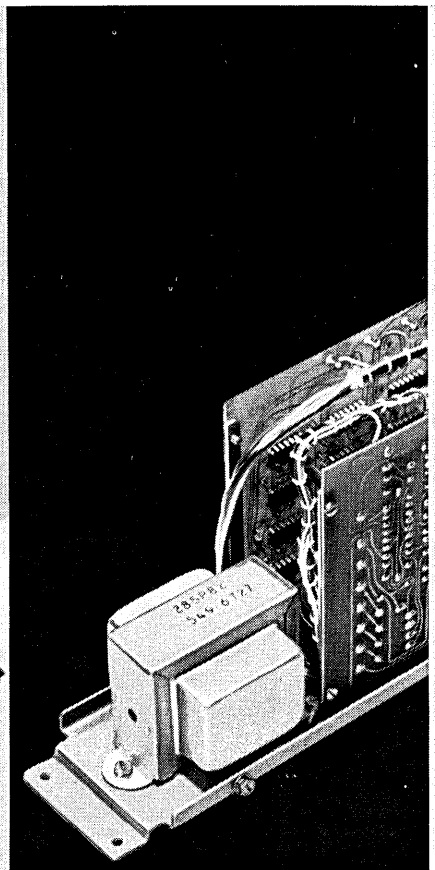
knowing who's going where, when and now!

Maintaining a passenger flight manifest is a vital part of airline operations. And highly complex. One carrier, that deals with hundreds of flights and some 25,000 people daily, recently reduced some of the problems involved by integrating high-speed Teletype® equipment into its system.

Computerized manifest data, compiled in the airline's central office, is sent to departing terminals two hours prior to each flight. It's used in a variety of ways: As a boarding checklist. In computing aircraft weights and balances. For meal details. To meet special requests for wheelchairs, etc.

At the time of departure, "no show" passengers are deleted from the manifest, standby names on board are added, and the list resubmitted via Teletype equipment to central office computer for updating. The computer then generates the "official" manifest and sends it to both departure and arrival terminals involved, at 1050 wpm. The send-receive operation usually is complete before the flight gets into the air.

Teletype's Stuntronic™, electronic selective calling station controllers, also helped reduce computer port requirements of this system by 90%.



keeping a multistation network under control

Teletype has a simple solid-state logic device that provides a truly practical and economical way of establishing automatic control over multi-terminal data systems. The Stuntronic™ station controller is what it's called.

This helpful accessory provides station interface, control, and response for all ASCII compatible Teletype data terminals. Can be used with model 33, model 35, model 37, Telespeed™ and Inktronic® equipment. It will recognize all incoming station signals and respond to its own address characters.

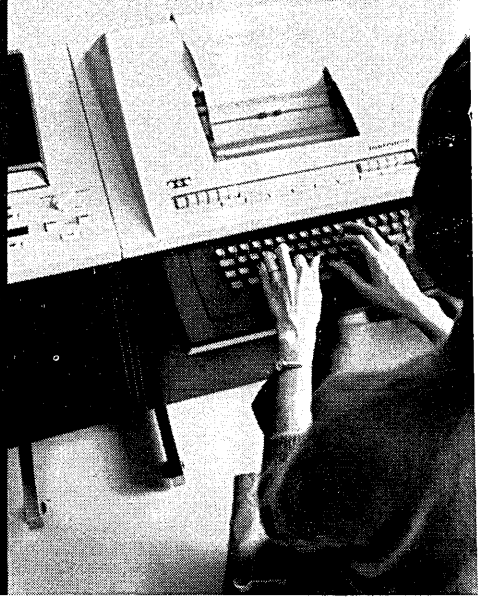
More than 100 different control arrangements are possible with the Stuntronic station controller — including detecting vertical parity errors and establishing computer communication and intra-circuit communication among a variety of system terminals.

total on-line time: divide by twelve

If you have a number of low-speed terminals in your time-sharing system that generate heavy loads of on-line time, it may pay dividends to do the above arithmetic. The Teletype Inktronic terminal is about twelve times faster.

This electronic, solid-state terminal will generate 128 ASCII combinations. Print 93 alphanumerics in upper and lower case. It achieves 1200 wpm printing capability. Charged ink droplets are drawn to the page through a series of electrodes that form the character called for. The ink supply and guidance system has only one moving part. So the Inktronic terminal requires little maintenance. And it's really quiet.

It has more than on-line operational economy, too. Uses ordinary teleprinter paper. And inexpensive ink. Like most equipment in the Teletype line, you won't find a more capable terminal on a price/performance basis.



on track with 80,000 cars

Numbers: important in every business. But, no one has to contend with more of them than a railroad. Keeping the digits straight that identify rolling stock alone, staggers the imagination. These numbers represent big money to railroad and customers alike.

One major railroad uses over 500 high and low speed Teletype terminals in its system to provide the type of car utilization that means business and profitable operation. The terminals are linked to a computer by communications channels.

The Teletype equipment has parity error detection capabilities. Important in keeping the identity and location of over 80,000 cars straight. Teletype solid-state terminal logic permits the computer to poll stations and terminals to respond automatically.

Data generated includes immediate car availability, projected car availability in 1 to 3 days, condition of cars, what type of goods each can handle. Locomotive power available. Enabling the railroad to provide shipper customers the equipment they need for loading, when needed. The data system handles over 30 million data bits daily.

recommended reading

Teletype has a number of brochures on equipment, applications, and case history data. A short description of what is available is contained in: "How to get answers to your questions about Teletype equipment." Write for your copy.

Teletype data communication equipment is available in send-receive capabilities of up to 2400 words per minute. Included are hard-copy, magnetic-tape and paper-tape terminals, error control devices, options and accessory equipment to fit most data communication system requirements. For information write:

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Teletype is a trademark registered in the U.S. Pat. Office

That's how much DATATILE™ can cut access floor surfacing costs and still provide the static dissipating properties your computer room needs.

DATATILE is Armstrong's new anti-static vinyl-asbestos surfacing for access floor systems. When compared to other surfacing materials providing similar static-dissipating properties, DATATILE costs approximately 40% less per square foot.

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CIRCLE 82 ON READER CARD

LETTERS

Denigrates on him

Sir:
Even assuming that Mr. Grankenhuis' comments (July 15, p. 27) on Ianuzzo's article on computing in Brazil (May, 1970) are correct, I must object to his denigration of scientific and sophisticated applications in the Brazilian, and by implication in all developing countries, context. It is precisely in countries experiencing rapid population growth and vast excesses of demand over supply that such applications have the most potential. Where resources are scarce relative to needs, they *must* be managed efficiently if economic and social development are to succeed within a reasonable period.

A. WILLIAMS
University Park, Pennsylvania

Spiro mania

Sir:
I feel just like Mr. Agnew and other great men of our time. I've been misquoted.

On page 176 of your June issue Miss Edith Myers credits me with saying: " . . . the system has been on the air only 17% of the time . . . " What I really said was: " . . . we've been down 17% of the time."

I further explained that the down time was due to several factors, the least of which, as it turned out, was the software package. Our down time now is 5% or less and getting better.

We can and will do better, but we are satisfied with the progress we are making and the software package we bought.

JOE F. BALDRIDGE, JR.
Fort Worth National Bank
Fort Worth, Texas

Give the nut a wrench

Sir:
In reference to the March Editor's Readout: People seem inclined to be either absolutely silent or violently disruptive. But certainly there is a middleground where effective action can be taken. This middleground, however, has two aspects, positive and negative. Lt. Sora's reply (May, p. 43) stresses the positive side. Let me stress that again, with a word of caution: Most of us will say, "All this is obvious," and then go about our way, forgetting to apply what is so obvious, forgetting that knowledge not applied is of no credit to us.

How can we be positive? In two ways. We can be positive within our data processing profession. We can be positive in the sense that we try to be pleasant and helpful, that we give praise as well as correction; and we can be positive in the sense that we actively work to be positive, that we take some part in destiny, not let it just take us for a ride. It is too easy to follow a "scientific systems approach" and conclude that only negative feedback provides stability, forgetting that the human system is not to be treated so simple-mindedly. The carrot is still preferable to the stick.

Secondly, we can be positive in our community and on broader issues that affect the nation and the world. I contend that here, too, positive action is not only more decorous, but that it is also more effective. A handful of "Nader's raiders" will accomplish more than a street full of mobs. We must be patient in that the mills of orderly action grind slowly, but that they grind exceedingly fine; that our sincere and carefully reasoned efforts will ultimately bear some good fruits. I conclude that "A monkey wrench applied to the right nut is

(Continued on p. 11)

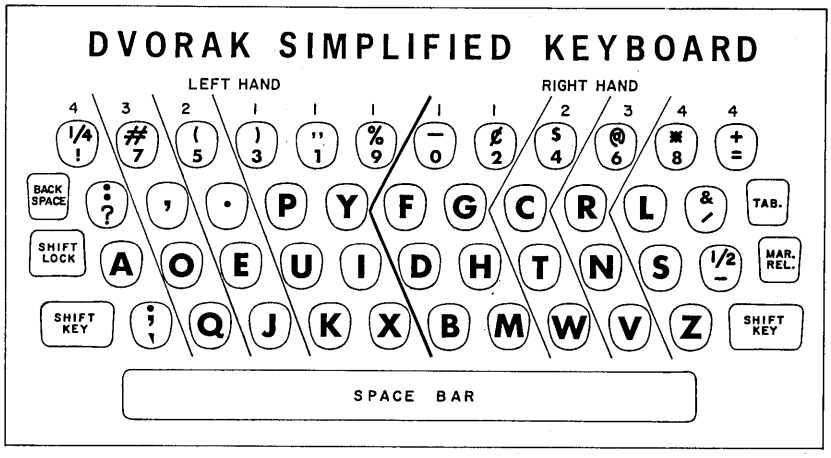
Keyboarder line

Sir:
In Robert Stender's article (June, p. 60) "The Future Role of Keyboards in Data Entry," it was stated that, while the cost-effectiveness of the computing power of computers has increased over 1000% since 1951 and that of computer output over several hundred % during the same period, that the best modern keyboard entry device is only 50% better in "throughput" than the original card punch keyboard devices.

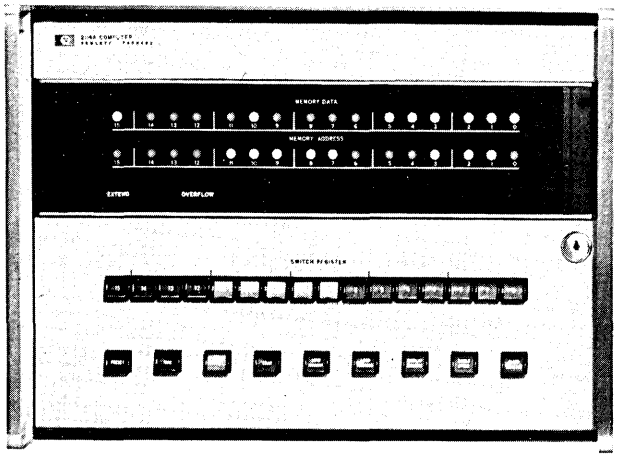
It might be of interest to note that another 30 to 50% increase would be possible with the keyboard as illustrated. This keyboard, the Dvorak Simplified Keyboard (DSK) was scientifically designed to reduce finger movement and minimize awkward strokes and the result is faster speeds, reduced errors, and reduced fatigue. Typewriter speeds of 190 to 200 words per minute have been recorded using the DSK. (The world's record for the standard keyboard is somewhere near 150 words per minute.)

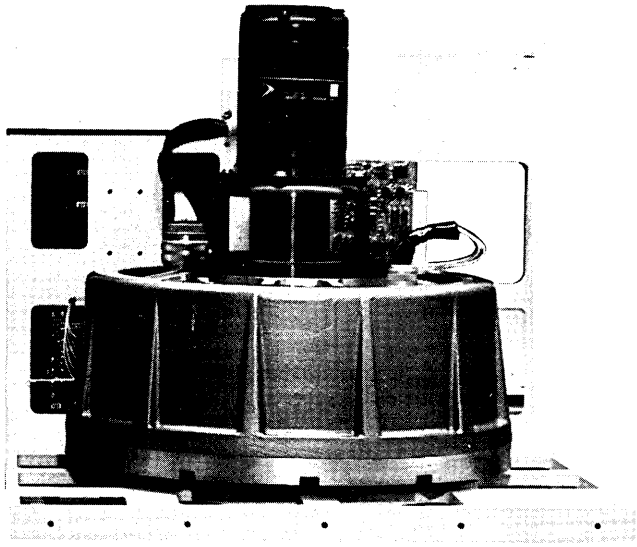
The question is, when does the bottleneck overrun the need for compatibility?

BOB MCCAULEY
St. Paul, Minnesota



Maxi-memory:mini-price





DATUM's Series 6000 Drum Controller System was designed for Hewlett-Packard computer owners caught in a storage squeeze. You can add from 32K to 262K words of storage capacity to HP 2114, 2115, and 2116 minicomputers at a cost-to-core ratio that's hard to beat. Systems start under $6,000.

A system includes from one to four drum memory units, a controller (which plugs into two adjacent I/O card slots within the computer), and connecting cables.

With a single-drum system, you can add storage capacities, depending on the drum selected, of 32,000, 64,000, 131,000, or 262,000 words. Transfer rates also vary with the drum: 88,000, 120,000 or 130,000 words per second. Data transfers directly to memory via Direct Memory Access (DMA) Channel, or, optionally, interlaced transfer can be made over the I/O bus for HP computers not equipped with DMA capability.

Under DMA control, the system is compatible with the Hewlett-Packard Model 12610A Drum Memory software.

The rugged, head-per-track drums offer high performance characteristics, combined with the maximum reliability derived from flying-head techniques.

For complete information on the Series 6000 way out of your storage squeeze, write or phone **DATUM — the mini-peripheral people.**

DATUM, INC., 170 East Liberty Avenue, Anaheim, California 92801 (714) 879-3070

datum inc.

more effective than one thrown askew into the gears." If we don't keep them busy turning nuts, the wrenches may find their ways into the gears.

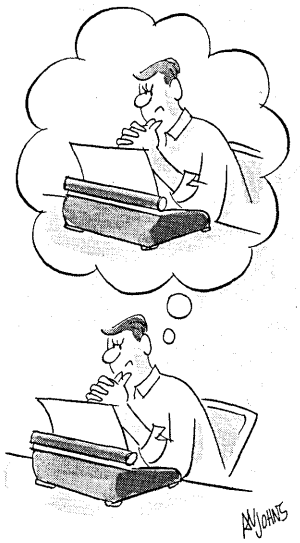
ARCH C. DAVIS
Princeton, New Jersey

Make a batch of it

Sir:

In regard to the article entitled "Evaluation of Keyboard Data Entry Systems" (June '70), I would like to make the following comments:

Having worked extensively in the keyboard data entry system area, I found this article to be extremely well written and complete. The only area I would criticize as lacking is the one of verification. Visual verification is mentioned very briefly and given extremely bad reviews. I feel that visual verification, as well as intermixed, key and visual verification, has its place. Textual data or any data which can be verified on a word or phrase (series of words) basis as opposed to a character by character basis is open to visual verification



procedures.

Another interrelationship which is not mentioned is the one between increased validation/checking techniques of the new keyboard-to-tape equipments and the possible decrease in amount of verification required. For example, let's look at the feature of batch totalling provided by some of the new equipments. One can enter a batch of records with several numeric fields being constantly subtotalled by the keyboard data entry system. When the batch is completely entered, then the batch totals which were provided with each batch can be entered in the system. A batch total function, which consists of a comparison between both the internally and externally computed batch totals, is then performed. If the comparison matches (=) then no verification of this batch data is required. If no match is obtained, then the field(s) in error will be specified. Verification can proceed, record by record for only the field(s) in error. Whenever a field is changed, the internally computed batch total is modified accordingly and a new batch total comparison is made. Therefore, the amount of verification of numeric fields which are batch totalled is minimized. Since verification increases the effective volume of input data, any decrease in this effort adds to increased data entry system throughput.

BENNET A. LANDSMAN
Cherry Hill, New Jersey

Matchless article

Sir:

Since our own organization, in affiliation with Adaptive Systems, Inc., is very much involved in computerized job-matching, I was especially interested in the content of the excellent article, "Head-hunting by Computer" (May, p. 169).

However, firstly, under the caption, "For the Disadvantaged," it mentions the fact that Information Sciences, Inc., developed a system under contract to The North Carolina Manpower Development Corporation, which *is now in use* in Charlotte, matching the hard-core unemployed to job and training opportunities. I must advise you that that system is not in use at present and, in fact, has not been in use since at least May, 1969.

Currently, the North Carolina Man Power Development Corporation is using the Cleff Job-Matching System, developed by Dr. Samuel Cleff of Adaptive Systems, Inc., our affiliated company.

What that article essentially deals with, as you pointed out, are a variety of systems which might be more properly labeled job location systems, skills inventories or job retrieval systems. Job-matching is a far different concept. Typically, the retrieval systems are in use as an employment technique, which first locate individuals whose qualities *then* must be matched into job requirements.

On the other hand, the Cleff Job-Matching System is a way for describing jobs and people with a common language based upon tasks or activities which are actually involved in the proper performance of a job. It also takes into account those tasks which must be avoided in order to prevent failure on the job. It then allows the computer to search for the best match between the two.

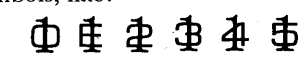
In short, a bona-fide job matching system, and the only one we know of is the Cleff Job-Matching System, first evaluates and describes the activities experiences and preferences of applicants. It also evaluates and describes jobs in exactly the same terms. It then allows the computer to search objectively and quantitatively for the best correlation between people and jobs.

ROBERT M. HECHT
Personnel Testing Service, Inc.
New York, New York

A hex on decimals

Sir:

A nuisance that plagues computer users is the manner of thinking and writing and speaking of hexadecimal numbers, as mentioned before in DATAMATION (e.g., the confusion of AA with 88). A simple solution that avoids these difficulties, and from which it is easy to revert to the present inconvenience when necessary: to think and read "ten" for hexadecimal "A," "eleven" for hexadecimal "B," "twelve" for hexadecimal "C," "fifteen" for hexadecimal "F." Had the manufacturer devised new symbols, like:



for ten, eleven, etc., much confusion would have been avoided, but we are saddled with the current system. I find the changes suggested quite helpful.

DAVID M. FINE
Seattle, Washington

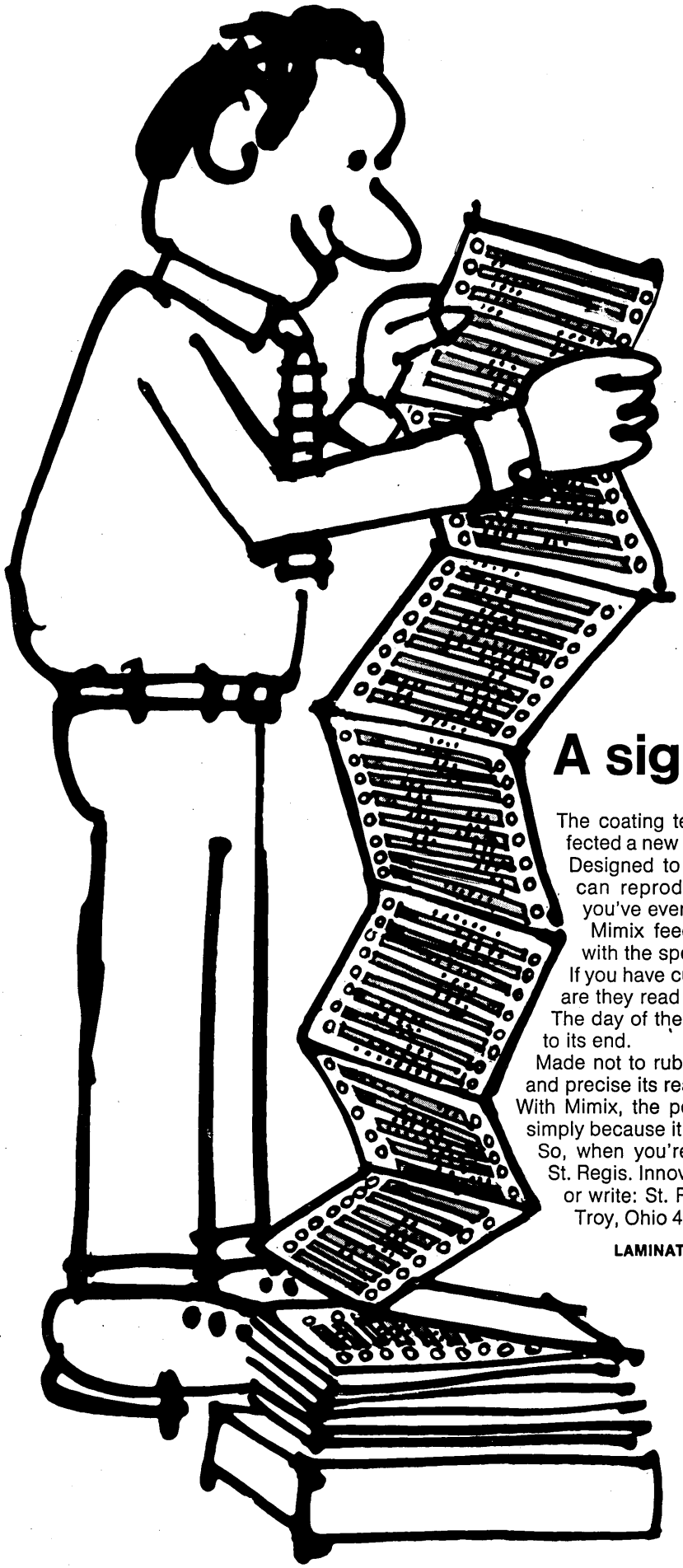
News seen

Sir:

Why, oh why, did you have to pick on News Briefs for your economy drive?

Surely, there are many more newsworthy items that deserve to see the light of day than your slim column (July 15) would indicate.

J. F. PLATUS
Upper Darby, Pennsylvania



Mimix.
A sight for sore eyes.

The coating technologists at St. Regis developed and perfected a new carbonless paper called Mimix.

Designed to run on high-speed computer printers, Mimix can reproduce eight or more of the sharpest copies you've ever seen.

Mimix feeds, prints, punches, perforates and delivers with the speed and ease of forms bond.

If you have customers that work in the back room, chances are they read smudged, illegible, daily computer print-outs. The day of the blurred and hard to read print-out has come to its end.

Made not to rub off or smudge, each Mimix copy is so clear and precise its readability is superb from beginning to end.

With Mimix, the pesty task of disposing carbons doesn't exist, simply because it's carbonless.

So, when you're in the market, buy from the professionals, St. Regis. Innovators for better business forms. Give us a call or write: St. Regis, Laminated & Coated Products Division, Troy, Ohio 45373. Tel. (513) 332-1271.

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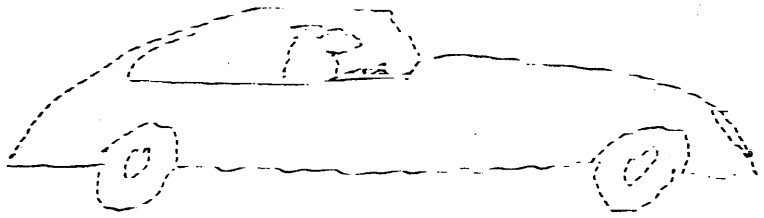

PDP-15 is a Jaguar at a soap box derby.

Lots of companies make medium size computers. Too many. But a lot of them are obsolete, and some of them never did have any horsepower. PDP-15 is different. Half the price of some of the competition. But better than that, software proven in 400 field installations, full monitor control, four versions that fit most applications specifically, and all budgets. Write.

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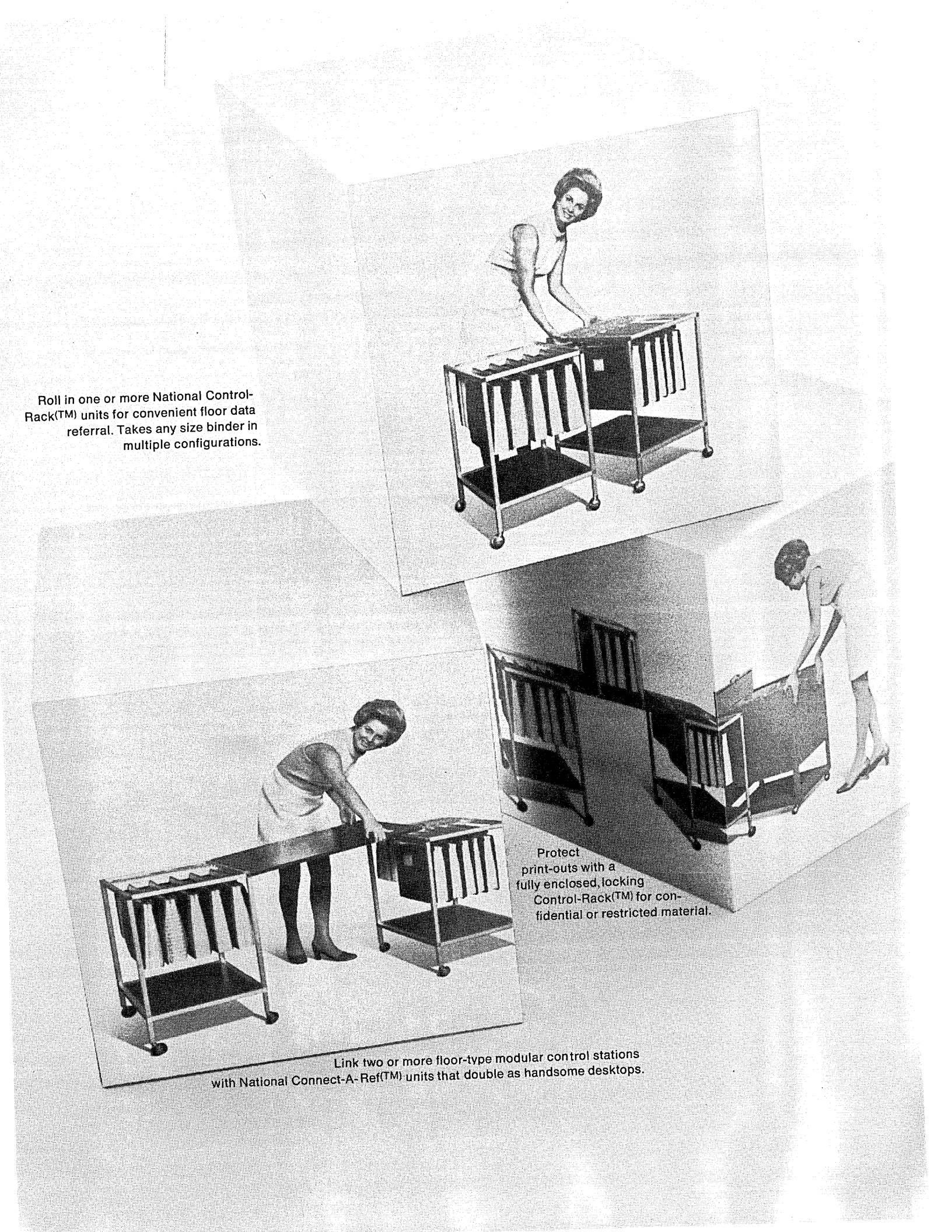

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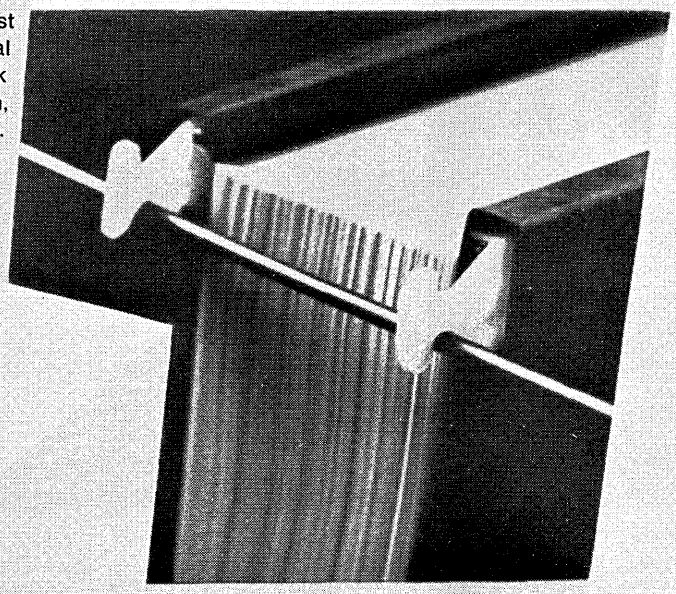

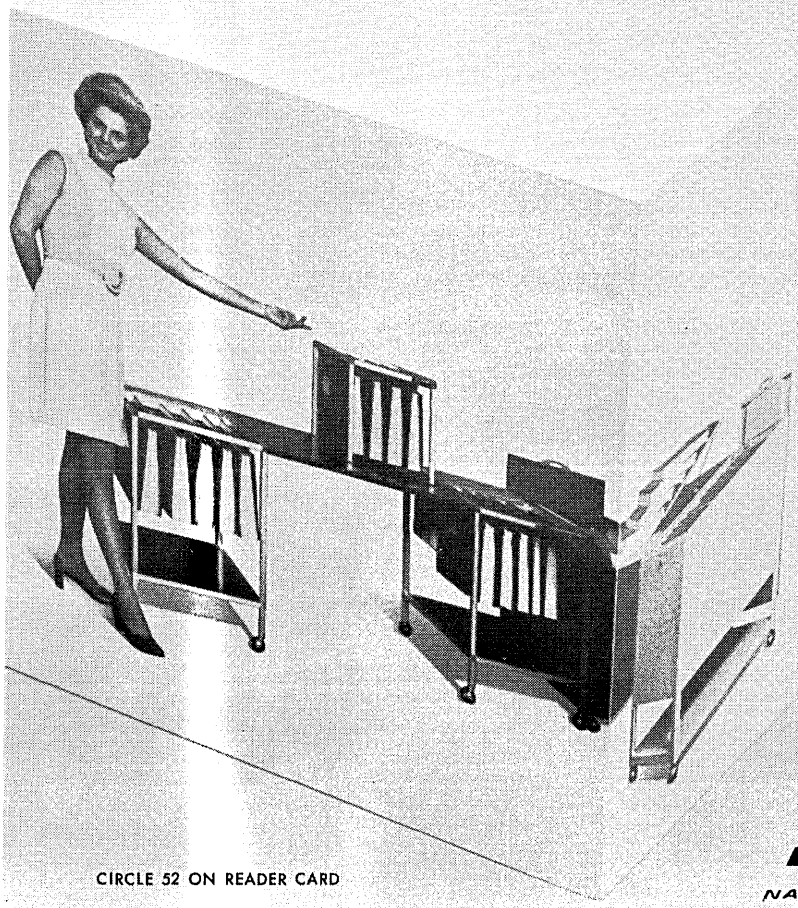

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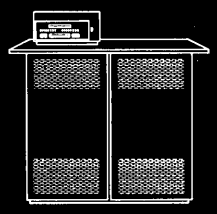

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LOOK AHEAD

RCA HAS DESIGNS ON IBM LUSTER

IBM's System 370 is looming as the potential king of the communications-oriented lines, observers say. But if RCA has met its design objectives (its new line is due out soon), the industry may see a more serious competitive attack on IBM than any of the other dwarfs has been able to muster in recent years. An internal design report espoused the RCA line's suitability for computer utility use, with features as potent as those of Multics (GE-645s). It is also said to have an open-ended design that can carry it up to supercomputer size some day.

Here are more claims about the RCA design besides abandoning 360 and Spectra 70 compatibility in favor of emulation of those systems and a new stack architecture (see Aug. 1, p. 17): paging and segmentation is more efficient than that of the 360/67 and GE 645—no associative memory is needed because of a new addressing scheme; emulation, as on the 370, can be multiprogrammed with other tasks; also like the 370, a single operating system is the aim for all models that are upward compatible; unlike the Spectra 70 and 360, I/O instructions are not privileged, so any peripheral device can be used without modifying standard software; no ad hoc limits, at least in original design, were placed on the number of processors in a system, according to the design report. "We might, for instance, someday have a thousand 10^6-bit cryoelectric memories using the same refrigerator and serviced by perhaps 50 processors."

PENN CENTRAL AFFILIATE DROPS COMPUTER INTERESTS

Great Southwest Corp., Texas land developer which took over control of ailing Scientific Control Corp. of Dallas last January at a bargain-basement $1 a share, is now considering pulling out. Strapped for cash after banks became nervous over GSC's position as an 80%-owned affiliate of Penn Central, it also has abandoned plans to open a service bureau in Newport Beach, Calif., which was to be called GSC Computer Services and have access to a 360/40 in Newport, a 35 in Dallas and two 20s in Atlanta and St. Louis. It had recruited a staff and was about to announce the new service this summer when the financing problem arose.

Meanwhile in Dallas, GSC Scientific Control officers weren't returning calls from reporters, but it was learned negotiations to sell the Scientific Control interest were under way with three prospects.

VIATRON CLAMS UP ON MERGER RUMORS

Viatron officials decline to comment on rumors that it is holding merger talks with Martin-Marietta and Motorola, but admit they're taking a long, hard look at their entire operation and add that anything can happen. What's happening: production of the System 21 terminal has dropped sharply. Despite earlier predictions that shipments would reach 6K/month by mid-'70, and although production did reach 600/month last spring, the volume is "nowhere near that now," a Viatron spokesman says.

(Continued on page 18)

Many look for production of the terminals to go to outside vendors, although the firm will probably retain its MOS facilities. In addition, there could be more price increases in the works. As for the low-cost computer, Viatron says it will begin delivery this month.

LOGICON LOOKING COMMERCIAL WITH NEW T-S MACHINE

Turning its marketing attention to the commercial arena is a software and systems engineering firm in L.A., Logicon Inc., 90% of whose revenue has been coming from the government. Bill Lee, ex-president of Scientific Control, has been brought in as vp-marketing to make this change, and the first major product is a $20K/month t-s machine, the 2+2. Simulation runs show it'll provide 2-second response times while serving 128 terminals, Lee says, with first deliveries due next March. More than a mainframe supplier, Logicon will install entire systems, a virtual turnkey operation.

CON ED IN THE DARK

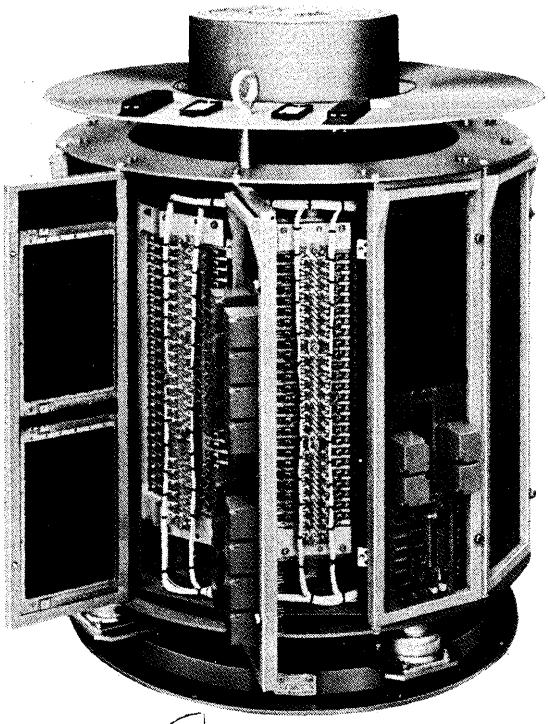
NYC's Consolidated Edison should be blushing as well as blacking and browning out. The power supplier is looking into "uninterruptible power supplies" (UPS) for its own data processing center. It doesn't know too much about UPS, understandably, and it's trying to find out on the QT, but everybody laughs when the situation is explained. Which is also understandable in Sun City. (UPS, for those still in the dark, is provided by battery stored and/or diesel generated power.)

BREAKING OUT ...AND HANGING IN

Dr. William Jacobi resigned last month from three-year-old Jacobi Systems Corp., Van Nuys, Calif., a systems and software firm he founded, leaving behind a work force which had dwindled to 46 from 100 in May and only two of his half-dozen co-founders—W. J. Hanna, head of the firm's data center, and Victor Mayper, a senior scientist. His resignation followed closely that of Jack K. Weinstock, vp, finance and administration, who has turned to consulting. Jacobi's plans were unknown at presstime. Hanna said the company began losing money in May when two major contracts ran out and still is, although his data center is "hanging in and growing," bringing in $140K per month compared to $90K last year. The company has "temporarily shelved" its MINITS (mini t-s) system for economic reasons but doesn't count it out because "we put a lot of money into it." Richard Reinhardt, exec vp under Dr. Jacobi, has assumed the reins.

RUMORS AND RAW RANDOM DATA

Brewing at IBM in the S/3 department: a slightly smaller version of the machine, probably for terminal use, will be announced this fall ... A restaurant franchise is using the GE t-s service to control construction costs. They've stored building information on their standard-design restaurant in a GE file, and at each new franchise site contractors are requested to obtain a terminal and use the file not only for configuring their bids but also for scheduling construction. No room for padding or goldbricking here ... Unreachable by phone (where are they?) are Computers Unlimited (Rochester, N.Y., t-s operation), APL-Manhattan (t-s), Conley Corp. (Edina, Minn., software house), and EDP Central (Portland, Ore., bureau), among others.



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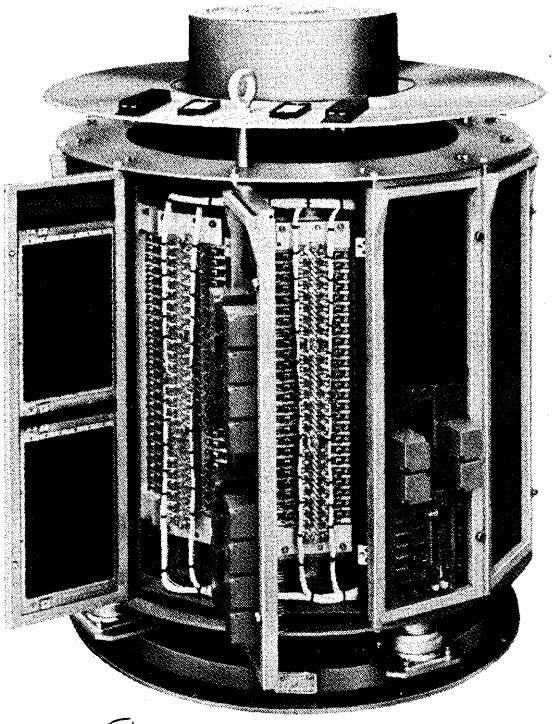

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Difficult to define, design, and justify, MIS remains a shimmering grail on management's horizon

The Elusive MIS

by Robert V. Head

In the computer age, perhaps no other system concept has been talked about so enthusiastically by computer professionals and management men alike and yet been so frustrating in its realization than that of management information systems. If a latter-day Mark Twain were somehow to find himself embroiled with computer technology, he might justifiably be expected to observe that an MIS is something like the weather: Everyone talks about it but nobody does very much about it.

In seeking to gain perspective on the current state of the art in MIS, several questions should be posed: (1) Just what is an MIS? (2) Who has one? and (3) Why do they have it?

1. *What is an MIS?* Our troubles begin when we confront the question of what is an MIS. Definitions abound, but there is no consensus among the numerous contributors to the literature as to what really constitutes an MIS.[1] Consequently, nearly every paper written on the subject, nearly every article in the trade or business press, begins either diffidently or belligerently with the author's prized definition. None of these definitions will be repeated here, nor will this paper contribute to the confusion by essaying yet another. It may provide a useful insight, though, to note that most attempts at definition are couched in terms of either (1) hardware, (2) software, or (3) management usage.

The hardware approach seeks to pin down the concept by associating it with such devices as mass random access storage, on-line terminals, and communications networks. This is by far the easiest kind of definition to derive, and also the least meaningful since the hardware componentry of an MIS is also applicable to numerous other systems having nothing whatever to do with management information.

The software approach to MIS emphasizes techniques for structuring the company data base and endeavors to define an MIS according to volumes of information that should be included, methods of data base organization, languages for information retrieval, etc. Also subsumed under this definition is the software necessary to provide access to the data base, e.g., programs for communications control and conversational processing, software that usually represents a significant extension of the manufacturer's operating system.

Definition or description of an MIS in terms of management usage is the most difficult to achieve. Here, one must be concerned with the purposes for which an MIS is designed and endeavor to take into account management needs for information and management usage of the information. Those who have delved into the MIS problem from a management viewpoint soon discover that the "classical" systems methodology for identifying output requirements simply doesn't work in an MIS environment. Conventional requirements analysis as a prelude to system design is based on the assumption that user needs can be adequately defined in advance whereas experience has shown that management's need for information is largely *ad hoc* in nature and cannot be predicted even by the most thoughtful and articulate of managers. We shall have more to say about this problem later in this paper.

Before proceeding, it should be mentioned that there is a sizable—and highly vocal—band of skeptics who assert that there is no such thing as a management information system, that it is a concoction put together by overenthusiastic technologists seeking new outlets for their creative energies now that the routine data processing applications in large companies have been computerized. This might be called the "ostrich approach" to definition, in that it requires its adherents to ignore the growing body of literature and the underlying system concepts that have coalesced around the term MIS, however ill-defined.

2. *Who has an MIS?* Turning to the question of who has an MIS, the answers are equally bleak and confusing. An organization may have all the hardware attributes commonly associated with an advanced information system and may possess the requisite software packages, but still not have anything resembling a true MIS. Consider an airline reservation system, possessing all the hardware and software trappings, including remotely distributed crts, mass random access files, real-time response capability, etc. Most MIS practitioners would agree that such a sys-

1. An MIS bibliographic project, jointly sponsored by the Society for Management Information Systems and the MIS Research Center of the School of Business Administration of the University of Minnesota, has thus far compiled some 2,000 citations of MIS literature.

tem, though advanced technologically, is dedicated to the recording of individual transactions of a well-defined type, i.e., passenger reservations, and hence does not qualify as an MIS. Yet, as a by-product of such a system, management information is indeed generated. Airline top management is interested in timely information about the "load factor," that is, the percentage of seat capacity utilized each operating day, and is dependent on computer-generated reports produced as a by-product of the transaction-oriented reservation system. Thus the issue becomes cloudy as to whether this system is, at least in part, a management information system. This lends credence to those who object to the term MIS on grounds that an MIS is parasitic in that it merely taps transaction-oriented operational systems to produce management reports.

Crossing organizational lines

Another school of thought insists that one does not have a true MIS unless it cuts across organizational lines. Thus, a system that provides only marketing information, even though used by top management in the company, would not qualify. Others insist that there can be no real MIS unless the information produced is used in a meaningful way by the chief executive officer of the company. If this is not the case, they assert, the system masquerading as an MIS is actually only an advanced version of a traditional management control system.

But despite this lack of benchmarks for determining who really has an MIS, there is growing evidence that many companies have systems that, according to most definitions and points of view, would qualify as management information systems. For example, the preliminary results of a research project on on-line managers being conducted by the Society for Management Information Systems reveal that of some 600 respondents to a questionnaire, almost 350 replied affirmatively to the question, "Has your organization installed any type of terminal device, connected to an on-line system, for use by management level people?" This is an impressive percentage, even when one concedes that the respondents, being drawn from the society's membership, doubtless have a stronger interest in this technology than the business community at large.

3. *Why have an MIS?* Acknowledging, then, that there is a high level of interest and activity in MIS, despite the spongy nature of the subject, the question remains, "why?" To go from conventional transaction type processing to something beyond, usually with a real-time connotation, can be horrendously expensive, especially when one adds to the cost of the requisite hardware that of the software necessary to make all the pieces work. How can all this be justified?

Of all the questions posed, this is by far the most troublesome. For we have left behind the kind of "hard dollar" cost justification we have been accustomed to applying in the past. When, 10 years ago, we replaced a battery of clerks with a data processing system we reduced the per-transaction cost to process, say, customer accounts or passenger reservations, and achieved a demonstrable economy. But what we are concerned with now is the benefit to be derived from providing information which makes management decision making more effective, and we have yet to derive realistic cost/effectiveness formulas for MIS.

One difficulty, of course, is that there is no really objective way of comparing the efficaciousness of decision making in the past—the pre-MIS era—with that which is abetted by an MIS. The same problems may not arise in a way that permits comparison and, even if they do, the personalities of the executives in two comparable situations may be so different, or the business environment so altered, as to make the comparison meaningless.

At a lower and more specific level of executive decision making which lends itself to quantitative approaches, such as new product introduction decisions, selection of new warehouse locations, or evaluation of changes in plant capacity, evidence can be accumulated to help justify computer-supported decisions. But much remains to be done to make the justification of an MIS a more disciplined exercise.

Most systems today are being supported by management, and company resources allocated to MIS development are based largely on an "act of faith" with respect to system payout potential. The stated or unstated managerial motivation is often based on the systems accomplishments—or lack thereof—of the competition. The company that foregoes a venture into MIS may lose ground to its more ambitious business

adversaries. Or, if a successful MIS effort can be mounted, the company may gain a competitive advantage.

The vital data base

As any MIS enthusiast will aver, be he lowly programmer or company president, the componentry and gadgetry associated with these systems is abundantly available—and zestfully employed. Indeed, today, the culprit in MIS development is usually not the traditional stereotype of the overzealous computer salesman; rather, the technological push frequently originates within the company.

In most management information systems worthy of contemporary interest, there must, of course, be one or more computers of adequate capacity to accommodate multiple on-line terminals as well as, perhaps, to perform batch updating in a background mode. And there must be system software that enhances the efficiency of the hardware, rather than hindering it through diversion of system resources to nonproductive overhead operations. That the selection of the appropriate hardware and software configuration is today an enormously difficult task is evidenced by the growth in the usage of system simulators to (1) aid in initial equipment selection and (2) monitor performance of the system once it becomes operational.

But central to the successful design of any management information system is the approach taken to structuring the company data base. For the design of the data base will dictate, or conversely in some situations be constrained by, the type of storage devices to be used, the data management package chosen to manipulate information in the data base, the degree of security that must be built into the system to protect the data base, and the rapidity of the responses that must be made to management inquiries.

As has been mentioned, it is no longer possible to structure the data base by performing a requirements analysis to determine what management's information needs are. System designers have had to abandon this time-honored approach. At the opposite extreme lies what might be termed the "kitchen sink" approach whereby every possible element of information that could conceivably be relevant to management's information needs at some future time is stored in the data base. This is equally impractical due to the size of the resultant data base and the hopelessness of trying to efficiently retrieve data elements which have not in some way been organized according to their anticipated usage. Further, mass storage, while becoming less expensive, is still a significant cost component of an information system, forcing the designer to be selective in what he includes in the data base. Inevitably in a situation like this, the result is compromise.

Here the compromise is between organizing some information in a prestructured manner, usually into records and files, and making other information available only as a result of a special search.[2] In this context, prestructured information might be no more than a reworking of existing files and printed reports in such a way that they are conveniently available on-line. In a marketing system, for instance, sales figures might be made available summarized according to salesman in each branch office, according to branch office within a product, and according to product performance by salesman. Within such a relatively simple classification, it would be easy for a manager to obtain a variety of information about product and salesman performance by geographic area. But suppose now that management wishes to obtain information about shipments to a particular customer, say all products shipped to this customer during a certain period, or the value of shipments from a certain warehouse by product. Since this type of information accumulation had not been prestructured into a conveniently accessible format, it would be necessary to search, say, an entire file of invoice records looking for the particular elements of data in those records pertaining to a certain customer number or warehouse number (assuming of course that the system designer had been sufficiently astute to include these data elements in the invoice records in the first place).

Another way of saying this is that the information in the prestructured report has been indexed for easy retrieval on the assumption that demand for it will be frequent, whereas the information called for by the second type of request, while available, will require the search of a complete file before it can be compiled. Thus, the data base design problem can be viewed as one of tradeoff between ease of retrieval and rapidity of delivery of information versus redundancy in the data base, since data elements, like accumulations by product or by individual salesman, must be repeated in each prestructured record. There is a growing body of literature dealing with optimum search strategies in information retrieval, but the practical effectiveness of an MIS depends largely on the good judgment (and intuition) of the system designer in anticipating the nature and pattern of requests for information.

Generic classification

There have been numerous attempts to achieve a generic classification of the information in a data base. A popular approach is to classify data according to its usage, that is, whether it is intended for day-to-day operational usage, for control purposes, or for planning. Operational data, such as the current status of inventory or current balances in depositor accounts, is transaction oriented. While information pertaining to individual customers or accounts is needed for maintenance of the records of the company, operational data is of little interest to management. Management control data consists of information on exception conditions, usually triggered by operational level systems. It includes summaries, recaps, comparisons, etc., generally for use by middle management in controlling the company's operations on a short-term basis. Planning information is intended for usage by top management in exercising its broad responsibilities for determining the long range programs and objectives of the organization. This attempt to specify information according to its usage within the company hierarchy may be useful, but it is only one way of gaining insight into the data base.

Another approach is to distinguish between in-

2. This distinction corresponds closely to Dr. Olle's usage of the terms "predefinable" and "unpredefinable" in his paper in this issue.

formation which is historical in nature and that which pertains to the future. Most data produced by today's systems, regardless of the system's hardware and software accouterments, is descriptive of events and activities that took place in the past. Thus, our systems produce monthly operating statements, budget performance analyses, and numerous other outputs which are based on the accumulation of figures reflecting sales, production, and other operating data. Such information is routinely produced by most computer systems, though it is often poorly organized and badly integrated and not presented in its most effective form. (For instance, most reports are still compiled in tabular rather than in much more meaningful and impactive graphic outputs.)

But there is another type of information that is potentially of much more value than today's rather pedestrian comparisons of last month's performance to the equivalent month a year ago. This is information that is predictive in character and augments the manager's own judgments about what performance is going to be like in the future. Here one becomes involved in a wide array of techniques and methodologies for exploiting the information in the data base, ranging all the way from simple extrapolations to the employment of complex models with the capability of manipulating numerous variables.[3] Both historical information and information pertaining to probable future performance are important to management, but the latter is more difficult to develop in a meaningful way and consequently progress in that area has been limited in most companies.

A third overall way of looking at the data base emphasizes the utility of environmental as well as internally-generated information. Most information produced for management today is based on, and is a by-product of, data collected in the normal course of conducting business operations. Thus, the loan-to-deposit ratio in a commercial bank is derived from recaps of the individual loans outstanding and customer deposits on hand during a given period. Now, to do a comparative analysis, let us say, of the loan-to-deposit ratio of a particular financial institution with that of other institutions on either an individual or a composite basis would require external information, that is, data concerning the operations of these other institutions. Other environmental information not having to do directly with competition but still of great potential interest to management might include economic indicators, information about securities markets, and demographic data of various kinds. Indeed, acquisition and usage of such information is limited only by the character of the business, the difficulty of procuring the data, and its cost versus its value in management decision making.

It should be noted that this distinction between internal and external information is somewhat different from that made previously between historical and future information. One can perform certain analyses of the future, usually straightforward projections, using only internally-generated data. It must be conceded, though, that more sophisticated predictions require at least a minimal amount of environmental information, if only in the form of planning assumptions. It should be noted further that environmental information need not necessarily be captured and stored in the data base on a recurring basis. Instead, it may often be obtained when needed to perform a particular analysis. For example, census tract information and other descriptive data about a given area might be procured to assist in making a one-time determination, perhaps using a model, of the preferred location for a new department store or bank branch.

It is not the intent here to suggest that all MIS design problems revolve around the data base, but rather to emphasize its importance in MIS design. Although the usefulness of the system to management depends critically upon the data base, other factors such as ease of usage, adequacy of response time, and system reliability obviously also affect management's satisfaction with the system.

Implementation alternatives

Once the system design has been formulated, there follows the formidable task of bringing the system up to operational status. Most practitioners agree that a system of major scope, especially one that cuts across organizational lines and involves numerous organizational components, should be implemented gradually. Rather than work toward a day several years in the future when an entire grandiose scheme goes "on stream," it is better to implement the system in chunks or pieces. These may be either vertical in the sense of perhaps first implementing a marketing information system, then a production control system and so on, or horizontal in the sense of moving up the managerial hierarchy by satisfying the information needs of managers at different levels as implementation work progresses.

But such a piecemeal strategy by no means obviates the need to have an overall "road map" of what the system will ultimately look like. A careful job of planning the data base can help here. And the system design must, through the use of packages or in some other manner, be left "open ended" so that it can be adapted to accommodate changing managerial needs as operating experience is gained following system implementation.

While there may be agreement that a gradual conversion to an MIS is necessary, there is not similar agreement on whether implementation should take into account the existing files that have grown up over the years for conventional applications like accounts receivable, payroll, and inventory control. Should the MIS build on these and serve as a sort of capstone over them, drawing upon existing data with but minimum disruption to present systems and operations? Or are these systems so poorly designed and inefficient that it is better to let them continue undisturbed while building a management information system that will ultimately replace them?

These alternatives might be called respectively the "transitional" and the "apocalyptic."[4] Advocates of the transitional approach argue that, since an MIS is largely parasitic anyway, it is only logical to try to

3. For a more thorough discussion of the role of modeling in MIS, see Dr. Emery's paper in this issue.

4. Some commentators use the terms "bottoms up" and "top down" to describe essentially the same problem, though with a slightly different shade of meaning. The bottoms up approach implies a gradual building up of the MIS to the point where information meaningful to executive management will someday be forthcoming; the top down philosophy stresses satisfying the needs of top management first and foremost.

interface it with existing files and systems. They argue further that the typical company has an enormous investment, often millions of dollars, in these systems and that this investment must be protected and written off over as long a period as possible.

Partisans of the apocalyptic philosophy base their arguments largely on an indictment of the efficiency and adequacy of existing systems, asserting that it is better to start anew than to pour good money after bad by attempting to perpetuate "second generation" system concepts into third or perhaps fourth generation management information systems.

There is no single answer to this question, and the selection of alternatives depends upon individual company objectives and resources. In some situations, like the rare one in which there *is* no commitment to a predecessor system, implementation of an MIS can begin with a fresh design concept. In the more likely instance where there are numerous systems in being, the feasibility of somehow tying these together must be carefully weighed.

Another implementation problem has to do with the geographic distribution of MIS capability. Should the system be implemented at all company locations simultaneously for a given function or should certain selected locations be given the benefit of the system, perhaps for multiple functions, before others are placed on-line? Numerous alternatives must be considered, and the centralization decision for a large national company is not a simple one. It may be, for example, that for a given corporate function the data processing capability, and perhaps the data base itself, should be distributed geographically. In other cases, certain functions and their associated data base elements might best be located at a central computer site, and in still others part of the job might be performed centrally with certain subfunctions allocated to a regional or plant location using a smaller computer which may or may not be on-line to the central data base.

From an equipment and communications standpoint one can envision three possible levels of distributed computing: 1) a large data processor at company headquarters, 2) smaller data processors, perhaps minicomputers, at regional or plant locations, and 3) terminals in managers' offices, connected either to a regional computer or to the central computer or perhaps to both for given purposes.

As the centralization question is resolved, a collateral question of the best location of the system development staff must also be faced. Do geographically distributed centers require their own systems and programming groups to suppport local needs or can this be done centrally, with "packaged" systems installed on a uniform basis at the remote locations? This depends largely upon the functions to be allocated to the different locations. It may be that query packages can be provided at the remote locations which permit managers to make effective use of the data base without the need for special intervention on the part of a technical staff except in unusually complex cases.

The foregoing comments are meant to suggest that because MIS development is not yet a well-defined discipline, there are difficult problems in design and implementation to be overcome before technology can be exploited effectively for the purpose of assisting management. The road to achievement of an MIS is fraught with difficulty, and vast sums of money can be expended with little payout. In conclusion, therefore, it seems appropriate to try to identify some of the critical decisions that must be made, either consciously or implicitly, by management and by the company systems staff in committing to an MIS. Some of these questions have already been raised in this paper; others are explored in the other articles in this issue. And the list could no doubt be augmented with other pivotal questions borne of the experience of those who have lived through an MIS project.

The MIS decision

1. *Go-no-go?* This fundamental question must be posed and satisfactorily answered before an MIS project proceeds at all. Is this really what the company should be doing with its resources? Are existing systems, or perhaps relatively modest enhancements of these systems, adequate to satisfy management information needs? Are there alternative applications of MIS resources that should be given higher priority in company planning? Is management allowing the technological enthusiasm of the systems staff to obscure more prudent courses of action? Certainly all but the most avid partisans of MIS would concede that there are organizations that simply don't need one, that can get along very well with more conventional data processing systems. The question of "go-no-go" is not a capricious one, despite the blandishments of glamorous new hardware and software products.

2. *Go all out?* This is a restatement of the problem of whether to salvage existing systems or replace them with a presumably more powerful MIS. To find answers, such factors as the relative cost of the two approaches, the efficiency of existing systems, and the ease of operating the company under each alternative must be evaluated. It is a difficult decision to scrap perhaps ten years of development work but in many cases it may be the right one.

3. *Go on-line?* There is a sharp dividing line, both in system complexity and system cost, between a management information system that provides immediate response to management inquiries and one that produces data on a deferred basis. There is considerable merit in the on-line approach, especially when one gets into usage of simulation models which demand close interaction between man and machine in evaluating alternative courses of action. However, at the sacrifice of some sophistication, it may be that in a given company environment a one day turnaround is sufficient for the vast majority of users of the system.

A subquestion might be raised here to discriminate between on-line inquiry and on-line updating. On-line inquiry with off-line updating represents an intermediate stage of sophistication that may prove desirable in some situations. Under this approach, the data base is updated by conventional off-line data processing during the evening hours and made available for management inquiry during the working day with the restriction that no updating occurs during that time, with today's transactions being batched for entry in the evening. This procedure has worked well

in many companies.

4. *Go centralized?* This topic has already been touched upon and concerns the merits of development of a massive centralized data base versus the distribution of this data base, and attendant capability to interrogate and maintain it, to remote geographic locations or to various functional components within the company. While there are disadvantages to a completely centralized system, among them communications costs and system complexity, it does in many cases allow the procurement of more powerful equipment. Decentralization has the merit of placing data closer to the source of its generation and usage and providing greater flexibility and autonomy. The price to be paid for decentralization is usually some diminution of overall system capability per dollar expended and some redundancy and inconsistency in the data base.

5. *Go topless?* A perennial source of debate among MIS practitioners concerns the role of top management in design and usage of the system. There are those who vehemently maintain that the president should interface with the system only at second hand, employing secretaries and other intermediaries to procure information from the system. (Or from other sources, for that matter.) Others, including a number of chief executives, maintain that there is no substitute for the man-machine interaction achievable through personal usage of the system, whether this usage be for purposes of information retrieval or for problem solving with the aid of simulation and other quantitative methods. It is likely that within the next few years, as a new generation of management accedes to the executive suite, this question of topside participation will become academic, but at present it remains an outstanding one.

6. *Go outside?* This question has reference to the differences between internal and external information in the data base. The simplest approach to MIS, and the one being pursued in most organizations at present, is to attempt to organize internal operating data more effectively before proceeding to pull external information into the data base. While pragmatically this may seem attractive, there is no denying the fact that to achieve the full power of an MIS, especially in providing meaningful analyses to top management, one must go beyond manipulation of company operating information by introducing environmental data into the system. The acquisition of this external data need not be an insuperable problem if management and the systems staff have some idea of the kinds of information that should be obtained selectively without inundating the system with a torrent of meaningless outside facts and indicators.

7. *Go package?* There are several kinds of packages available to the designers and users of contemporary management information systems. These can be classified as: (1) system control packages, (2) problem solving packages, and (3) application packages. System control packages are designed to facilitate such technical functions as input and retrieval of information from the data base, communication and terminal control, and time-shared computer usage. In most situations, it is almost certain that the MIS designer will take advantage of such packages, just as users have in the past accepted manufacturer-supplied operating systems. The same comment applies generally to problem solving aids, such as LP codes, simulators, statistical analysis packages, and the like. Many of these "FORTRAN type" packages are now available, though modification may sometimes be required. The area in which the least progress has been made to date is that of application packages. Such packages are obtainable but are usually of the "stand alone" variety and cannot readily be integrated with other application packages or with tailored applications software. This situation should improve in the future, as suppliers gain more experience in designing the variety of application packages required in an on-line MIS. In the meantime, it is likely that the design and implementation effort saved through the use of system control and problem solving packages will need to be diverted to the development of application packages tailored to a company's operating needs.

8. *Go quantitative?* There are numerous quantitative techniques applicable to management decision making that are usually categorized under the heading "operations research" or "management science." In many companies the custodians of such tools, that is, the mathematicians expert in their usage, have been relegated to a Management Science Section largely divorced from the realities and stresses of management problem solving. Too often, management has viewed these specialists, if not with suspicion, then with a bemused tolerance, finding them helpful in solving such mundane problems as scheduling bond redemptions or assigning tellers in a bank but not for the major decisions confronting executive management. The question, then, is whether the system should be designed to encourage management usage of these quantitative methods or should it merely provide "raw" information to management to make decisions in the same old intuitive fashion as in the past.

If this appraisal has stressed problems and questions more than solutions, then it is reflective of the current state of the art in management information systems. This emphasis should not be construed as pessimism or negativism. Interest in MIS is increasing, not waning, despite the problems. And inevitably, as more successes are achieved, as system designers and management users gain in experience, answers and directions will become more readily apparent. ■

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It's tough and costly, but systematic planning is the only hope

MIS Planning

by M. H. Schwartz

The crucial purpose of planning in any sphere of life is, in my view, to be as sensible as we can in deciding what to do, how to do it (in terms of methods and resources), and when to do it. There are important relationships and feedbacks among these three objectives: for example, we are practically always constrained in what we decide to do at any given time by limitations in capabilities or resources. Oftentimes we simply do some of those things that we happen to know how to do and that we have resources for without consciously and conscientiously weighing alternatives.

Designing and executing a large scale management information system is a costly and difficult undertaking—far more costly and difficult than early proponents recognized—in reward for which is offered a number of highly desirable potential opportunities for the improvement of management and organization performance. These cost and benefit magnitudes and the complicated relationships among planning objectives demand that MIS management establish a *highly systematic and analytic approach* for short-range and long-range planning. There is no better approach for deciding what to do, how to do it, and when to do it—and these are the most perplexing and most meaningful questions for management to decide.

This article describes the particular systematic and analytic approach to MIS planning that we are experimenting with in the further development of the U.S. Atomic Energy Commission's agency-wide management information system. We could call our approach a "system for MIS planning." In setting forth the planning system, I shall (a) define "MIS" according to my view, (b) place MIS into the context of the major systems of an organization (with the help of material developed at ESSO Standard of New Jersey), (c) take a stand on the overall strategy of MIS development (emphasizing the need for an evolutionary approach), and (d) set forth the planning system we are experimenting with at the AEC.

In my view, an MIS is a system of people, equipment, procedures, documents, and communications that collects, validates, operates on, transforms, stores, retrieves, and presents data for use in planning, budgeting, accounting, controlling, and other management processes for various management purposes. The data concern people, money, physical assets (materials, equipment, and plant), and other resources that are employed in the fulfillment of the organization's objectives. The operations and transformations include recording, comparing, reconciling, tabulating, summarizing, and mathematically analyzing. Information processing systems become management information systems as their purpose transcends a transactions processing orientation in favor of a management decison-making orientation.

This is a pragmatic definition deliberately scaled down from the over-blown, over-sold, all-encom-

The positions taken in this article are the author's; they should not be considered as a definitive official statement of the U.S. Atomic Energy Commission at this time, pending availability of the results of the planning experience. The article draws very heavily upon presentations made by the author at the Finance and Budget Directors' Conference, U.S. Atomic Energy Commission, April 2, 1970; and at the Sixth Annual International Computer Conference, Amsterdam, Holland, April 8, 1970.

ESSO'S SIX TYPES OF

1. BUSINESS ENVIRONMENT—These so-called systems represent the environment in which the Jersey organization utilizes its resources to obtain a return on the stockholders' investment. The Business Environment, as opposed to the Jersey Resources System, is not—by definition—controllable by Jersey management. The Business Environment includes the following subunits:

   a. Customers
   b. Vendors
   c. Governments
   d. Public
   e. Stockholders
   f. Manpower Market
   g. Competition (existing and potential)
   h. Opportunity Areas
   i. Financial Community
   j. Contractors

2. BUSINESS TRANSACTION SYSTEM—This major information systems classification includes the following interrelated subsystems:

   a. Data Acquisition and Validation
   b. Order Entry and Processing
   c. Invoicing and Price Checking
   d. Trade Accounts Receivable
   e. Stock Control and Replenishment
   f. Yield and Material Balance Accounting
   g. Materials and Supplies Accounting
   h. Personnel (Payroll, Benefits, Personnel Records)
   i. Retail Business Accounting (Credit Card)
   j. General Accounting
   k. Fixed Assets
   l. Inventory Evaluation
   m. Etc.

   These subsystems are required to process Business Transactions and Operating Results but do not provide the information required for resource management without further processing.

3. MANAGEMENT INFORMATION SYSTEMS—This major information systems classification includes the following interrelated subsystems:

   a. Sales Statistics
   b. Supply/Demand
   c. Manpower
   d. Facilities and Capacities
   e. Costs (Allocation and Statistics)
   f. Prices

passing definitions of MIS that I believe have hurt the MIS field in the eyes of executive and general management.

Management Information Systems live within a context; they no more stand on their own than do modern communities; they depend upon other, lower level, activities on the one hand, and, on the other hand, are themselves depended upon by other, higher level activities. One of the best descriptions and analyses of which I am aware of the framework within which MIS's exist has been compiled by ESSO Standard of New Jersey. I present the substantial quotation below partly to illuminate my definition of MIS and partly to illuminate the crucial second step of the planning system set forth later in this article. I do not present the quotation as a literal blueprint for immediate application in all organizations; as noted later in the article, local adaptation of the "model" is generally necessary.

The ESSO document defines six types of systems that they believe exist in any kind of business. The document also identifies three organizational levels:

1. Central (Parent Company)
2. Regional (Humble, Esso Europe, Esso Standard Eastern, etc.)
3. Operational (Refinery, Chemical Plant, etc.)

It further notes that business transactions systems, management information systems, and planning and control systems must be planned and coordinated on a unified corporate-wide basis so that long-range plans may be developed and so that individual implementation projects may be effectively identified, scheduled and performed.[1]

The significance of the word "system" in the expression "Management Information System" is that the people, equipment, and other elements of the system are interrelated parts of a coordinated whole. A special word for "coordinated whole" is "integrated." The latter word has no more absolute meaning than does the word "coordinated." Neither word is like the word "pregnant," which a woman cannot be partly or nearly—it's all or nothing at all. Integrated, like coordinated, is a word that embraces a continuum. An information system increases in integration as it flows more smoothly and more automatically, and as the interfaces between the parts become efficient and effective. *Each* management information system within an organization should be as nearly fully integrated as economy dictates.

"The" management information system for an entire organization, however, must be visualized, I maintain, as a supersystem of systems, as a *federation of management information systems.* Only the most monolithic of organizations can build and gain strength from a single total system. The federation is necessary to provide coherence in architecture, design, standards, documentation, operating procedures and other *achievable commonalities,* and to *provide economy* in implementation and operation. The federation should be structured as a set of systems, each system tightly integrated internally, but loosely integrated when taken together. There must be some integration among all of the systems, for they all contribute to the management and organizational performance of the one enterprise. They are all parts of a whole. But only loosely. The wider the range of activities of the enterprise, the looser must the integration be.

Take the case of a large chemical corporation: can its highly contingent research be managed with the same management system as its large volume, highly deterministic production? Can a single information system serve the needs of the pluralistic management systems?

Development strategy

My view that an MIS should be visualized as a federation of systems, rather than as a "single" system, involves a strategic decision that precedes specific planning. The late Sherman Blumenthal put the issue into the sharpest terms that I know:

"Management information systems whose perspective is 'top-down' are much in vogue, altogether too frequently because of the recklessly drawn analogy between management control in industry and military command and control. The rigid hierarchy of command in the military, and the need for instant, accurate, and coordinated response in singular tactical situations, almost unavoidably entail a monolothic, all at once approach to military command and control

Business systems

g. Operating Statistics
h. P/L Statement
i. Balance Sheets
j. Budgets
k. A&O Report
l. Corporate Outlook
m. Consolidations
n. Environmental Information
o. Planning and Control Data for Math Models
p. Etc.

Both historical and forecast information are processed by these subsystems. The resulting output from processing serves to provide mainstream management with the information required for resource management. Business Transaction Systems are one source of input data for Management Information Systems.

4. PLANNING AND CONTROL SYSTEMS—This major information systems classification includes mathematical models and statistical techniques for planning and control, as well as quantitative methods for the design of physical facilities:

a. Opportunity Indentification and Evaluation
b. Objectives Development and Evaluation
c. Investment Planning and Evaluation
d. Resources Development and Evaluation (including Physical Systems)
e. Logistics Planning and Evaluation
f. Operations Scheduling and Evaluation
g. Operations Control and Evaluation

These systems are usually developed by Operations Research/Management Sciences specialists.

5. MANAGEMENT SYSTEMS—This classification is intended to represent the oil/chemical management of the business at all organizational levels.

6. OPERATING SYSTEMS—These are the physical facilities of the business (e.g., refineries, pipelines, tankers, oil fields, chemical plants, bulk plants, etc.).

[1]From a document (dated 9-11-69) furnished me in 1967 by Mr. Mel H. Grosz, a Vice President of ESSO Mathematics and Systems, Inc.

systems development. This is technologically very risky, financially very expensive, and the resulting problems of systems management are enormous. . . . To postulate and then pursue . . . 'a total, integrated management information system' as the appropriate target of systems planning and development efforts . . . is not only to court technical disaster, but to lose sight of the basically economic objectives of systems planning. . . "[2]

The second strategic decision that I believe we should make is to adopt an evolutionary approach to planning, design and implementation. The evolutionary approach stands in contrast to the strategy of designing a total blueprint for an entire MIS and then setting out to implement it. "The" evolutionary approach is not a narrowly defined way, however; there are a variety of evolutionary ways. At one extreme, closest to the one-time blueprint, is the decision to *evolve towards a highly specified objective.* That is, the designer really knows exactly where he wants to go. He is not sure, however, how to get there. In this "how" sense, the strategy is evolutionary; but the evolutionary approach in the example is limited to the techniques of implementation. At the other extreme of evolutionary approaches is accidental evolution—haphazard, sprawling growth.

Evolutionary planning

We want evolutionary perspectives, but we want neither of the extremes. As for evolving towards a given specification, modern organizations are too varied and too complex for designers to understand except over a long learning, living, period. For most of us, the planning process must be concurrent with the implementation process. Plans for the future made in the past must be sharply modified by the lessons of experience. Planning must be constantly updated. Planning for information systems for an organization with a wide scope of activities can only be iterative. Planning and learning go hand-in-hand. Indeed, the planning *methodology* is itself evolutionary. That is, we learn how to plan as well as what to plan. As for the extreme of accidental evolution—well, we certainly do not want to end up with an unmanageable hodgepodge of duplicating applications that not only waste resources but that, perhaps more significantly, waste the large opportunity that continuous study of the organization and its problems will surely reveal.

We should stand in the middle, then, not because of the ease of "muddling through" but rather because we believe that both extremes are wide of the mark. We want to know where we are going, but we honestly must recognize that the further ahead we try to look, the less sharp the focus.

To "know" where we are going, we must consciously decide where to go and how to get there. We must establish a long range plan and we must keep that plan up to date. Long range planning of a large-scale information system, however, is a formidable task; it should itself be systematic. There are enormous pragmatic problems in systematic planning. One must begin with an ideal planning system and then—in the same evolutionary spirit that should dominate MIS design and development—shape the planning methodology to fit living realities. In my present view, an "ideal" planning system for MIS embraces the following steps:

1. Working closely with management, line, and staff people of the organization at large, identify—in terms of management and user needs and apsirations—the broad missions of the MIS effort and the specific objectives whose achievement will fulfill the missions. (N.B. Great effort should be made to encourage management, line, and staff people throughout the organization to participate as actively as possible in the entire planning process. Their ideas at many points are likely to be more valuable than those generated by systems technical experts. The real planning roles of the expert are (a) to bring discipline, structure and articulation to user expressions of problems, needs, and objectives and (b) to provide for reasonable consideration of technological potentials and problems.)
2. Map the framework structure of (a) the external systems that affect and are affected by the organization and (b) the internal systems—present and potential—that comprise the organization.[3]
3. Delineate as fully as possible the purposes, structures, contents, and interrelationships of the management information systems, distinguishing between present and potential systems.
4. Identify those current systems and applications that are working reasonably well, in the understanding that they will enter subsequent phases of the planning process only in connection with relationships to possible systems development efforts.
5. Identify those *current* systems and applications for which highly preliminary priority considerations (rough cuts through step 8 below) suggest that either thoroughly revised implementation or substantially improved implementation is desirable.
6. Identify those *potential* systems and applications for which highly preliminary priority considerations (rough cuts through step 8 below) suggest that initial implementation is desirable.
7. Consider alternative approaches to developing, and alternative ways of operating, the various identified opportunities for current and potential systems and applications.
8. Perform a critical priority analysis of the set of grossly screened possible projects in order that we may be as sensible as we can in deciding what to do, how to do it, and when to do it.
   a. Process of Analysis
      (1) Describe the expected direct and indirect

[2]Sherman C. Blumenthal, **Management Information Systems,** Prentice-Hall, Inc., 1969, page 89.

[3]At the AEC Headquarters, we began with the ESSO framework mentioned above, and it turned out to be a most helpful starting place. Each organization has its own character and its own circumstances, however, and we believe that we shall need to modify the ESSO framework to fit our situation. Mr. W. R. Mitchell, who is in charge of our Financial Information System Development Group, has, for example, proposed that we need to recognize a class of systems called "Indexes and References." Within this class would be, for example, a classified document control system. Such a system fits none of the ESSO classes very neatly, reflecting the relative importance of the class to the two very different organizations. It should be emphasized that I make this comparison not to criticize the ESSO approach—hardly that, for without it we would have had to reinvent a costly wheel—but rather to emphasize the need for MIS and computer applications generally to be shaped to the local and particular situation. Whenever possible, of course, adaptions to existing models like the ESSO model should be preferred to reinvention. We all should avoid the near-fatal NIH disease (not invented here).

benefits of each alternative.

(2) State the grounds for the expectations.

(3) Evaluate the merits of each alternative.

(4) Estimate the resources needed for development, conversion, and operation of each alternative, including resource commitments of users as well as developers and operators.

(5) State the grounds for the estimates.

(6) Measure the costs of the resources.

(7) Allow for the influence of undesirable side effects on the merits of each alternative.

(8) Choose the alternatives that appear to yield the greatest net value from the investment of resources.

b. Criteria for Evaluating the Merits of Alternative Projects[4]

(*Note:* All criteria are constrained by certain influences. For example, no matter how high a potential payoff, there is a limit to the scope of any project, owing to absolute limits on possible expenditures.)

(1) Explicit dollar estimates of the (discounted) value of returns where feasible, like clerical savings (which are not the major goal of the MIS).

(2) Qualitative factors (like the value of faster information where it is needed—a real value exists even if we cannot put dollar figures down).

(3) Institutional factors (like a "fair" sharing of total MIS resources among divisions and other entities of the organization).

(4) Systems management factors (like the probability of success).

(5) Systems technical factors (like implementing "adjacent" applications sequentially).

9. Prepare a five-year proposed implementation and operating plan.

a. Show for each priority project:

(1) the purposes to be served and the implications of implementation—and of delay in implementation,

(2) the justification revealed by the priority analysis, and

(3) broad plans for development, conversion, and operation including resource requirements and schedules.

b. Specify and justify nonproject resource requirements

(1) Management and administration.

(2) Planning.

(3) Resource development.

(4) Standards.

(5) Production operations.

10. Present the proposed plan to management for approval, in the context of missions, objectives, and the framework of systems.

11. Continuously review, test, and refresh the statement of missions and objectives of the MIS effort, and the contents of the priority analysis.

12. Each year recycle

a. mapping of the framework structure of systems,

b. delineating possible management information systems,

c. identifying desirable tasks and approaches,

d. performing a priority analysis,

e. improving upon and extending the five-year plan another year, and

f. presenting the five-year plan to management.

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Summary

Running through the planning-executing-learning-planning cycle annually is, in my opinion, the heart of the fulfillment of an evolutionary strategy for MIS. The need for interaction with managers and users can hardly be overemphasized. The whole planning-development process should be done in concert with management, line, and staff persons throughout the organization.

Indeed, stimulating effective user involvement creates major challenges for the systems architect. Achieving balance is very hard. At one extreme are the overly dynamic users—applications tweakers—who would never permit any really solid accomplishment to be attained. We know them in all walks of life. At the other extreme are potential users who doggedly turn their backs and dig in their heels. Planning and implementing for either of these extremes is impossible. There is a wide range of responsive, responsible users, however, who—when coupled to responsive, responsible systems developers—not only permit and support but in fact share massively in planning and implementing. In these circumstances, genuine planning is feasible and rewarding.

The systematic approach to planning that I have laid out is clearly a difficult affair. Translating project benefits into comparable value terms is particularly difficult, and while theoretically appealing is in practice a most elusive task. There is no easy way to perform a conscientious priority analysis and this means that there is no easy way to determine how to be as sensible as we can in deciding what to do, how to do it, and when to do it. The system presented must be reckoned, therefore, as an ideal towards which one strives. In the end, its most imperative requirement is give and take among the three parties mostly concerned: management, users, and systems developers. ■

[4]A detailed analysis of criteria for project selection appears in the author's "Computer Project Selection in the Business Enterprise," **Journal of Accountancy,** April 1969 and **Datamation,** June 1969.

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Models can be helpful in MIS optimization decisions – but not all problems allow their use

Part I

Decision Models

by James C. Emery

Man's ability to perform arithmetic calculations has probably expanded in recent years at a more rapid rate than any other form of technology (with the possible exception of his ability to blow himself up). Since the early 1940's, raw computational speed has increased by (at least) a factor of ten million, while the cost per calculation has decreased by considerably more than a thousandfold. Rapid progress has also been made in other aspects of information processing—e.g., input/output, data storage, and communications—but not nearly to the same extent as internal processing speeds.

In light of these technical developments, it is instructive to examine the various ways in which information processing can be applied within a management information system. The various applications can be classified (somewhat arbitrarily) as (1) routine data processing, (2) analytical decision models, and (3) simulation models.

Transaction processing

Conventional data processing applications primarily deal with routine transaction processing. A transaction typically enters the system as a condensed description of such external events as the receipt of a sales order or check from a customer, adding a new item to inventory, or the receipt of material from a supplier. Transactions may also be triggered by the passage of time, resulting, for example, in the accrual of a depreciation charge for the accounting period.

Output from such processing consists of various working documents that serve the operating activities of the organization. Examples include invoices, checks, shipping papers, replenishment orders, and schedules. In addition, periodic reports are prepared on the basis of transaction activity (e.g., an income statement) and the resulting record status (e.g., a balance sheet).

Any successful MIS must be built upon the solid foundation of a transaction processing system. It is at this operations level that the bulk of data enter the system, are processed, and are then transformed into outputs. Furthermore, higher-level tactical decisions, such as those dealing with scheduling or inventory control, rely heavily on data inputs coming from transaction processing. Even high-level strategic decision making depends to some extent on periodic reports based on transaction processing.

Nevertheless, routine processing is not an ideal application for computers, since it tends not to exploit that part of information processing technology that has shown the greatest progress. Most routine applications involve reading and sorting of large files, but require relatively little internal computation (although exceptions obviously exist). Furthermore, a significant portion of the cost of implementing and operating routine processing systems involves high-priced labor in the form of system designers, programmers, operators, keypunchers, and so forth. It is fairly well understood by now that conventional transaction processing systems yield fairly marginal returns except in the relatively rare cases dealing with large volumes of repetitive transactions.

Current technology favors those applications that more fully exploit the capacity of the central processor. Such applications can often be combined with

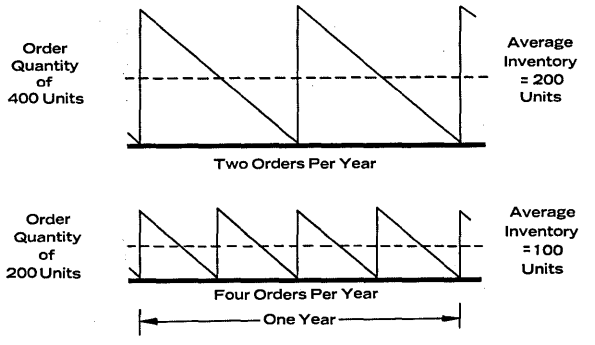

Fig. 1. Effect of order size and orders per year on average inventory level.

transaction processing. For example, the analysis of transaction data for management purposes (such as summarizing sales by product group), or handling special-purpose inquiries, can sometimes be incorporated within the routine file updating programs. The central processor in these cases is used as a filter between the detailed transaction data and management. This more sophisticated use of the computer begins to capitalize on the great efficiency of internal processing. The real payoff often comes, however, when the computer is used more directly in the decision process than merely supplying a decision maker with digested information.

Analytical decision models

Considerable effort has been spent in applying computers directly to the decision making process. Linear programming models, for example, have been used extensively, particularly in the petroleum industry. Some of these models can tax the internal computational capacity of even the largest computer.

The aim of the model builder is to describe the problem at hand in a mathematical form that permits the calculation of the *optimum* decision out of all possible alternative decisions. For example, one may wish to find the inventory ordering quantity that minimizes inventory costs, or the schedule that maximizes the value of production. The plan calculated is then executed in the real world, and hopefully leads to the results predicted by the model.

Three requirements must be met in order to develop an optimizing model: (1) It must be possible to duplicate the real world in mathematical form with sufficient accuracy that results from the model make sense, (2) there must exist an explicit measure of the objective to be optimized, and (3) there must be available a computationally feasible procedure for finding the optimum solution. Failure to meet any one of these requirements precludes the use of an optimizing model, and one must then be content with other means of decision making that normally involve more direct human participation.

One of the simplest optimizing models is the one used to calculate the economic order quantity (EOQ) of an inventory item. We can use it to illustrate the three requirements for optimization.

Expressing the problem in mathematical form. In the classical version of the EOQ model, only carrying cost and reordering cost are considered. Inventory is assumed to be received in a fixed-size order quantity, q, and is then withdrawn (e.g., sold or issued to production) in response to demands that arrive at a constant rate. It can be seen from Fig. 1 that the average inventory under these circumstances will be one-half the order quantity, or q/2. If it costs C dollars per year to carry one item in stock (which includes interest on the capital invested in inventory, incremental storage cost, obsolescence, etc.), the annual carrying cost is therefore q·C/2.

There is assumed to be a fixed cost, R, of placing each replenishment order. Reordering cost includes such elements as the cost of the data processing to prepare a requisition; the cost of receiving, material handling, and inspection associated with each reorder; and setup costs (in the case of self-manufactured items) required to produce a reorder quantity. The expected number of orders per year is proportional to the total forecasted annual usage of the item, F, and is inversely proportional to the order quantity. Thus, the orders per year equals F/q, and the annual reorder cost is R·F/q.

We have now developed a simple model of the inventory item. The total annual inventory cost of the item, T, can be expressed in the following equation:

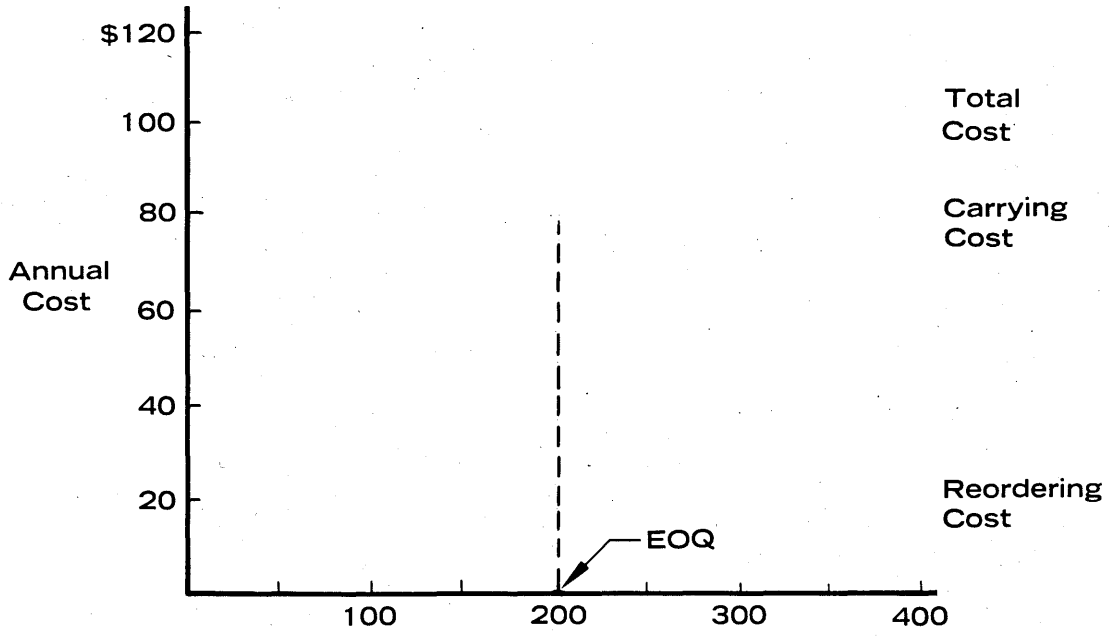

Fig. 2. Inventory costs as function of order quantity.

T = Annual Carrying Cost + Annual Reordering Cost = q·C/2 + R·F/q

The cost in this equation is a function of the order quantity q (as well as C, R, and F). The values of C, R, and F are not subject to change—at least not as far as inventory decisions are concerned—and are therefore viewed as *parameters* of the model. The only *decision variable* subject to optimization is the order quantity q.

Determine an objective to optimize. The objective of the inventory model is quite simple: to minimize total annual inventory cost. The above equation for T expresses this cost as a function of decision variable q and parameters C, R, and F; it is said to be the *objective function* of the model.

Calculate the optimum decision. The simple inventory model permits the use of a well-known minimization procedure based on elementary calculus. Using this procedure it is possible to show that the value of q that minimizes annual inventory cost is equal to $\sqrt{2 \cdot F \cdot R / C}$. This is shown graphically in Fig. 2.

Total inventory cost is the sum of carrying cost and reordering cost. Suppose that annual usage is 800 units, reordering cost is $10 per order, and carrying cost is $0.40 per unit. If orders are placed for 200 units four times a year, the annual ordering cost will be $40; the annual carrying cost will be 200 x .40/2, or $40; and total cost will be $80. Total annual cost for other order quantities can be calculated similarly. It can be seen from the graph that the minimum cost occurs at an order quantity of 200 units. This agrees with the formula,

$$EOQ = \sqrt{\frac{2 \times \text{Forecasted Usage} + \text{Reorder Cost}}{\text{Annual Carrying Cost per Unit}}}$$

$$= \sqrt{\frac{2 \times 800 \times 10}{.40}} = 200$$

Linear programming model

Linear programming is probably the most widely used of the optimizing techniques. The technique requires that the objective function be expressed in linear form, which means that a change in a decision variable brings about a proportional change in the objective function. This implies, for example, that the profit per unit of an item being scheduled remains fixed over the range of production allowed by the scheduling model.

Suppose that we are interested in scheduling the production of two hand-made products, rugs and blankets. The profit for each rug is $6, and for each blanket it is $9. The problem is to determine the schedule that maximizes profit. The decision variables are thus the quantities to produce of each of the products. Let x_1 represent the number of rugs scheduled, and x_2 the number of blankets. The objective function is therefore Profit = $6x_1 + 9x_2$.

The problem as it is now written is clearly incomplete, because otherwise one could make an unlimited profit by producing either product without limit. We must introduce *constraints* on the decision variables that recognize restrictions on production capacity.

Suppose that production of rugs and blankets requires skills of weavers and spinners. For a given scheduling period (a week, say) we have 1800 hours of weavers' time and 300 hours of spinners' time. Each product requires 2 hours per unit of weaving; while a rug or blanket requires .2 and .5 hours, respectively, of spinning. The capacity constraints can then be expressed as

Weavers: $2.0 \cdot \times_1 + 2.0 \cdot \times_2 \leq 1800$

Spinners: $0.2 \cdot \times_1 + 0.5 \cdot \times_2 \leq 300$

Two comments are in order regarding the constraints. First, the constraints, like the objective function, are linear equations (since each product requires a fixed unit capacity of each type of labor); this is a requirement of linear programming models. Second, the *inequalities*—in this example, a less-than-or-equal ($\leq$) relationship—express the fact that it is only necessary not to exceed the fixed capacity constraints; the model permits the use of only a portion of either resource (although in this problem it is not optimal to leave any unused resources).

Within the constraints, it can be shown that the optimal schedule is to produce 500 rugs and 400 blankets. This will result in the optimum profit of $6,600. (See Fig. 3.)

Requirements for optimization

With these simple examples as illustrations, we can now examine in more detail the three requirements for using an optimizing model.

1. *Expressing the problem in mathematical form.*

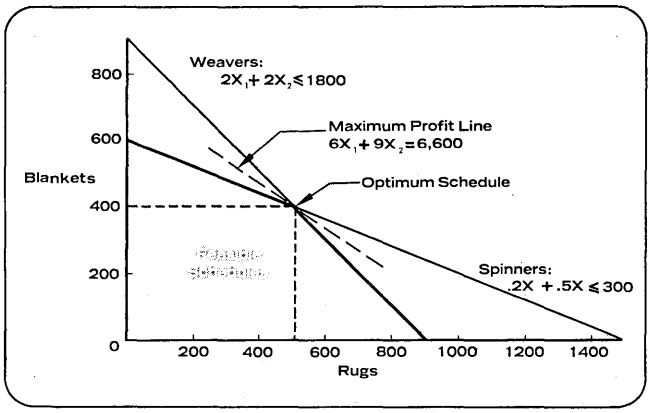

Fig. 3. Production scheduling using linear programming.

The first requirement is that the problem be expressible in mathematical form. Thus, one must develop equations that relate the consequences of actions (e.g., annual inventory cost) to decision variables (e.g., order quantity) and uncontrollable parameters (e.g., cost per reorder). In general form,

Consequences = f(Decision Variables, Parameters), where f(. . .) means "function of" or "dependence on."

The nature of the mathematical expression can vary from a quite simple equation (as in the inventory model) to exceedingly complex functions. Some of the complexities that the analyst must face are as follows.

Uncertainty. Often there exists considerable uncertainty about parameter values. In an inventory problem, for example, sales forecasts may be subject

to fairly wide error. Even cost parameters, such as reordering cost, may be known only within a range of possible values. If the uncertainty significantly affects predicted results, one must consider introducing a *probabilistic* estimate in place of a single *deterministic* estimate.

The "pessimistic," "most likely," and "optimistic" estimates used in some PERT systems provide one way of representing probabilistic estimates. Uncertainty can also be represented in the form of a probability distribution having specified characteristics (such as mean and standard deviation). In a queueing model concerned with waiting lines in a supermarket, for example, we could represent the average interval between the arrival of customers at the checkout counter by a probability distribution of the sort shown in Fig. 4.

(Empirical observations [Fig. 4] can be made to determine the time at which customers arrive at a checkout queue. The time intervals between arrivals can then be represented in the form of a probability distribution [bottom figure]. The above distribution indicates, for example, that in 75% of the cases the interval between successive arrivals is less than 40 seconds.)

Large number of decision variables or parameters. Models often have many more variables and parameters than the simple examples given earlier. For instance, in a large scheduling model there may be several thousand decision variables, one for each product scheduled. There may similarly be a large number of parameters, such as individual product forecasts, processing times, capacity limitations, costs, and the like.

Constraints. We have seen from the linear programming example that a limitation on a physical resource such as labor can impose a constraint on the decision variables. Constraints can arise in other ways as well. For example, a decision variable may be constrained to fall within a given range over which the parameters of the model remain valid. In the previous linear programming example, the production of rugs might be limited to, say, 300 units because it is judged that sales cannot exceed that level at a price of $6 per unit. (This constraint would then shift the optimal schedule and thereby reduce the optimum profit to $6,120 from the unconstrained—but unobtainable—level of $6,600.)

In other cases the underlying logic of the problem may constrain decision variables to nonnegative values (so that a negative output of a product cannot be produced, say) or to only integer values (so that 1.37 warehouses will not be built at site A, for instance). In still other models, a constraint may represent a policy decision rather than a physical restriction—as in a financial model that limits bank borrowing to, say, $5 million even though additional bank loans are available (but perhaps at undue cost or risk).

2. *Determining the objective function.* In the simple inventory and scheduling examples, finding a suitable objective function presented no problem. In many cases, however, the objective is by no means obvious. The problem arises because of the multidimensional nature of organizational goals: it is usually difficult, or even impossible, to find a reasonable *single* objective that can be optimized; it is particularly difficult in the

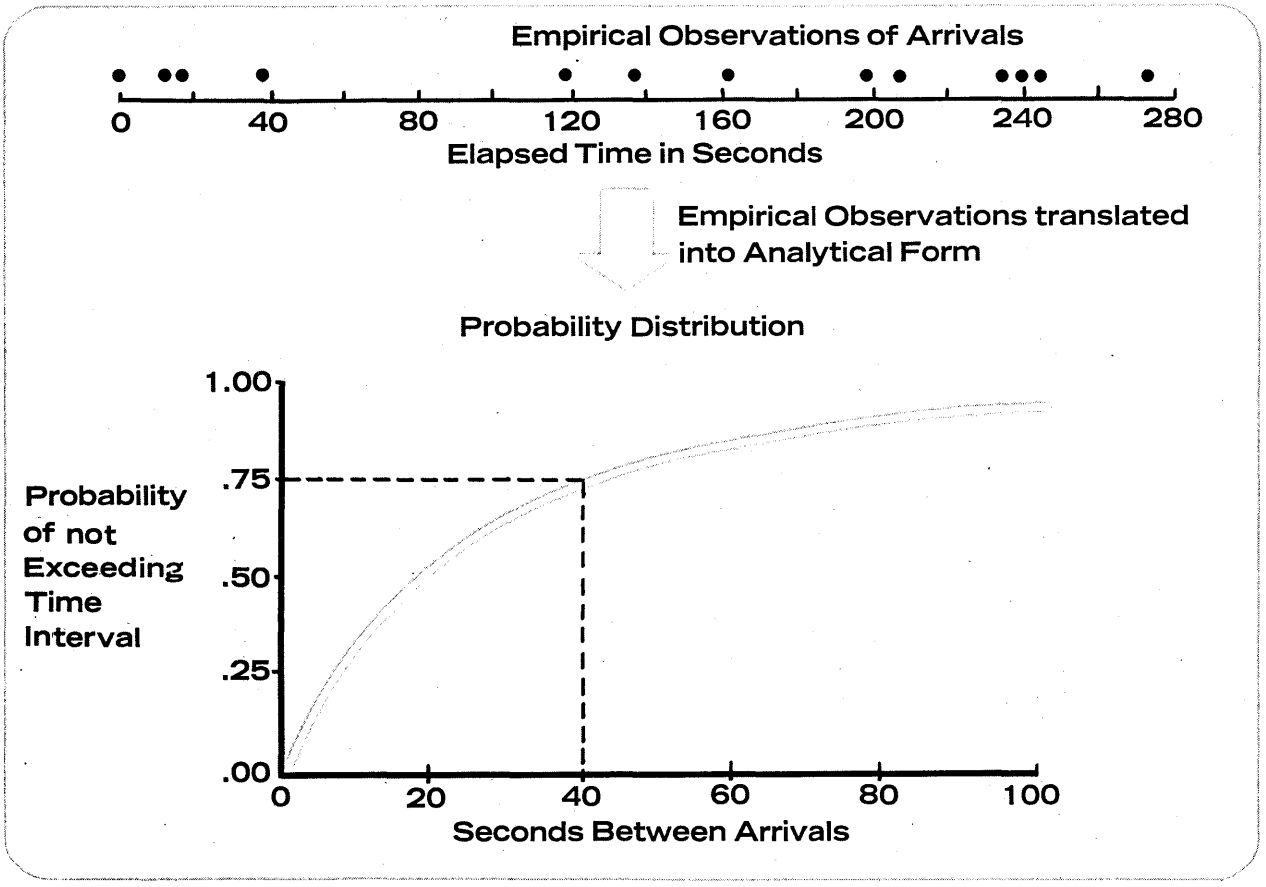

Fig. 4. Distribution of arrival intervals at checkout counter.

case of higher-level decisions. And yet, optimization demands that a single objective function exist. (An operations researcher rebels at such policy statements as "Our goal is to provide the maximum possible service at the minimum possible cost.")

Even in the case of profit-making organizations, a single over-all objective cannot be specified. Companies often devote some of their resources to such noneconomic goals as the support of education or the arts (although cynics can no doubt always find a profit motivation behind any corporate act). But even if we were bent solely on maximizing long-range profit, we would then be faced with the impossible task of actually measuring it. Operationally, we can only measure short-term (e.g., one year) profit as determined through a whole host of (often arbitrary) accounting conventions. In the absence of a single (measurable) objective, profit-making firms create supplementary goals such as growth in sales, share of markets and cost ratios.

Lower-level managers are also typically faced with multiple objectives. A plant manager, for example, concerns himself with production levels and costs, but he must also consider quality, safety, labor relations, community relations, and other "intangibles." The same sort of problem persists at the lowest decision-making level. For example, the objective in inventory control is usually not merely to minimize costs; it must normally also consider the risk of having stock-outs.

If one can find a suitable trade-off among multiple goals it is then logically possible to optimize a single composite objective. For example, in dealing with an inventory problem we might be able to determine the cost of having a stockout (which includes such costs as customer ill will, disruption of production, and special costs of handling expedited orders). Knowing the trade-off between cost and service, we could then develop a composite cost objective to be minimized. Unfortunately, determining such explicit trade-offs tends to become increasingly difficult as one deals with higher-level problems. It is probably not feasible, for example, to obtain a general consensus about the appropriate trade-off between plant safety and profit.

In the absence of explicit trade-offs among objectives, one can introduce constraints on the objectives for which trade-offs are not available. The problem then becomes one of optimizing—to be more precise, *sub*optimizing—the remaining objectives. This approach is based on the perfectly sensible proposition that overall results are improved if one is as efficient as possible with respect to the unconstrained objectives, even if the constrained objectives are not set at their "true," but unknown, optimum value. The resulting suboptimization leads to a situation (called a *Pareto* optimum) in which performance cannot be improved without relaxing at least one of the constrained objectives.

Numerous examples exist of this approach. In an inventory problem with unknown stockout costs, one can minimize carrying and reordering costs subject to a maximum frequency of stockouts. In a financial model it is usually not possible to establish a trade-off between the cost of a bank loan and its risk, but it may be possible to minimize financing cost subject to an upper limit on short-term bank debt. These examples demonstrate that there tends not be a clear distinction between the objective function of a model and its constraints, since a constraint is often introduced in order to avoid the problem of specifying explicit trade-offs.

3. *Calculating the optimum decision.* The final requirement for optimization is the ability to manipulate the mathematical equations that form the model in order to determine the values of the decision variables that optimize the objective function. In some cases the manipulation is done analytically by hand. This was the means used, for example, in deriving the optimum order quantity from the simple inventory model. Once the analytic solution is available (such as $EOQ = \sqrt{2 \cdot F \cdot R / C}$), a computer can then be used to calculate the optimum decision in a given case with specified parameter values.

The size and complexity of many models make it infeasible to derive general analytical solutions that merely require evaluation in a specific case. It may still be possible, however, to calculate the optimum solution using a suitable arithmetic procedure. Problems of this type can involve a great deal of computation, and almost always demand the use of a computer. Many of the best known optimization procedures, such as those used in linear programming, are of this type.

Despite the availability of very large modern computers, there exist a great many decisions that cannot be optimized because no computationally feasible procedure is currently available. This may be true even though both a suitable model and objective function are available. Certain scheduling problems fall into this class. For example, an integer programming model (a linear programming model in which all decisions variables must be integers) has been developed for scheduling a job shop, but it involves far too many variables to be computationally feasible for even small shops.

The feasibility of a given optimizing procedure depends on the state of the art in both computer technology and computational methods. As computers grow faster and bigger, and as more efficient computational procedures are developed, a wider and wider class of problems become tractable. Nevertheless, there will always remain still larger problems beyond the threshold of feasibility. ■

(This is Part I of a two-part article. Part II will appear in an early issue.)

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The Devonshire...

PERSPECTIVE

an interpretive review of significant developments

Calif. State Computers: The Power & the Fury

California's state government has more computer power at its disposal than that of any other state in the union, at least 1.5 times that of runnerup, New York. How California would rank in terms of computer use is another matter, a matter subject to question and considerable speculation.

Charges of waste and misuse and even of lack of use fell thick and fast in the early months of this year. Equally abundant were ideas as to what should be done to optimize use of the state's 187 digital computers and its 4,000 edp employees.

By early summer these ideas were falling on either side of a demarcation line based on degree and speed. One side liked a five-year plan adopted by the state's Office of Management Services which has the blessing of Governor Ronald Reagan and already is in the early stages of implementation. The other was backing a bill introduced in the state legislature by State Sen. Stephen P. Teale (D), the fate of which was to be decided by mid-August when the state legislature was due to adjourn.

Do it

Proponents of both lines of action were in total agreement that something must be done. Senator Teale said some departments of state government were using their computers "like they did their little old Burroughs adding machines 50 years ago." He said usage in state departments was running from 100% down to 17%. His bill would put all state computers excepting those in the state colleges and universities under a new Dept. of Data Processing and is aimed, he said, at ending a tendency of some department heads to set up "little empires" by having expensive computers in their respective office buildings.

The state spent $62 million on edp in the fiscal year ended July 1 and the estimate for expenditures in the current fiscal year is $67,500,000. Teale feels his bill could trim $4 million from this right away. Five-year-plan advocates feel the plan can do just as well.

Charles P. Smith, Director of Management Services and a primary author of the five-year plan, feels the Teale bill is premature and unneccessary and said if it were passed the governor would veto it. Smith said his plan would have the effects desired by backers of the bill. They don't agree. They feel the plan is too slow and not sufficiently definitive and, they contend, it would place the state's computers under the direction of seven departments instead of just one.

Seven up

The plan creates seven consolidation groups, each including a number of state agencies and each assigned the responsibility for studying the edp requirements and operations of member departments and suggesting a better way of doing things, preferably on a joint basis.

It recommends the development of statewide standards and uniform procedures in data processing, including common data elements in information systems and standards by which to evaluate the performance of different edp installations in comparable terms.

Smith said it will develop strict rules to protect individuals against unauthorized disclosure of personal or confidential information.

The plan includes 139 computers used by state colleges and the Univ. of California, excluded by the Teale Bill, which was passed by the state Senate in late July by a vote of 31-2. The bill's proponents at that time were not optimistic about its chances in the state Assembly which would have to act before the mid-August legislative adjournment or "it would die." And, of course, if it were to pass the Assembly, there was the promised veto by the governor.

But those who backed the bill feel it will have a lasting impact even if it is never enacted. The very threat of the bill, said one, "will force them (the Administration) to do something before we do it for them."

The department that would be set up under the bill would take over ownership of all state computers, excluding those used in higher education and no individual agency would have one of its own which, according to one legislator, has become "a new status symbol like carpet on the floor." The department also would be given authority to execute lease or purchase agreements for the future procurement of all edp equipment. It would have control of a Data Processing Revolving Fund that would include all money appropriated by the Legislature for edp and any money that came into the state treasury by virtue of dp operations and services rendered by the department.

Whatever, whoever, or however — computer use by the state of California is in for some upgrading, maybe to the point where its usage will approximate its capability.

— Edith Myers

The 370 in Europe ... Filling in the Gaps

Details in IBM's 370 announcement filled in a lot of missing pieces for the European competition.

IBM World Trade has had a steadily mounting influence on the corporate balance sheet, and the advent of the 370 gives every evidence of being geared to accelerate this trend. For one thing, it has created as European an organization as could be expected to come from the offspring of an American parent. Model 165 will be built in the U.K. and the 155 in France. Germany gets applications responsiblity for the 370, and Italy takes over System/3 applications, all clarifying recent real estate acquisitions and heavy recruitment activity monitored by the competition.

(Continued on p. 40)

Also more clear is the reason behind the delay between IBM's unbundling announcement in the U.S. and the announcement of a milder policy in Europe last April. Now it appears as if IBM European groups were being given a chance to stuff their lockers with software intended for separate pricing on 370 and System/3.

An example is a new optimizing compiler for PL/1 offered by IBM-U.K.'s Hursley laboratory which also is offered for 360 systems. The compiler reportedly combines faster translation and execution of PL/1 programs with reduced demand on main store capacity. Compatibility with existing PL/1 source programs is stressed for both OS and DOS versions of the optimizer. Improvements are supposed to be possible through recompilation with little or no tinkering with the source coding. This latest Hursley product would seem to be in line with the lab's emerging role as manager of all European PL/1 activities.

Other program products have been slipping into the unbundled catalog with less fanfare than might have been expected. There are things like new facilities for FORTRAN and a compiler falling in line with ANSI COBOL and the time-sharing programs, TSO (time-sharing option) and ITF (interactive terminal facility), that are designed to encourage the user to develop terminal and batch processing work under an integrated OS or DOS. Other basic software for both 360 and 370 have been simultaneously released together with a battery of selected industry applications packages. By the time the user has absorbed the performance statistics of the 370, he will find himself aware of unbundling as a reality.

Surprise and anxiety

European manufacturers appear to have been taken by surprise by the market slot IBM aimed at with the 370 announcement, but there was little they could have done to respond quickly whatever the aim. The idea behind the integrated emulator obviously has heightened anxieties. Competitors view a machine capable of taking mixed 1400 and 360 job streams in one pass as open to all sorts of skullduggery. It seems to be just a matter of time before software independents offer to graft-on emulators for ICL 1900, Siemens 4000 series, etc.

The only industry counterattack so far is a rumored placement of a PL/1 contract by ICL, possibly for its System 4 series. There's little doubt that a lot of people have been left gasping and, as an interim measure, have been scrutinizing their own price structures.

The alacrity with which Leasco World Trade placed an order for some $60 million for two 155s and 10 165s didn't offer much cheer. These are for the time-sharing division, Leasco Response, and are expected to be installed in Holland, Sweden, Germany and the U.K.

— Pearce Wright

Mr. Smith Goes to ACM and Things Are Looking Up

There's a new feeling of enthusiasm and progress at the national headquarters of the Association for Computing Machinery in New York City these days.

And it's almost impossible to escape the attribution of the new go-go look at ACM to anybody but Gordon W. Smith.

Smith, a handsome, graying man with bags under his eyes, looks what he is: a veteran of edp marketing wars at IBM, Univac and Diebold. He was brought in to fill Don Madden's shoes as executive director (July 15, p. 62) on July 1 . . . but on a temporary basis, two to four months at last estimate.

Lameless leadership

The lame duckness of his position hasn't hindered Smith from infusing a salesman's enthusiasm into his attempts to rethink the 27,000-member ACM and its goals, and to institute changes into an organization that has recently been beset by financial woes and static membership.

His innovations have ranged from strong-arming old buddies to place ads in the *Communications of the ACM* to providing free coffee to ACM employees, a privilege that had been restricted previously to visitors.

He's discovered that the organization was paying out $60,000 a month in salaries to computer personnel on work that a private service bureau says it will do for $18,000.

And he's trying to come to grips with the organization's inability to encompass a larger group of business-oriented people, who wonder why members don't stick with the organization longer. "There's a helluva turnover in this organization's membership," says Smith. "People join as students, stick around two-three years, then quit because ACM is not meaningful to their careers. That's quite an indictment." So now when a member doesn't renew, he gets a phone call to find out why. The answers may offer an insight into how the ACM must change.

The ACM, Smith feels, has also been guilty of not serving its members. As one way of changing that, Smith is going to offer any member who has been laid off a free classified ad in the *Communications*. He won't be surprised if the idea meets with strenuous objections.

Working on the ACM's 1971 Chicago conference — which will try to come up with some answers to the problems posed by ACM 70 — Smith called the Chicago chapter to suggest they enlist the aid of manufacturer members in planning the conference. The Chicago chapter had no manufacturer members. So Smith called some of his old buddies there. They were glad to join. Nobody had ever asked them before.

ACM is also trying to get a handle on "this whole question of literature search. We'd like to mechanize it." For the Joint User Group, ACM will prepare in machine-sensible form a list of programs available from user groups ("GUIDE submitted three," adds Smith, wryly).

Says one of Smith's temporary helpmates, "Gordon has so changed the whole atmosphere of the organization that the people here feel he must walk on water. In a volunteer organization, it's hard for the staff to give direction. But Gordon commands respect. If anybody can do it, he can . . . if he'll stay."

— Robert B. Forest

COSMIC Moves to Plug Gaps in Software Distribution Project

A program by the National Aeronautics and Space Administration to disseminate computer programs to the public has been less than a rousing success during its first four years, but the agency claims enough bugs have been removed to make it a "viable national resource."

Ronald J. Phillips, director of NASA's Technology Utilization Div., says the program has moved a long way from the floundering of its early days. "The quality and volume of the programs are sufficient to qualify it as a resource to be investigated by the public, not only for the obvious advantages of cost, but because it is a large capability developed at public expense."

Software companies with proprietary programs think otherwise. They feel programs which cannot be meticulously maintained by the seller will receive a long, hard look by users. The Association of Independent Software Companies, at this magazine's request, recently polled its members on their position concerning the NASA program. All but one agreed it did not constitute a threat to independents, nor was there any useful purpose in free distribution of programs, other than software that only appeared to be free, such as system manufacturer software distributed on a bundled basis.

The acronym

The NASA program was started in the summer of 1966 at the Univ. of Georgia's Computer Software Management and Information Center (COSMIC) under contract from the agency to distribute to the public at nominal duplicating costs software developed under NASA-sponsored contracts.

It was an instant flop. Users howled at the poor quality of documentation and the center soon found that orders for documentation, which was free, exceeded sales of programs by a ratio of 50 to 1.

"We learned a lot," says 28-year-old Harry B. Rowell who took over as COSMIC director three years ago and who last month left the post to pursue studies for a doctorate. He is succeeded by Howard Bedell who has been the center's associate director. Rowell established an elaborate quality control program to examine the packages sent in by NASA contractors, evaluate their value to potential users, check the documentation, and get back to the authors. He has headed a staff of 20 at the university in Athens, of which 13 are professionals, "people who are familiar with edp, but who also hold engineering degrees in a variety of fields and understand the disciplines to which the programs apply."

Their selectivity has been devastating. They evaluate 100 packages a month and reject 70% of them, for poor documentation or for having limited application. Of some 2,000 submitted, only 600 have been accepted for distribution. The center has sold 3,000 packages and 15,000 documents. Documentation now goes for 10 cents a page. Prices of most programs average below $300. Largest is a 300,000 source statement program from the Goddard Space Flight Center for dynamic and static stress analysis of space vehicles and written for four machines with use in up to five operating systems. It cost $4 million to develop. COSMIC sells it for $2000.

For each program in its library the center must sell 10 copies to break even. To date, the average has been five. Operational costs during the first three years totaled $750,000. Currently, costs which reflect an added staff and increased input are estimated at $500,000 a year. And this will increase as the flow of input goes up. COSMIC this year began accepting programs from two other agencies — the Atomic Energy Commission and the Defense Dept.

Many bugs

A study last year by the Auerbach Corp. research company and a spot check of users by *Datamation* this summer found users still complain of missing pages in documentation. Some say the documentation is not sufficiently complete to determine whether the program is useful. Others complain they lack detailed discussion of algorithms used. Universities say the prices are too high in view of the inadequate documentation. The prevalent complaint is that it is difficult to get back to the originator when problems come up.

In response, NASA's Ron Phillips points to other parts of the survey showing a user can save from 50-90% in development costs by applying COSMIC programs and 10-30% by using only the documentation and developing their own programs. But he admits it's hard to trace the originators. Most were developed for NASA mission requirements and always were in a state of transition. "A programmer would write a subroutine, then move on to another job."

Rowell's office tries to get back to originators to fill the gaps before the program is made available to the public. He admits he hasn't always been successful.

Take it away

COSMIC's other major problem — like any giveaway program — has been in giving it away. A year ago NASA began issuing a quarterly catalog, *Computer Program Abstracts,* which describes all new programs added to the COSMIC library and lists others in it. It's available for $2.75 a year from the Government Printing Office, Washington D. C. 20402. Last fall six NASA technology utilization distribution centers were authorized to sell the programs in an effort to expand the distribution base. So far, sales through these outlets have been negligible. In Los Angeles, the Western Research Application Center said in a six-month period it sold less than two dozen documents and no programs.

Last October the Small Business Administration distributed a brochure to small businesses advising them of the program. There were 1,000 inquiries but no sales. Phillips says this may be due to the nature of the programs, which mostly are for large scientific applications that appeal to big companies and universities. He says the center is now evaluating many that have business applications pertaining to management systems, personnel records, financial and inventory control, and this probably will open the COSMIC service to smaller companies.

— Tom McCusker

Whatever happened to modular programming...?

Can COBOL Cope?

by Peter H. Vaughn

The economic significance of software maintenance on current computer-based systems has been strongly highlighted by the advent of the third generation. The redesign, reprogramming, and retesting required to make a change to a large current system constitute a critical challenge to data processing administrators. As systems grow larger and more complex, and the number of steps involved in changes grows, the dimensions of the challenge grow. The bigger the problem gets, the more compelling the need to find a resolution, since the dollar difference between writing a new system and patching a current one is getting bigger too.

Since it takes a programmer so long to learn the inner workings of a large monolithic system, the desire on the part of the dp administrator to retain such a person in a maintenance capacity is easy to understand. Maintenance programmers are often worth far more to their employers in that capacity than they would be in new systems development. In spite of this, most programmers do not wish to function in a maintenance capacity for an extended period after a system is on the air, since they feel that the interest and challenge are gone.

It may be true that the technical challenge is gone, but the administrative challenge is just beginning when a new system goes on the air. For most companies, it is absolutely essential that a large system be kept alive for some specified period of time. As things stand, the best way to do this is to have the people who wrote the system maintain it, but they don't always want the job. Most experienced dp administrators have scars to prove this fundamental conflict cannot be resolved by edict. But somewhere in the dim recesses of our subconscious we recall that modular programming was supposed to solve the problem, so whatever happened to modular programming?

Indeed, modular programming has been the rule rather than the exception within the scientific dp community for several years, but, with a few notable exceptions, is only just finding its way into the business data processing community. There are many reasons for this, not the least of which is the fundamental hostility of the COBOL environment to effective modular design. However, there is one very significant causal factor which accounts for many of the problems encountered in business data processing: business applications are generally less rigorously defined than are scientific applications.

When a scientific problem is presented to an analyst, the mathematical statement of the relationships that exist between the data elements of the system is part and parcel of the problem statement. This statement of element relationships is frequently absent in the statement of a business problem. The seeming lack of mathematical rigor has led us to assume that the job of the business system designer is less complex than that of the scientific designer. Quite the contrary —the job of the business system designer is often rendered impossible because the heart of the problem statement is missing!

The fact that the relationships between some of the data elements of a business problem cannot be stated

in conventional mathematical notation does not imply that the relationships are any less important or rigorous than the more familiar mathematical ones. These relationships form a cornerstone of any system analysis, and the development of a problem statement notation for business problems, similar to mathematical notation, could be of tremendous value. The point is that while modular programming can provide a significant measure of help to us, it is not the whole answer—the specification of the processing which occurs within a modular needs attention too.

A functional analysis

While many of us know of some practices to the contrary, we are on reasonably safe ground to assert that, theoretically, analysis precedes design, which precedes programming. The success of modular programming hinges very largely on the adherence to this theoretical sequence—modular analysis precedes modular design, which precedes modular programming. The design of a system must be approached at the outset with modularity in mind; the probability for successfully breaking a monolithic system into modules after the design is done is essentially zero. Breaking a system into several large chunks of code which will fit into core is not modular programming. How, then, do we achieve a modular system design?

To begin at the beginning, a designer must first satisfy himself that he has identified all of the system requirements. At this point, the requirements can be placed in a functional block diagram, but these are only the highest level functions, visible to the user, and seldom represent an optimum functional breakdown of a supporting computer-based system. For example, it is unlikely to occur to a user to isolate his I/O requirements, but a designer who wishes to remain device-independent must do so. The first step of the process is, then, analysis and restatement of the major system functions from a data processing point of view. We take each of the gross user functions and break it down into individual functions, applying the process iteratively from the top down. The result of this sort of analysis is usually represented comfortably in a tree diagram, wherein major user functions at the top are successively broken into separate data processing functions in the lower branches of the tree. As a very simple example, we might diagram a portion of a corporate personnel function as in Fig. 1.

As the breakdown continues, we observe two important phenomena: (1) the branches are beginning to terminate in atomic functions, which do not lend themselves to further breakdown, and (2) some of the functions are turning up in more than one place. When the process is done, we have a complete functional analysis, we do *not* have a system design. It should be noted that this procedure is slow, particularly the first time through. An analyst often finds alternative ways to break a function down and will spend a great deal of time changing his mind and filling in details he considered unimportant on an earlier pass. But time spent here is worthwhile since this step forms the heart of the system analysis.

When the functional analysis is complete (this is the modular analysis mentioned earlier), we are in a position to design a system using modular concepts. It may be useful to define a program module here: A module is a closed subroutine, to which control is passed by a calling program and which returns control to the calling program when it completes its processing. Decisions may be made in a module which will cause a change in the flow of the system,

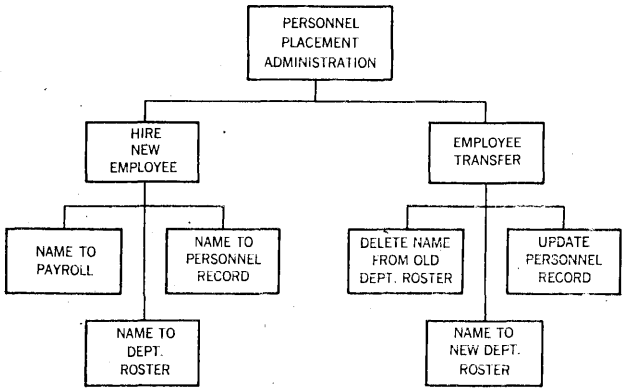

Fig. 1. Diagram for portion of a corporate personnel function.

but the module will not actually execute the branching; it will communicate the decision to the calling program, which executes the branching. The creation of a modular design is much easier since we have a problem statement redone to consist of functional data processing modules. The specification of the actual processing in the modules is a function of the relationship between data elements and results from the analysis mentioned earlier. Note that the only functions which are actually programmed are the data processing functions at the bottom ends of the branches (with one minor exception), since they are the building blocks of which the higher level functions are made.

System structure

Our next design task is to create a system structure for the functional modules which will operate within whatever hardware constraints we have. For example, placement of often-used functions within an overlay structure is an important element of the structural design.

This structure (Fig. 2) has 3 levels—there will be one module from each level in memory at a single

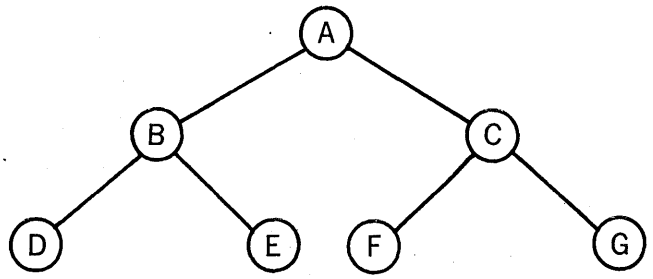

Fig. 2. A system structure.

instant. Hence, the execution of E requires that A and B be in memory. Now if E were a generalized function which must also be used by F, the situation is impossible; whereas if A is the generalized module, it is available to all other modules.

Execution of the modular system requires at least one module (the minor exception) that wasn't on the analysis tree: a control module. Most of the funda-

FORTUNE, JUNE 1970

At least fifty U.S. companies today make minicomputers and 140 other firms turn out terminals. The field is one of great technological pioneering. For example, it is here that large-scale integration (LSI), the extension of microcircuitry beyond integrated circuits with component densities of up to 100,000 to the square inch, is finding its initial applications. Typically, a small new company, Four-Phase Systems, Inc., of San Jose, which was founded less than two years ago by Lee Boysel, then a twenty-nine-year-old computer designer, is challenging big established firms like Texas Instruments and Fairchild Semiconductor in the race to apply the large-scale integration concept to the making of small computers. Under one roof, Four-Phase Systems has assembled a group of young engineers and designers who were formerly with Fairchild Semiconductor, I.B.M., Control Data, and other companies—specialists in both large-scale integration and computer design. Cloyd E. Marvin, a Four-Phase vice president, notes that these disciplines "usually do not exist together in either computer-equipment companies or semiconductor houses." The company will soon start taking orders for a $15,000 computer.... Large-scale integration computers still have to prove themselves in a working environment. But their development is obviously setting the big-computer makers on their ears.

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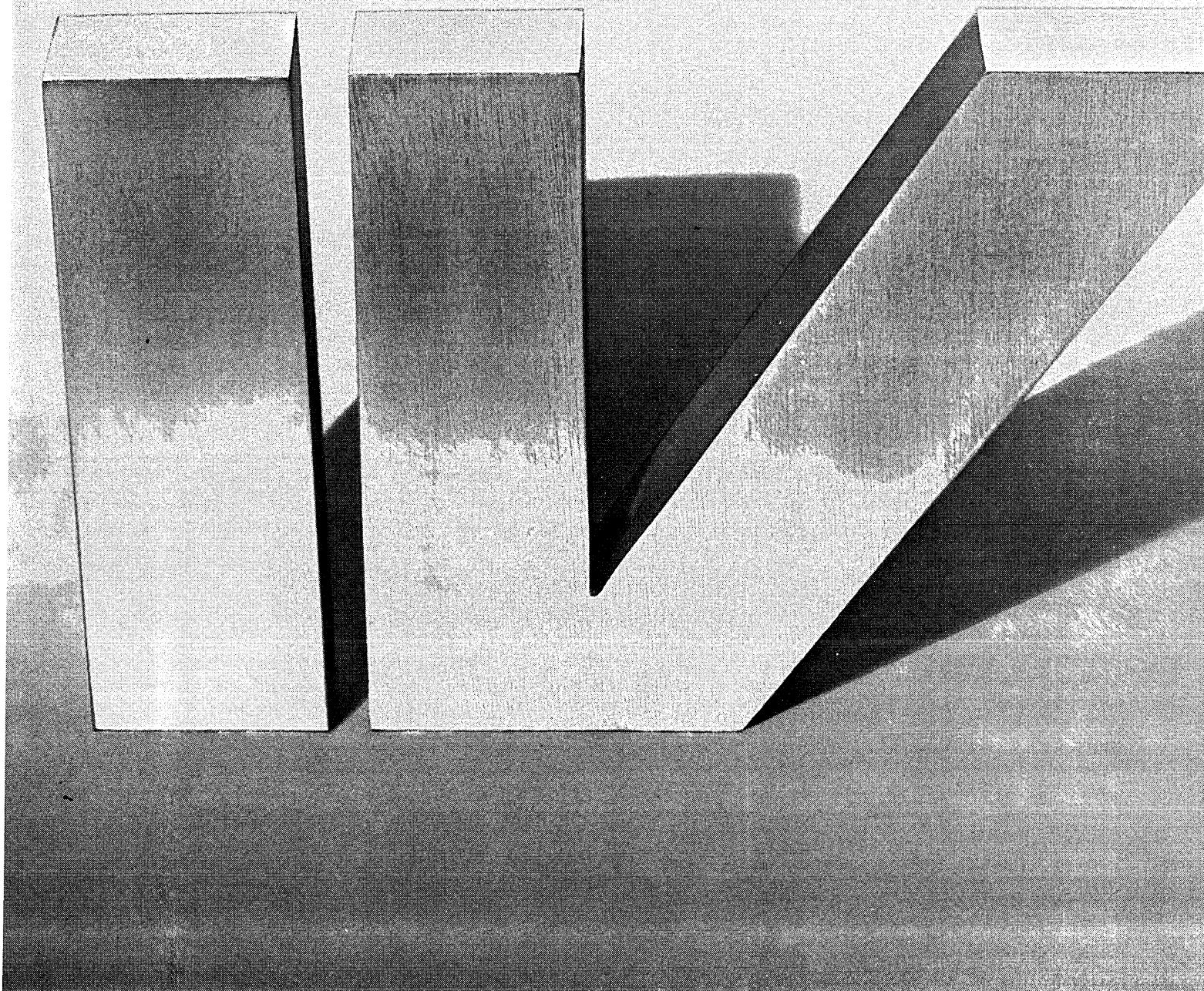

mental system flow logic is in a control module, which controls the order of execution of the functional modules.

It is clear that this approach to system design, despite its rather simple mechanics, is very demanding. Ignoring the fact that, once having produced such a design we would find it extremely difficult to implement in a standard COBOL environment, the process of arriving at a good design requires perception and imagination.

It is impossible to catalogue all of the things a designer should think about while going through the process, but the single most important thing, from the technical point of view, is the certainty of change. If we take a very broad look at any computer-based system, we can readily identify three types of change which occur frequently:

1. Fundamental system flow logic changes, involving a reordering of system functions.
2. Redefinition of a specific procedure or function.
3. Individual parameter changes, such as changes to table values.

A functionally modular system will accommodate all three of these with relative ease. Fundamental system logic changes will nearly always be accomplished by changes to the control module; redefinition of a specific procedure is accomplished by reprogramming the specific module involved and replacing only that one, after it has been tested.

Finally, it is clear that modular design concepts can indeed help us build business systems that are more efficient and a great deal easier to maintain. However, before we can really make use of the technique, we must take steps to render the COBOL environment more hospitable. (There are one or two specially modified COBOL compilers which support modularity, but the general picture is quite discouraging.) Specifically, the development of a much more efficient CALL linkage is necessary, as well as the development of a COMMON storage facility such as is found in FORTRAN. ■

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A separate minicomputer for control of data communications can improve system performance

External Control

by Richard L. Brening

During the '70's, it has been estimated, a clear majority of all large-scale computers installed will incorporate capabilities for on-line communication processing. This, in turn, means that the majority of users of large-scale data processing systems will ultimately have to face the problems and decisions of designing, selecting, and implementing data communication control systems and equipment.

In the face of these obvious requirements, data communication devices and services have, cumulatively, become possibly the fastest growing area of information-processing activity. As a result, there has been a tendency to place emphasis and attention on the communications function and devices to the point of impairment of the central processing task.

Productivity can be impacted

This is a major problem for potential computer/communication users. The larger the scope of the system, the more important it is to have systems analysts measure total productivity. In particular, the throughput of the central processor must be evaluated in terms of return on investment and degree of achievement of processing objectives as they are required now, not as they were when the system was first specified.

Admittedly, this is not easy to do. There are many factors interrelated with the throughput of a large processor, and both forecasting and even actual operational measurement become so difficult that it is frequently not worth the effort. In fact, the definition of throughput is not equivalent from one application to another. However, where extensive communication activity is involved, criteria can be defined to characterize inefficient utilization of the processing capabilities of such systems.

Specifically, the more a processor is interrupted on a demand basis—no matter how great its over-all capacity—the more efficiency is bound to suffer. When a communication-oriented system uses a "hard-wired" communication controller, total reliance is placed on the central processor. In effect, the central processor must interrupt its operations on a demand basis each time a character of data or message segment is received. This is true even where communication controllers are buffered for receipt of a few characters of data at a time, or where memory-access schemes allow for the input/output of entire message segments.

Since the communications interface is characterized by a flow of data not totally under its control, the central processor is often required to accomplish the function requested by the interrupt in a very short period of time. In addition, the processor cannot ignore the interrupt for any duration of time exceeding a few microseconds. The total time from interrupt generation to completion of the interrupt processing may not exceed the character maturity time for the communications link. If transmission rates of 2,400 bps are used, this duration may be 3 msec. This is compounded, however, if more than one communications line is involved, since the time duration becomes shorter. For instance, 15 simultaneous full duplex lines, operating at 2,400 bps, will allow only 100 msec or less.

Then, for each character or message unit received, the central processor must validate its format. When a full message is received, the central processor must go into a multicycle operation to assemble and validate the full message, then determine what processing, file access operations, and application programs will be needed.

Without belaboring this point, published figures have indicated that a large-scale computer can be impaired by up to 40% of its throughput capacity if it is required to handle its own data communication "housekeeping." Increasingly, therefore, users are becoming aware of, and taking a close look at, programmable communication controllers which are external to the central processor.

The programmable controller

Typically, a programmable controller consists of a minicomputer with high-speed main memory. The memory size generally ranges between 8K and 64K bytes—though some systems use communications controllers with memories ranging as high as 128K or even 256K bytes.

Memory size is primarily dependent upon the expected traffic throughput, the maximum amount of time the message will be resident in the controller awaiting acceptance by the central processor or transmission over a communications line, the complexity of the communications network control procedure, and the amount of preprocessing delegated to the controller. Associated with this minicomputer is a wired multiplexor which provides a data path between the data communications network and the communications controller memory. On the one end, it interacts with the computer itself, often transferring data via direct memory access. Functional control is effected by generating interrupts by executing computer commands. On the other end, the multiplexor is linked with a series of applications-tailored interface devices connected to the modulator/demodulator (modem) terminations of communication lines.

The relationship of the multiplexor, interface devices, and modems to the minicomputer which acts as a communication controller is diagrammed in Fig. 1. It should be stressed that this illustration does not

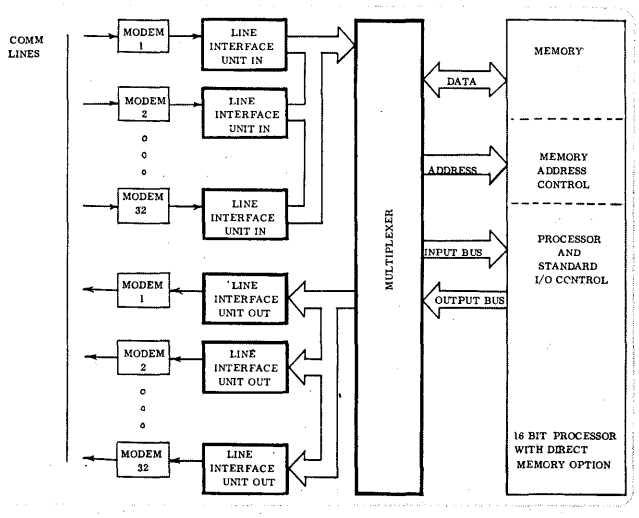


Fig. 1. Communication interface.

show the functional relationship between the communications controller and the central processor itself. Rather, it diagrams the relationship between the communication controller and the user network.

Within this structure, note that the diagram shows independent line interface units, even for full-duplex communication lines. The line interface unit provides control and character detection unique to the particular line discipline. Therefore, this unit must normally be tailored separately for each application. It also provides the function of serial-to-parallel and parallel-to-serial conversions for input and output traffic. Routinely, these line interfaces also perform parity and longitudinal checks to verify transmission accuracy of the input data, and add parity bits or longitudinal check characters as necessary on the output. Typical of the control characters recognized on input is the end-of-message character. Upon recognition, the interface will interrupt the communications processor to indicate that a full message or processable message segment is now resident in core. This activity, in turn, will trigger assignment of a new core area for assembly of the next message.

Role of the minicomputer

In terms of impact upon over-all system productivity, the real achievement of the programmable controller lies in the software-hardware features within the minicomputer itself. In effect, this computing device functions within a computer/communication network under an entirely different philosophy from a large-scale central processor. Typically, a large computer is designed to work best when it can function continuously, executing a full set of program instructions on a given application before branching to another. This is true even with third-generation computers with built-in demand interrupt features. Even though computer hardware and operating system software are designed to respond to interrupt demands of communication controllers, the fact remains that interruptions cause discontinuity which, in turn, impairs productivity.

On the face of it, for example, a "cycle stealing" operation performed in less than one microsecond does not appear to hamper productivity. But this applies primarily to the insertion of single transmitted characters into core. The real time loss lies in such areas as network control and message assembly area allocation, where full sequences of processing operations must take place in response to demand interrupt commands because of the time criticality of the data communications process.

Typical of the time-critical, communications-oriented processing tasks which impair processing productivity are error detection and correction, message formatting, message addressing and routing, message storing and forwarding, terminal polling, terminal control, message assembly and data concentration, transmission speed conversions, and others. Each time such an interruption occurs, several operating system commands must be executed and application program processing must be interrupted and stored. Such processing losses are unavoidable because of the basic nature of the demand interrupt function. Simply stated, if the processor does not interrupt its normal functions to handle communication supervision, subsequent transmitted data can be lost and communications line efficiency will suffer.

By contrast, a minicomputer, used as a programmable communication controller and fitted with suitable interface hardware, is configured and designed for interrupt responsiveness. Such a computer

has no long sequence of processing tasks. Rather, its full capacity is directed toward responding rapidly to each communicated signal, sensing message conditions, and interacting with the central processor under a priority scheme which greatly reduces mainframe interrupt requirements. Introduction of the programmable controller can thus improve the response time of an interactive system.

Further, the minicomputer can handle all monitoring of response to terminal functions and operations in the data communication network. As an added protection, the programmed communication controller can provide "fail soft" protection between the communication network and the central processor. Should the central processor go down, the programmable controller can complete receipt of in-process messages up to the limits of its own memory. Then, it can interrupt terminals with status messages. Or, if the communication controller has access to its own disc or tape files, message receipt can be continued to the full limits of these devices.

Minicomputer configuration

Up to this point, the discussion has centered upon the interaction between the communication network and the communication controller. Now it is pertinent to point out that, as shown in Fig. 2, the communication controller itself can be equipped, depending on the application, to function as a full capacity com-

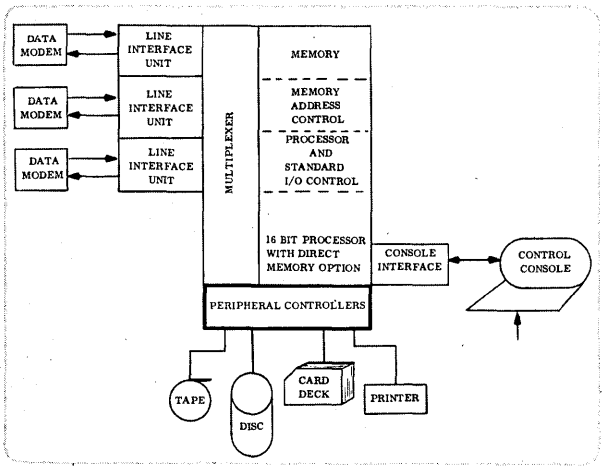


Fig. 2. System peripheral interface.

puter system in its own right. As Fig. 2 indicates, the programmable communication controller can have:

Control console. Depending on system objectives, this can be as simple as an ordinary teletypewriter keyboard. Or it can incorporate crt displays and/or status indicator lights.

Tape handlers. For the most part, magnetic tape devices associated with communication control units are used for logging messages or traffic statistics.

Disc files. Depending upon the system application, disc files may be added to supply supplementary data storage for message batching or store-and-forward applications. In addition, discs are used to store less-used task processing routines and to provide logging storage in lieu of using magnetic tape units.

Card readers and line printers. These devices are used primarily for program development, testing, and simulation operations. If the system justifies a fully redundant installation, these devices allow off-line data processing applications.

At this point, considering the minicomputer with the optional peripherals in its own right, we find a highly flexible stand-alone processor or subsystem. Although this presentation deals with the role of such devices in communication control, it should be pointed out that the same approach, including both software and hardware, is highly workable in such applications as message switching, data collection, terminal control systems, process control, and data concentration for optimum use of communication lines.

The computer coupler

Where a minicomputer is to be used within a programmable communication controller, another hardware element is needed. As shown in Fig. 3, this is a computer coupler. Functionally, the computer coupler is an interface between the minicomputer and the central processor. It handles parallel data

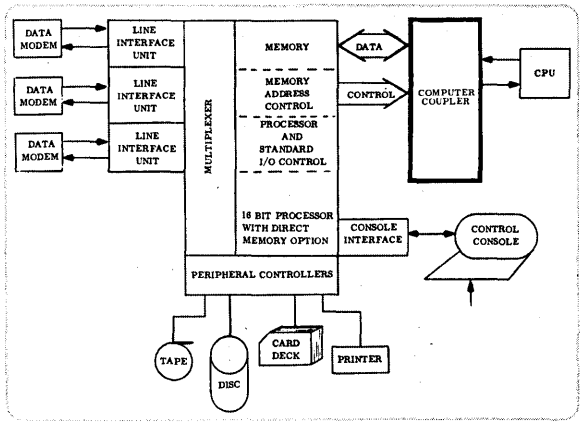


Fig. 3. System computer interface.

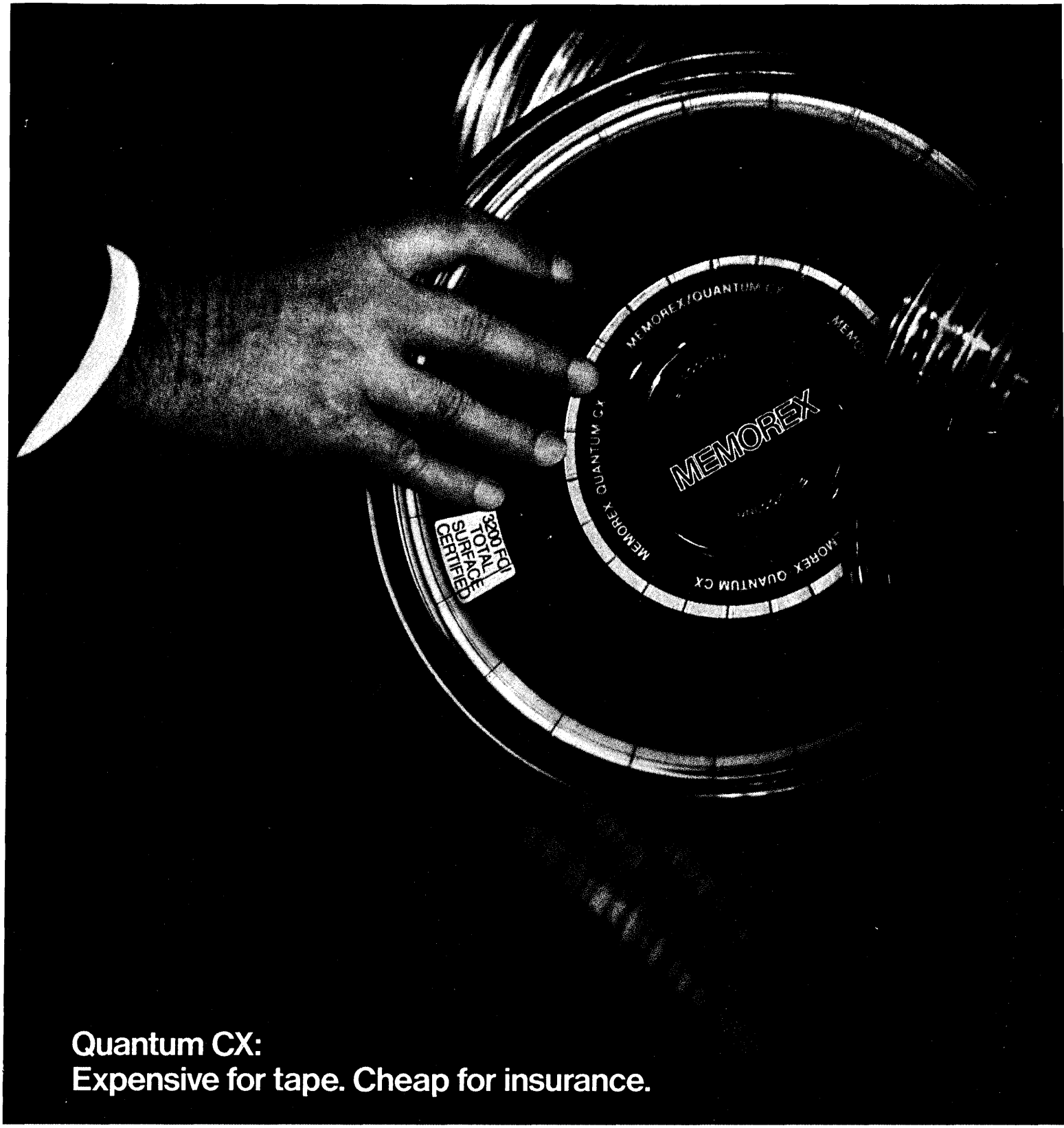
transmission and control to and from the central processor, meeting the operating specifications and requirements of the larger system. In effect, the computer coupler enables the central processor to interact with the communication controller as though it were a standard peripheral.

In effect, then, the central processor can handle data from the programmable controller pretty much in the same way as it can from a standard disc or tape drive. Special demand interrupt requirements generally associated with communication interaction are either drastically reduced or virtually eliminated. To illustrate, the central computer now receives complete messages ready for processing. This is roughly equivalent to referencing and bringing in data records from file devices. The number of operating cycles involved can then be controlled to where communication interfacing represents virtually the minimum productivity drain possible.

The computer coupler itself can be designed in two general configurations:

1. A single-channel design is used where the communication controller interacts on a one-to-one basis with a single central processor.

2. The communication controller, by adding multiplexing capability, can be adapted to interact with



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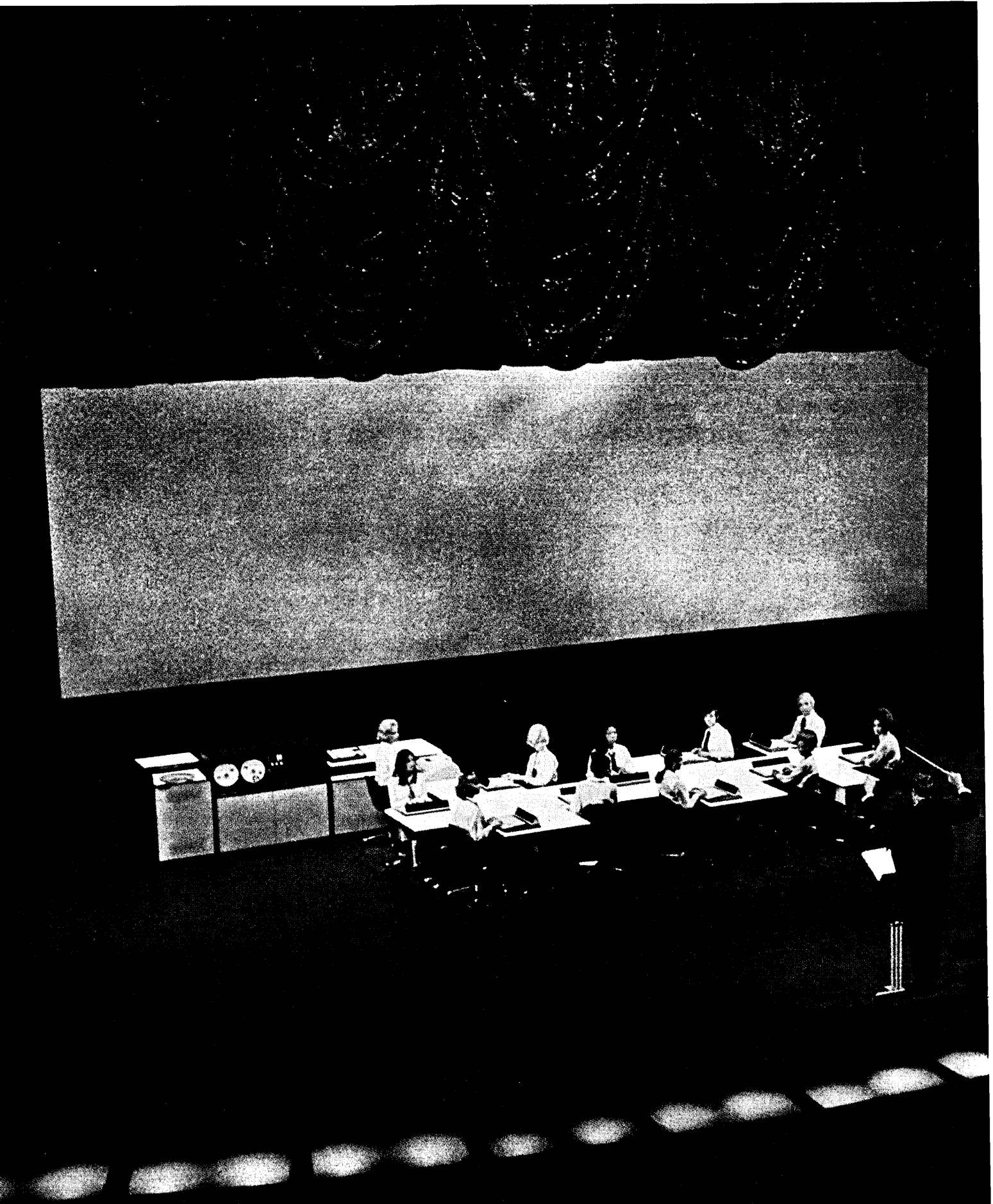

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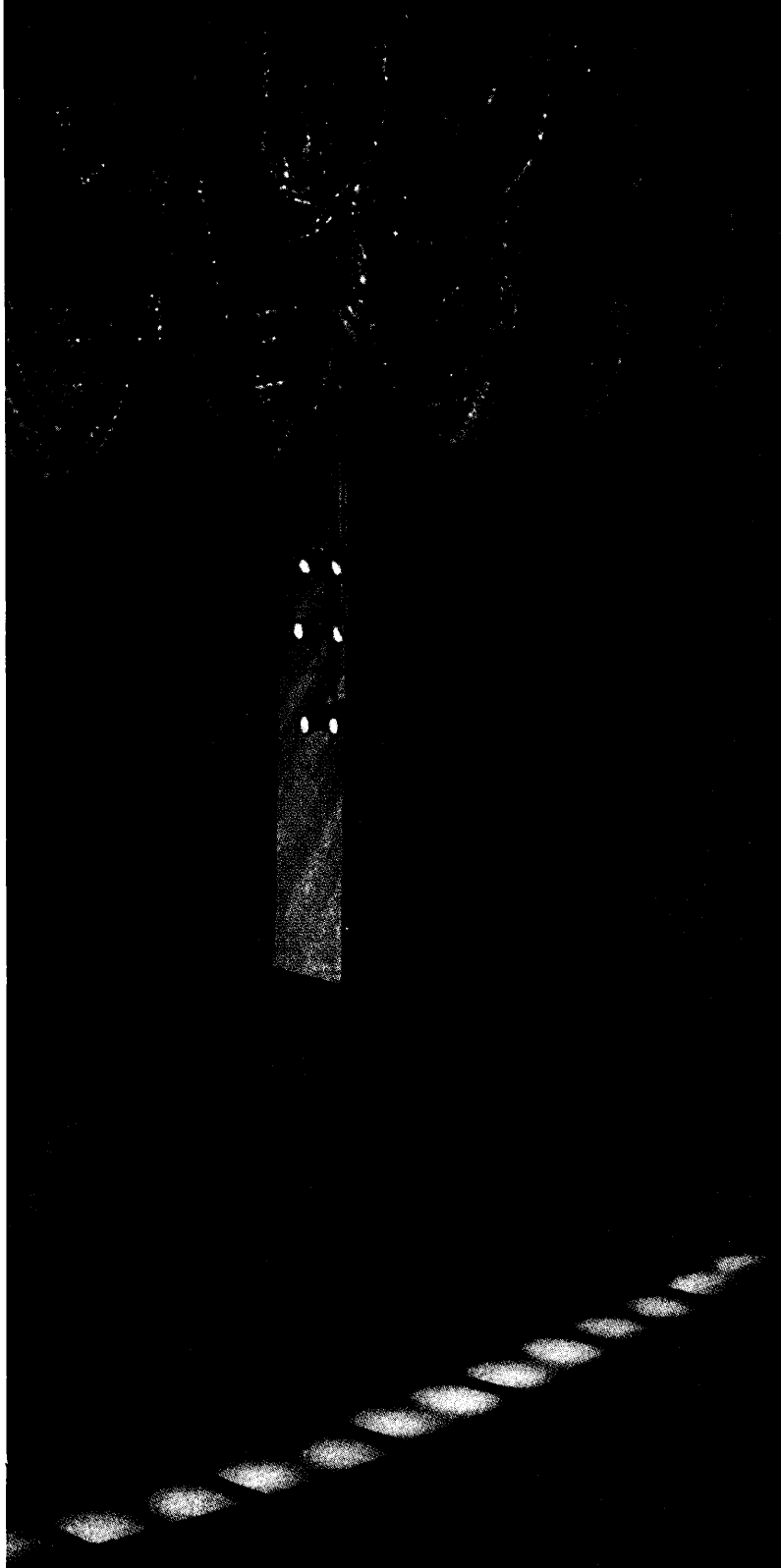

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multiple processors. These can either be redundant processors or processors used for different functions, each requiring data communications capability. In addition, this approach can be used to implement data processing load sharing schemes.

The multichannel technique is particularly attractive where a computer user has more than one processor, each dedicated to specific applications. To illustrate, in the airline industry, it is common for carriers to use separate processors for reservation control, flight planning and monitoring, cargo inventory and scheduling, and maintenance operations. By using a multichannel coupler within its communication control system, an airline can link all terminals available within all of its facilities with a single communications network, using the controller, programmed with selected addressing schemes, to deliver traffic between the proper processor and the desired terminal. This eliminates possible duplication of communication facilities for special applications. At the same time, the programmable controller is flexible enough to accommodate a mix of special-purpose and general-purpose terminals, ranging from special data stations, to crt terminals, to teletypewriters. Fig. 4 shows a typical configuration under which computer couplers have been adapted to a possible multiprocessor system. Similarly, other multiprocessor systems in the banking industry, insurance industry, time sharing industry, etc., are suitable for such applications.

Emerging industry conditions

In considering the alternatives of computer-associated communications control, particular attention is necessary to the current dynamics within the industry.

1. Specialized communication carriers operating

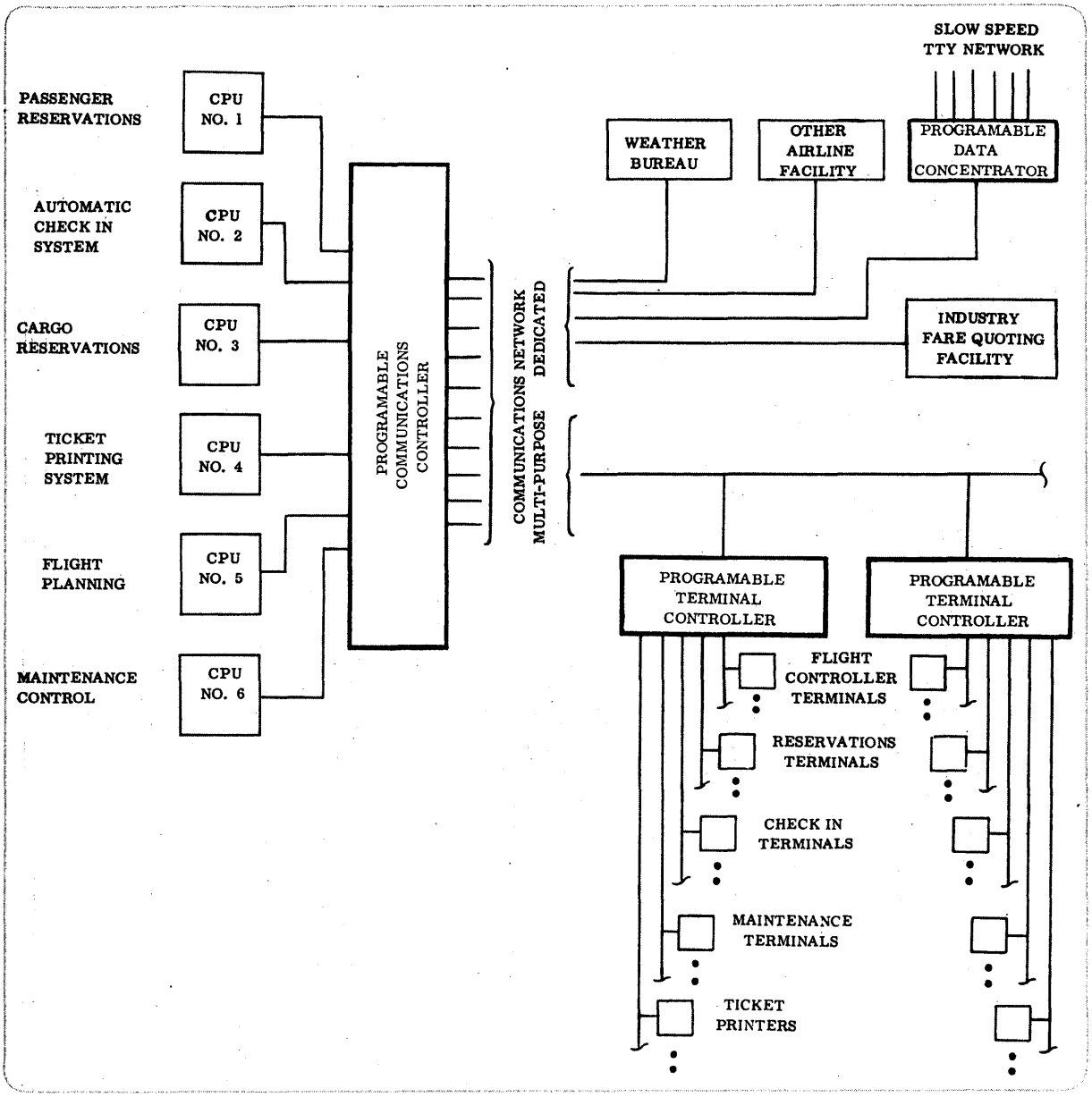

Fig. 4. Multiple central processor applications.

"private" microwave networks are proliferating. Lower cost, wider bandwidth circuits are being made available, in addition to the achievement of higher data rates over voice grade lines. Such services will impact both the economics and capacities of communication networks.

2. Terminal equipment is proliferating even faster. New terminals, generally, fall into two categories: (1) lower cost, general-purpose devices, and (2) special-purpose units, application-oriented through read-only memory or firmware capabilities. New developments in the terminal area promise a continuing multiplication of applications and usage for on-line systems.

3. Software packages, particularly in the field of management information systems, are becoming both more sophisticated and more readily available. These and other information system programs will tend to generate increasing demands for on-line systems.

There are other dynamics at work, of course. The main point to be made, however, is that a computer/communication system designed today should be flexible enough to accommodate to progress if it is to continue delivering cost-effective performance. Simply stated, such accommodation can be achieved only through careful design of flexible, high-capacity interface hardware and applications-oriented software capable of being changed to meet tomorrow's environment. Obviously, hard-wired controllers cannot meet these requirements.

Conceptually, the use of specially designed communication controllers represents an approach generally characterized as belonging in the fourth generation of dp equipment. That is, special-purpose interfacing tailors general-purpose devices to individual applications economically and with high performance.

Consider: A typical computer/communication complex will use a large-scale, general-purpose central processor. In most instances, the communication network will also include general-purpose terminals and common-carrier transmission facilities. Of necessity, then, introduction of a general-purpose communication controller into this network involves inevitable loss of efficiency, performance compromise, or both. By comparison, a programmable communication controller, tailored to the particular system application, can improve throughput for the whole system and remain flexible to accept changes as the system's environment varies.

Flexibility—a must

It should be stressed that this capability is not entirely achieved with programmable devices which are off-the-shelf in nature, and which provide a multitude of features not used in all applications. That is, the same general pitfalls that apply to fully hard-wired controllers also apply to programmable controllers utilizing established, general-purpose software packages and preset multiplexing devices designed for today's requirements and capabilities.

By and large, the present state-of-the-art is such that a user with a large-scale central processor and extensive communication facilities will generally do better—in terms of economy and productivity—to arrange for an adaptable, programmable communication controller, specifically configured to conform to the needs of his own system. This does not mean to suggest that a communication controller should be built from the ground up for each installation. On the contrary, most of the components and know-how for configuration of customized controllers already exist and are readily available. These include a variety of low-cost minicomputers, multiplexors, and communications-oriented software logic. Through careful integration of these system components, and the applications-tailored computer programs and interface logic, any user can achieve a desired level of economy and productivity.

A case could be made that it costs less, in many instances, to design and implement a customized controller than comparable costs for many general-purpose devices. This, however, would tend to be an oversimplification. It is true that the general-purpose controller's equipment and software costs, on today's competitive market, can be catalogued at lower prices. However, the adaptation, debugging, conversion, and implementation problems associated with using a general-purpose controller with a specific system can run actual implementation costs up to the same level, frequently higher than that of the custom-designed controller.

There are further trade-offs still. For example, a customized communications controller has a much longer potential life. To start off with, it can be designed to meet foreseeable changes in communication carrier services and terminal equipment and it can be altered to accommodate changing system objectives or configurations comparatively inexpensively. By comparison, a general-purpose controller, designed to meet today's capabilities and specifications, could become obsolete in a time frame as short as a year or two. Yet, the design and tooling investment made initially by the manufacturer of the general-purpose system will not allow continuous change.

The communication system user today, then, faces a continuing conflict between a flux in the state-of-the-art and a need to act now. At this point in time, with the high rate of advancement being seen in data communication technology, a customized programmable communication controller has a lot going for it, particularly where large-scale existing systems are concerned. ■

Mr. Brening, as manager of the Interactive Computer Systems Dept. at the San Diego operations of the General Dynamics Electronics Div., supervises a staff of both software and hardware people responsible for implementing dp interface systems. He holds degrees from the University of Colorado in applied mathematics and business management.

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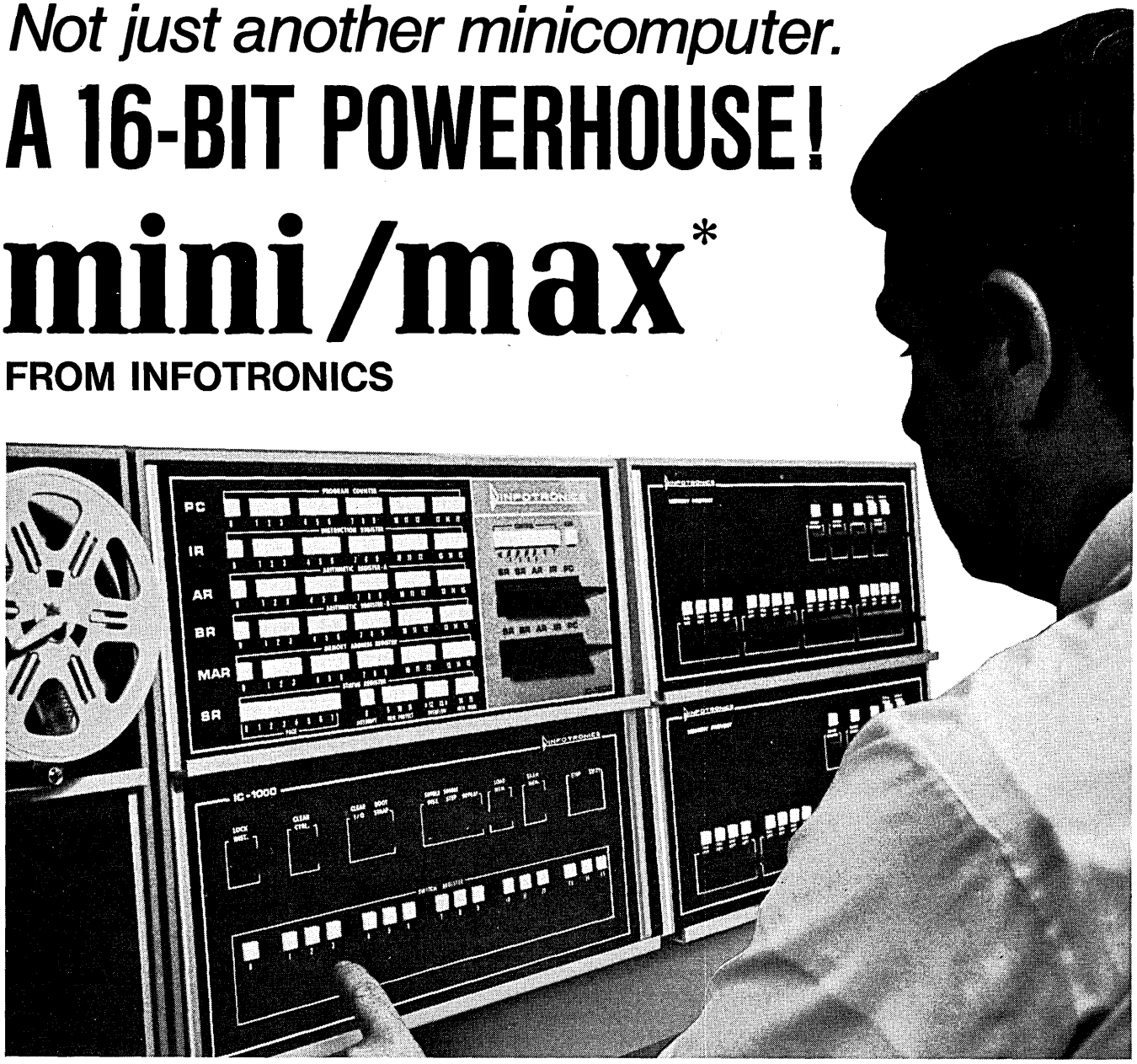

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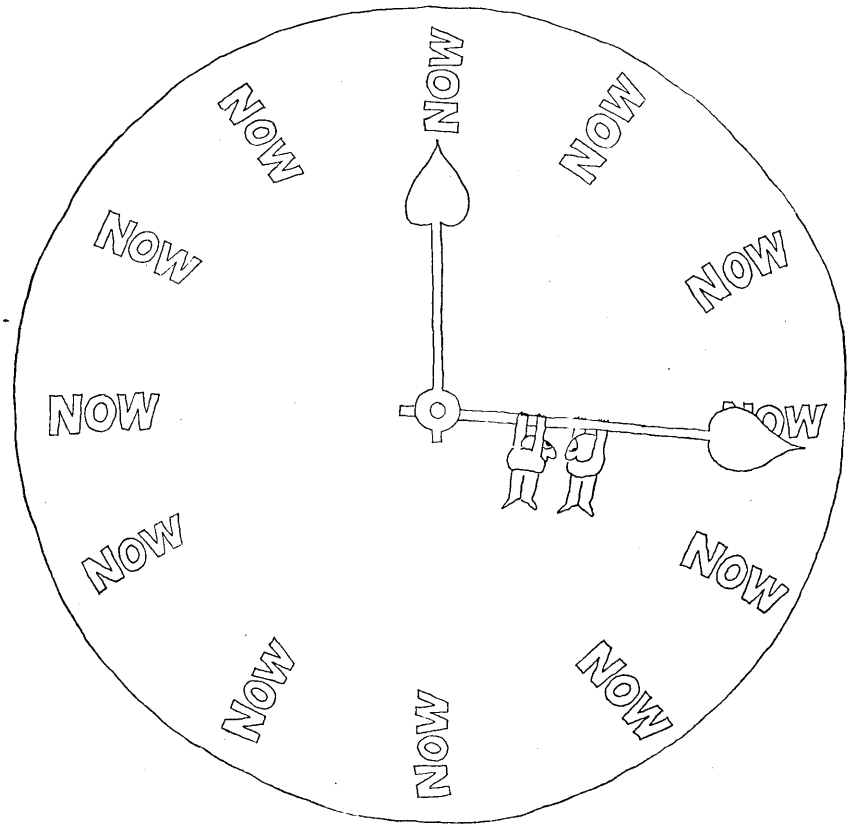

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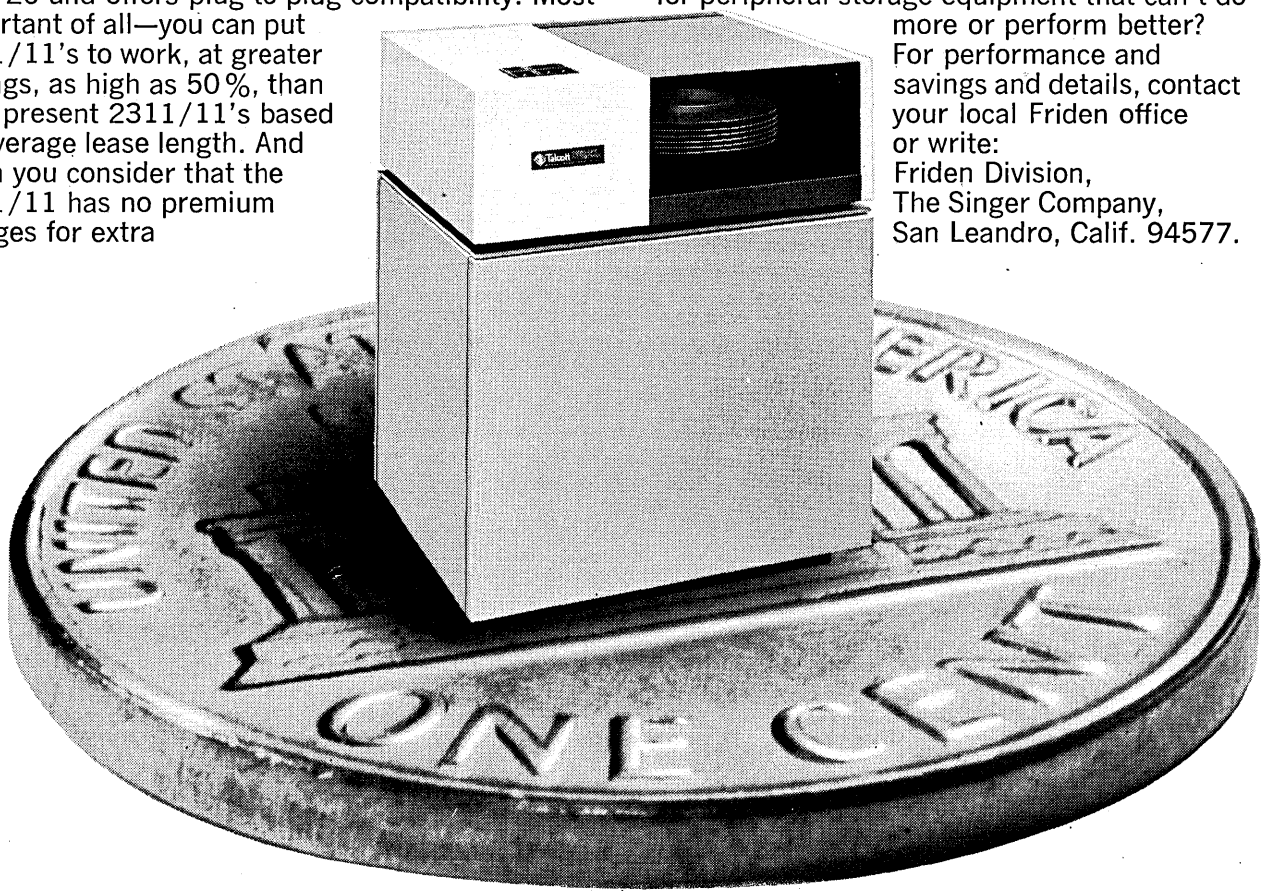

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Mapping for Survival

"Please introduce yourself to anyone who looks intelligent enough to realize that maps and only maps can make spatially variable information more than superficially intelligible."

This was the first announcement at the Conference on More Effective Approaches to the Improved Mapping of Quantitative Information, held at Evanston, Ill., March 23-25, and sponsored by the Laboratory for Computer Graphics & Spatial Analysis of Harvard University and the Center for Urban Affairs, Northwestern University.

From this beginning we proceeded to the final statement that mapping is a must for survival, that we must use maps to communicate visually the extent and distribution of our various urban problems and to help plan their solution. The unexpected number of 275 registrations resulted in an unusual mixture of geographers and cartographers together with urban planners and computer specialists, academics, and members of public agencies and business firms.

As always happens when a profession first meets to consider the role of computers in their work, the conference quickly turned to a re-examination of the field: What really is geography and cartography? What do they really want to do? What purpose do the results serve? The controversies quickly emerged, in this case between those used to intuitive hand methods for mapping information and those desiring to automate as much as possible. I'll try to summarize some of the main themes.

1. The chairman of the meeting, Howard T. Fisher, associate director of the Harvard Laboratory, distributed the first draft of a book which emphasizes the need for classifying the various symbolisms used. He talked of spot, band and field; of extent, tone and countability, and of the problems of location, classing, and interpolation. Many, however, felt that the symbolism was the least of the problems.

2. The second theme was the use of the currently available production systems for computer mappings, particularly the SYMAP system developed and marketed by the Harvard Laboratory with Ford Foundation support. It requires only a line printer, achieving a gray scale by means of overprinted characters. Although it was stated time and again that as a tool of analysis an interactive system would be useful, no such system was reported on. Nor was the possibility of animated cartography discussed (showing continuous time series on maps), which the speed of microfilm plotters could make a reality now. One wonders whether the cynic's law does not hold here that the funds and type of equipment available varies inversely with the social value of the work.

3. Another element which would lead towards improvement is the theoretical predictive ability of a scientific approach to geography. William Warnz, the director of the Harvard Laboratory, in describing some of the work in theoretical geography pointed out that geography has a long history of spawning new disciplines—physics and economics included. It identifies nonspatial properties and hands these off for study by others (urban planning being the most recent) while it retains interest in the analysis of spatial properties. It is becoming apparent that a relatively small number of regular spatial patterns recur in various settings. Notice the similarities, for example, in river tributaries, trees, the lungs, leaf veins, etc. The laboratory of the spatial analyst is the map.

4. Another area which emerged, mainly through the efforts of Waldo R. Tobler of Michigan, is the application of mathematical and statistical techniques as well as ideas from fields like pattern recognition, data processing and electrical engineering. He beautifully exemplifies the cross-fertilization possible by enriching his own field by developments in other areas. This, of course, requires considerable awareness and knowledge of mathematics, computers, and the like.

Since "the establishment" held forth most of the time, the younger people arranged a late night rump meeting (no conference is worth its salt without it these days) to find out about more advanced computer techniques.

Although the geographers dominated the meeting, the urban planners carried the day in the end. Admitting that topological maps will still be useful and that geographical research retains its long-term value, the problems that were mentioned time and again as requiring imme-

"I'm sorry, Miss Conley, but last week I explained to you in great detail binary coded decimal notation at the Malgren's cocktail party."

Mapping for Survival...

diate attention were those of our urbanized society. Maps can show clearly, for example, that the rich pollute the air and the poor breathe it. The mapping of the distribution over individual cities of population, segregation, poverty, traffic noise, unemployment and so on were mentioned by many as of overriding urgency.

A matter of will

The impact of a graphic presentation of the overall picture can be an important tool for frustrated planners and prognosticators to bring about pressure from the public and action by the politicians. "It is not important to map the world, but to change it," said one speaker. The thematic map or cartograph—which was the main subject of the meeting—is just the tool needed for these purposes. G. M. Gaites of the U.K. Ministry of Housing and Local Government, for example, showed computer-produced colored maps of data never before mapped, such as the number of economically active females over age 15, the distance to work, the number sharing dwellings, the percentage retired and so on. Of course, there is always the danger that the politicians may not want to know what the real situation is.

In a final summation session, the experts of various persuasions agreed that most of the technical problems are solved, that it is a question of resources and particularly a question of will. What is necessary is to apply these tools to help provide a clear picture of the situation as it has developed and as it is likely to develop further. The real problems are mainly with people, with institutions and with communication. On communication, for example, it was pointed out that although SHARE published a contour mapping program for a crt in 1954, most geographers still do not know about computer mapping possibilities. Obviously, the professional societies are not doing their job.

William Warntz put the point the most sharply. It is no longer a question of what we can do (the pure research that makes life worthwhile), not even of what we ought to do (directed or mission-oriented research), it is a question of what we must do (survival research). We must map the quality of life to help bring the compassionate revolution about.

—L. Mezei

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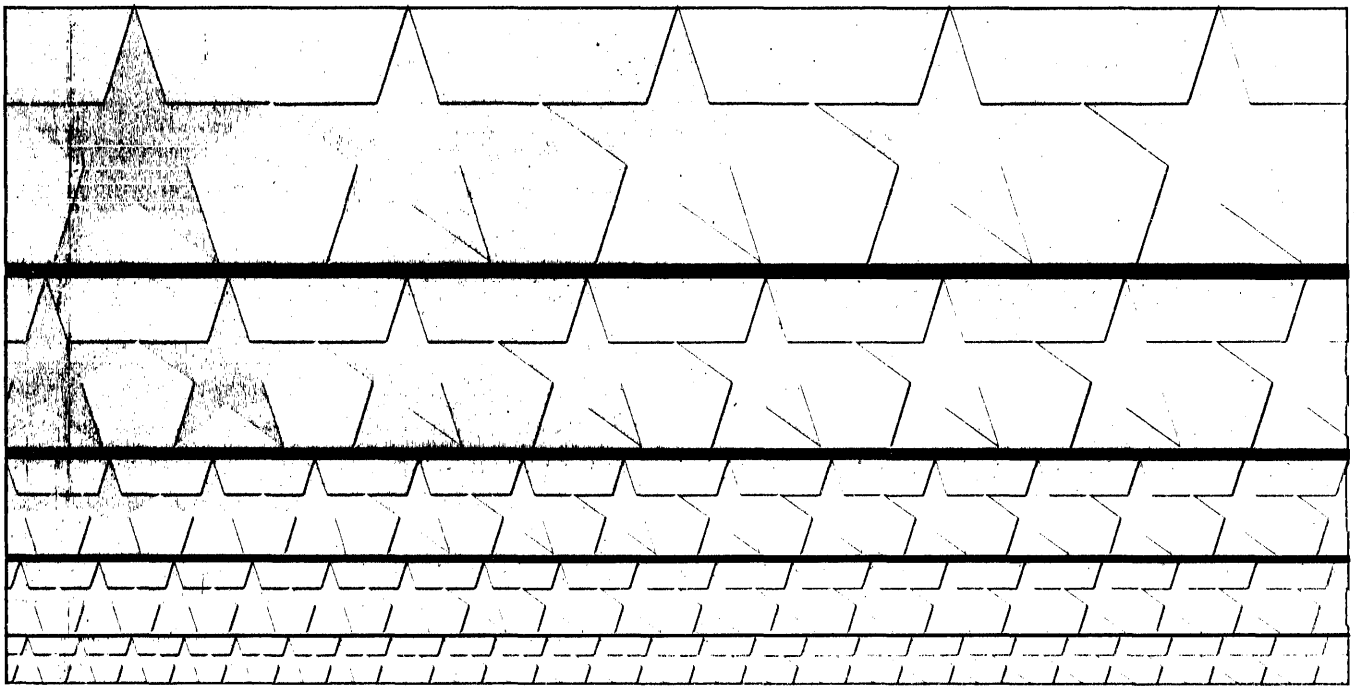

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CIRCLE 87 ON READER CARD

NEWS SCENE

Bank Needs 360/195 to Replace 22 Mainframes

The first financial institution to order IBM's largest computer, the 360/195, is the Mellon National Bank and Trust Co., Pittsburgh. The bank is the nation's 15th largest with assets of $4.5 billion, and presently uses no less than 22 mainframes for both in-house and banking-related service bureau processing.

All of the present cpu's will probably go and be replaced by the 195 plus perhaps a 370/165, but the bank's goal is not simply to dispose of 22 computers and replace them with two: rather, the bank plans to be able to provide in-house time-sharing, expand its teleprocessing network to permit on-line updating of accounts from the 101 branch offices which can now only retrieve information, and implement a central information file.

The central information file, which has already been designed, will be facilitated by use of the 195 and the large on-line storage capability afforded by the 3330 disc system. Accounts are presently being structured for use of the CIF, which will enable access to all accounts of a given customer through an inquiry based on the customer's name. Operation of the CIF on a very small scale should be effected during the first quarter of next year.

Present Mellon hardware includes two 7074s, a half dozen 1401s, several 360/30s, a 50, and two 65s. If the bank does not order a 370/165, one of the 65's will probably be retained. Mellon does a substantial amount of service bureau work, including demand deposit accounting for more than 80 other banks, as well as payroll accounting, utility billing, lock box analysis, etc. The present computer facilities handle Mellon's transactions for all its deposit, loan, and trust accounting, as well as record keeping for the branch offices.

The bank hasn't decided whether to buy or rent the 195, but there's still time: delivery isn't due until early 1972. Model 195 rental is $165-300K per month, and purchase is between $7 and $12 million.

Supernova Prices Cut In Price Nonwar

There may not be a "price war" in the minicomputer industry, but prices are coming down, and Data General is latest to hop on the bandwagon with a reduction from $11,400 to $9,600 for the firm's Supernova.

That's the price for a configuration including 4K (16-bit) words of core, a data channel, and Teletype interface. The 800-nsec Supernova cpu has been reduced from $6850 to $5600, and 4K core subsystems that were $4500 are now $3650. The same discount schedules previously applied to the Supernova will apply to the new prices; discounts range up to 40%

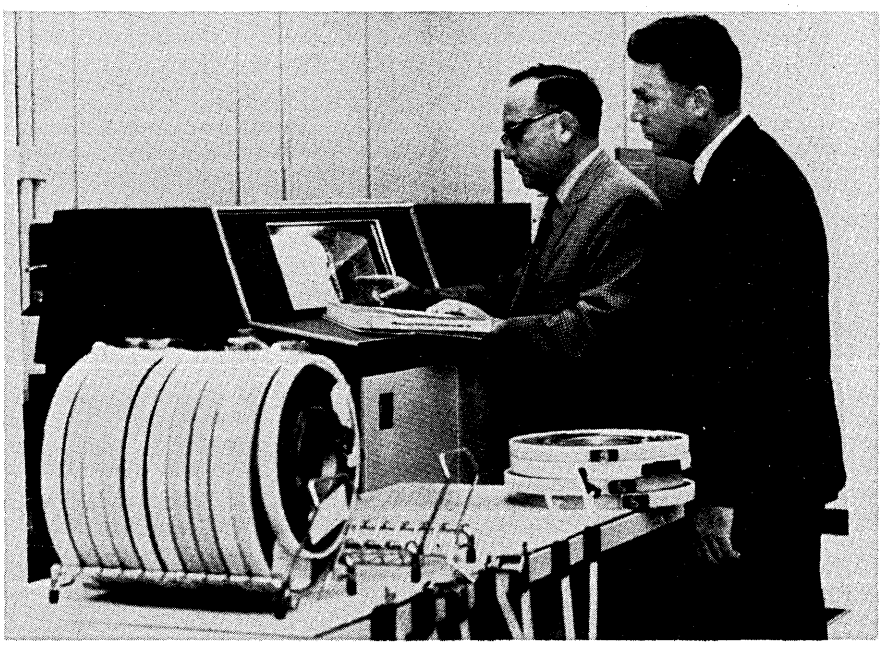
New York Uses Computer to Monitor Pollution

New York State may not have figured out how to *combat* pollution, but at least it's well along toward pinpointing pollution levels and locations. The Dept. of Environmental Conservation is using the Burroughs B 3500-based system to provide monitoring of air and water conditions, enabling conservation officials to be quickly warned of excessive pollution levels.

Essential elements of the system include 12 water monitoring stations and 11 air monitoring stations at critical sites around the state; a remote information center, which is used to receive alarm information from the computer, to call the computer or the monitors for additional information, and to transmit functional commands to the monitors; and a telecommunications system which transmits the data among the monitors, the computer center, and the remote information center. The field monitoring stations are specially equipped trailers with environmental sensors that measure either 10 water characteristics or 18 air characteristics. The computer automatically polls each air station every 15 minutes, and each water station every hour.

The B 3500 used is a commercial general-purposes system which is also used — through multiprogramming — for maintaining a blood bank inventory for hospitals in Albany, matching donors and recipients for kidney transplants, or calibrating equipment used for radiation detection, and other applications.

(Continued on p. 64)



State of New York Health Dept. receives regular reports on air and water conditions in pollution monitoring program. Department's edp director Harold Gottheim and Bill Thomas of Burroughs examine printout.

and are calculated separately on each subsystem; e.g., in an 8K system, there are discounts on the two 4K memory units.

The reason for the price reductions are said to be less because of competition from other firms than from rumors that new, cheaper mainframes will be forthcoming from Data General. The latter have apparently caused prospects to postpone orders. Meanwhile, competitive 16-bit machines are on the market (such as the Varian 620/f), and the Supernova prices will still glean a profit, so if lower prices increase sales sufficiently, both vendor and users should benefit.

Money Tight? So Who Needs It!

When Jack traded his mother's cow for a handful of beans, nobody was worrying about tight money.

And shades of those days, some people aren't letting it bother them now. A two-man Albuquerque systems house, Instrument Systems, Inc., last month sold the rights to a digital-to-voice converter to Bio-Logics, Inc., Salt Lake City. The price — 12 Nova's.

Bill Richards and Mike Breheny of I.S.I. developed the device they called Digivox over an 18-month period during which they had thoughts of producing and marketing it themselves. They quickly learned that the kind of money they would need to do this wasn't readily available. So they decided to sell.

Frank Atmore, marketing manager for health care services at Bio-Logics, saw the device and felt it would interface well with several of his firm's medical systems. Bio-Logics, a two-year-old subsidiary of the ITE Imperial Corp., had over-ordered on the minicomputers about a year ago based on (never met) sales projections for its Nova-based medical systems. They used the extra Nova's to buy Digivox.

I.S.I. is happy. Breheny said they consider the Nova's "highly negotiable." They planned to sell all but one which they'll keep to "play around with." And Bio-Logics is happy. They plan to start manufacturing the Digivox for sale for nonmedical purposes sometime this fall and to market it nationally by Jan. 1. Simultaneously they will begin incorporating it into some of their medical systems, such as an intensive-care monitoring system in which it would be possible for a doctor to dial the system and get a voice report on the state of a patient's respiration, etc.

Anyone for beanstalks?

Laser-Based Computer Promised for Next Year

First deliveries of a laser-based computer, featuring a trillion-bit electro-optical memory, are said to have been scheduled by Computer General, Inc., Irvine, Calif. Scant details on the processors and no information on the buyer are released by Dr. Frank Marchuk, the firm's president. But he said the first eight of 40 units ordered by three buyers will be delivered next April without the memory at a price of $350K each. Mainframe price with a trillion bits goes up to $500K, and for another $100K the buyer gets 10 trillion bits. The read-write memory reportedly has a full access time of 20 nsec. A new firm, CGI is a subsidiary of Marchuk & Metcalf Assoc.

Remote Maintenance to Be Offered in '71

Xerox Data Systems next year will offer maintenance-by-telephone service to Sigma series users who would be connected to a diagnostic laboratory at the company's El Segundo, Calif., headquarters.

Data from diagnostic tests on computers and peripherals at a user's site would be transmitted to El Segundo over telephone lines and analyzed by XDS systems service people who would send back step-by-step repair instructions.

The company said pilot tests with 28 selected installations were "highly successful" but it would like to cut down the time it takes to isolate the malfunctions. Although the tests were 100% successful in finding the source of malfunctions, the average time was five hours. One approach is to isolate only replaceable modules — a two-hour search — rather than tracing the difficulty all the way down to a single component, which would take another three hours.

IBM promised a similar service for 370 users in their June 30 announcement. It is called RETAIN (Remote Technical Assistance and Information Network). A system specialist would interrogate a computer for information relating to a problem and then check out the user's system over a telephone line.

Both companies look to obvious economies in maintenance talent. An XDS spokesman, for example, says that although five hours to check out a system is a lot of telephone time, it's much cheaper than sending a top maintenance specialist on a three-day trip from El Segundo to New York.

"It spreads our talent around."

Computer Follows Crop Following Students

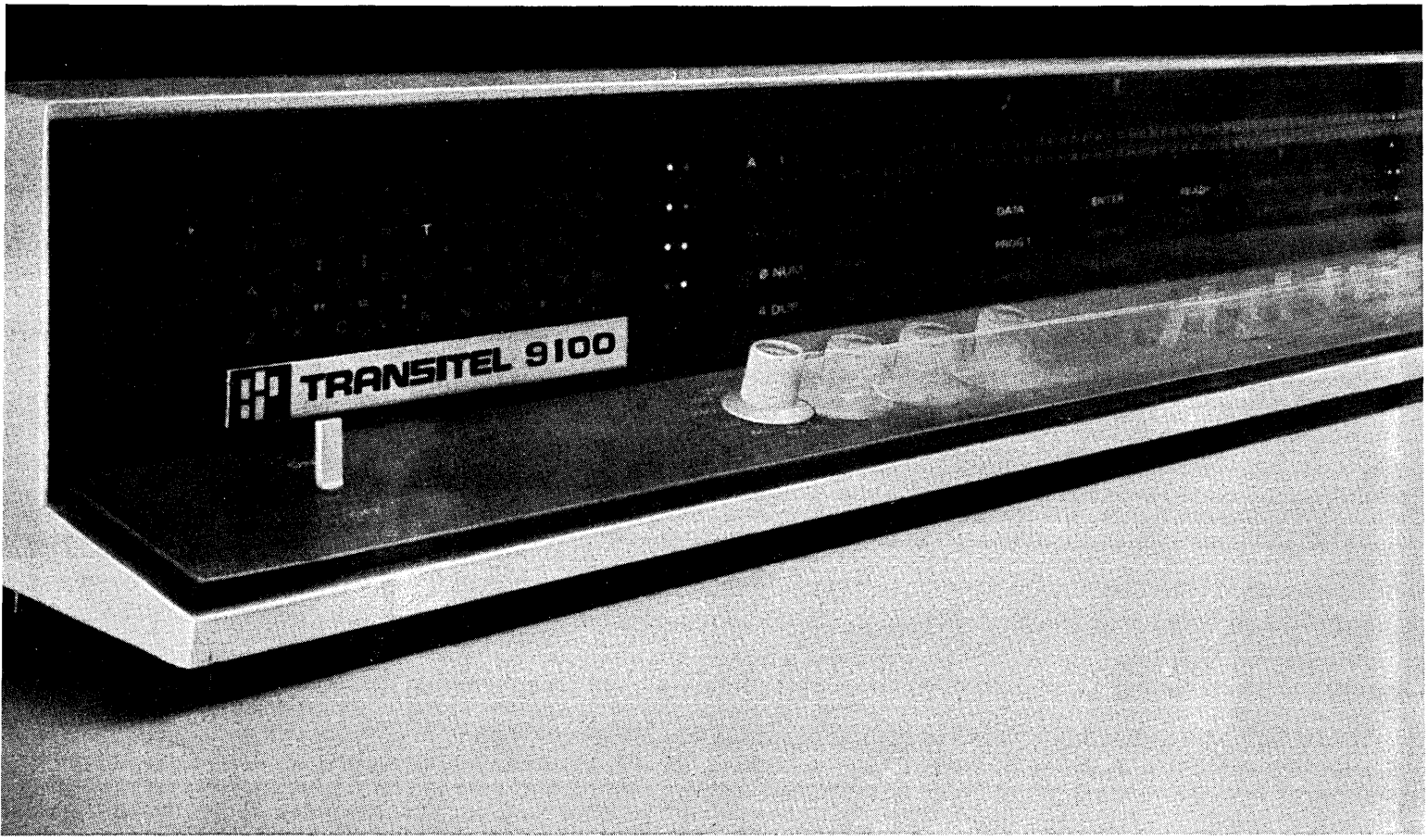
Children who follow the crops will, for the first time, be closely followed by up-to-date school records with implementation this month of a Migrant Student Record Transfer System.

Heart of the system is a CDC 3300 in Little Rock, Ark. Ultimately it will serve some 300,000 migrant students in 47 states. This month the first block of seven states goes on-line. Full implementation is scheduled for the end of the current fiscal year, July 1, 1971.

There was a time when just getting the children of agricultural migrant workers out of the fields and into the schools posed a big problem. Tighter labor and social welfare regulations have all but licked this. These children, whose families might move up to five or more times in one year, are attending schools, in many cases very good schools, but their physical presence in these schools isn't doing them much good. Student and teacher time often is wasted in administering tests already taken and repeating previous inoculations. By the time a placement decision is made, the student is often on his way to a new school.

With the new system, when a migrant student enters a school, his educational and health records are collected and put into the data bank. When he transfers, the new school requests and obtains his records via Teletype and is immediately aware of what additional tests must be adminis-

(Continued on p. 71)



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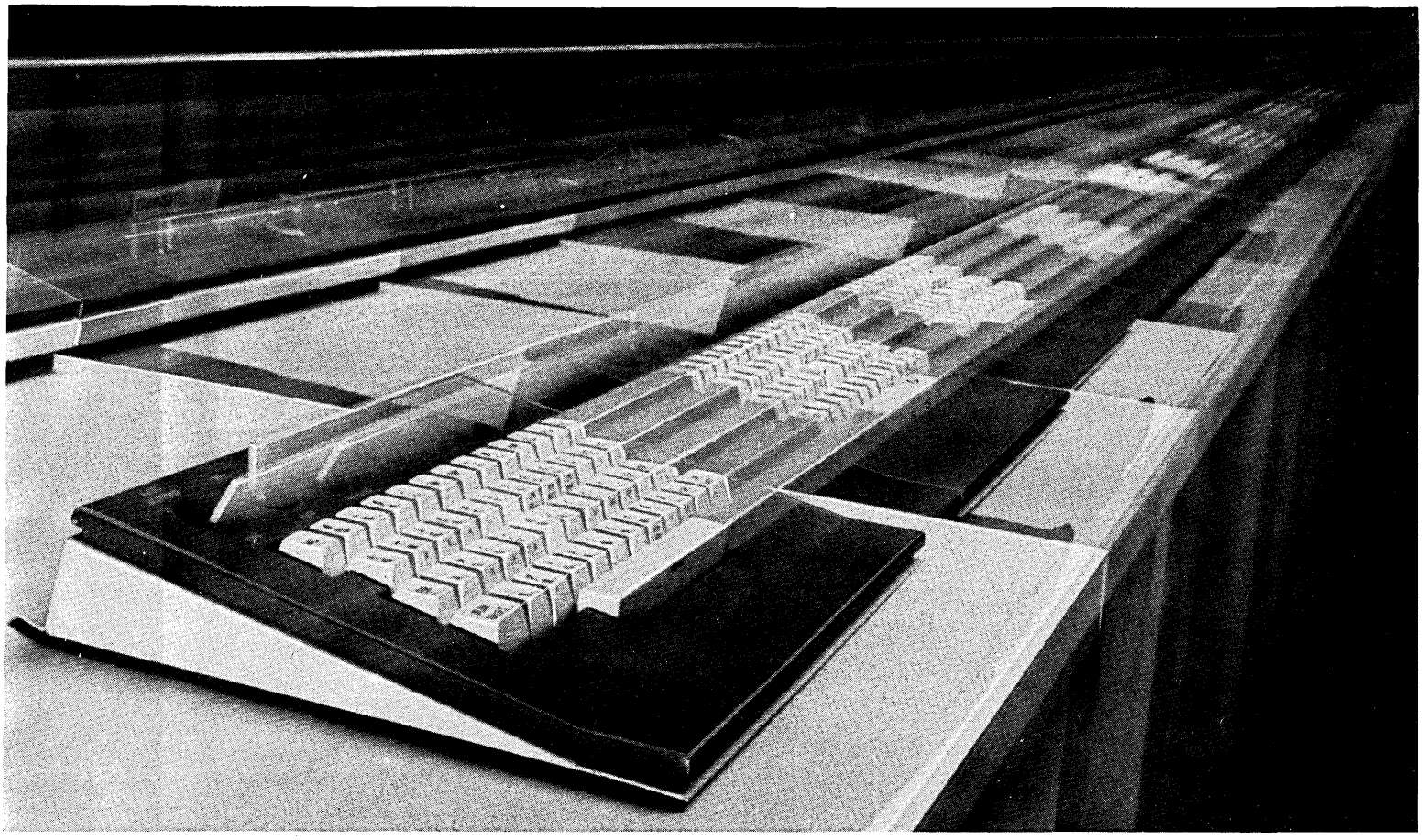

These high-performance units demonstrate Transitel philosophy. First, to engineer in more production potential. Then to people-design the equipment so workers can realize this potential... and enjoy doing it.

Consider these Transitel Data Station features:

English display uncomplicates learning. With true character representation, trainees don't have to memorize codes. They can read characters instantly. English display also helps them toward more accurate verification and easier error recovery.

Comfort design increases productivity. Operators appreciate the large work area (over five square feet of desktop), the convenient personal effects drawer, and the added leg room to reduce strain and fatigue.

Plus total tape control. Tape transport sits in upper desk drawer for easy access. Reel-to-reel handling, with automatic tape loading and unloading features, cuts set-up time.

And easy error correction. Operator-sensed errors are quickly corrected by backspacing, then entering the right character.

And flexible programming. Selectable record size (20-240 characters) permits a wide range of data formats.

And computer compatibility. Your choice of 7 or 9 channel ½" tape models, 200, 556, or 800 bpi density.

Transitel Key-to-tape Data Stations. Faster than others. Far easier to learn and use. Complete details in the new Transitel line brochure. Yours for the asking.

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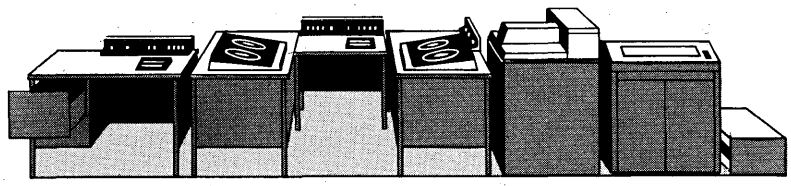

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Under normal line conditions, the Transitel Data Communications Terminal (7 or 9 channel tape models) transmits 1200 bps over Direct Distance lines. Or 1600 bps over private lines. Transmission is error-free and without loss thanks to character, format and parity error detection, as well as odd-even record check.

But what happens under storm conditions? Or any other noise-on-the-line conditions. Just flip the exclusive half-speed switch. Instantly the Transitel Data Communications Terminal slows to a more intelligible 600 (or 800) bps. Which, with Transitel error checks, assures clear, correct communication.

Easiest all the way. Basically an expanded Transitel Key-to-tape Data Station, the Data Communications Terminal can be quickly learned by any office clerk. It offers the proven advantages of English display and easier error recovery for simplest possible operation.

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Whatever the case, you'll find a Transitel Data Communications Terminal the most efficient of all. Under any line conditions. With any operator you choose. Additional facts in the new Transitel line brochure. Free on request.

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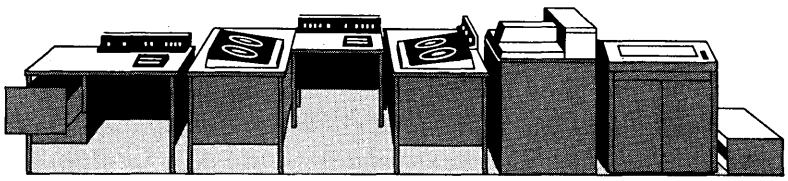

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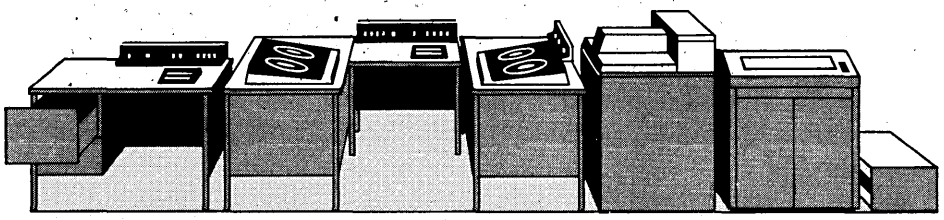

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tered, his educational level, and his health needs. Placement would be immediate.

The system includes a 266-million-character capacity disc file, a 96K ticipating school districts of federal model 200 user terminal, and high- and low-speed terminals. Disc storage is used for active records and tape for inactive students.

All files in the system have an access security code which must be known in order to access the files. The information will be available only to authorized educational agencies which will be governed by the same regulations in regard to them as cover dissemination of all academic and school health records in their respective states.

The system was developed under contract to the U.S. Office of Education by the Arkansas Dept. of Education and the computer department of the Univ. of Arkansas Medical Center. It is funded by set-asides by participating school districts of Federal appropriations under the Elementary Secondary Education Act.

Automated Systems Corp., Washington, D.C., which served as a consultant to the Office of Education in development of the RFP for the system and monitored its development, currently is studying its feasibility for use for military dependents based on an inquiry from the Air Force. Also under study is possible use by the U.S Public Health Service of fallout of health information from the migrant student data bank.

FCC Edges Toward Phone Competition

The FCC last month took a small step toward opening new specialized communications systems to new carriers, particularly those planning data transmission networks. After splitting three to three on the issue, the commission decided to seek comments on a staff paper that concluded that market potential is sufficient to support more than one applicant in an area, and that users should have a wide choice.

The paper found that new entries would disperse risks and initiatives, and stimulate technical innovation. It saw no merit in the claims of existing common carriers that the applicants for new systems were trying to "skim the cream" off the most profitable markets, and stated that the applicants are seeking new communications markets.

Comments are due to be filed by Oct. 1, 1970, and replies by Nov. 2, 1970. Commissioner Nicholas Johnson, calling the action "timid," said it was "simply a prelude to interminable delay."

Proxmire Committee Looks Closer at EDP

Joint Economic Committee hearings last month indicated that Sen. William Proxmire's legislative group will be bearing down more on government edp equipment procurement and management.

Proxmire faulted the federal edpe inventory system for excluding equipment within weapons/space systems and much of that used by contractors. He accused the industry of footdragging on its standards program and suggested the National Bureau of Standards budget be boosted to speed up its interface program. Committee members said lack of interface limits competition and wastes funds. They expressed frustration at government dependence on industry to develop the "state of the art" and urged more federal independence.

NBS sources indicate the agency will give more priority to interface development and is looking hard at a black-box type interface as a near-term solution. NBS won't build it but will do engineering analysis and design specs for government purchase.

CUC's New Management Looks at New Markets

Computer Usage Co.'s new management is taking the venerable software company into new markets in search of profitability.

President Vic Bartoletti has outlined plans that will have CUC selling systems engineering services, ser-

(Continued on p. 72)

vice-center-based applications data processing, and sales representative services for peripheral gear, in addition to its staples, contract software and facilities management, which have been emphasized since he took office.

The plan, in the works since Bartoletti and his crew from Computer Technology/South came on board, tries to make the most of existing capabilities. Bartoletti said the company is already partially in systems engineering and that implementation of this portion of the plan will be accomplished by redefining and repackaging services and hiring some applications specialists.

The sales representative service, he said, will get under way in the last quarter of this year. The company is negotiating with four or five manufacturers and has hired as director of the operation Allan Flitcraft, previously with Computer Technology, Inc., as vice president for new markets and before that product manager for the IBM 360 computers.

The data processing centers will be implemented last. Bartoletti said the earliest opening date could be April 1971 but would probably be June of that year. He said each center would handle specific applications but did not say which ones they would be.

Bartoletti, who claims a single product company is a weak company, said broader markets are necessary for survival and growth. He added that entry into the new areas will not cost that much. The money for the expansion will come out of some $5 million collected from pre-1968 earnings and a 1967 stock sale. Some of the money will go to increase sales outlets — initially the reopening of CUC offices in Dallas and Chicago — and to hire more salesmen and people to run the applications centers, he said.

Bartoletti has been at CUC since June. He came to the post through the good offices of Morgan Stanley & Co., the company's investment banker, and has apparently moved smoothly into the president's chair. He is also treasurer.

Over the past few months he has begun the facilities management marketing operation. A staff of eight directed by vp Bob Creekmore, one of five from CT/South, touches base with all operating units and has begun to exert some centripetal force on the decentralized CUC organization.

Next on Bartoletti's agenda is completion of a long-range plan for the company. It is now being formulated under the guidance of Fred Connelly, another ex-CT'er, now a vice president and director of CUC and the man who prepared the current plan.

Commerce Launching EDP Export Campaign

The Commerce Dept. will launch an edp equipment "Global Marketing" export program this month.

The program provides for extensive market research in 25 promising countries, counseling services, and participation in Commerce-sponsored promotional projects. Research covers the full edpe range, pinpoints sales prospects, and analyzes end-users, current distribution and pricing practices and trade restrictions, and technical requirements.

Lists of suitable importers will be compiled for each country. Commerce has identified some 200 overseas trade shows and meetings for 1971 and plans to participate in 30. The agency wants to work with individual firms in planning two-to-five-year export programs. Contact local Commerce field offices for materials. Project coordinator in Washington is William Bushwaller, Global Marketing Program. Telephone: (202) 967-2356.

New Financial Services Compete with S&P

A firm founded by former Standard & Poor's executives last year is now offering securities information services for financial institutions in competition with S&P. Telstat Systems Inc., New York, characterizes itself as being in the "computer publishing" business, distributing tapes containing financial information for user computer installations. A time-sharing service to provide on-line access to information is also provided, however.

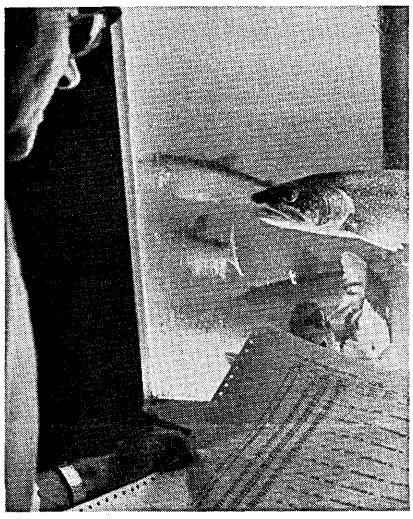
The company's first product, Telprice/70, was introduced in May. It's a tape service which provides more than 40 blocks of information on nearly 12,000 securities traded on several major exchanges, and in-

cludes dividend information. Tapes are distributed daily or at less frequent intervals if desired. A daily service for the New York and American stock exchanges, including stocks and bonds, plus over-the-counter information, is $6600 per year. A new on-line service, Telac/70, provides retrieval and manipulation of data using FORTRAN IV-H, Extended BASIC, and the firm's own financial language, ASSIST (A Simple Statistical Investment Selection Tool). Telestat's computer center uses a Sigma 7 cpu.

The 26-man Telstat is headed by a woman, Miss Penny Kaniclides, founder and president, who was formerly vp in charge of computer operations at Standard & Poor's. Despite the tight money situation, the new firm has raised more than $1,000,000 privately, and has seen fit to spend about $250K of that outfitting itself with luxurious offices only slightly less beautiful than the company's president. But it's all intended to serve the user. They claim their services are cheaper than S&P's for what is provided. And they're open 24 hours a day in case of graveyard shift problems.

NEW COMPANIES

A firm founded with expectations of benefitting from the IBM/370 is **On-Line Business Systems, Inc.,** which, while counting on its own "proven techniques" to make transition to online terminal-oriented systems economical, thinks the 370 will be a big help. Founder Jeffery D. Stein was r&d manager for Greyhound Computer in San Francisco before setting up shop in the same place .... A software leasing division has been formed by **Equipment Finance & Management Co.,** again in S.F. The user is offered a program package without the usual initial outlay, and the originating software house receives immediate operating capital and can retain its proprietary rights by buying back the package at the end of the lease. EFM already is leasing packages to 360 users; its new division will act solely as a financing agent, won't provide maintenance or program modifications.... Down the peninsula in Palo Alto, **Data Economics** will audit computer installations to measure their efficiency and cost effectiveness in both operations and support services. The company also offers to help user personnel become accustomed to their computers by teaching computerthink in information processing operations.... A group formerly with IBM's service bureau has formed **Universal Analytics, Inc.,** in L.A. to furnish "problem-solving services in engineering and management sciences" and already is developing several proprietary software packages. ... **Faim Information Services, Inc.,** has a new subsidiary, **Information Spectrum, Inc.,** which in turn has a new division, **Bell & Associates,** both in Cherry Hill, N.J. ISI will deal in source data automation techniques, and B&A will educate the requisite personnel for the systems.... **Dest Data Corp.** has been formed in Sunnyvale, Calif., to provide components and systems for video processing equipment, claiming it can eliminate much computer processing of data. Its vp and technical director, Ian H. Mallender, has made important contributions to laser systems and has been active in establishing OCR and COM standards.... Another facilities management company, **Industry Computing Systems, Inc.,** has been formed in L.A., one-third owned by Scott Paper, and says it already has a $750K contract.



There's nothing fishy about this printout except, perhaps, the surroundings and its purpose. It and the specimens are part of studies being conducted by the Great Lakes Fishery Laboratory of the effects pollution has had on the Great Lakes fish population. An IBM 1130 correlates data from lab studies, from four research vessels on the lakes, and from commercial fisherman and state agencies.

MERGERS, ACQUISITIONS

Specialized services for specific industries are being grabbed off as plums by those looking for a comparatively ready-made market. **Data Listing Service,** Chicago, is being acquired by **Tracor Computing Corp.** of Austin, because its "products and services will be immediately applicable . . . in markets we have been seeking to enter" through TCC's regional information processing centers. DLS software and services encompass wholesaling, heavy equipment and clothing franchising. . . . **Auto-Graphics, Inc.,** a computerized typesetting company in L.A., has acquired **Automated Price Lists,** Cincinnati, and its system for the production and maintenance of price catalog information already used by some 50 paper companies. The melding of these two services into one organization should result in "enormous savings in money and time for paper companies." . . .

Also in the publishing field, **Rome Research, Inc.,** NYC, has acquired **Software Systems, Inc.,** with subsidiaries **Reid & Thomas** and its **Polygraphics** division, for cash and licensing privileges on some of its proprietary programs, with the idea of extending its computer dp publishing services into the Washington, D.C., and Atlanta areas. Rome also furnishes data-base services to the advertising industry. . . . Firms presided over by *Datamation* contributing editors have made acquisitions: **Information Management, Inc.,** San Francisco COBOL-oriented software house headed by Howard Bromberg, now owns **La Prelle Associates,** a NYC and Lexington, Mass., firm specializing in design and installation of computer facilities. It will operate as a subsidiary. . . . Lowell Amdahl's San Fernando Valley systems consultancy, **Compata, Inc.,** now owns **Synergetic Sciences, Inc.,** same location, specializing in analysis and engineering of complex systems, with emphasis on the financial community. . . .

Automatic Data Processing, Inc., with centers in most of the metropolitan areas of the country, is still acquiring — **Petro-Chem Computing, Inc.,** Houston; **Keystroke Services, Inc.,** Atlanta; and **Computer Data Prep, Inc.,** Stamford, Conn. Their names will all be changed to ADP of wherever city they are; ADP hq is Clifton, N.J. . . . **Computer Applications Inc.,** which recently scrapped its five-year, $16 million investment in the Speedata computerized national market information service for the grocery business, has unloaded certain of its assets relating to services in the Northeast and the NYC area to **Programming Methods** for an undisclosed amount of cash.

NEWS BRIEFS

IBM Answers Xerox

International Business Machines again denies it is infringing or wrong-

(Continued on p. 76)

Get computer printout at 1/3 the paper cost:

Use a service bureau equipped with a KOM-90 Microfilmer.

A wide range of computer users in the Midwest send their magnetic tapes to Computer Microforms, Inc., "An American Micro Affiliate," Kansas City, Missouri. This service bureau uses its KODAK KOM-90 Microfilmer and COMplete Service program to do such jobs as converting a bank's daily trial balance to microfilm at one-third the cost of paper printout.

It also processes engineering catalog data for an industrial firm. Accounts payable for retailers. Stock transfers for a brokerage firm. Sales reports for many companies.

A service bureau near you, equipped with a KOM-90 Microfilmer, can offer you similar savings. You'll get your data back fast on compact, easy-to-read microfilm—even coded, if you wish, for automatic retrieval.

Can you use a service bureau and save money? Call your Kodak microfilm systems representative. Or write Eastman Kodak Company, Business Systems Markets Division, Department DP682, Rochester, N.Y. 14650.

Kodak Microfilm Systems

fully using Xerox patents or confidential information with its new line of copiers. Filing its brief in late July, IBM pointed out that Xerox had withdrawn 11 of the 22 patents it claimed the computer manufacturer had infringed in its April 21 patent suit and asked that the remaining patents be declared invalid. The company asked the court to rule that the Xerox patents were unenforceable because the copier manufacturer had misused its patent position and technical information. IBM claimed basic patents on the Xerox copier have expired and can be freely used by anyone, but the company has tried to bar competition by patenting large numbers of minor variations of the methods and materials used in its machines.

Poppa Heads DPF&G

At 36, Ryal R. Poppa has achieved near elder statesmanship in the computer leasing business. The one-time IBM executive is president of the Computer Lessors Association, until last month was president and chief executive officer of Greyhound Computer Corp., the computer leasing and service organization, and now is the new president and chief executive officer of Data Processing Financial & General Corp. (DPF&G), also a computer leasing firm.

In May DPF&G, which said it expected to report a loss of $4.3 million for fiscal 1970 ended May 31, announced the resignations fo Harvey Goodman, founder of the company and chairman and chief executive officer, and of Archie J. McGill, president. The company still is without a chairman. At Greyhound, W. Carroll Bumpers, 49, was named president.

COM-ing On Strong

COM equipment is coming on so strong that forecasters are hard put to predict just how far the market will go by 1975, but the most conservative of recent estimates by three different companies says it will at least triple by then. Quantum Science Corp., a technological information service of both NYC and Palo Alto, Calif., puts the '75 figure at $120 million, up from a present $40 million. Creative Strategies, Inc., a research firm also based in Palo Alto and staffed with Stanford Research Institute alumni, figures in its COM report that the market for alphanumeric recorders alone will go from $17 million to $118 million in the next five years. CSI believes there will be even more spectacular development of automatic retrieval devices.

Both companies agree that "equipment" strictly interpreted (as William Coggshall of CSI points out, much so-called COM equipment included in some predictions is also used for other purposes) will not amount to an overwhelming percentage of the microfilm industry as a whole, which is also expected to triple by '75, to about $1.2-1.4 billion. But Frank Sheer, physicist at National Cash Register's microfilm facility in Dayton, Ohio, which recently installed its first COM system, the FR-80, believes that equipment will take up 70% of the total '75 microfilm market, which he estimates will be a comparatively modest $750 million.

I/O Systems Seminar

Fourteen manufacturers of I/O products will take part in "Input/Output Systems Seminar 70," Oct. 26-28 at the Barbizon Plaza hotel in New York.

The seminar, sponsored by the Data Processing Supplies Assn., 1116 Summer St., Stamford, Conn. 06905, will consist of "case history" presentations on OCR hardware, key-input devices, high-speed printers, perforator-tape devices and allied memory products. Registration fee is $150.

Tomorrow the World

One outfit apparently unafraid to face problems on a global scale is Simulation Councils, Inc., technical society that has formed a World Simulation Task Force, originally proposed a little more than a year ago, now enhanced with an impressive roster of newly elected trustees. The purpose and progress of the group, as stated in its recently released report outlining a program for the year ahead, is in promotion and evaluation of world simulation work, using the Delphi forecasting technique to synergize already existing data. A symposium is being organized to bring together the workers concerned, and proceedings will be published.

The trustees involved are Ben Clymer, Wayman Crow, Murray Dickman, Donald Fairburn, Buckminster Fuller (of geodesic fame), Carl Hammer, Peter House, Philip J. Kiviat, Yoshitaka Koue, Michael R. Leavitt, Paul Medow, P. N. Rastogi, Thomas B. Turner, Murray Turoff, and Roland Werner. John McLeod, editor of the society's journal at headquarters in La Jolla, Calif., was appointed executive director.

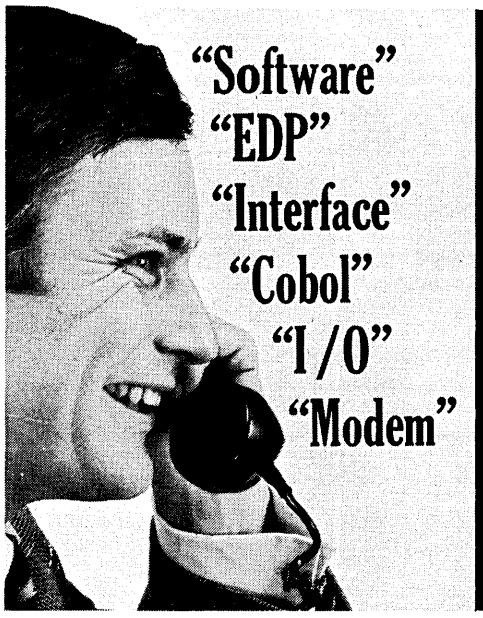
Let the Biller Beware

Companies which rely on computers to send out monthly credit statements would be required to admit their systems' mistakes under the Fair Credit Billing Bill (S.4108) introduced by Sen. William Proximire (D-Wis.). Companies would be required to mail statements 21 days prior to the payment due date; to acknowledge a customer complaint of a mistake within 10 days; to either correct the error or explain why there was no error within 60 days; and to inform the customer of his "computer rights" at the time an account is opened. Failure to comply would mean foreiture of the right to collect the disputed amount and possible punitive damages.

SHORTLINES

The Singer Co. has agreed to bolster Cogar Corp., go-getting upper New York State computer technology company, with $6.5 million, secured by notes convertible into Cogar common stock by the end of 1972. Singer expressed faith in Cogar as an investment, particularly since it is helping Singer's Friden Div. develop an "important new product of advanced technology," due in 1971. And Cogar top management is anteing up another $1 million of its own.... In the meantime, Singer's Link Div. agreed to buy $5 million worth of Systems Engineering Laboratories' 86/88 midicomputers over a three-year period and is planning to incorporate some of them in simulators that will train flight crews for jumbo jets like the Boeing 747 and DC-10.... In its first year of deliveries, Computer Machinery Corp. has shipped $10 million worth of its KeyProcessing systems, not a bad beginning. ■

DO YOU KNOW THESE MODERN BUSINESS TERMS?



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JUST 6 LESSONS—24 HOURS OF YOUR SPARE TIME

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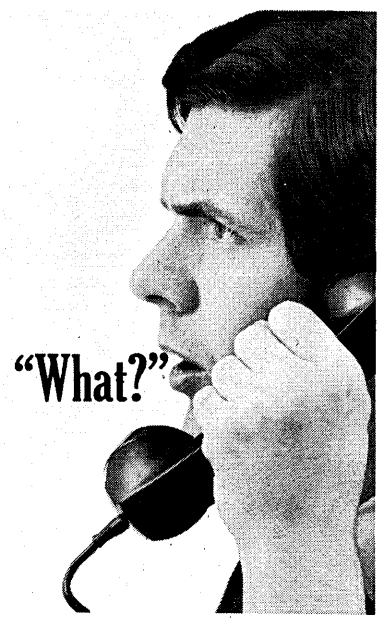

The future belongs to the computer oriented executive

Prepare for tomorrow now! Hundreds have learned to understand this modern business tool quickly, easily, at home, the A.T.I. way. You can, too. Enroll, without risk, in **"Computer Basics for Management"** today.

6 easy lessons to full understanding

Without any prior knowledge, by the final lesson you have cleared up the mysteries of EDP, written your own program to prove it and, most important, as a "Computer Oriented Executive," you are ready for tomorrow's opportunities.

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But, in just 24 hours of your spare time you can master the fundamentals of EDP—all aspects, from the major elements and functions of computer systems, through machine and assembly language, to basic programming principles. It's comprehensive, concise, but certainly not a crash course. You study at your own pace, thoroughly mastering one lesson before proceeding to the next.

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Through the repetition of hearing—seeing—doing, the Tri-Media Method skillfully combines the major elements of learning to increase your perceptive and retentive ability. The many students tested on campus and TV found Tri-Media the easy way to EDP understanding. So will you!

Developed by a task force of experts

A.T.I. is an accredited member of the National Home Study Council, specializing in management training. It was organized by the publishers of "Datamation," the most respected magazine in the computer field. This singular association made possible the selection of outstanding EDP instructors, who perfected and tested this course at a large university.

All course material supplied by A.T.I.

Absolutely no extras! Your complete study package arrives, postage-paid, ready to start. This includes • a standard, fully transistorized, cassette tape player with 4 batteries, which you can use for pleasure, later • 6 cassette taped lectures • an illustrated workbook • flip charts and test books for each lesson • plus an introductory cassette with full instructions on how to proceed.

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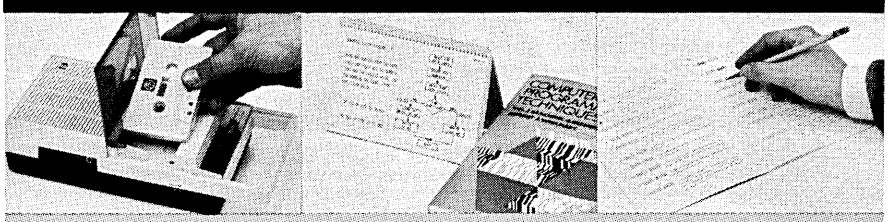

YOU HEAR **YOU SEE** **YOU DO**

While you **LISTEN** to the lecture you **LOOK** at accompanying flip charts, clearly illustrating every step as you progress. When instructed, you stop to **RECORD** your newly acquired knowledge in your workbook. This implants it firmly in your mind. If not clear the first time, replay a lesson as often as you like, or repeat portions as you go until you fully grasp every detail. Finally, to avoid any misunderstanding, complete the Test Book for that lesson and mail it to the A.T.I. Grading Center. There, an experienced instructor will personally review your work, returning it promptly with corrections or suggestions clearly noted. **It's that simple . . . but so effective.**

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FREE Datamation Glossary: Enroll right now and receive as a gift the popular "Datamation Glossary"—62 fact-filled pages of data processing terms. It's the last word for anyone who must communicate in modern business. And it's yours FREE, whether or not you decide to keep the course, **if you act at once.** So, fill in the coupon and mail it today.

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What's a Honeywell 1648 Time-Sharing System?

It's FORTRAN IV: Hollerith strings; mixed mode arithmetic; memory-to-memory format conversion; octal constants; file I/O with six concurrent files; dynamic file redefinition; random files; time functions; compile and go; AND, OR, EXCLUSIVE-OR functions; program trace; item trace; object files.

It's BASIC: extended matrix, string, file I/O with six concurrent files, dynamic file definition, external subroutines chaining, time functions, trace, compile and go, data format statements.

It's 48 simultaneous users, random files, tape files, project accounting, 960 subscribers, many active temporary files, dedicated or dial-in ports, password files.

It's an applications library of programs: business and marketing, curve fitting and regression, general education, electrical engineering, financial, general engineering, mathematics, mechanical engineering, operations research, social science, statistics, general purpose utility, general purpose scientific, etc.

It's over 30 commands. It's EDIT. SOLVE. TEACH. It's the best in cost/performance.

It's worth finding out more about: the H1648 Time-Sharing System. Buy or lease? Write Honeywell, Computer Control Division, Framingham, Mass. 01701. Can't use a whole one? Rent a piece of one. Write Honeywell, Information Services Division, Minneapolis, Minn. 55408. But whatever you do, consider the alternative. Consider Honeywell.

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Honeywell

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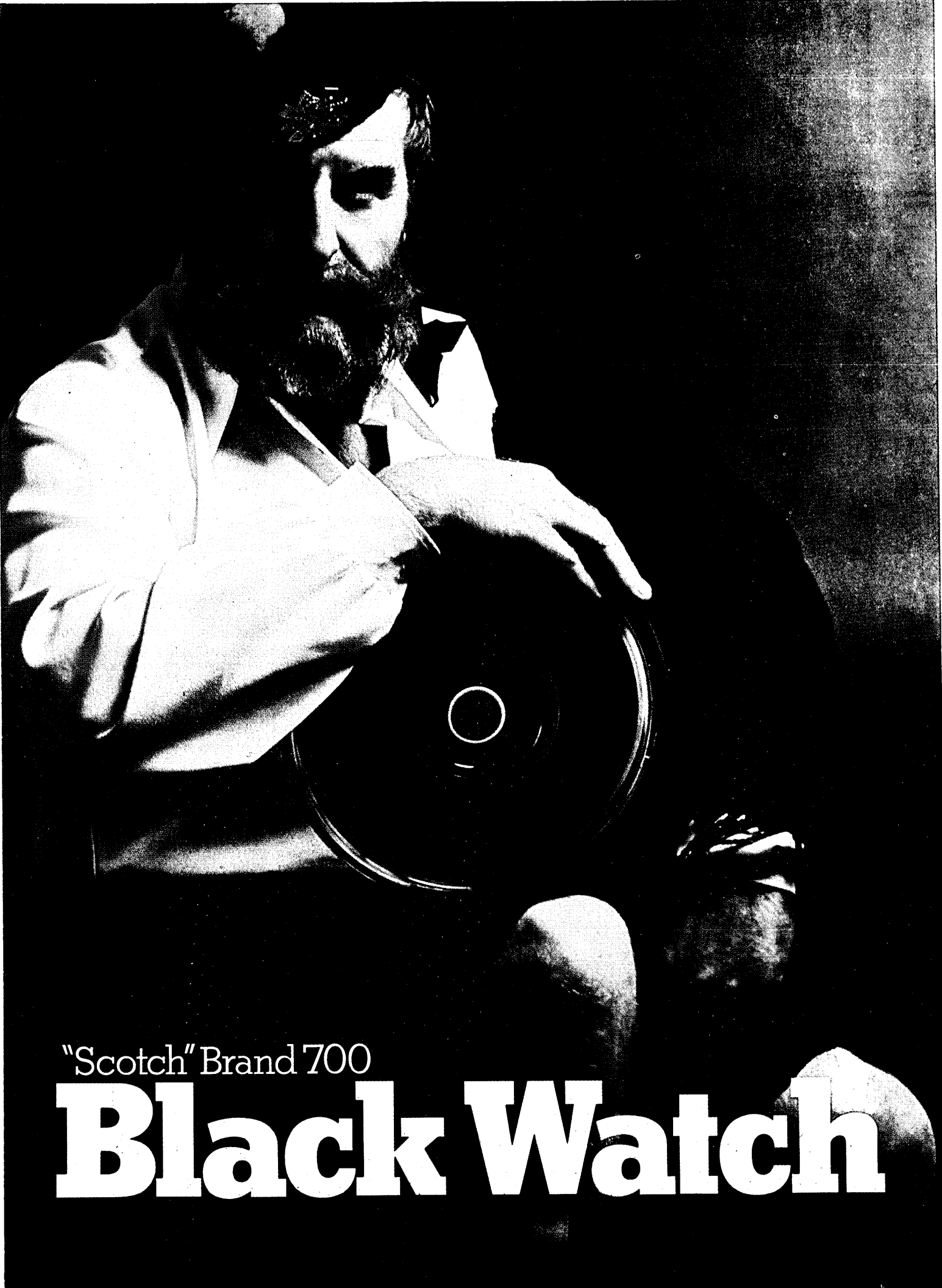
CIRCLE 55 ON READER CARD


"Scotch" Brand 700
Black Watch

The computer tape that guards itself.

It protects your valuable data.

Now, 3M takes the next step in computer tape. An exclusive new textured backing gives Black Watch a built-in resistance to physical damage in shipping, storage and handling.

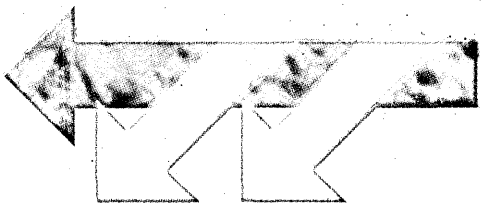
Cinching and edge damage are dramatically reduced.

If the tape shifts, due to temperature change or improper wind tension, the textured backing permits the roll to regain its normal configuration without permanent damage or loss of data.

A new resistance to scratches on the backing helps prevent the redeposit of dropout-causing polyester chips and effectively extends tape life. Where conventional tape was severely scratched after 500 passes, Black Watch showed no significant wear after 2000 passes on the same tape drive.

New protection against dust and airborne contaminants is built in, too. The conductivity of the textured tape backing reduces static attraction of dust and dirt particles. In addition, increased tape compressibility minimizes distortion and damage caused by wound-in debris.

Lower tape skew (a diagonal passage across record heads) means fewer interchangeability problems and fewer reruns.



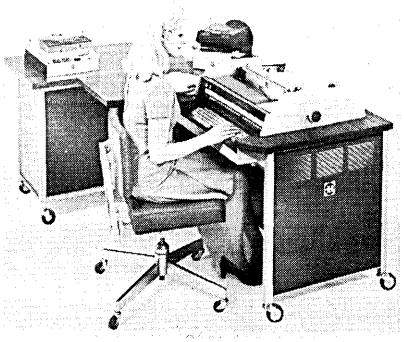
Want to call out the guard? Ask your 3M representative or write Market Services, Magnetic Products Division, 3M Center, St. Paul, Minn. 55101. Find out how "Scotch" Brand 700 Black Watch computer tape can protect you against loss of time and money.

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

3M COMPANY The barrier breakers.

Accounting Computers

The L3000 Series accounting computers can also operate as billing computers or as terminal computers for on-line applications. The five models use firmware to perform basic logic and arithmetic functions, including control of I/O. Programs are written in COBOL. The L3000 computers handle punched tape and edge punched cards as well as 80-column cards. An alphanumeric keyboard and a numeric keyboard



permit manual input.

Four models perform as operator-attended accounting computers, while the fifth model can perform both in an operator-attended mode and in an on-line communications mode. All are sufficiently modular to permit upgrading. Purchase prices range from $9,490 to $13,290; rental is $240 to $335 per month. Applications programs are separately priced. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 330 ON READER CARD

Modular CRT Terminal

The first departure of this vendor from magnetic tape oriented systems is a modular crt/keyboard terminal, which is available in several configurations. Modular components include a 64-character/16 function code alphanumeric ASCII keyboard, video monitor, acoustic coupler, and electronics unit, arranged in traditional tabletop console fashion or installed in a desk. The terminal is available less the monitor if tv sets or monitors are already available to the user.

The keyboard is compatible with standard tv sets, attached by a wire to the antenna terminal posts. A single keyboard is capable of driving up to 50 monitors. A portable unit including keyboard, acoustic coupler, and electronics is available. The crt provides 20 lines of 40 or 72 characters at speeds from 110 to 9600 baud. Price for the basic unit—keyboard, monitor, and electronics—starts at $3350. COMMUNITYPE CORP., New York, N.Y. For information:

CIRCLE 331 ON READER CARD

Image Digitizer

For conversion of pictorial images into digital format for processing by a computer, the model 55 digitizes 16, 35, or 70mm slide or roll film with a resolution of 1024 by 1024 or 2048 by 2048 points with 64 different intensity levels. (Other variations on the theme exist for digitizing odd-size film or opaque material, and for interface to a customer's particular optical system.)

Together with their previously announced crt unit, the vendor markets the digitizer as their "Photomation" system. It is capable of far better resolution than television images, and is used in such high accuracy applications as aerial reconnaisance and medical research. The digitizer is base priced at $29,500. DICOMED CORP., Minneapolis, Minn. For information:

CIRCLE 332 ON READER CARD

Arithmetic Processor

The capacity of small-scale computers can be extended using the Model 2400-10J Trigonmetric Processor. The unit operates in real-time as an additional arithmetic processor with a general-purpose computer. It incorporates 24-bit arithmetic for multiplying and dividing, as well as for complex arithmetic.

The 2400 operates on a subroutine basis, permitting the use of macro-programming. Initial use of the 2400 was in automatic radar data control systems using Varian 520/i minicomputers. These systems generate four sets of coordinate rotation information at a rate of 20 per second. Additional applications include map making, high-speed crt display computations, automatic test equipment, and hybrid systems. The price for a system, including interfacing, is around $10K. Delivery requires 60-90 days ARO. MILGO ELECTRONIC CORP., Miami, Fla. For information:

CIRCLE 333 ON READER CARD

Office Microfiche

The initial product from this vendor is a microfiche processor unit so easy to use that even untrained personnel can run it. No darkroom or other special equipment is required.

Microfiche is created by inserting a film pack into the device, removing the protective cover, placing the material to be filmed on a platform, and pressing the magic button. This process is repeated until all the single frames desired have been read, and then a process button creates the fiche frame.

To aid the operator in keeping track of exposure placement is a visual display panel which constantly shows the position of the image being reproduced. The operator may temporarily bypass as many spaces or rows as necessary to organize information on the fiche.

Documents up to 14 x 14 inches, including handwritten, sketched, and color material, are accepted. Delivery will be in January for the $9970 machine. It can also be leased from MICROGRAPHIC TECHNOLOGY CORP., Orange, Calif. For information:

CIRCLE 392 ON READER CARD

(Continued on p. 89)

HARDWARE

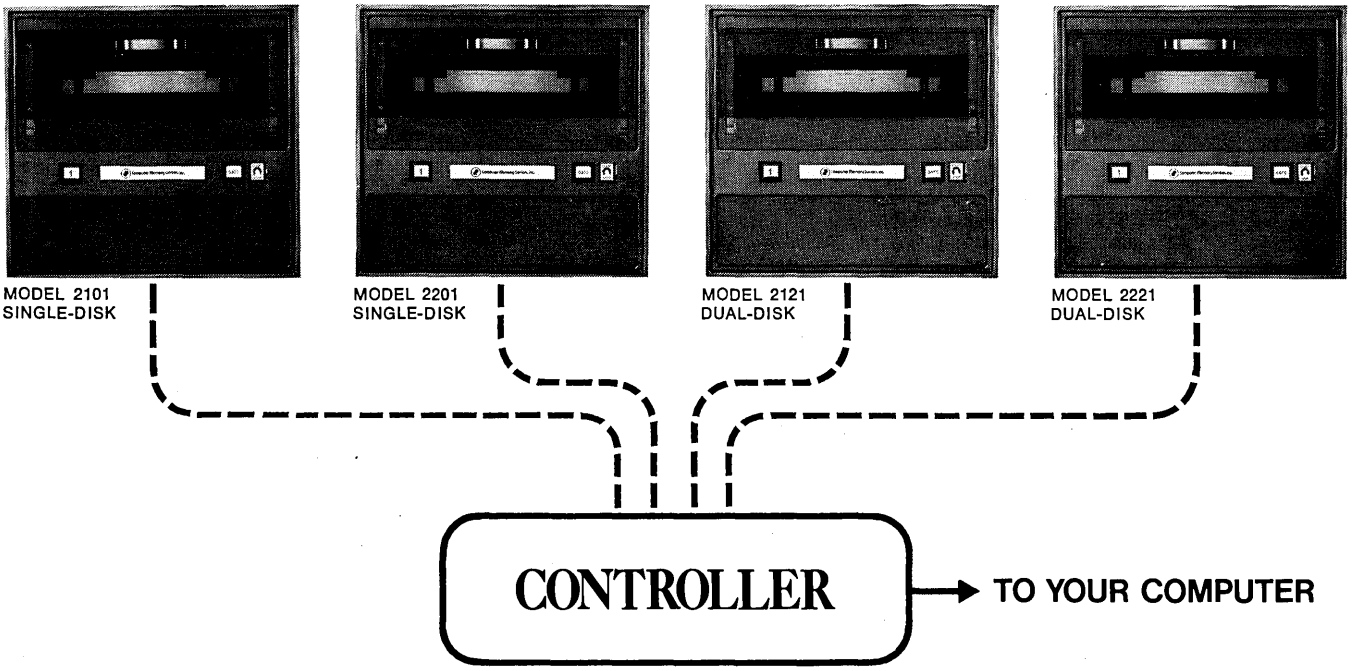
Computer Memory Devices Announces a $9,950 Disk Sub-System

...for any computer

We proved that a good disk memory drive doesn't have to be expensive, with our MD-2101-2. Now, we're proving that a disk sub-system doesn't have to be expensive. Computer Memory Devices is offering a complete disk sub-system including our MD-2101 single disk drive, power supply and controller for *any* computer for $9950... and that's just *one* of the systems available.

Because CMD offers a complete family of ultra-reliable disk drives using the IBM 2315-type disk cartridges with capacities ranging from 11.5 megabits to 46.0 megabits; in single (removable) and dual (fixed and removable) disk configurations *you* can choose the sub-system which best fits your needs... at the lowest prices in the industry.

Your disk sub-system will be backed up and serviced by a nation wide field service organization. And most important, you get *proven* CMD quality and in-the-field reliability. For detailed information contact Tazz Pettebone at Computer Memory Devices, Inc., 5170 W. Bethany Home Road, Glendale, Arizona 85301, Phone (602) 939-9444, TWX 910-950-1244.



	MD-2101	MD-2201	MD-2121	MD-2221
Density (bpi)	1100	2200	1100	2200
Capacity (megabit)	11.5	23.0	23.0	46.0
Disk Sub System Single unit price*	$9950.	$10,995.	$11,600.	$12,200.

*OEM DISCOUNTS AVAILABLE

All models measure 19" wide, 17½" high, 28½" deep. All fit standard 19" rack.

Computer Memory Devices, Inc.

5170 W. Bethany Home Rd., Glendale, Ariz. 85301 · (602) 939-9444 · TWX 910-950-1244

CRT Terminal

This desktop data display terminal expands the Sanders 620 line by increasing memory capacity to 1K characters. It also presents more options and costs about $10 a month more than previous models.

Called the 622 Stand-Alone Data Display System, its screen accommodates 32 lines of 64 characters. Along with the standard model 620 features the 622 has "memory save," a technique using horizontal and vertical tabs and a control character set to increase the amount of data communicated in each message by 50%. The standard interface for the unit is an 1800 baud asynchronous modem.

Options include dual intensity display for distinguishing between format and entered data, 84-character line length, and 2000 or 2400 baud synchronous transmission modules.

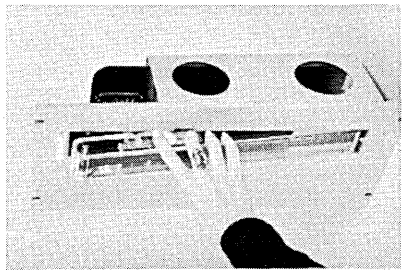
The 622 display is now available for $199 a month rental or $6100 purchase price. SANDERS ASSOCIATES, INC., Nashua, N.H., For information:

CIRCLE 334 ON READER CARD

Random Access Tape File

The Comfile random access memory system provides the data access and organization style of discs and drums for about the cost of sequential access magnetic tape cartridge systems. Storage is on a 30-inch magnetic tape loop capable of providing up to 72K characters with an average access time of 350 msec. Worst case access is 900 msec starting from a stop. Data is recorded on the loop serially by bit on one track at a time, for a density of 3000 bpi.

The tape loop is enclosed in a magazine inserted into a Comfile drive. A file-protect mechanism, similar to a write ring in a reel-type tape drive, guards against inadvertant recording. The magazine and drive combination has only three moving parts. The tape head and tape cleaners are the only parts touching the oxide side of the tape.

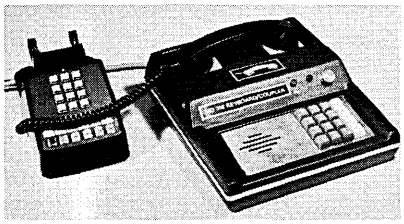


A complete Comfile system sells for $1200; additional magazines are $35. Delivery requires 60 days ARO. A Comfile memory system, including one Comfile drive, controller, interface, and software in a free-standing cabinet sells for $4500. COMPAT CORP., Westbury, N.Y. For information:

CIRCLE 335 ON READER CARD

Data Entry Terminal

No bells and whistles here—the Model 316 terminal is designed for low-cost general application of computer services to small business operations. Data entry is accomplished through a 16-key adding machine formatted keyboard via Touchtone code.



For transmission through any standard telephone, the Model 316 is available now for $395. A model with a card reader is also available. HYTEK TECHNOLOGY, INC., Bellevue, Wash. For information:

CIRCLE 336 ON READER CARD

Correction

We must have had decimal points in our eyes when we wrote in the June issue (p. 217) that the Center For Communications Management prices for their Quick Rate Reference Guide of rate data for telephone and record communication offerings were $67.50 for the first interstate or international guide; $102.50 for the combined guide; $47.50 and $82.50, respectively, for additional copies. Lower all those prices by a factor of 10 and you'll have what we thought we wrote!

Also, an order of $500 or more enables one to obtain a free microfiche viewer—not an order of 500 or more Microfiche Tariff Files.

Disc Controller for Mini's

The System 23 random access memory (RAM) controller permits the connection of up to eight 2311 or 2314 type units to a single minicomputer. It combines plug-compatible interfaces and control logic in a single unit. The control logic features an overlap mode that enables data transfer from one drive while seek operations are in progress on the others. Data transfer is on a direct path, memory access basis. Most interfacing and control functions are implemented by firmware.

The RAM controller also provides data chaining, command chaining, data skip, overflow read/write and status monitoring and error dignostics. Media compatibility with System/360 is an option.

The unit price for System 23 is $10,000. Delivery is 8 to 12 weeks ARO depending on configuration. CYBERMATION, INC., Washington Crossing, Pa. For information:

CIRCLE 337 ON READER CARD

PDP-11 Arithmatic Unit

The extended arithmetic element (EAE) is a device for fast execution of PDP-11 arithmetic operations, The EAE multiplies and divides both positive and negative numbers. Signed integer multiplication can be done 15 times faster. Its price is $1800; deliveries begin this fall. DIGITAL EQUIPMENT CORP., Maynard, Mass. For information:

CIRCLE 389 ON READER CARD

a COM that develops its own film?
a COM that puts an end to overnight waiting?

that's the inside story of Quantor 1·2·3

Cobol Assistance

"Yes, you can peacefully co-exist with COBOL," reads the METACOBOL announcement. The package is designed to assist the System/360-370 programmer in writing, testing, and debugging source programs. It consists of a macro translator to reduce the required coding effort, and optionally, the test data generator and run-time analyzer facilitate program testing and debugging. METACOBOL accepts standard COBOL and user-defined METACOBOL statements and transforms them into acceptable input to the COBOL compiler (System/360 Level-E, IBM Level-F, and ANSI). The idea is to overcome common COBOL weaknesses and incorporate additional capabilities as well.

METACOBOL facilities include: defining and using macro statements embedded in COBOL programs; defining new verbs for use in COBOL programs; abbreviating existing COBOL required words and phrases; simplifying the writing of multi-part verbs; eliminating the need for writing extensive data name qualifications; producing program listings of standard appearance in easy-to-read format; defining a library of standard macros and abbreviations; and debugging source programs by automatically generating test data for any input program and pertinent information for the programmer in source form.

Many of the limitations inherent to standard COBOL are thus significantly reduced. And much of the drudgery involved in the detail coding of COBOL programs can be eliminated. The programmer may further simplify the coding effort by substituting his own abbreviations for frequently recurring statements and logical functions. Other possible uses of METACOBOL include report writing, information retrieval, and other generalized programs from simple parameters; developing custom-tailored languages to suit individual user needs; enforcing installation standards; and facilitating conversion among non-compatible COBOL compilers.

METACOBOL is presently available for OS, and a DOS version will be released in the fourth quarter. Licenses are priced about $7-9K depending on options. Rental is also available. APPLIED DATA RESEARCH, INC., Princeton, N. J. For information:

CIRCLE 320 ON READER CARD

Cobol for Minis

Diets are all the rage nowadays, and it must have taken quite a bit of will power for this COBOL version to get down to 8K (16-bit) words. The trick is to retain as many features as possible, and this one contains a Level 1 nucleus, table handling, sequential access processing, plus inter-program communication (call and exit) linkages.

Developed specifically for the CD 404, the single-pass compiler runs either with the vendor's standard monitor or their T/S Executive. Datacomp COBOL is also available in a 12K 16-bit version, adding a report writer, random file handling, and the COPY verb. The 8K version is tentatively priced at $500, while the "big" version is ticketed for $750. CLARY DATACOMP SYSTEMS INC., San Gabriel, Calif. For information:

CIRCLE 322 ON READER CARD

Virtual Core

The X-TEND system enables users of 360/25s and up to extend memory size without additional core or increased costs. Using a combination of software and 2311 or 2314 disc space, X-TEND provides "soft-core" whenever "hard-core" is insufficient to meet program requirements, under either OS or DOS. No-modification of user programs is required.

Admittedly, there is some degradation when a program begins to execute instructions beyond physical core, but the substantial cost savings are obvious when comparing the $2400 price of X-TEND to the cost of physically adding more memory. The system is available nationally, with implementation and interfacing included in the price. PDA SYSTEMS, New York, N. Y. For information:

CIRCLE 321 ON READER CARD

Payroll/Personnel

There seems to be a perennial market for payroll and personnel systems, so this vendor now offers PAYPLUS which is an integrated payroll/personnel package also containing a report program generator that will allow you to add reports to the module (25 are standard) or change the existing ones. Full tax calulation and reporting, along with unlimited deduction capability, is claimed.

Other features of the COBOL system include no restriction on the record size, and it has multi-firm capability. The basic payroll system is $9000. To that add $3000 for personnel processing capability, $3000 for the report program generator, and $2000 for labor distribution and tax reporting. CONSOLIDATED SOFTWARE INC., Los Angeles, Calif. For information:

CIRCLE 325 ON READER CARD

Data Base Management

A communications-oriented data base management system, billed as being exceptionally easy to implement, has been announced for Spectra 70/45, 55, and 60 computers. OCRCA was jointly developed by Orange County, Calif., and RCA. It operates in both real-time and batch multiprogram environments under Tape-Disc Operating System with minimum 131K core. A centralized program library concept reduces the need for program changes each time data sets or formats are revised. Three basic subsystems in OCRCA are data base management, generalized processing facilities, and communication facilities. The DBM subsystem is designed to utilize and support the vendor's standard random access devices (70/5464, 70/568, 70/590). Interfacing with the DBM function, batch programs can be run in the background.

Offering system expansion capabilities with a minimum of reprogramming, the generalized processing facilities can incorporate programs written in assembly language, COBOL, FORTRAN, and RPG. The communications facilities subsystem provides facilities that are common to data collection/dissemination, inquiry/response, and remote job entry. OCRCA is available at no charge to both bundled and unbundled Spectra 70 users. RCA, Cherry Hill, N. J. For information:

CIRCLE 328 ON READER CARD

(Continued on p. 93)

SOFTWARE

OS/360 Utility Programs

Three programs comprise the Master Series: Data Set Dump, for printing or dumping any OS data sets, including indexed sequential in either character or character-with-hexadecimal translation mode, either by physical or logical record; Update, for creation and maintenance of source programs and other card image files; and Map, for listing source libraries in partitioned data sets by modules, showing section names, core requirements, and full segment-length breakdowns, by module, without using control cards.

The PL/I modules generally require approximately 100K bytes and are available for a "21 day free home trial" for evaluation. Should you decide to buy, Data Set Dump is $1000; Update goes for $1500; and Map is $2000; or all three (including documentation) cost $3500. INFODATA SYSTEMS INC., Arlington, Va. For information:

CIRCLE 324 ON READER CARD

Data Base Management

The Hayden Analysis and Reporting Tool is a data base management system designed to allow selective retrieval of information and to produce reports. HART establishes a dictionary on a given data base containing all the information necessary to define not only the file or files comprising the data base, but also each field within the data base. When the dictionary is written, a search name is assigned to each field which can be referenced.

Translation, extraction, sort, and report generation are controlled by English language request statements, and output may be reports, cards, or tapes. HART is written in assembly language for System/360s with a minimum of 32K core, card reader, punch, printer, disc, and two tape drives. The price is $5K. THE HAYDEN GROUP, INC., New City, N.Y. For information:

CIRCLE 323 ON READER CARD

Applications Management

Billed as the first "applications management system," COSMOS is an integrated package of modular computer programs that provides control of all development and processing functions to reduce design, implementation, and production costs. It is intended for use by banks, service bureaus, and other firms operating in a production environment, and requires a System/360 or Spectra 70 with a minimum of 256K core, but 512K is recommended for best results.

The key to COSMOS is its organization of all functions common to serial file processing. The system provides a design framework, as well as much of the necessary coding during implementation, leaving programmers free to concentrate on the particulars of the application. Repetitive housekeeping functions are provided automatically, requiring less coding. COSMOS programs are compatible with each other, further reducing production codes, with one environment serving all processing. All programs must be rewritten in the COSMOS language; however, the vendor claims that COSMOS is easier to use and teach than COBOL. The price is $75K, or lease plans are available. PHI COMPUTER SERVICES, INC., Arlington, Mass. For information:

CIRCLE 326 ON READER CARD

Cobol Bit Manipulation

Users of System/360 COBOL running under DOS or OS can add bit manipulation capability through B2BCONV, an assembly language support subroutine that enables the user to set individual bits on or off. Since a byte contains eight logical yes or no settings, it is possible to conserve disc or tape space, reducing data base storage requirements I/O time. B2BCONV follows IBM linkage conventions and is serially reusable. The price is $595. A re-entrant version is available for real-time applications. TRIVALENT ENTERPRISES, LTD., Greenwich, Conn. For information:

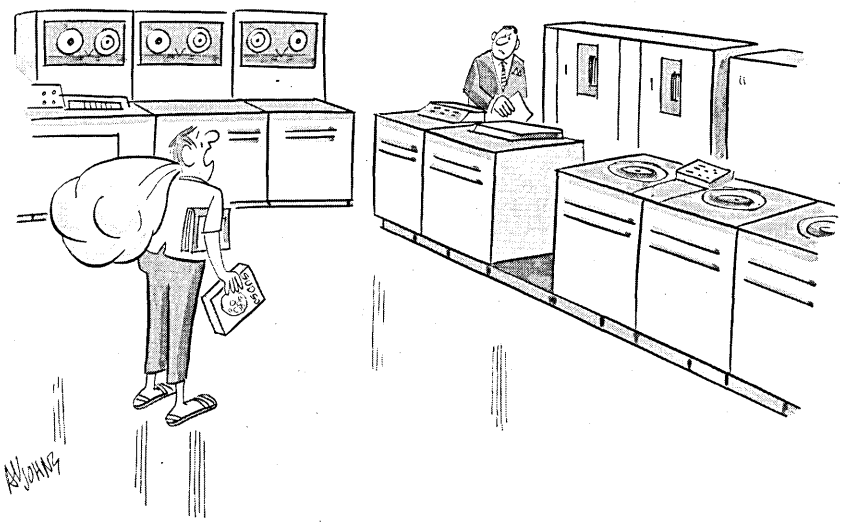
CIRCLE 327 ON READER CARD

Manufacturing Data Base

A manufacturing data acquisition and retrieval system called Manufacturing Data Base/70 operates on all Spectra 70 series computers with minimum 32K core. MDB/70 is communications oriented, and can be used in any mix of "master" and "structure" files. Master files contain the data base, while structure files define the relationships of the data. Within each master file, as many as four sets of chains can be built. MDB/70 maintains files on finished goods inventory, work in progress, customers, vendors, etc., and updates all related data with a single entry. No charge to Spectra 70 users. RCA, Cherry Hill, N.J. For information:

CIRCLE 460 ON READER CARD

(Continued on p. 95)



"Oh, I'm sorry . . . . . I thought this was a laundromat."

SOFTWARE CONTINUED

Some people get Social Security before they retire.

All it takes is one slip and you're out of work. Flat on your back. Without any income.

But, that's where you're wrong.

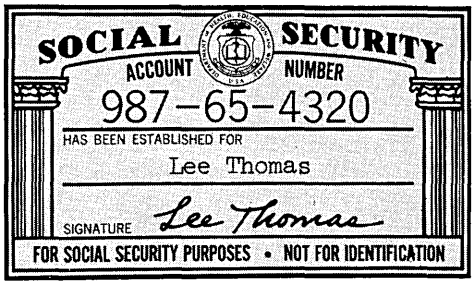
Social security covers accidents like this with disability benefits. Accidents of any kind, that will keep you from working for a year or longer. The same goes for a serious illness. Any illness.

A young disabled worker, who earned $100 a week on the average, for example, and who has a wife and two children, receives $348.80 a month in social security benefits.

Or, suppose you die. From a bad fall. Or any reason. Your social security survivors benefits may provide your family with a steady income. Regular monthly checks until your children are 18. And on to 22, if they're in school.

If you think social security helps when you retire, you're right. But it's also something you can depend on *now.*

Whenever you need information, contact any social security office.



Social security pays four benefits: survivors, disability, retirement, and Medicare.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE • Social Security Administration

Independent Assembler

Developed for applications where communication with a computer using specialized jargon would be desirable, DUAL (Dynamic Universal Assembly Language) is a computer-independent meta-assembler. The ability to create new machine languages for a number of computers in man-months rather than man-years is claimed by the vendor.

User features include: interprogram linkage, which allows modular construction of programs; an update feature, which facilitates program growth and modification; a library of target computer system parameters; built-in list processing; free format coding; I/O device independence; and self-defining terms for using binary, octal, hexadecimal, decimal, fixed-point, floating-point, and textual constants.

DUAL is available for IBM 360 and 7094 machines, Standard Computer, Monitor Data, and Burroughs computers; and the vendor can ready it for other makes in approximately one month. It requires 24K bytes on a 360.

The price of $25,000 includes documentation, manuals and installation assistance. PROPRIETARY SOFTWARE SYSTEMS, INC., Los Angeles, Calif. For information:

CIRCLE 461 ON READER CARD

Bank Cash Forecasting

The Bankserv Cash Flow Forecaster, successfully used by the Philadelphia National Bank, is now available for use on IBM and GE hardware.

Using a client's financial data and projection factors, the forecaster projects complete income statements, balance sheets, cash flow and analysis ratios for up to eight time periods. It allows for variable analysis, simulating the effects of varying levels of sales volumes, cost of materials, etc., on future cash positions, profits, and earning ratios.

Written in FORTRAN IV, the system requires about 18K core and operates on System/360 Models 30 and up, as well as GE computers. It can be operated as either a time-sharing or in-house system. Price of $9K includes installation, documentation, and one-year warranty. ARTHUR S. KRANZLEY AND CO., INC., Cherry Hill, N. J. For information:

CIRCLE 329 ON READER CARD

Add interactive graphic display capability to your IBM 1130 for $5500!

That's right. We wanted this capability for our own in-house IBM 1130. But it was not available at our price. So we built our own system. And it's working so well we've decided to offer it to other IBM 1130 users.

We call our versatile display the Bendix ICD-1100. Its basic features include:

- Hardware/software interface
- FORTRAN callable routines
- Compatibility with digital plotter software
- High resolution (10 bit)
- Two-speed joystick for program interaction
- Alphanumeric display

We have more good things to tell you about the ICD-1100, as a peripheral to the IBM 1130.

Call (301) 825-7604. Or write: The Bendix Corporation, Communications Division, East Joppa Road, Baltimore, Maryland 21204.

Bendix

WASHINGTON REPORT

NEW DOD PROJECT MONITOR ESTABLISHED

A new monitoring system for dp system development projects has been established by DOD for all Services. Basically, the project manager establishes milestones and estimates the man-years and dollars needed to reach each one. Then, when he gets there, he reports his actual expenditures, adjusting his future estimates where necessary. Actual and forecasted costs are compared at each milestone, and if the former exceed the latter by specified percentages, the project is reviewed by the Service's chief adp official. Hopefully, the new system will uncover cost runaways before they become really expensive, and before Congress discovers them.

GSA SERVICE BUREAU ALMOST VIABLE

GSA's experimental service center, established in Atlanta last February, reportedly has attracted enough customers "to approach a break-even point" in its first six months' operation. But the agency's front office has been told (by a study team) that a vigorous promotion effort is needed to raise the load high enough to support a permanent operation. The East Coast and the Chicago area are considered prime markets. GSA brass, while considering these findings, have extended the experiment for three more months. The system consists of a GE 435-440, which provides interactive and remote batch services to federal agencies via FTS, ARS, and multiplexed private lines.

FORTY LESS AT COMCET

Forty employees have left Comcet recently, including marketing vp Jim Hix (now head of UCC's Government Services Div.), technical marketing director Royce Pipes, component sales manager Al Bernadini, and advertising/pr director Warren Gailbreath. "Not all of the people hired since Comcet began were perfect decisions," explains President Lee Johnson. "Also, we've found that some jobs could be consolidated." A personnel review is made every six months or less, Johnson added; he thought future ones could trigger additional departures.

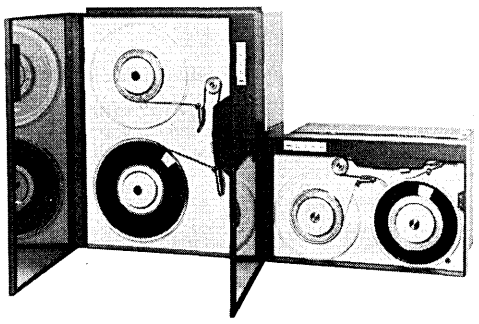
COMRESS'S SUPER OS

Comress was planning to unveil a "super operating system" called "Datanetics" at presstime. Designed for multiprocessors, it allocates resources and optimizes load scheduling in real-time — saving the user more than enough to balance the lease charge, says Comress. That charge hasn't been announced. The new system, which runs on a 360/40 or larger, includes both remote and on-site control capabilities. Initially, it will be leased to 360 users, later to commercial service centers — maybe.

WIMMIX WOES

After trying and reportedly failing to get a JOVIAL compiler added to the Wimmix spec as a mandatory requirement, CDC is considering an appeal to the Secretary of the Air Force. SDC's TDMS, a candidate for the Wimmix DMS, has been tested and dropped. Three other candidates — a SAC-developed revision of TDMS, TRW's GIM (Generalized Information Management), and a COBOL-oriented revision of FFS — aren't likely to fare any better. DCA "wants NIPS to be the winner because this will make it easier and cheaper to integrate the 360s already installed at Wimmix sites," we were told.

PEC builds incremental transports in 28 irresistible varieties.



Now you can choose the right tape transport you need for your data reduction and system requirements. With over two dozen models, PEC offers the most complete line of incremental and low data rate synchronous tape transports. All IBM compatible, including System 360. All available in 45 days. At competitive prices.

Incremental Write. 8 models excellent for automatic test equipment, data acquisition, and format conversion applications. Stepping rates to 1,000 char/sec.

Incremental Write/Synchronous Read. Here are 12 models with additional facilities ideal for data verification, data transmission systems and off-line devices where incrementally recorded data must be outputted synchronously at very low speeds. Synchronous reading rates from 1½ ips to 25 ips. Incremental write stepping rates to 1,000 char/sec.

Synchronous Write. 4 models to provide good, low cost solution for data acquisition systems needing low data rates. Synchronous rates from 4 ips to 25 ips.

Synchronous Read. 4 models just right for off-line applications requiring low data output rates such as plotters, printers, data transmission and tape conversion. Reading rates from 1½ ips to 25 ips.

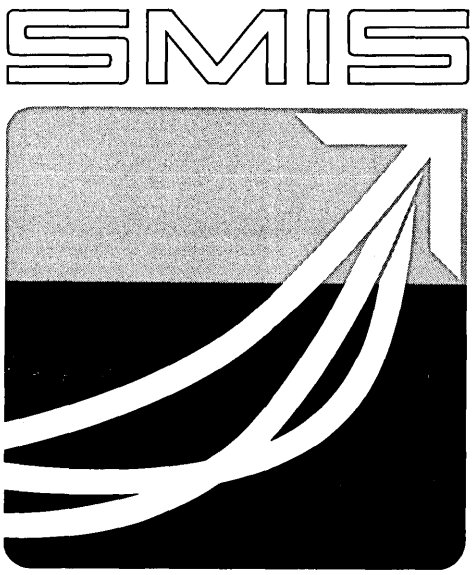
These 8½ and 10½ inch reel transports are complete with data electronics and control logic. They're available in 7 and 9 track, with standard 800, 556, and 200 cpi data densities. And a simple design, field proven in more than 1,000 units, that gives you data reliability and lower system costs.

We've got the whole story in our new brochure. It's full of facts, figures and comparisons to help you choose the right transport for your own unique need. Write for it today. Peripheral Equipment Corporation, 9600 Irondale Avenue, Chatsworth, California 91311, (213) 882-0030.

SALES OFFICES:
Los Angeles (213) 882-0030 • Orange County (714) 546-4836 • Chicago (312) 696-2460 • Boston (617) 899-6230 • New York (203) 966-3453 • London Slough 34003

PEOPLE

Some caustic computer comment at the FJCC (Nov. 17-19) can be expected when columnist **Art Buchwald** holds forth under the Astrodome in Houston, where he will be a featured speaker. "We're looking forward to his observations concerning our profession's interactions with our society," said general chairman **Robert A. Sibley.** "At least, I think we're looking forward to them." . . . For those who make it through to spring, AFIPS has announced that **Dr. Jack Moshman** will be general chairman of the SJCC, May 18-20, in Atlantic City again. He helped form the federation in 1961, and now is a Washington, D.C., consultant and recognized authority on computer election projection and MIS. . . . Still with societies, DPMA has a new roster: president **James D. Parker, Jr.,** assistant manager of computer operations for Texas Eastern Transmission Corp., Shreveport, La., succeeds **D. H. Warnke,** who remains on the executive committee; exec vp is **Edward O. Lineback,** computer services manager (commercial airplane program) at Boeing in Seattle; and old-reliable **David B. Johnston, Jr.,** information systems manager at Western Electric, is going into his fifth term as secy.-treasurer. . . . **Enoch J. Haga,** dp text and reference book author, has been elected executive director of The Society of Data Educators, which he cofounded in 1960; **Arthur H. Pike,** of Norwich Univ., Northfield, Vt., is president. . . . **Larry O. Kurtenbach** resigned for personal reasons as president of Management Computer Network, Inc., New Hampton, Iowa-based accounting and business management servicer with 21 locations in the Midwest and California, and was succeeded by **Dr. Ray W. Sammons,** who helped develop the company's MARK-3 analysis program, and who is, incidentally, a graduate theologian, has a PhD in agricultural economics, and training as a veterinarian. New exec vp **Donald Stokes'** background is less well-rounded, but enterprising: he developed a coin-operated shoeshine machine that became franchised nationally, and at one time was a partner of the Chicken Delight man, A. L. Tunick. . . . After two years as board chairman of Data Network Corp., lately rechristened Mega Systems, Inc., **H. L. Meckler** has resigned, no reason given, no replacement yet. . . . Another resigner for personal reasons is **C. R. Hall,** president of Applied Time Sharing, Inc., a Bunker-Ramo affiliate in Villanova, Pa. He is succeeded by **Guy E. Warner,** a Bunker-Ramo man, as is new board chairman **Frank C. Casillas.** Both also have long GE management experience, and Casillas also served with RAND. Hall founded ATS, an automobile dealer service firm, and will continue as director. . . . **Dr. John R. Huffman** left the industrial systems div. of Aerojet-General Corp. to become vp of the consulting firm of Semco, Sweet and Mayers, L.A., where he will specialize in application of computers to materials handling. . . . **Ralph Iredell** has been appointed vp/gm of Corporate Synergy Technology in Dallas. CoSyTe supplies a computer-programmed service for corporate growth which Iredell helped develop for handling stored detailed information through a system that assures complete anonymity of the principals interested in acquisition, merger, sale or pooling of resources. . . . Cybercom Corp., a Sunnyvale, Calif., peripherals manufacturer, has successfully bestowed the presidency of its company on **Robert L. Wehrli,** who comes from being president of Dresser Systems, Inc., subsidiary of diversified Dresser Industries. . . . Reorganization at Itel Corp. goes on in San Francisco. **Donald S. Safford** recently joined as corporate secretary, a transfer from Xerox Data Systems where he was corporate counsel. In the dp division, **Milt Nelson** is now group vp of operations. Market and product planning will be handled by vp **Patrick Dolan.** . . . At Greyhound Computer Corp., **Gilbert J. Mitchell** has been elected vp of data services, a newly created position, in which he takes responsibility for national service operations and project management. . . . **William W. Otterson,** who says the digital cassette market should be $50 million by 1975, has been elected president of Cipher Data Products, Inc., San Diego, Calif., manufacturer of digital mag tape recorders. . . . Boston Education Research, Inc., has named **John C. Sims, Jr.,** president of its local subsidiary, Information Transfer Corp., automated instruction system design firm. Sims joined in forming a company that later became Univac. . . . Carterfone founder **Thomas F. Carter** has resigned as board chairman, will continue to consult. ■



ANNOUNCES THE SECOND ANNUAL CONFERENCE

Shoreham Hotel
Washington, D.C.
September 14 and 15, 1970

This year's conference will follow the successful pattern of the Founders' Conference held last year. All sessions will be plenary – none will be concurrent. Executives, management scientists and academicians will present papers and hold discussions on management informations systems oriented around the theme:

THE INTERACTION OF INFORMATION AND INTUITION IN THE GENERAL MANAGEMENT PROCESS

There will be five presentations and discussion sessions with a principal speaker, followed by a panel of two discussants and the session chairman. The five sessions will be:

☐ **DOES MANAGEMENT SCIENCE PRODUCE MANAGEMENT INFORMATION?**
DAVID B. HERTZ, Director, McKinsey & Co.

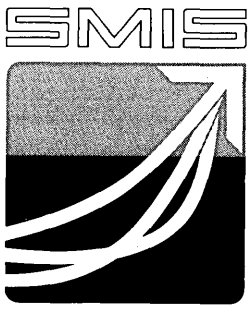
☐ **WHAT IS "MANAGEMENT" INFORMATION?**
GEORGE F. WEINWURM, Senior Corporate Planner, Systems Development Corp.

☐ **CENTRALIZATION VS. DECENTRALIZATION OF THE M.I.S. EFFORT**
M. L. ROARK, Director, Systems Office, Ford Motor Co.

☐ **PEOPLE - SENSITIVE ISSUES IN M.I.S.**
WILLIAM GOMBERG, Professor, University of Pennsylvania

☐ **THE IMPLICATIONS OF EDUCATIONAL PROGRAMS IN M.I.S.**
DONALD C. CARROLL, Professor, M.I.T.

Keynoting the Conference will be Dr. Clarence Walton, President of Catholic University, Washington, D.C.



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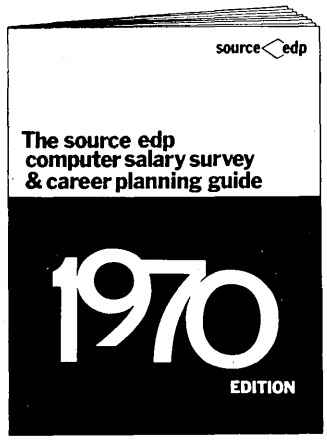

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