MAY 1970

MODERN DATA

It's new.
It's fast.
It's Varian's 620/f.

Varian Data Machine's new "superfast" computer has a 750-nsec cycle time. That means it executes two and a half times faster than the well known 620/i.

And check these other outstanding features:

- 100% upward compatible from the 620/i.
- All 620/i software executes on the 620/f —you can take advantage of the extremely large library of software field-proven on the more than 1,200 620/i's in worldwide use.
- Fastest I/O in minicomputers.
- Powerful new addressing modes and instructions.
- Read-only memory.
- All 620/i peripherals plus a new low-cost line.

For full details, request the new handbook. The 620/f—another development that keeps us the big company in small computers.

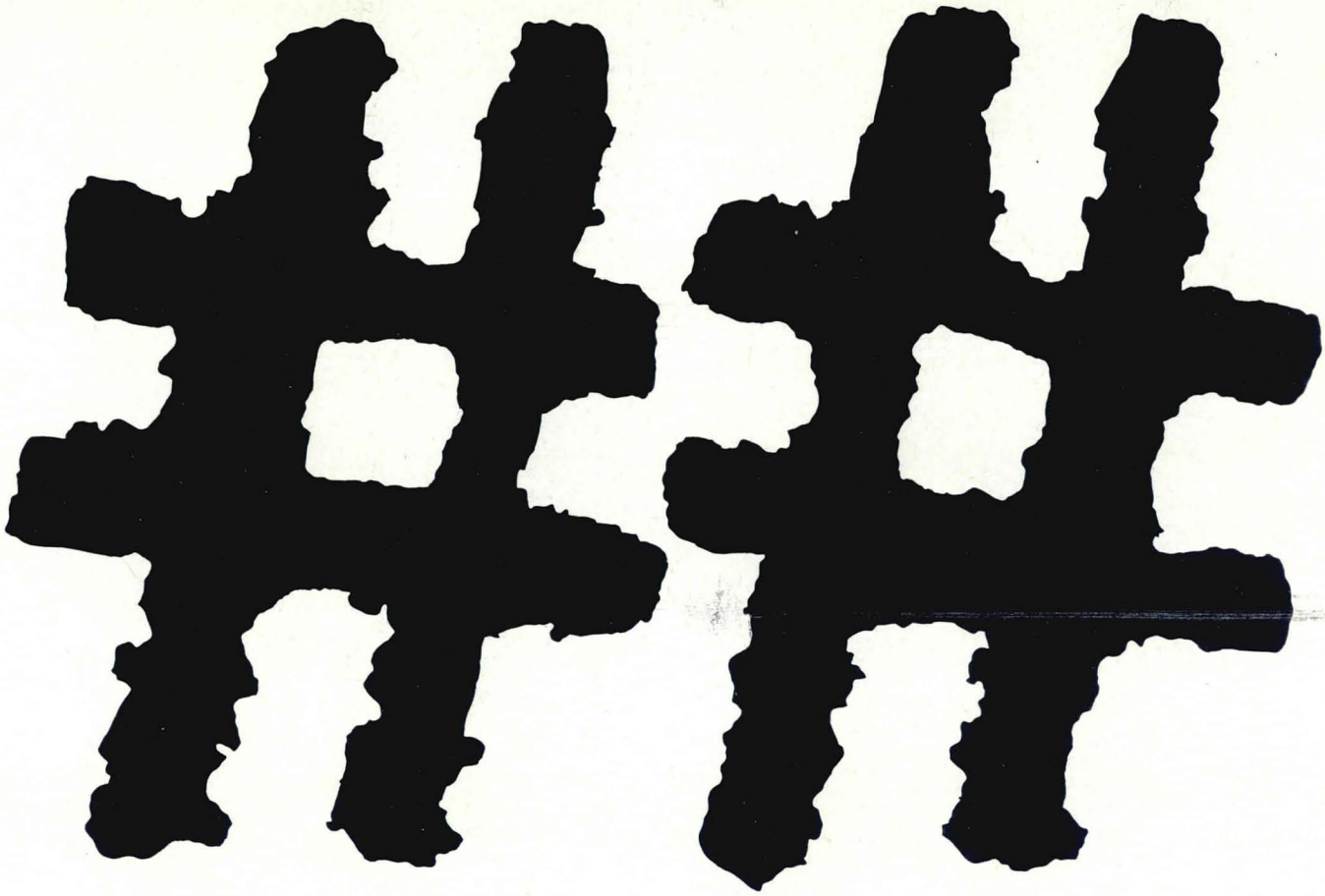
U.S. Sales Offices: Downey, San Diego, San Francisco, Calif.; Washington, D.C.; Atlanta, Ga.; Chicago, Ill.; Waltham, Mass.; Ann Arbor, Mich.; Albuquerque, N. Mex.; New Rochelle, Syracuse, N.Y.; Fort Washington, Pa.; Dallas, Houston, Tex. Other offices worldwide.

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 NO. 1 ON INQUIRY CARD



This is all it takes to get the good citizens of zipcode 10022 together.

Addressing mail with the Cheshire System is like taking a step into the future. And you can easily save enough in the process to justify the step.

For the first time you fully utilize the selectivity, speed and convenience of your computer to get the job done.

Have your computer print out your names, keeping similar zipcodes together. At the end of each group, program two pound marks—like so ##. When the sensor in our Mod III "sees" these marks, it will address and automatically stack your mail by zipcode.

Mailing was never so simple, fast or economical. Our smallest unit will process your mail at approximately 2 pieces per second. With zip separation, you can take advantage of the lowest postage rates.

No matter how many computer-generated labels you run through a Mod III, the last label is as clear, clean and legible as the first. You rent or buy to fit your needs. Either way it's a small price to pay to make your computer more effective.

For more information, write our subsidiary,
Cheshire Incorporated, Dept. 34
408 Washington Blvd.,
Mundelein, Illinois 60060.
Or call 312-566-7880.

XEROX

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CIRCLE NO. 2 ON INQUIRY CARD

Vermont Research
CORPORATION
Precision Park, North Springfield, Vermont 05150
Tel. (802) 886-2256, TWX 710-363-6533

DRUM AND DISK MEMORIES – CONTROLLERS

EXPAND YOUR MEMORY

CIRCLE NO. 3 ON INQUIRY CARD

MODERN DATA

MAY 1970 ■ VOLUME 3 ■ NO. 5

If you're an OEM, Raytheon Computer will get your system off the ground,

like we did the Flight Simulators.

For Link, Division of the Singer Company, one of our 16-bit computers improves the performance, stability and maintainability of their Radar Land-mass Simulators.

Raytheon Computer could economically add power to your systems, too.

Make your cost/performance trade-offs by choosing a CPU from a family that offers cycle times from 900ns to 1.75μs, prices from under $10,000. They all come with direct I/O to the CPU, 4 addressable registers and 74 instructions so all you trade is dollars for speed.

Pick the peripherals you need from all the standard types and from a lot of not-so-standards like the Raytheon Computer Array Transform Processor.

Then use our instant interfaces to interface to anything you've got. Analog or digital, high speed or low speed, data processing or process control, one-of-a-kind or OEM.

We'll get the whole system on-line faster than anyone else because we've got the most complete line of software available. Over 400 programs and subroutines off-the-shelf. Executives and monitors. Conversational FORTRAN in just 4k of core. The fastest, most accurate math library in the medium-scale computer class. All tested, debugged and being proven in systems every day.

So write for all the details now. Ask for Data File C-186. There isn't a better price/performance story in the industry.

RAYTHEON

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CIRCLE NO. 4 ON INQUIRY CARD

MODERN DATA

PUBLISHED FOR CORPORATE AND TECHNICAL MANAGEMENT, SYSTEMS ANALYSTS, EDP MANAGERS, SOFTWARE SPECIALISTS, AND COMPUTER SYSTEMS AND OPERATIONS MANAGERS.

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LETTERS TO THE EDITORS

To the Editor:

Thank you very much for the inclusion of some of our software products in your "Survey of Program Packages—Programming Aids" appearing in the March, 1970 issue of MODERN DATA. However, I would like to make a few "alterations" in the information you already have. UPGRADE, our 1401/1440/1460 to COBOL Translator sells for $12,500. (The $50,000 number you had was nice but —.) Also, UPGRADE can be leased for $1,000 per month plus a $2,500 installation fee. The 60¢/source card figure normally needs some explanation but, clearly, your alotted space for price makes that a bit difficult. There also is a way in UPGRADE to obtain data-name substitution. DETAP, our decision table preprocessor, only requires one sequential device (instead of one disk and one tape). TDG, our Test Data Generator, also can be leased for $420/month or lease/purchased for $320/month for 36 months.

Finally, I want to compliment you on the article in general. While I might quibble with some of your categories, I have no real argument against your reasons for setting them up. Like you, I do hope that a prospective user of any of these packages will use your tables as a reference guide to investigate packages rather than as a mail order catalog. There is good software and there is bad and the proof of the pudding is in the using.

Robert P. Bell
Director, Applications Devel.
Information Management, Inc.
San Francisco, Cal.

To the Editor:

Mr. Moffett's February On-Line column entitled "The Day of the Terminal" was very timely in pointing up the importance of these devices which are rapidly becoming an essential element in computer systems today. However, we would like to point out to you that the Bunker-Ramo Corp. (formerly Teleregister Corp.) had on-line terminals operating as early as 1956. We even demonstrated overseas remoting from New York to Lisbon and San Juan in the late 1950s. Just ask some of the old timers at American Airlines and Pan Am.

Our people were ahead of their time, but it has paid off, as we now have over 30,000 non-Teletype terminals on-line, most of them CRTs.

So you see, although the bright day of the remote terminal is in the 1970s, its dawn was in the 1950s. The world just wasn't ready for that sunrise at that time.

Guy Mallery
Vice Pres., Mktg.
The Bunker-Ramo Corp.
Stamford, Conn.

New Data Modem

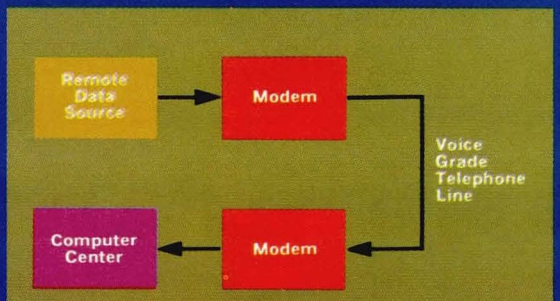
AUTOMATIC EQUALIZATION. The ADS-448 modulator-demodulator automatically equalizes your data source to the telephone line. No manual adjustments.

4800 BITS PER SECOND. This super-modern modem can transmit and receive data in any combination of data rates 1200, 2400, 3600, totaling 4800 bits per second. It is useful in a variety of data systems.

LOW ERROR RATE. Typical error rate is less than one in five million bits. Self-checking loop-back is built in. The modem is insensitive to telephone line phase-jitter.

FRONT PANEL DISPLAY. System diagnostics — including relative line condition — are displayed continuously on color-coded lights on the front panel.

MODULAR DESIGN. One of a family of compatible, solid-state data system modules by American Data Systems, the ADS-448 is versatile, reliable — practical in every respect. Send for full details.



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CIRCLE NO. 6 ON INQUIRY CARD

APPLICATIONS

- **Message Composition and Transmission**
- **Information Dissemination**
- **Message Editing**
- **Data Base Update**

THE BR-700 INFORMATION SYSTEM

. . . is a stand alone, off-line data information display system operating from its own local base . . . Since the BR-700 is a completely self-contained system, the local data base may be accessed, altered, and data refiled without software . . . The controller and the local storage is field expandable to service 16 operator stations . . . Off-line message composition and validation assure error-free transmissions . . . The BR-700 has provisions for communicating with printers, mag tape, modems, computers, and other operator stations of the system . . . Bulk data transfers may be accomplished into and out of the BR-700 storage at high speed when communicating with a central data bank . . . For additional information contact the Bunker-Ramo Marketing Department.

THE BUNKER-RAMO CORPORATION
DEFENSE SYSTEMS DIVISION
31717 LA TIENDA DRIVE, WESTLAKE VILLAGE, CALIFORNIA 91360

CIRCLE NO. 7 ON INQUIRY CARD

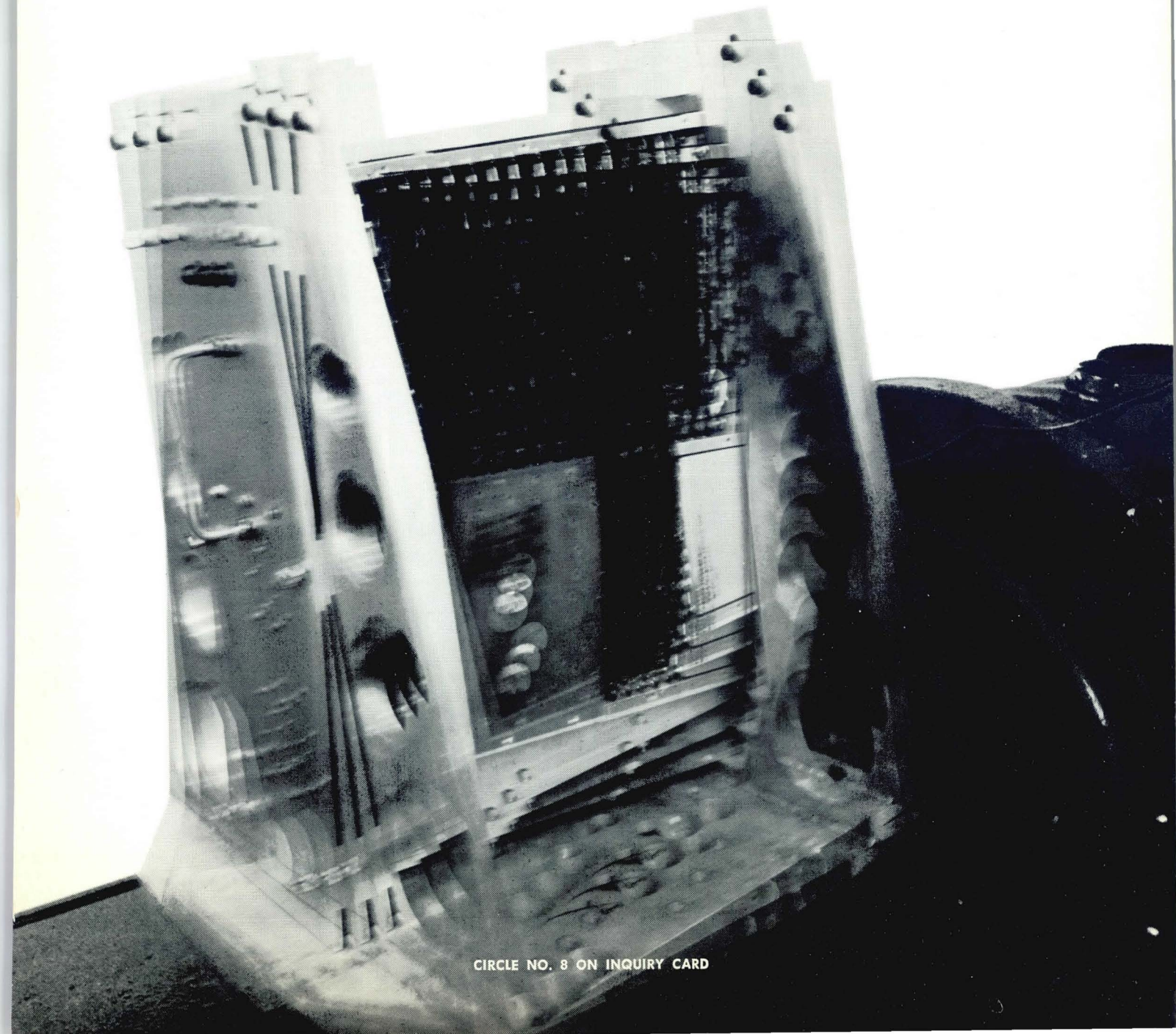
This militarized core memory takes a real beating. Before it goes to work. Which is why CR-95s are already proven in tough, jarring applications and are far exceeding their estimated 10,000-hour MTBF.

Look at the credentials. The CR-95 meets MIL-E-16400, MIL-E-4158, and SCL-6200. It has 950 nanosecond cycle time and comes in 4K or 8K capacity of up to 40-bit word lengths. Only 4½″ x 12″ x 13″, this rugged system even contains a built-in power supply that accepts raw prime dc current and feeds the entire memory.

In any system that has to take punishment, the CR-95 is the right memory. We make sure of that. You can, too, by circling our number and getting the full specs.

LOCKHEED ELECTRONICS
Data Products Division
A Division of Lockheed Aircraft Corporation

We put our CR-95 memories through survival school.



CIRCLE NO. 8 ON INQUIRY CARD


radiac series two thousand
xomec inc

Introducing the IODISC series 2000:

probably the world's most advanced disc drive systems.

IODISC* series 2000 data storage systems are probably the most advanced systems available for mini and midi computers. They are also the most usable. And the most flexible.

The 2000 series includes *five* new disc drive systems with capacities ranging from 24 to 96 megabits. Each with a data transfer rate of 1.56 megabits per second.

IODISC series 2000 systems are complete memory systems, with interface controller/adaptor and integral power supply unit. And everything is housed in a single console, in your choice of style and color.

The new IODISC series 2000 includes:

IODISC 2011: 24-megabit capacity on one removable disc cartridge.

IODISC 2012: 48-megabit capacity on one removable disc cartridge and one fixed disc, both operating on the same drive.

IODISC 2022: 48-megabit capacity on two removable disc cartridges operating on two separate drives.

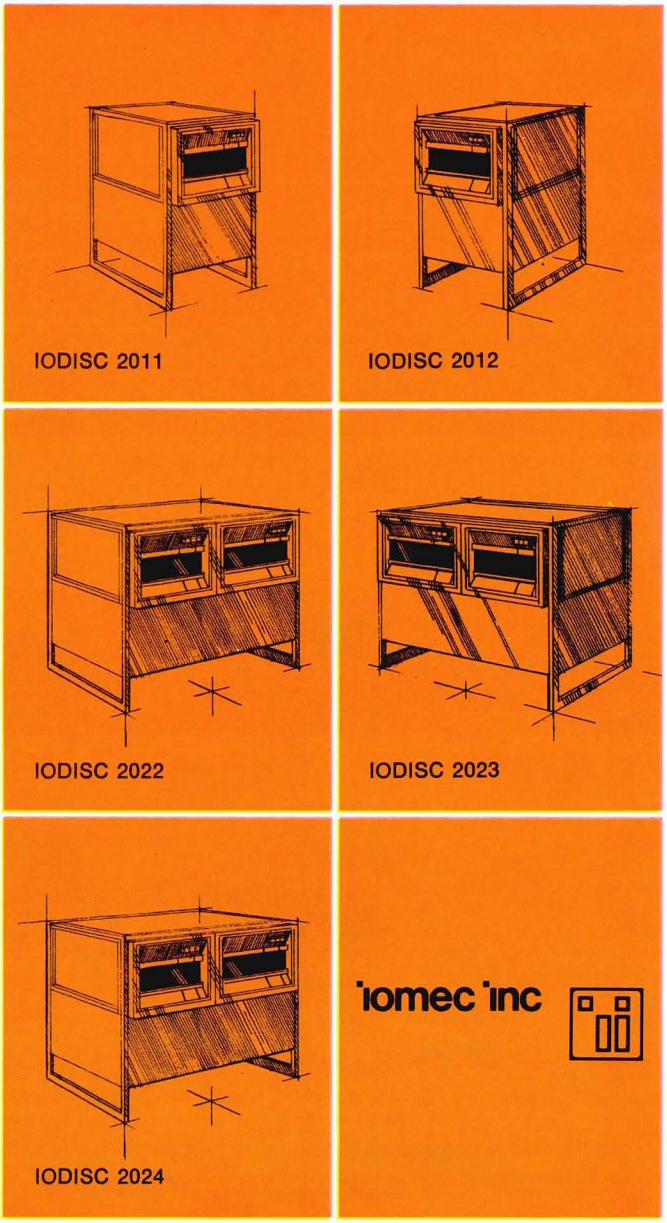
IODISC 2023: 72-megabit capacity on two removable disc cartridges and one fixed disc, operating on two separate drives.

IODISC 2024: 96-megabit capacity on two removable disc cartridges and two fixed discs, operating on two separate drives.

As a result you can now buy the exact configuration that fits your needs. In capacity, and in system flexibility. And get the same high performance features found in the popular IODISC series 1000 data storage systems—70-ms average access time, extended operating temperature range, voice coil head actuator, absolute air filtration system, and mechanical simplicity. IODISC removable cartridges, common to all five new systems, give you unlimited off-line storage.

This is part of the IODISC series 2000 story. We'll gladly send you the rest. IOMEC, INC., 345 Mathew Street, Santa Clara, California 95050. (408) 246-2950

* A TRADEMARK OF IOMEC, INC.



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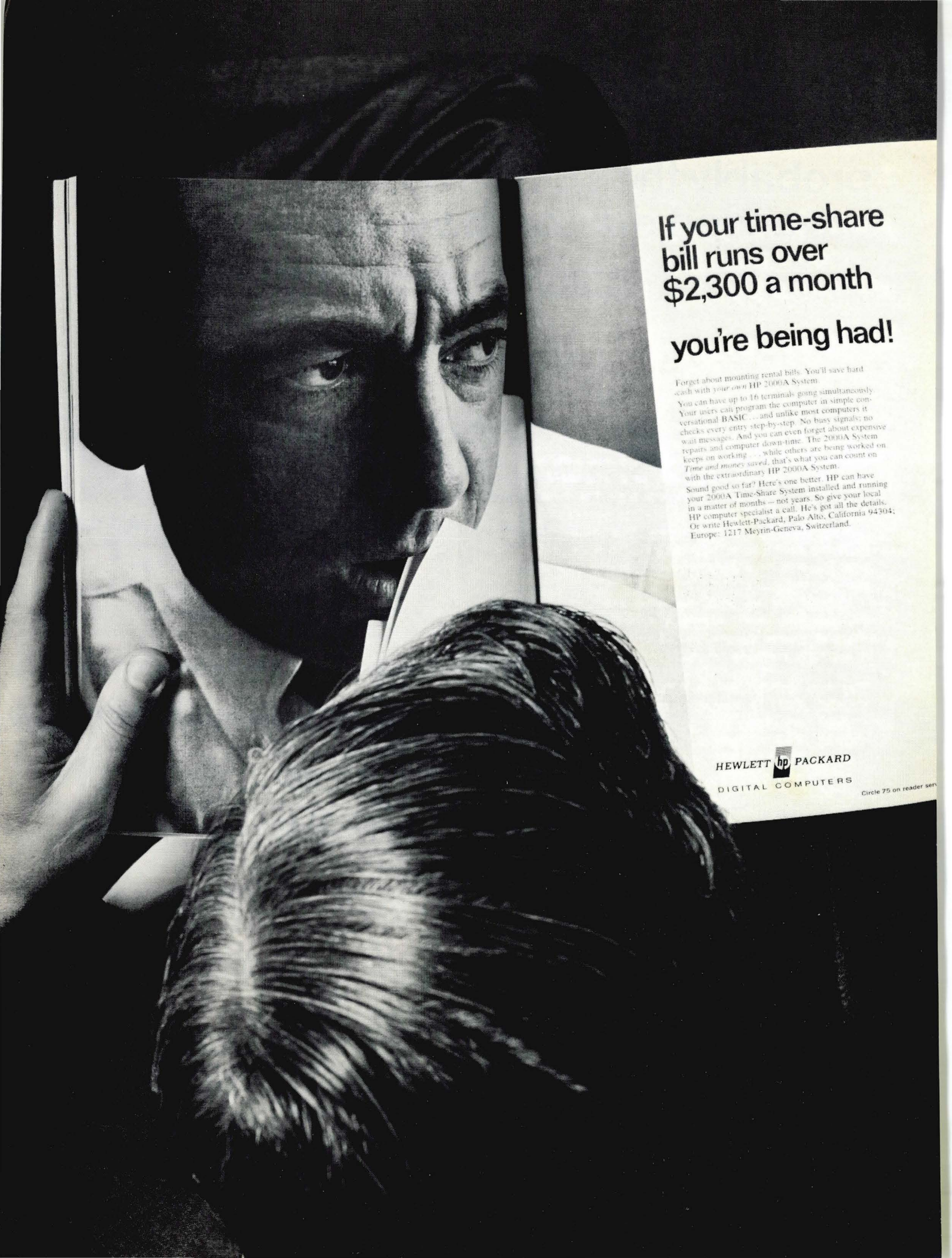
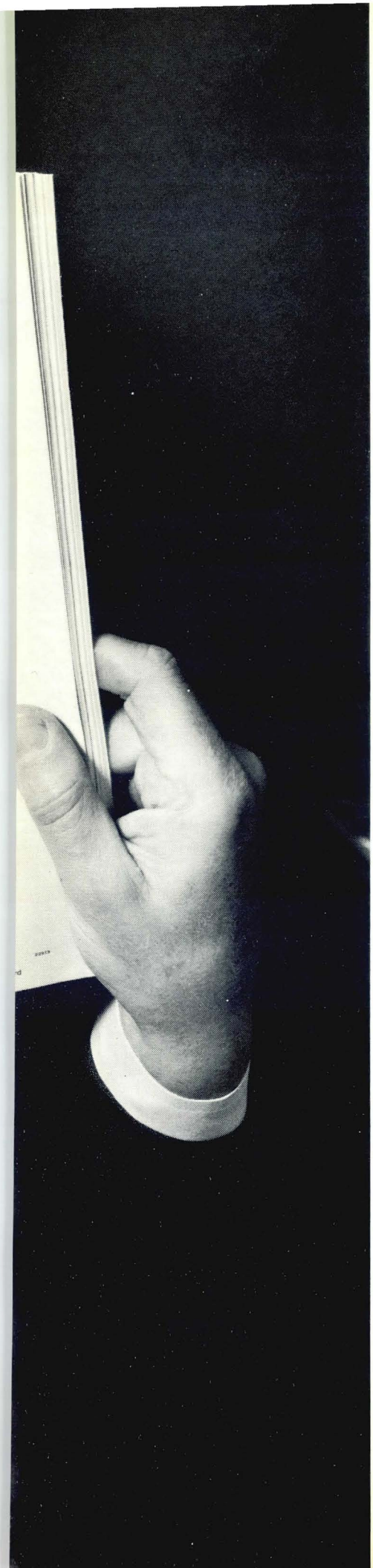

If your time-share bill runs over $2,300 a month
you're being had!
Forget about mounting rental bills. You'll save hard cash with your own HP 2000A System.
You can have up to 16 terminals going simultaneously. Your users can program the computer in simple conversational BASIC . . . and unlike most computers it checks every entry step-by-step. No busy signals; no wait messages. And you can even forget about expensive repairs and computer down-time. The 2000A System keeps on working . . . while others are being worked on. Time and money saved, that's what you can count on with the extraordinary HP 2000A System.
Sound good so far? Here's one better. HP can have your 2000A Time-Share System installed and running in a matter of months — not years. So give your local HP computer specialist a call. He's got all the details. Or write Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.
HEWLETT hp PACKARD
DIGITAL COMPUTERS
Circle 75 on reader ser



Last year this ad offered you the best time-share buy on the market.

Now we've got an even better deal. Our new system handles twice the users for just $3117 a month.

Last year, we had one Time-Share system that made a lot of sense to a lot of people. Now, we've got two! Our new HP 2000B System does an even better job of holding the line on rising time-share costs. It handles 32 users simultaneously. Twice as many as its "little brother" (HP 2000A)—for only a third more cost.

Of course, if you already have a 2000A (or only need a 16-terminal system right now), you can upgrade to 32 terminals any time you're ready. Either way, you'll still have the best time-share buy on the market.

Both systems provide the advantages of HP BASIC, easiest programming language around. More scientists, engineers, educators and businessmen are using it every day. To make the 2000B even more useful, some new language features have been added. Like chaining (where one program calls in another automatically). Common storage for simplified programming. And doubled data file capability, for access to 16 files simultaneously.

Sound good so far? Here's more. Our 2000B, complete with custom software, control teleprinter and all 32 terminal interfaces, costs just $119,900. Or $3117 a month on our four-year lease plan. And if you want to start with a minimum investment, our HP 2000A is still only $92,000. And don't forget what we said about upgrading!

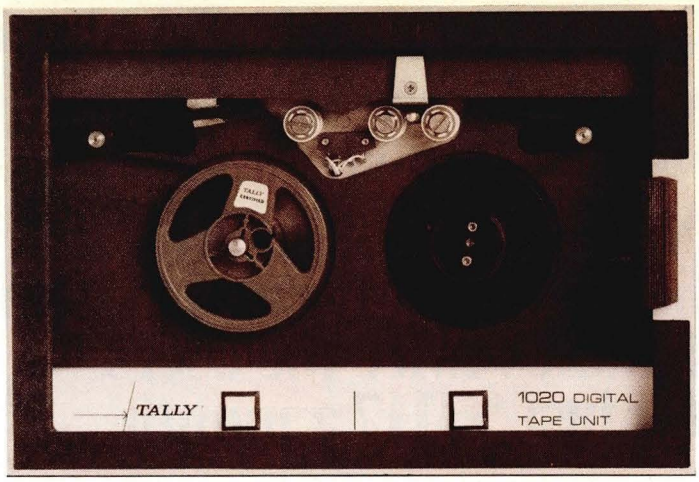
For all the details, contact your nearest HP computer specialist. Or write to Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

HEWLETT hp PACKARD

DIGITAL COMPUTERS

22006

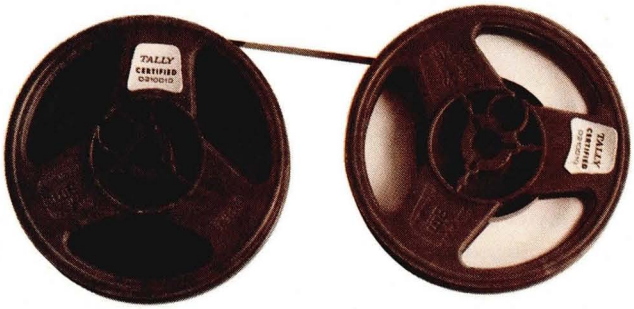
CIRCLE NO. 10 ON INQUIRY CARD



The low cost Tally 1020 incremental ¼-inch mag tape unit transfers data incrementally at 120 characters per second and continuously at 1600 characters per second. Unique among all incremental units, it can backspace and rewrite a single character or block of characters anywhere in the tape (try that on your cassette). Other features include new DTL logic, error checking, simplified construction and maintenance, 280,000 or 560,000 character storage on a 3-inch reel, and low tape wear because of single capstan drive.

Tally's answer to the reel question.

It's funny how those of us in the peripheral equipment business get carried away by new devices from time to time. A few years back, a lot of us thought punched cards would be displaced by paper tape. Then magnetic tape equipment came along and you know what the doomsayers said. Fact: More cards and paper tape are in use today than ever before, even as mag tape use increases. As a matter of fact, Tally thought so much of magnetic tape we developed a line of mag tape equipment to complement our broad paper tape line.



☐ Now, we come to the latest controversy in data handling, reel-to-reel versus cassette. Tally's prediction: both will share a part in an ever growing market. Parenthetically, our view is illustrated by the home entertainment field. Although cassettes are in the limelight, for full fidelity recording and reproduction, nothing beats reel-to-reel handling of music tapes. ☐ When we add up the key factors, we find both cassettes and reel-to-reel offer distinct advantages in a data handling environment. ☐ Reel recording offers greater storage capacity, faster continuous transfer rates to and from the CPU, and faster asynchronous transfer rates to and from the communications lines. Reel recording offers high speed incremental recording and a history of proven reliability. The cassette offers easy loading and ease of handling, and it doesn't require a precision drive. Cassettes require less physical room and are more manageable in a less than ideal environment. ☐ So our advice to you when you design a working storage device into your data system is to choose the method best suited to solve your application problem. ☐ For information on the Tally 1020, as well as other Tally products, please write us for our interface specifications at Tally Corporation, 8301 South 180th Street, Kent, Washington 98031. Phone (206) 251-5500.

TALLY®

CIRCLE NO. 11 ON INQUIRY CARD

LINE TAMER

$6660.00

Syner-Data's **ALPHA** is a highly reliable 80-column 300-line-per-minute line printer specifically designed for use with mini-computers. A full 80-character buffer and interface are included in the one-piece mini-price of $6660.00

ALPHA is an impact printer, so it makes up to six clear, sharp copies using standard sprocket-fed fan-fold paper. No messy ribbon to change either . . . instead, a throwaway Porelon roller.

ALPHA is small; only 11 inches high (x 22 inches W x 29 inches D), and it can either be desk-top mounted or placed on its own handsome pedestal. Paper loading is quickly and easily accomplished from the front of the machine.

ALPHA is over a thousand dollars lower in cost than its nearest competitor. It was designed to operate at 300 lines per minute with a print drum turning at only 375 RPM — using a proprietary hammer mechanism that can be turned out with high volume manufacturing techniques instead of expensive machining methods.

At only $6660.00 for one and only $4995.00 in quantities of fifty (even less if you want to supply some of the electronics yourself), **ALPHA** is the first line printer that makes economic sense in mini-computer applications.

SYNER-DATA
Route 128, 133 Brimbal Avenue
Beverly, Massachusetts 01915
Telephone: (617) 927-3222.

a GENERAL ECONOMICS CORPORATION company

SYNER-DATA CANADA, LTD., 130 Rivalda Road, Weston Ontario, Canada Tel. (416) 742-7804

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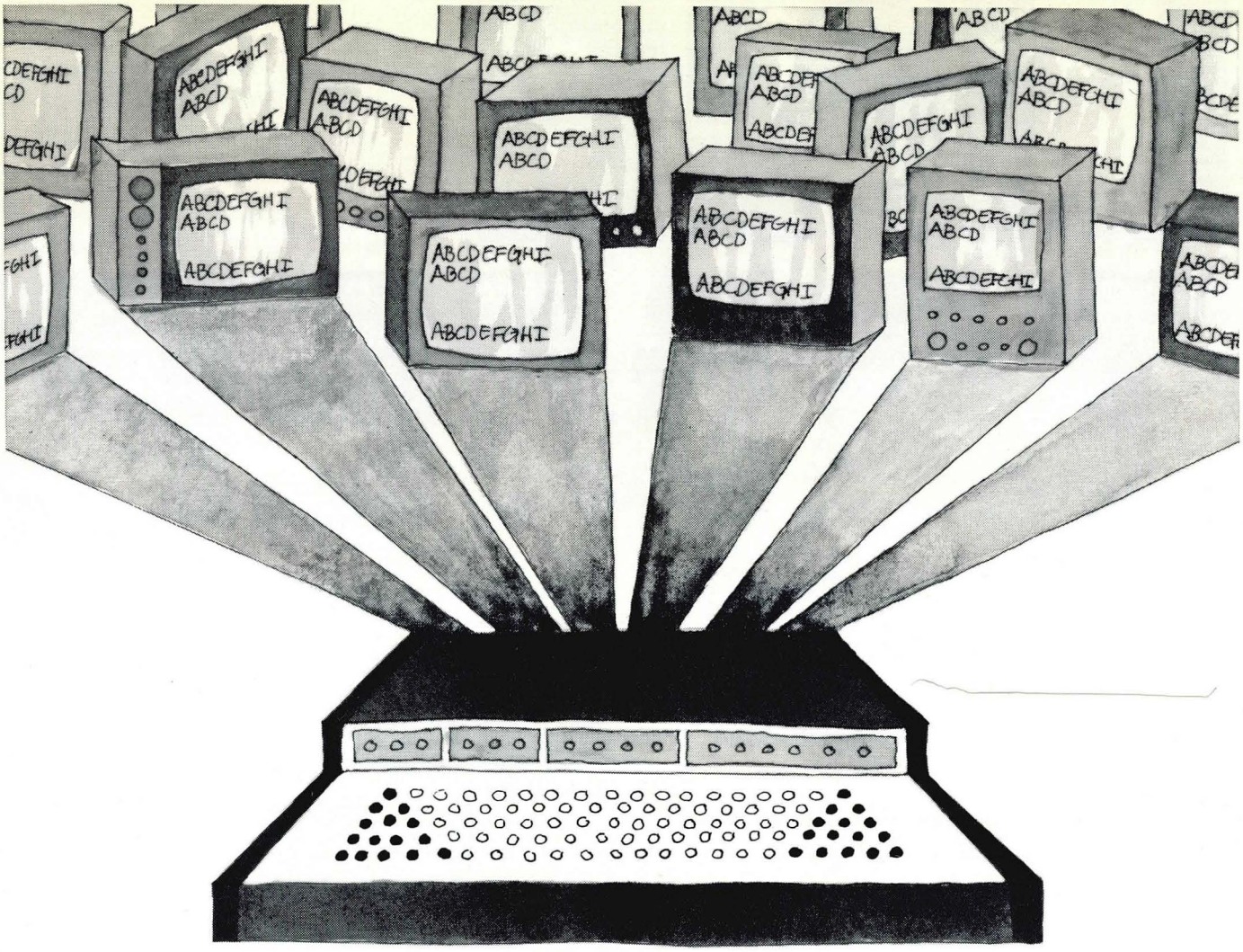


MEGADATA
STAR OF SCREEN, SCREEN, SCREEN AND SCREEN.

JUST ONE KEYBOARD TERMINAL DISPLAYS SIMULTANEOUSLY ON AS MANY AS 50 TV SETS AND MONITORS

Simply clip the Megadata terminal to the antenna of any ordinary TV set or monitor—and it's ready to use. A wide choice of display formats includes 20, 40, 72 and 80 alphanumeric characters per line, with 5 to 24 lines of data. The terminal hooks up with teletypes (10 ch/sec); acoustic couplers (10-60 ch/sec); high speed telephone lines (2400-9600 baud); and computer I/O buss speeds to 500 kilocharacters per second. This versatile unit is particularly useful for applications involving time sharing, hospitals, schools and universities, industrial training, and communication networks. For a demonstration and complete information on the many features and options of the Megadata terminal, call or write us today. You can catch our act in black & white—and color too.

MEGADATA COMPUTER & COMMUNICATIONS CORP.
151-8 West Industry Court, Deer Park, New York 11729 • (516) 667-2900

CIRCLE NO. 32 ON INQUIRY CARD

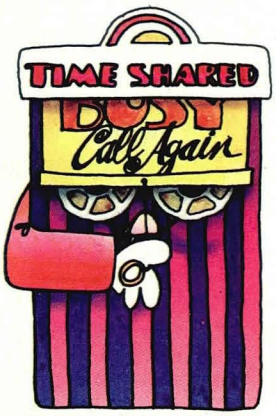
A BED TIME SHARING STORY

·ENTITLED·

THE DILEMA OF THE PROGRESSIVE EXECUTIVE

There was once a progressive executive who believed that time-sharing could solve many problems for his company. And indeed it did. However, he soon found three major weaknesses with his outside time-sharing bureau.

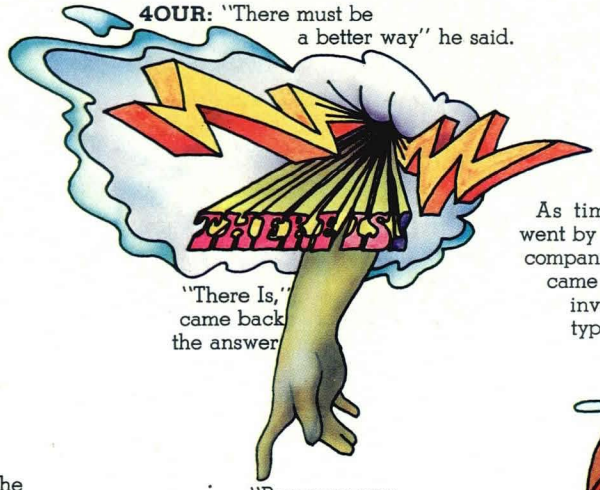
1NE: As his company prospered—and indeed it did—more and more people were buying more and more time with the time-sharing system down the street. At $6, $8, or $10 an hour connect time plus CPU time, that's a lot of profit flying out the window. Over $2,000 a month!



2WO: The progressive executive also discovered that all of the companies on his time-sharing party line would sometimes try to talk to the system at the same time. Those peak load bottlenecks began to hurt real bad.

3HREE: And like any progressive executive, he was concerned with the security of his data. Could an error deliver valuable information to a "friendly" competitor?

4OUR: "There must be a better way" he said.



"There Is," came back the answer.

"Buy your own time-sharing computer in the mini-system class."

5IVE: But which one?

Like all progressive executives he had his people carefully weigh the "pros" and "cons" of all the time-sharing mini-systems. The answer came back loud and clear. The Jacobi Systems MINITS I had a decided advantage over the closest contender.

Pros & Cons

Time-sharing Mini-system	Number of Simultaneous Users	Time-sharing Languages
JACOBI MINITS I	24	Enriched Basic Fortran Editors
Big Entry from Northern Calif.	16	Basic

B. STEWART

6IX: So MINITS I came to work for the progressive executive. His company grew faster and was more profitable than ever before ...with thrifty little MINITS I doing the job for only $2 an hour connect time with free CPU time.

As time went by the company became so successful that it had to invest in a super-duper, number-cruncher type of computer. Like the 360 or the 1108.

7EVEN: Has MINITS I outlived his usefulness? Not at all. Big-little MINITS is instantly converted into a hard working front-end helper to the 360 or 1108, using the number-cruncher for storage and those really big jobs—and continuing to handle the mundane every day time-sharing tasks in its inimitable economical way.

Phone for a demo or write for the MINITS brochure

Jacobi Systems Corp.
16625 Saticoy St.,
Van Nuys, Calif.
(213) 787-8360

Canada:
Alan Crawford Associates Ltd.
(416) 636-4910 in Toronto

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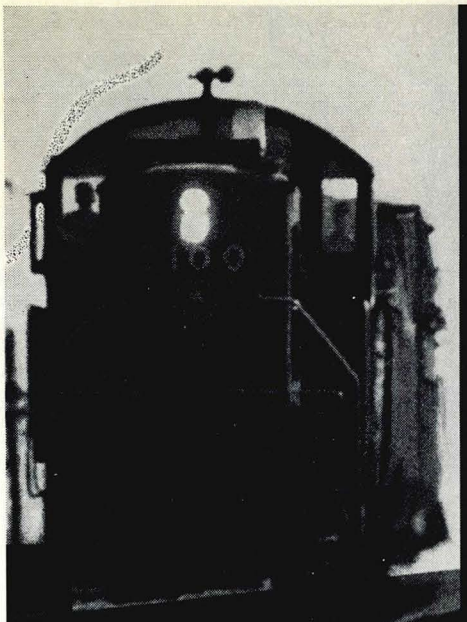


data bits from Teletype

8 million pounds of food moved daily!

When you handle 14,000 food-filled freight cars annually, deal with more than 160 truck carriers to service the daily needs of over 500 retail chain and independent outlets, the need to know takes on staggering proportions.

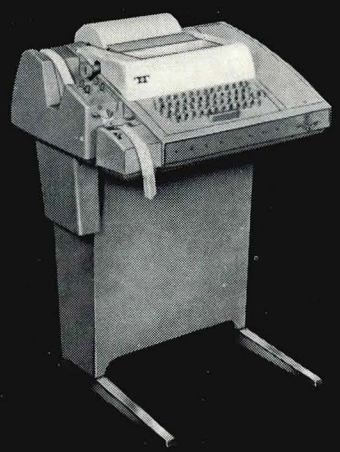
The warehouse that copes with this logistical problem has linked its customers with a computer using Teletype® terminals. Shipping data from processors and food packers is fed into the computer on a daily basis. Retail buyers use Teletype equipment to obtain up-to-the-minute inventory status reports, to place orders and receive concise shipping data. This enables the warehouse to keep track of, and move some 8 million pounds of food every day. Fast, accurate data communications has also helped cut processor billing time down from over a week to twenty-four hours.

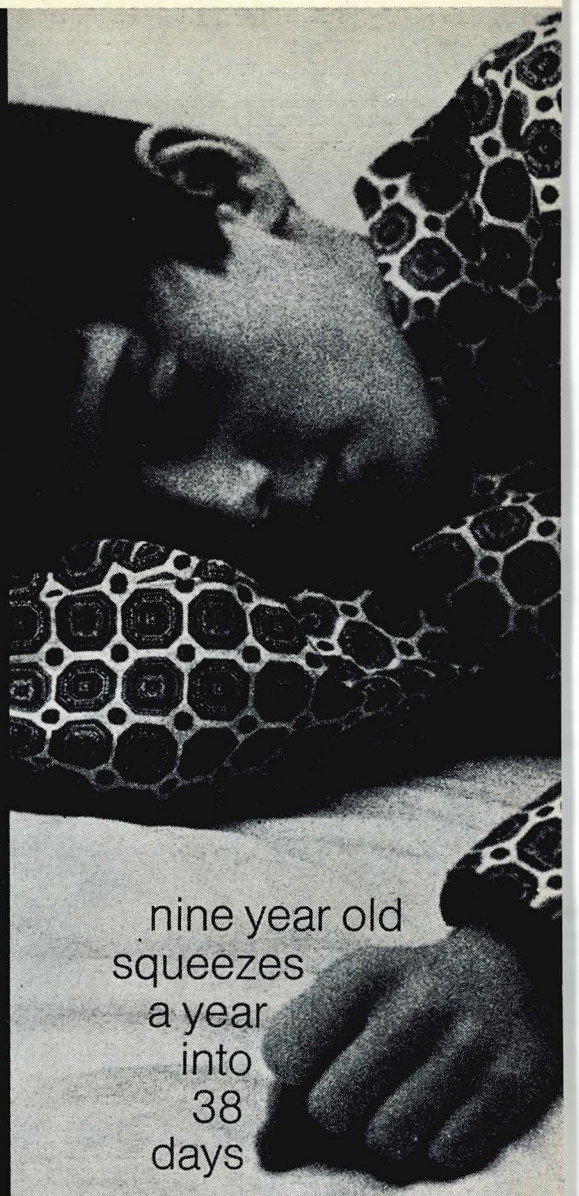
time-sharing money saver

There are probably more Teletype 33 sets being used in time-sharing applications than any other data terminal. Because, on a price/performance basis, it is one of the most reliable and economical terminals available.

The model 33 has everything required for preparing programs, getting them into the computer and retrieving information. It communicates in ASCII and operates at 100 words per minute. Its design simplicity makes computer dialog easier for the operator. But, what's really nice, is the price: It's amazingly low for all of its capabilities.

The model 33 line includes options and accessories needed for a variety of time-sharing needs. If you would like to know more about this low-priced terminal line, write for the model 33 brochure.





nine year old squeezes a year into 38 days

A young boy became so fascinated with a Teletype 33 terminal that he completed a whole year's arithmetic program in 38 days. His school is involved in a computer assisted educational program using a remote university computer. The simplicity of the terminal enables the youngest of students to master its operation in a short period of time.

Some subjects included in the program are reading, science and arithmetic. Students receive individual drill and instruction geared to their own level of comprehension. The slower student gets much needed practice at a level which he can achieve. The average student reinforces his grasp of the subject with drill and practice at the terminal. The bright are offered programs that challenge and are limited only by their own abilities. Computer assisted education also enables teachers to find more time for individual student needs.

erasing errors on-line

Teletype has an interesting solid-state device called the Stuntronic™ parity error detector which helps locate and eliminate parity errors. It can be used with Teletype 33, 35, 37, Telespeed™ and Inktronic® terminals.

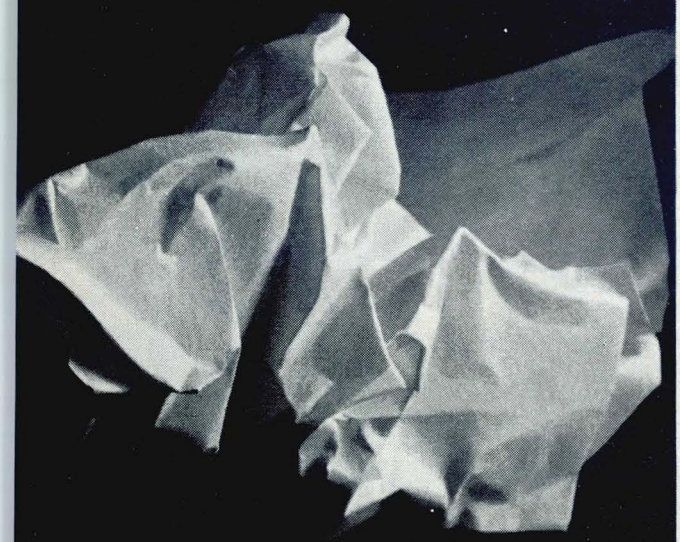
This accessory will accept a signal with up to 45% distortion and regenerate the signal with less than 5% distortion before passing it on to the terminal. Minimizing erroneous print-outs due to distorted signals.

It will also locate individual vertical parity errors and alert the station operator so that corrective action can be taken.

```
HERE IS AN EASY WAY TO SPOT AND      432*
CORREC* ERRORS RECEIVED IN TEXT      5678
OR NUMBER TRANSMI*SION.              90*2
```

With the Stuntronic detector, a preprogrammed substitute character can be used to graphically indicate exactly where an error is on the terminal print-out.

Stuntronic accessories can also count errors, light a signal lamp and generate a line break, notifying the sender of any errors.



recommended reading

Teletype has a number of bulletins 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:

TELETYPE CORPORATION
Dept. 40-12, 5555 Touhy Ave., Skokie, Ill. 60076
machines that make data move
Teletype is a trademark registered in the U.S. Pat. Office

CIRCLE NO. 14 ON INQUIRY CARD

Time-sharing is like paying bills in the dark.

Before you get your bill from a service bureau, there's no telling how much it's going to be. Because you never know how much time you need.

But now there's a different kind of time-sharing that costs the same every month no matter how much you use it.

It's called the Interplex System I. It's an in-house system with a 12K general-purpose computer, hard-wired to as many as 16 specially designed terminals. So you don't need phone lines. And only you can use it.

It's easy.

Our new time-sharing terminal is the first to combine BASIC language programming with an electronic calculator in a single desktop unit. So you can do up to 90% of your time-sharing jobs in BASIC without leaving your desk. And for a lot less than you're paying now.

You can even stop in the middle of a program to run your calculations, without paying an extra cent.

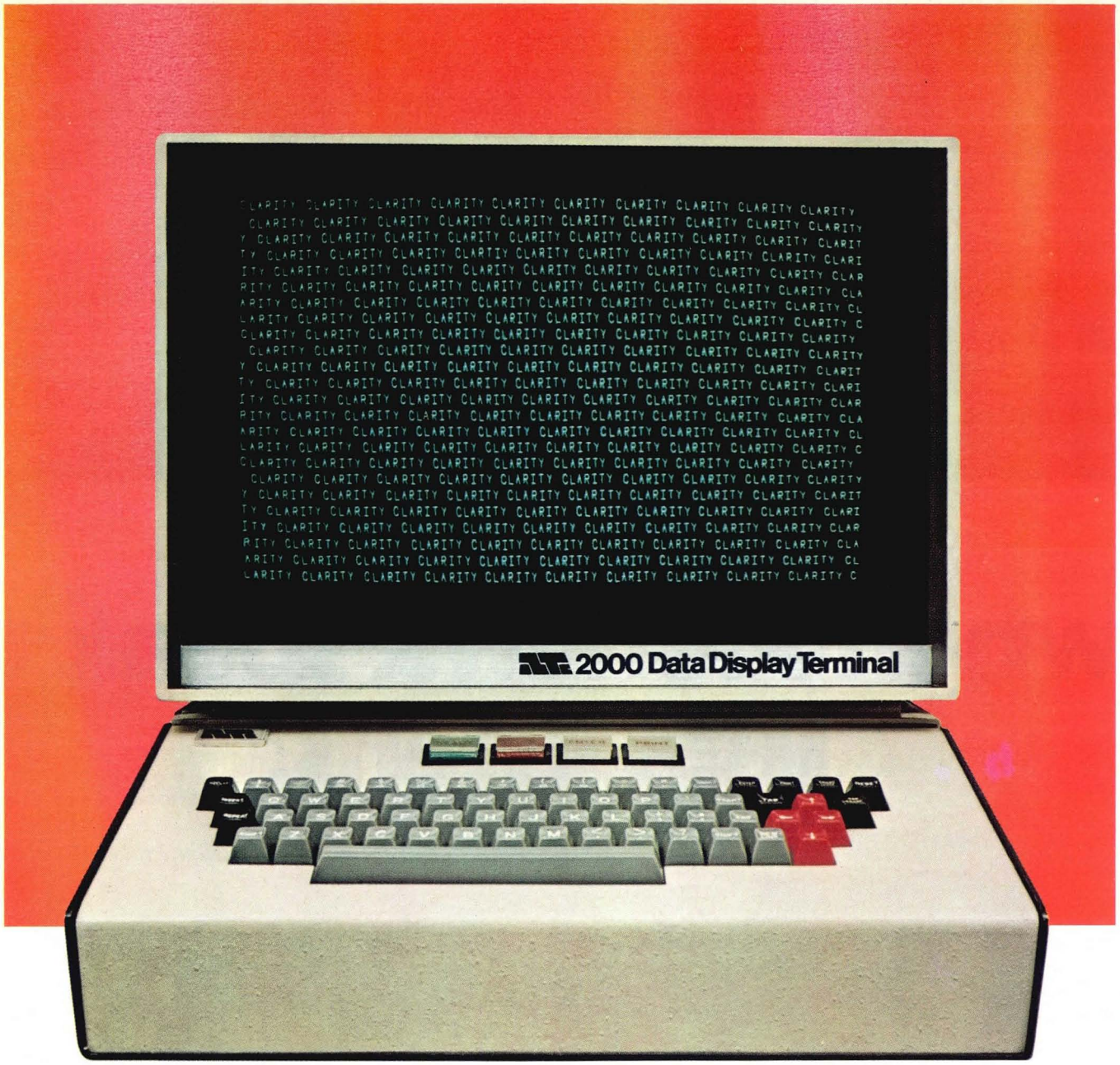
You can buy System I or lease it if you like. Either way, all its time is yours.

The Interplex System I. It's a different kind of time-sharing. You share it with yourself.

interplex

Interplex Corporation
400 Totten Pond Road
Waltham, Mass. 02154

CIRCLE NO. 15 ON INQUIRY CARD



we're sorry, Mr. Watson...

For yielding to temptation in a recent advertisement. And comparing your Model 2260 so unfavorably to our ATC 2266. Never again! Since the ATC 2266 Data Display Terminal does sell on its own merits, here goes.

To begin with, the ATC 2266 *puts up 1920 characters.* Clearer, more legible characters, too (our cursive stroke vs. the old dot matrix.)

Undeniably, the ATC 2266 *is* completely compatible with IBM System/360. Plug-to-plug interchangeable with the IBM-2848/2260 display subsystem. Right down to the software. And, what's more, you can have the ATC 2266 in less than 90 days. Maintenance is available from our network of close to 1,000 service representatives.

Here are some more merits. Program Controls for character addressing, formatting ability, protect mode and auto tab erase. Plus two Operator's Controls: insert key and delete key. Plus optional lower case, limited graphics and hard copy.

ATC also makes three other multistation display terminals, in 960, 480 and 240 characters. And standalones in 1920 and 960. All offering unbeatable cost/performance ratios, buy or lease.

Will you forgive us now, Mr. W.?

The ATC 2266 is sold and serviced through more than 45 MAI offices in the U.S.A.

MAI

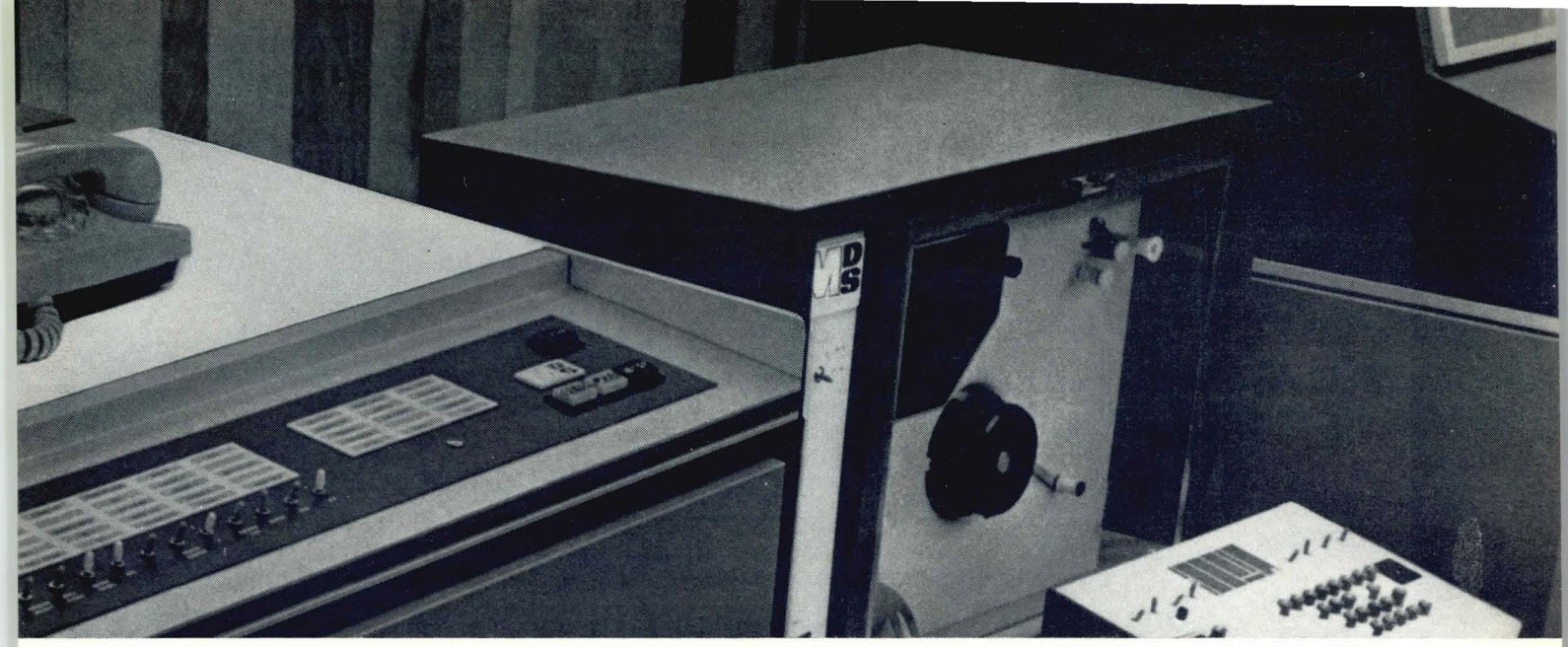
300 E. 44th St., New York, N. Y. 10017

Manufactured by
Atlantic Technology Corporation
The Display Company

CIRCLE NO. 16 ON INQUIRY CARD

"Starting now, when Mohawk speaks, IBM listens."

New product talk by Pat Smith, Vice-President, Product Planning.



"You need to send data from Salt Lake City into an IBM 360 computer in Brooklyn, let's say, and you want to talk mag tape on-line. Practically speaking, the only way you could do this would be to set up another 360 out in Utah.

"Well, not any more. We've built a black box called a Binary Synchronous Communications Adaptor that lets one or more of our Data-Recorders talk directly on-line to most IBM 360 configurations.

"You can talk mag tape from Data-Recorder to 360; you can have the 360 talk back to the Data-Recorder; you can have the 360 talk to a printer. You can poll your remote stations, and then select the ones you want to talk with.

"The Bi-Synch box can be used in a point-to-point system, or a multipoint system. The second one gives you station addressing capabilities. You can use permanent connections, or a leased line, or a dialup switched network setup. The possibilities are wide open.

"IBM gave Binary Synchronous Communications its Flash Gordon name. We'd prefer something simpler, but since we're talking to their computers, we might as well stick with their names, too.

"We're very pleased with one fact: there's no need to modify operating systems software. You can use ordinary BTAM or QTAM.

"About forty per cent of our business is in data communications. It's an immense area that's hardly been scratched. We like it for two reasons, really. It opens up new markets to us, which means more sales. And it lets us offer our present clients greater systems possibilities, which means better service. Paying attention to both is what has made Mohawk."

Mohawk Data Sciences Corp.
Herkimer, New York

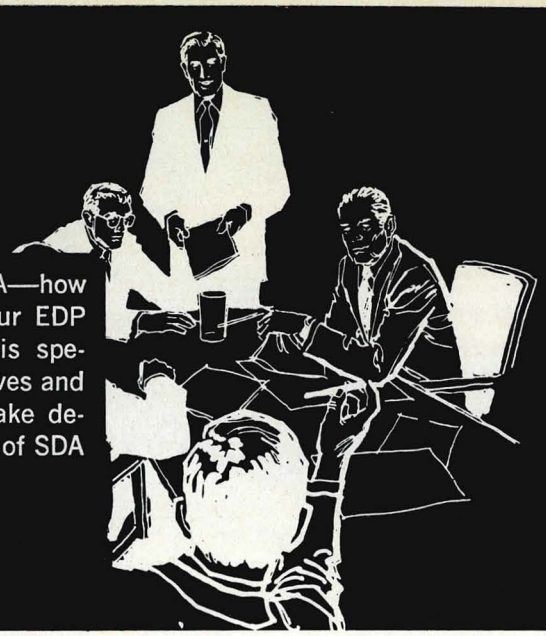
MDS

CIRCLE NO. 17 ON INQUIRY CARD

SOURCE DATA AUTOMATION

A two-day seminar sponsored by Faim Information Services, Inc. and MODERN DATA.

The basic concepts of SDA—how they can be applied to your EDP operations—this seminar is specifically directed to executives and managers who have to make decisions on the applicability of SDA to their EDP operations.



SEMINAR OUTLINE

Introduction To Source Data Automation

Fundamental principles of the Source Data Automation design concept: definition of terms; basic purpose; design philosophy; interface with the EDP system; benefits; how it can fit into your system.

Source Data Automation State-of-the-Art

A discussion of the various types of SDA equipments available, their characteristics, manufacturers, their strong and weak application areas. Types of devices to be described will be:

- Optical Character Readers
- Mark Sense Readers
- Bar Code Readers
- Remote Scanners
- Magnetic Readers
- Keyboard-To-Tape Devices
- Portable Data Recorders
- Alphanumeric Display Terminals
- Touch-Tone Telephone

Economics Of Source Data Automation

A quantitative comparison of various Source Data Automation devices considering total system costs, volume of data, error rates, operating factors and various data preparation complexities. Specific breakeven points will be presented graphically.

Decision-Making Criteria In Source Data Automation

Description of factors that need to be considered in SDA device selection; a quantitative methodology for SDA selection given with specific examples.

Implementing And Operations On SDA System

Description of actual SDA application in which problems and solutions in operating an SDA system will be discussed.

Trend Analysis Of Source Data Automation

A discussion as to the SDA State-of-the-Art technology for the 1970's including technical breakthroughs, equipment marketing, and application areas.

SDA STATE-OF-THE-ART REPORT

Included with the seminar will be a newly-published Source Data Automation State-of-the-Art report describing present commercially-available SDA equipment and their characteristics. The text will cover the topics discussed at the seminar in full descriptive form and contain SDA equipment comparisons in terms of performance and cost. Included in the price is a one year updating of report so as to include newly-announced equipment. Updating frequency will be at least quarterly or sooner depending upon SDA equipment news.

INSTRUCTORS & SPEAKERS

Lawrence Feidelman, Director & Principal Instructor

The seminar will be under the personal direction of Mr. Lawrence Feidelman, who is a noted authority in the Source Data Automation field. He has performed Source Data Automation studies for the government as well as industry. He has written numerous articles and lectured on the Source Data Automation field. He is a frequent lecturer for the American Management Association, has lectured on SDA for American University and various professional societies. He is presently Assistant Vice President and Manager of the Cherry Hill office of FAIM Information Services, Inc. He received his B.A. degree from New York University and his M.S. degree in Computer Information Science from the University of Pennsylvania.

Bennett Landsman, Instructor

Mr. Landsman, a senior systems analyst with Faim, has recently completed a Source Data Automation study for the Department of Agriculture and an equipment Source Data Automation design analysis for a data processing company. He is a major contributor to the Faim SDA State-Of-The-Art report.

REGISTRATION

Registration for the seminar, including the SDA State-of-the-Art Report with a one year equipment updating, is $210. Checks should be made payable to Faim Information Services, Inc. and forwarded with the registration coupon below. Your registration will be acknowledged by return mail.

Faim Information Services, Inc.
1020 Kings Highway North
Cherry Hill, New Jersey 08034

☐ Check enclosed
☐ Bill me
☐ Bill my company

Gentlemen: I plan to attend your Source Data Automation two-day Seminar at the following location:

City	Date	Hotel
☐ Washington, D.C.	May 19 & 20	Hotel Sonesta
☐ New York City	June 16 & 17	Warwick Hotel
☐ Boston	July 14 & 15	Hotel Sonesta

Hours: 9 A.M.-5 P.M.

Name _____ Title _____

Company _____

Street _____

City _____ State _____ Zip _____

Phone _____

Important Note: There will be a late cancellation fee of $25.00 if cancellation notice is not received at least one week prior to start of seminar.

Man does not live by mainframe alone.

Some computer makers give you a mainframe. Period.

Honeywell 316 and 516 computers come with everything from soup to nuts. Like one of the broadest lines of peripherals and subsystems.

These include: Seven-track and nine-track magnetic tape units with vacuum capstans and hardware error correction. Moving head disc stores, including a dual spindle model (performs read or write operations on one spindle while the other is in the seek mode) and a high-capacity model (14.4 million bytes). Buffered line printers with speeds up to 950 lines per minute. Paper tape and card readers and punches. Data acquisition and control interfaces. Displays. Plenty more, too.

Want to build your own subsystems? There are more than 400 compatible Honeywell logic modules to choose from. Memory systems, too.

Software? More than 500 field-proven programs.

Get more information about the Series 16 family of real-time, on-line computers and options. Write for the 316/516 literature kit. But whatever you do, consider the alternative: Honeywell, Computer Control Division, Framingham, Mass. 01701.

The Other Computer Company:

Honeywell

Sanders can throughput more input...

Misteak? It probably hit you right where you live. Error-free input is the life blood of any EDP man.

That's why Sanders designed a system that gets input moving, yet keeps it error free. The Sanders System 6000* Display Data Recorder.

The operator taps a key. Instantly, a replica of the source document—we call it a format—appears on the screen. Then the operator simply types information into the blanks. Logically. In the same order and position as on the original. Notice how the System 6000 displays data in two intensities. It makes it easy to verify. Errors are corrected by simply overtyping. Text automatically adjusts for insertions and deletions.

Once all the data is correct—and only then—the operator enters it on computer-compatible tape. Up to twelve units can share the same reel, so tape pooling is eliminated. And the operator can select many formats from a changeable tape cartridge.

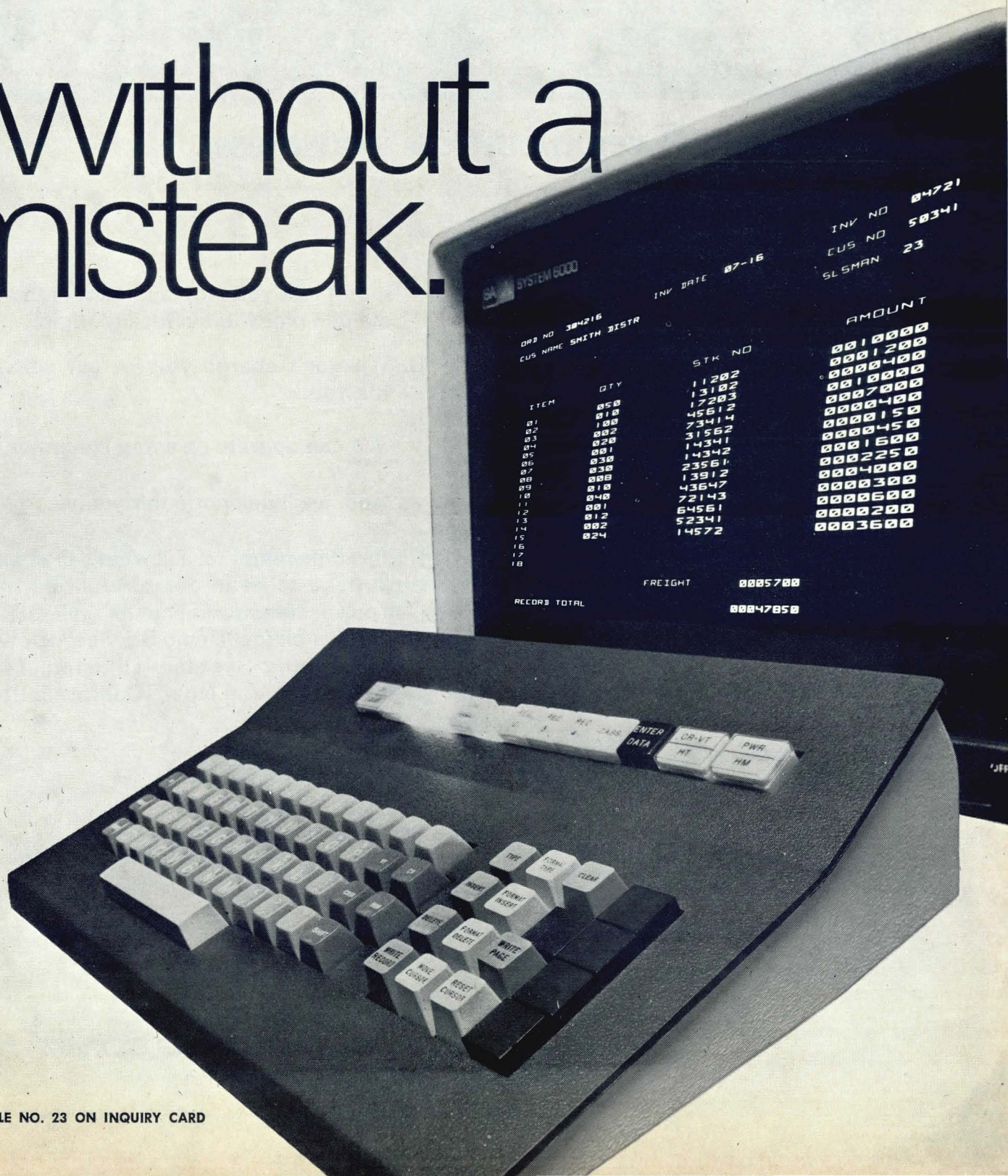
If you don't look at the system that can throughput more error-free input, you're making a mistake. Any way you spell it. Call your nearest Sanders sales office, or contact Marketing Manager, Data Systems Division, Sanders Associates, Inc., Daniel Webster Highway S., Nashua, New Hampshire 03060. Or call (603) 885-4220.

SA * SANDERS ASSOCIATES, INC.

*TM Sanders Associates, Inc.

SALES OFFICES: ATLANTA/BOSTON/BUFFALO/CHICAGO/CINCINNATI/CLEVELAND/CORAL GABLES/DALLAS/DENVER/DETROIT/HARTFORD/HOUSTON/LOS ANGELES/MINNEAPOLIS/NEW YORK/PHILADELPHIA/PITTSBURGH/RICHMOND/SAN FRANCISCO/SEATTLE/WASHINGTON, D.C./MONTREAL/TORONTO, AND HITCHIN, HERTS, ENGLAND

without a misteak.



CIRCLE NO. 23 ON INQUIRY CARD

If you put our plotter alongside what's their name's, you'd choose ours every time.

(Even if ours does cost less).

The "how comes?" are many. Here's eight.

1. Our Delta Control.* An exclusive feature that allows us to plot up to 1023 steps in X and Y from a single command.
2. The Delta feature also reduces computer write time as much as 30:1.
3. We've got the only incremental plotter available on-line or with three off-line modes of input: mag tape, punched tape or punched cards.
4. We're the only ones with programmable step size and speed control.
5. Our plot interrupt button is exclusive too! It lets you stop and start in the middle of a plot without losing origin.
6. We don't charge you for our software. It's free.
7. We can operate on every computer.
8. And, we'll deliver in thirty days.

Ruffle some feathers, ask what's their name for a head-to-head demo. We'll be there. Call our demonstration center collect. (213) 781-7100. Ask for "Demo Service". Or write UCC Graphic Systems Division, 14761 Califa Street, Van Nuys, California 91401.

*Pat. Pend.

UNIVERSITY COMPUTING COMPANY
GRAPHIC SYSTEMS DIVISION *First in Business Graphics*

CIRCLE NO. 24 ON INQUIRY CARD

CIRCLE NO. 25 ON INQUIRY CARD →

The incredible reducing machine.

KEY-EDIT

reduces data preparation problems to an absolute minimum

Reduces
errors to a minimum
Accuracy of source documents is checked at moment of data entry. KEY-EDIT's built-in computer filters out errors with variety of powerful editing routines.

Reduces
need for verification
The powerful edit routines can verify your data as it is keyed into the system, thereby reducing the cost of duplicate keying for verification.

Reduces
elapsed time and scheduling problems
Data that requires verification can be verified by one operator while it is being encoded by another operator—cuts job time in half.

Reduces
required floor space
KEY-EDIT actually saves up to 50% in floorspace over keypunch and key-to-tape units because of compact key stations.

Reduces
equipment problems
KEY-EDIT's fixed head magnetic drum is more reliable than the moving head disk found in other systems. And KEY-EDIT's fewer tape drives ensure even further reliability.

Reduces
personnel turnover
KEY-EDIT provides a far more pleasant working environment. This easy-to-learn system is virtually noiseless. Data handling is minimal.

Reduces
data preparation costs
You don't have to wait for your big computer to find source document errors. Checking and editing routines dramatically speed-up work cycle.

Reduces
job turn-around time
Fewer operators. Less equipment. Improved accuracy. Greater flexibility and productivity all add add up to significant savings.

Reliability is the key to KEY-EDIT. This most advanced data preparation system is in operation now at major high-volume EDP installations. KEY-EDIT works. It is proven. No "dealing in futures." Equally reliable is delivery. KEY-EDIT can be operational for you in as little as ninety days. This reliability is ensured by Consolidated Computer's coast-to-coast staff of experienced marketing and technical personnel.

For a demonstration, call or write now. Right now.

Boston: 235 Wyman Street, Waltham, Massachusetts 02154. (617) 891-0210

Toronto, Canada: 48 Yonge Street, Toronto, Ontario. (416) 366-7643

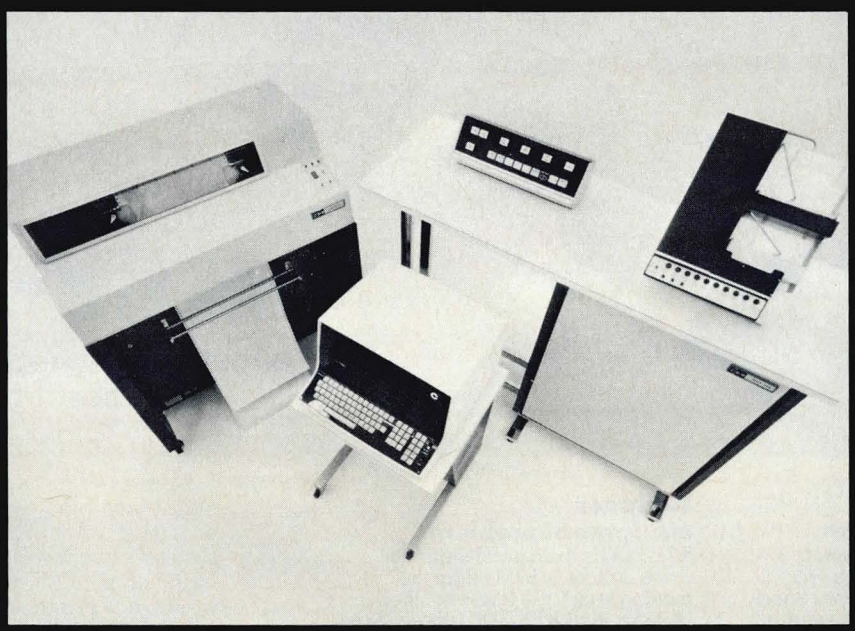
London, England: Northdale House, North Circular Road, London, N.W. 10, England. 01-965-9771

Expect more from
CONSOLIDATED COMPUTER

CLEVELAND CHICAGO DETROIT LOS ANGELES NEW YORK PHILADELPHIA SAN FRANCISCO WASHINGTON MONTREAL

When our terminal calls...

IBM, Univac and CDC answer.



We use software instead of hardware to make our DCT-132 speak several manufacturers' dialects. This saves you money initially and every time you expand. (Plus . . . we save you money today by replacing your present terminal.)

The basic terminal includes a controller, a 300 LPM printer, 300 CPM card reader, interface for full or half duplex operation at 2000 to 4800 baud, and a software emulation package. The off line capabilities beat those of any comparable terminal. It can handle many extra peripheral devices, including a CRT.

When you call us . . . see how fast we answer.

Scientific Control Corporation

P. O. Box 96 / Carrollton, Texas 75006 / (214) 242-6555

CIRCLE NO. 26 ON INQUIRY CARD

Here's the disc storage system for mini computers—Peripherals General Model 816/716. It interfaces directly to sixteen bit computing systems, and no other hardware is needed. The drives use 1316 disc packs and are plug-to-plug compatible with the IBM 2311. The sixteen bit controller can handle two drives and is tailored to the individual interface. Capacity is 116 million bits. About price, you can think particularly small. The basic system is in the $20,000 range. In OEM quantities it is considerably less. Delivery has also been miniaturized. It begins in July.

Peripherals General Inc.

Cherry Hill Industrial Park, Cherry Hill, NJ 08034 (609) 424-2010

CIRCLE NO. 27 ON INQUIRY CARD

The best is here NOW!

Time-sharing users: We will install immediately. Lease or buy directly from us.

Check these outstanding features • Complete teletype interchangeability • 72 character line, 25 lines per frame • 110-2400 bps transmission, selectable • Automatic roll-up • Stand alone unit.

To place your order today, call collect to your nearest Computer Terminal Distribution Center listed below.

Computer Terminal Corporation
A TEXAS CORPORATION

HOME OFFICE: 9725 Datapoint Drive, San Antonio, Texas 78229, (512) 696-4520
REGIONAL OFFICES: WESTERN — 3807 Wilshire Blvd., Los Angeles, Calif. 90005, (213) 380-2497 • MIDWESTERN — 7851 Metro Parkway, Minneapolis, Minn. 55420, (612) 727-1344
FEDERAL — 1815 N. Fort Myer Dr., Arlington, Va. 22204, (703) 524-6455 • EASTERN — One Bank St., Stamford, Conn. 06901, (203) 325-2244

CIRCLE NO. 28 ON INQUIRY CARD

NEWS ROUNDUP

CDC REVISES

Control Data Corp. has revised its software policies to affirm certain proprietary rights of its customers and provide for a pre-acceptance period for CDC licensed software products. Under new contracts implementing the policy changes, modifications or improvements to Control Data software by the customer, or CDC analysts working on behalf of the user, belong exclusively to the customer. Customers will also have a period of 90 days in which to accept or reject CDC software prior to initiation of use charges, unless the customer uses the software for his own productive purposes within that period. The new policy also gives customers the option to return unused software within the 90-day period without charge.

CREDIT-CARD SPECIFICATION STANDARD

A draft proposal which would provide for standardization of credit-card specifications has been presented to the members of American National Standards Committee X4, Office Machines and Supplies, for a letter ballot approval. The proposal was presented to X4 by Sub-Committee X4A11, specially created to develop this project. In developing the proposed standard, the Sub-Committee conducted surveys of the major credit-card issuing industries to determine characteristics and specifications of cards currently in use as well as the future plans of the issuing companies. In all, 95 million cards issued by the airlines, banking, petroleum, travel, and entertainment industries were covered by these surveys along with 101 million cards issued by retail merchants. After consideration of all the information presented, the Committee developed: (1) Physical specifications and type styles; (2) Alternative specifications for cases where name and address are required and for small cards; (3) Account numbering systems for interchange.

Copies of the proposed standard are available from the Committee's sponsor, the Business Equipment Manufacturers Association, 235 East 42 Street, New York, N.Y. 10017.

ITT REDUCES OVERSEAS RATES

Rate reductions of 15 to 20 percent in record communication services between the U.S. and 16 European countries were announced by ITT World Communications, a subsidiary of International Telephone and Telegraph Corp. The new rates cover Telex, privately leased telegraph, and voice/data circuits.

The reduction in telex comunication will be approximately 15 per cent. The reduction in 50-baud leased teleprinter channel (66 words a minute) and alternate voice/data rates will be slightly more than 20 per cent. The new monthly rate for a 50-baud channel will be $1,900 compared to the existing $2,400 rate, an annual saving of $6,000. The telex rate to countries where one-minute minimum service is available will be reduced from $3.00 to $2.55 a minute; and in areas where the three-minute minimum applies, it will be $7.65 instead of $9.00.

The revised schedule, effective April 1, was made possible by economies resulting from the recent establishment of a new, high-capacity trans-Atlantic Mediterranean cable which links the U.S. to Spain, Italy and Portugal, and connects with networks in more than 30 other nations in Europe, the Middle East, and Africa.

W.U. TO EXTEND MICROWAVE NETWORK

The Western Union Telegraph Co., a subsidiary of Western Union Corp., has filed a plan with the Federal Communications Commission to build a 400-mile "hybrid" extension to its 7,900-mile transcontinental microwave communications network. The extension would provide Western Union customers with digital and analog radio beam communications capabilities between Cincinnati and Atlanta. It also will permit customers in the Atlanta area to have direct access by microwave to Western Union's $80 million coast-to-coast microwave system completed in 1964. Initial circuit assignment of the $2.7 million Cincinnati to Atlanta spur will be 165 digital channels and 216 voice frequency analog channels.

SINGER ANNOUNCES BUSINESS EDP SYSTEM

System Ten, billed as "a people-oriented concept in electronic data processing," was announced by the Singer Company's Friden Division. Robert J. Campbell, Friden's president, referred to the new product as the most significant in Friden history, and described it as "the only known business data processor with on-line file capability that accomplishes multi-programming by hardware."

Although Friden has long been active in the automated billing/accounting field, System Ten is the company's first general-purpose business processor, and is aimed at a data processing market that Friden estimates will reach $30 billion in installed equipment by 1972. The company believes sixty percent of all installed units will be categorized as small computer systems, with the largest dollar share of this market segment going for business-oriented systems.

System Ten offers a choice between on-line, real-time processing and batch processing by card, disk, or tape. Prices will range from under $30,000 to over $150,000. A batch processing configuration, including a processor with 10K of core storage, a card reader, card punch, and a line printer, will sell for about $44,000 or lease for under $1,400 per month. A typical multi-terminal configuration, including a processor with 10K of core storage, a ten-million character disk drive, and five workstations will be priced at $42,250 or $1,355 per month.

The company also announced that a complete software and support program including education, service and field systems engineering will be available with first deliveries of System Ten in September of this year.

B.S. DEGREE IN COMPUTER SCIENCE

Computer science will be established as a major field of study at the University of Redlands (California) next fall in response to a mounting demand for computer specialists at the bachelors degree level. Dr. Jerome Johnson, chairman of the engineering science dept., announced that the University's present offering of five units in computer programming will be expanded to more than 30 units in computer science. The program will be a stand-alone major and not a special program within the engineering science curriculum. Redlands is one of the first universities in the nation to offer an undergraduate major in computer science.

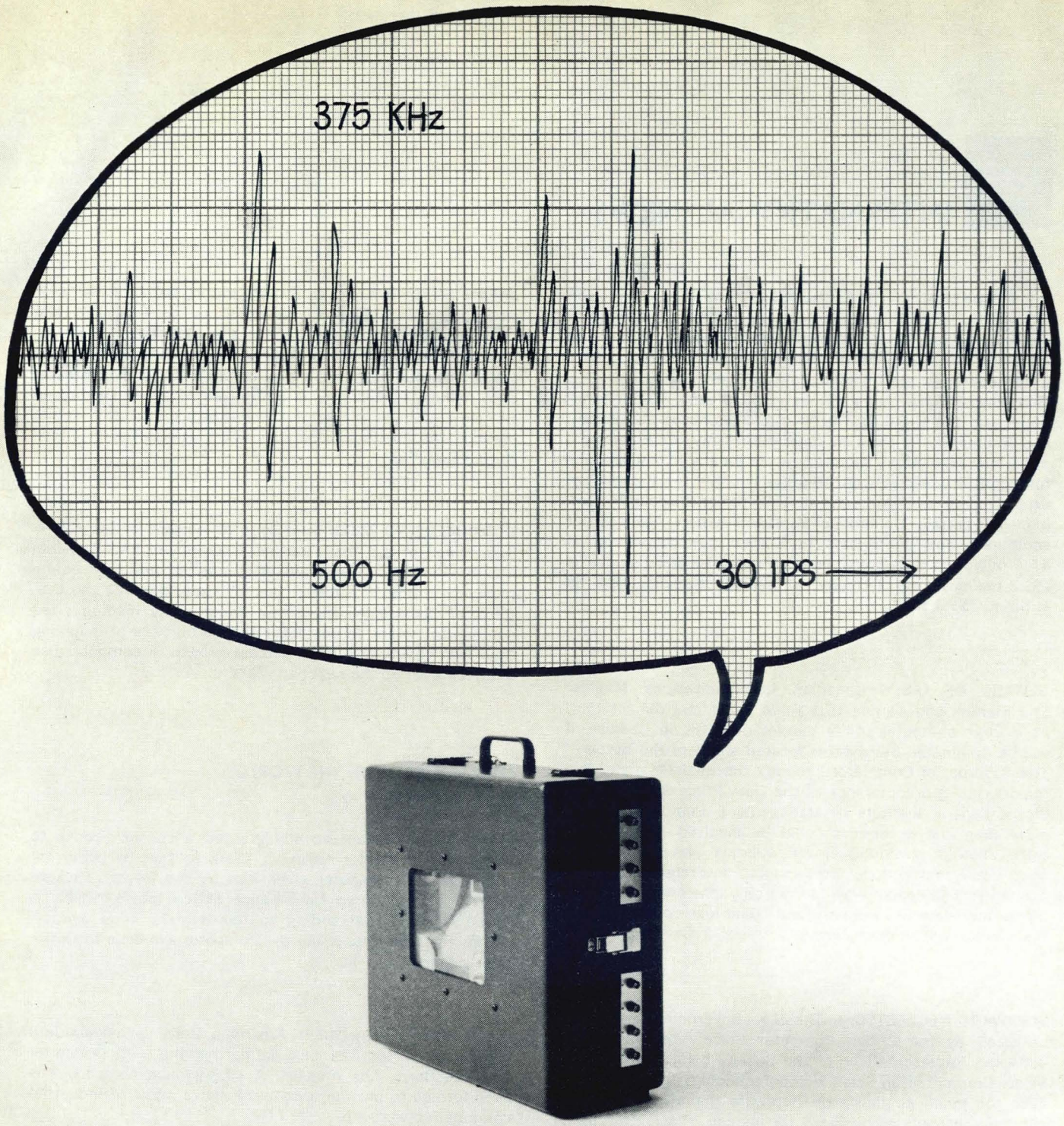
XDS OFFERS SYSTEMS TO PRISON INMATES

Inmates at Oregon State Prison in Salem are preparing themselves for careers in the computer industry by learning how to program, operate, and maintain a computer donated to the prison by Xerox Data Systems. The computer workshop has been offered since June to qualified inmates of the penitentiary and may be expanded soon to include other correctional institutions including those for women and children. John J. Galvin, Oregon's head of state corrections, said that one of the participating inmates, recently paroled, has obtained a programming position with the State. A second inmate, soon to be paroled, has been offered a position in industry.

RCA CHANGES PRICING STRUCTURE

As predicted by MODERN DATA in its Nov. 1969 issue ("A Round of Price Changes," — p. 87), RCA announced major changes in its computer pricing structure, including a plan with options to bundle or unbundle. The new unbundling plan gives computer users the option of leasing or purchasing RCA computers without systems support at a three per cent price reduction, or of acquiring the computer hardware with full systems support at present rates. J. R. Bradburn, RCA executive vice president, Information Systems, said the new unbundling program "offers the nation's computer users a price reduction equal to that offered by IBM on unbundled computers while still giving them the option of taking the total hardware and software package at no increase in price." Basic operating software, applications programs, and customer training services will continue to be provided by RCA at no extra cost under whichever option the customer elects to take, he added.

RCA also announced the details of a new lease-purchase plan which offers its commercial customers up to 15 per cent reduction in monthly charges for its computer systems over a six-year period, at the end of which they will own the computers. In announcing the new lease-purchase contract, L. E. Donegan, Jr., division vice president and general manager of RCA's Computer Systems Division, said it "represents a totally new concept in the marketing of computers to the business and industrial communities. Under this new contract, commercial customers have all the economic advantages of purchase, combined with the flexibility of leasing." Although similar contracts have been offered to state and local government agencies for several years, this is the first time any major manufacturer has made these terms available to non-government customers, Mr. Donegan stated.



No other 28-lb. data recorder can make that statement.

Now available, our new 417 WB speaks wideband to the tune of 374.5K Hz at 30 ips. Of course it's not the only recorder that meets IRIG specs for wideband Group II. But it's the only one that weighs less than 50 lbs. (The 417 WB's 28 lbs. also includes its carrying case and self-contained battery, by the way.) And it's the only one small enough to fit under an airplane seat.

So, when you have to hit the trail for data, let the new 417 WB take a load off your back. And off your mind. It needs less maintenance and fewer adjustments than any other portable recorder. It ignores bumps, jolts, vibrations and odd mounting angles. It normally draws only 25 watts of power. It records on seven channels. And it matches large rack machines for accuracy.

But that's just a taste. For the full 417 WB story and spec sheet, write Mr. Fred Romer, Dept. 412-10, Lockheed Electronics Company, Plainfield, New Jersey 07061. Or call him at (201) 757-1600. He, too, speaks wideband.

Lockheed Electronics
A Division of Lockheed Aircraft Corporation

INTERNATIONAL NEWS

U.S EXPORTS — The U.S. Dept. of Commerce has revised its rules for exporting computers and related equipment to Eastern Europe. Under the new rules, detailed information would be required only for country groups W and Y. The Y group countries are Albania, Bulgaria, Czechoslovakia, East Germany, Estonia, Hungary, Latvia, Lithuania, Outer Mongolia, and the U.S.S.R. The W group countries are Poland and Roumania. In the last quarter of 1969, Commerce issued new regulations requiring more details in applications for export licenses in order to judge whether the prospective export might be detrimental to U.S. national security. During that period, Commerce approved export licenses for computers and peripherals to Eastern Europe valued at $7.4 million. The exports were primarily to Czechoslovakia ($2.3 million), East Germany ($1 million), Hungary, and the U.S.S.R. ($1.4 million).

BEWARE OF U.S. — Canadian Communications Minister Eric Kierans has warned that there is "a real danger that, as a large computer utility market develops in Canada, it will be dominated by systems located south of the border." The "Journal of Commerce" reports the minister made this remark during a conference of the Data Processing Institute of the Federal Institute of Management. Pointing out that more than just economics could be involved if this trend were allowed to continue, Mr. Kierans stated "it could have grave implications for Canadian sovereignty." He explained that Canadians "would not only lose one more manufacturing or service industry, but could lose control of how information will be stored and processed" in Canada.

SOFTWARE NEGLECTED — The U.K. Government has been criticized by the British Computer Society for neglecting software. Representatives of the Society complained to the Select Committee on Science and Technology that there has been too much emphasis on hardware manufacturers. The economic aspects of business DP instead of scientific uses should be more fully recognized, they said. The Society urged more use be made of local suppliers and charged that little attempt had been made by the government to foresee trends in its requirements and correlate them with R & D plans.

UK SHOW IS SUCCESS — As evidence of current market opportunities in the field of computer-related equipment in the United Kingdom, the U.S. Chamber of Commerce cites a "highly successful" exhibition in London of U.S.-manufactured data transmission equipment. The Dept. of Commerce-sponsored event is said to have resulted in immediate sales of $1.2 million, and a projection of $26 million in the 12 months following the exhibition.

JAPAN BUYS RCA — The Export-Import Bank of the U.S. has authorized a $2.3 million credit to the Okura Trading Co. of Japan to finance half of the U.S. cost of buying eleven RCA Video Comp 800 electronic composition systems. The total cost of the U.S. procurement is estimated at $4.6 million. Financing was authorized to assist Okura and RCA in creating a market for this advanced printing equipment in the Far East. One unit will be displayed in Tokyo during Expo '70.

COMPUTERS TO MEXICO — Over 40 percent of the $20—$25 million of U.S.-made business equipment imported into Mexico annually is made up of computers and EDP equipment, according to a recent market study done by the U.S. Dept. of Commerce. The study found many medium-sized companies turning to computer service bureaus or installing their own computers. A 25 percent growth in computer use is forecast within the next two years.

QUICKLY AROUND THE WORLD

The Govt. of Ceylon recently granted a special license to science-fiction author Arthur C. Clark so that he could import a $4,000 computer given him by the Hewlett-Packard Co. Clark co-authored the science fiction movie "2001: A Space Odyssey." According to the Reuters news agency, Clarke has offered to make the computer available to Ceylonese scientists.

South Africa's giant Anglo American Corp. is moving into the computer services field in partnership with Computer Sciences Corp., Los Angeles. A $6.3 million company has been formed to provide a comprehensive range of industrial computer services.

Two Univac 1108 multiprocessor computer systems, valued at $4.4 million, have been ordered by the Bank of Finland from Sperry Rand Finland Co.'s Univac Division for delivery in the fall.

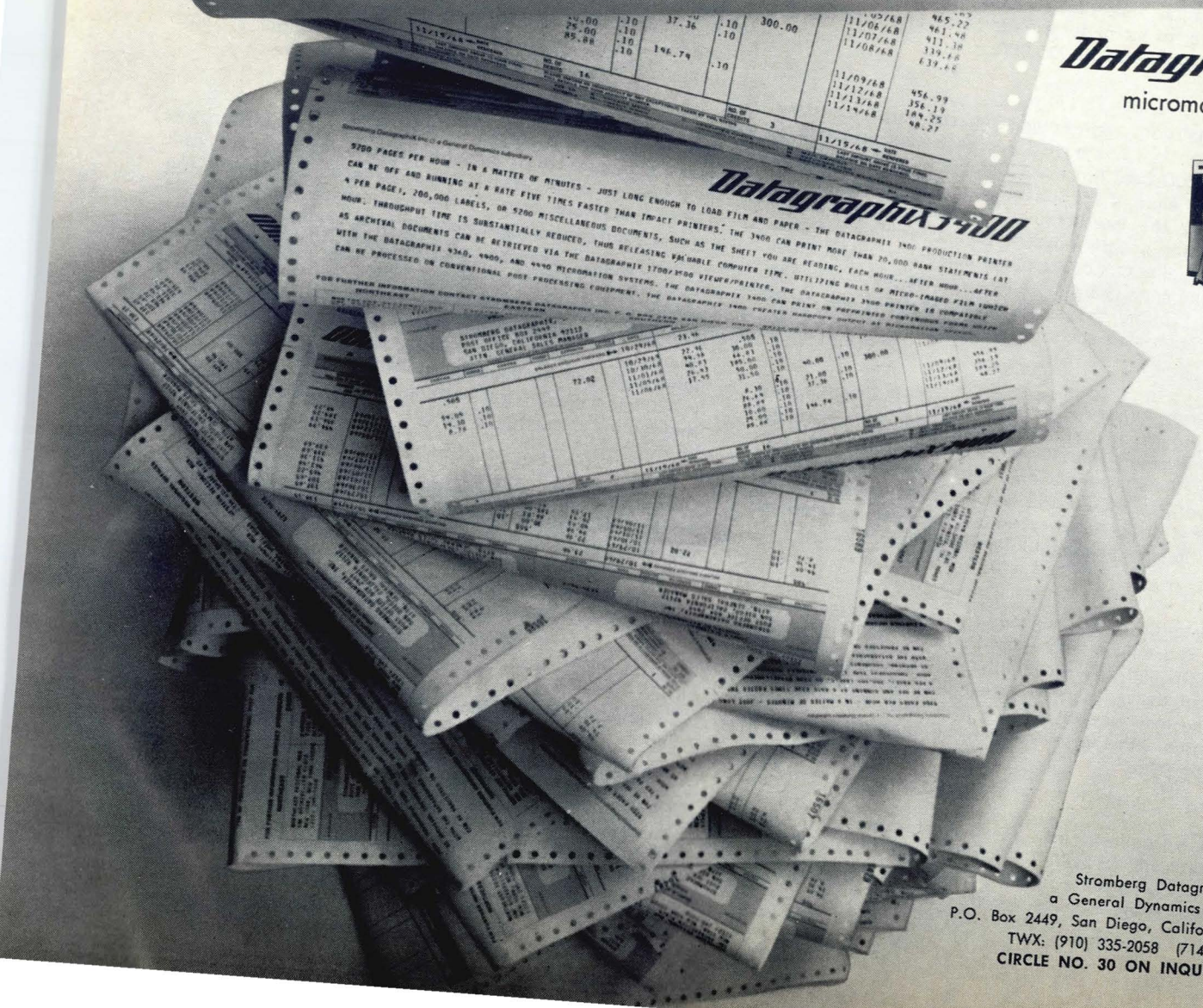
Total exports of computers and parts advanced 50 percent from 1968 to 1969 to $728 million—the largest advance since 1961. As in earlier years, most of the increase resulted from step-up shipments of complete machines to Western Europe, Canada, and Japan, where the pressure to achieve greater efficiency in DP and production and inventory control is strong.

how to get an extra 28,000 lines per minute out of your computer

Use a 30,000 line-per-minute Micromation printer. Considering the limitations of your present impact printer (1100 or 1200 lpm), you're getting short-changed 28,000 lines every minute. That's not all. Compared to impact printing, Micromation is roughly 27 times faster, takes 1/18th the computer time, slashes the cost of paper supplies 87%, and reduces storage 99%. Factor these ratios out of your operating overhead and you'll achieve an annual savings running into 6 figures or higher.

Unequalled speed brings fresher information to decision makers. Using a corporate-wide retention and retrieval system which accesses any of thousands of pages in seconds. And the first practical means of immediately communicating computer generated data anywhere. For external distribution, paper copies can be produced from data film at 5,200 pages per hour. In just one hour, you can get out 20,000 bank statements, 200,000 labels, or 5,200 direct mail pieces on preprinted, multi-colored forms.

Only one company offers the complete family of machine systems; service centers; Kalvar dry film processing; all associated supplies; systems and software support; worldwide maintenance. *Discover what Micromation can do for you. Contact our local office or National Sales Manager, James P. Whitfield.*



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CIRCLE NO. 30 ON INQUIRY CARD

ORDERS AND INSTALLATIONS

Computing and Software, Inc. announced receipt of a one-year contract valued in excess of $4.9 million from the National Aeronautics and Space Administration for continuation of data processing services at the Goddard Space Flight Center, Greenbelt, Md. The contract contains renewal options for two additional years, and provides the space flight center with on-site computing and related software services primarily concerned with the processing of satellite telemetry data, orbital predictions, and systems simulations.

Weismantel Associates, Inc. announced that Transworld Data Systems, Inc. has placed an order in excess of $2 million for Weismantel EDP sub-systems for use in European real-time computer systems. The equipment is to be delivered over a two year period.

Seaco Computer-Display Inc. of Garland, Texas has signed a purchase agreement with Interface Sciences Corp. of N.Y.C. for delivery of ten Seaco Model 401 Microfilm Recorder Systems at a total price of $441,504. The agreement also includes a letter of intent for an additional fifty systems at an approximate price of $1,925,000.

CompuTerminal Corp., San Francisco-based data processing service organization, has signed purchase contracts for 40 Burroughs B5500 Dual Processor Computers with an aggregate worth of more than $60 million. The transaction is believed to be the largest single purchase of computers ever made within private industry. CompuTerminal plans to open 20 regional computer/terminal centers in major cities throughout the country by the mid-seventies, each with two of the dual Burroughs systems servicing from 30 to 60 remote batch terminals each.

North Central Airlines has announced the company's changeover to its new "ESCORT" computerized passenger reservations system. The $8 million Electronic System Combining Operations, Reservations, and Tele-communications includes two IBM 360-65 and two Sanders 200 computers. The system is designed to expedite passenger reservations, message-switching, and flight information inquiries.

Control Data Corp. has signed a purchase agreement in excess of $25 million with Telex Corp. for the purchase by Telex of CDC high-speed computer printers. The agreement provides for deliveries over an extended period with shipments expected to begin in 1970. The controller to be used in connection with the printer is to be designed and manufactured by Telex.

Dominick & Dominick, Inc., a leading brokerage firm, signed a $50,000 contract with Computer Audit Corp. for CAC's COMPAK/360 software control package to be used with a $1.6 million teleprocessing system.

Westinghouse Corp./Hagan Systems Div. has signed a $500,000 contract with Peripherals General, Inc. of Cherry Hill, N.J. to supply removable disk drive systems for the Westinghouse Prodac 2000 computer. The Peripherals General system consists of a sixteen-bit controller and up to two disk storage drives providing a total capacity of 116 million bits.

Data Power Inc., Manhattan-based computer services franchise company, has signed a letter of intent with Viatron Computer Systems Corp. for the purchase over the next four years of 33,900 Viatron Computer System 21 Input Terminals. The order, dependent on results of evaluation tests, specifies that Data Power will order 1,014 units for delivery by the end of 1971, and the balance for delivery by the end of 1973. Data Power in the meantime has leased six units for delivery over the next several months, mainly to expand its test program on the equipment.

Data Products Corp. has received a contract in excess of $1.3 million from the U.S. Naval Ship Systems Command, Washington, D.C. The contract calls for high-speed militarized line printers to be used in conjunction with military communications systems and operational control systems centers in shipboard and land-based installations.

One of the first installations of Digital Equipment Corporation's computer-based industrial data acquisition and control system, INDAC-8, has been made at Brookhaven National Laboratory where it will be used to help physicists monitor and control high energy particle beams.

A contract to install a $6 million commercial audio-response computer system has been signed by Diners' Club, Inc. and Honeywell's EDP Division. Called DA_2SH (Diners' Club Authorization and Accounting System by Honeywell), the dual H-4200 installation will accomplish on-line credit inquiries and routine accounting functions.

The Government of the United Arab Republic has placed an order with International Computers Ltd. for a 1906A computer worth $3 million. Due to be installed in June 1971 in the Central Agency for Statistics in Cairo, this 196K system will be the most powerful ICL unit in the Middle East and one of ICL's largest single export orders to date.

Cubic Corp. of San Diego has been awarded a $3 million subcontract from Northrop Corp. of Los Angeles for the basic data transmission link of a new military system known as Joint Services In-Flight Data Transmission System (JIFDATS). JIFDATS will be used to collect reconnaissance information from aircraft in flight without the use of a camera and transmit the data to ground stations for processing and evaluation.

A dirty tape can make a computer look stupid.

Dirty tape causes data dropout. And data dropout puts computers down. And that costs money.

That's stupid.

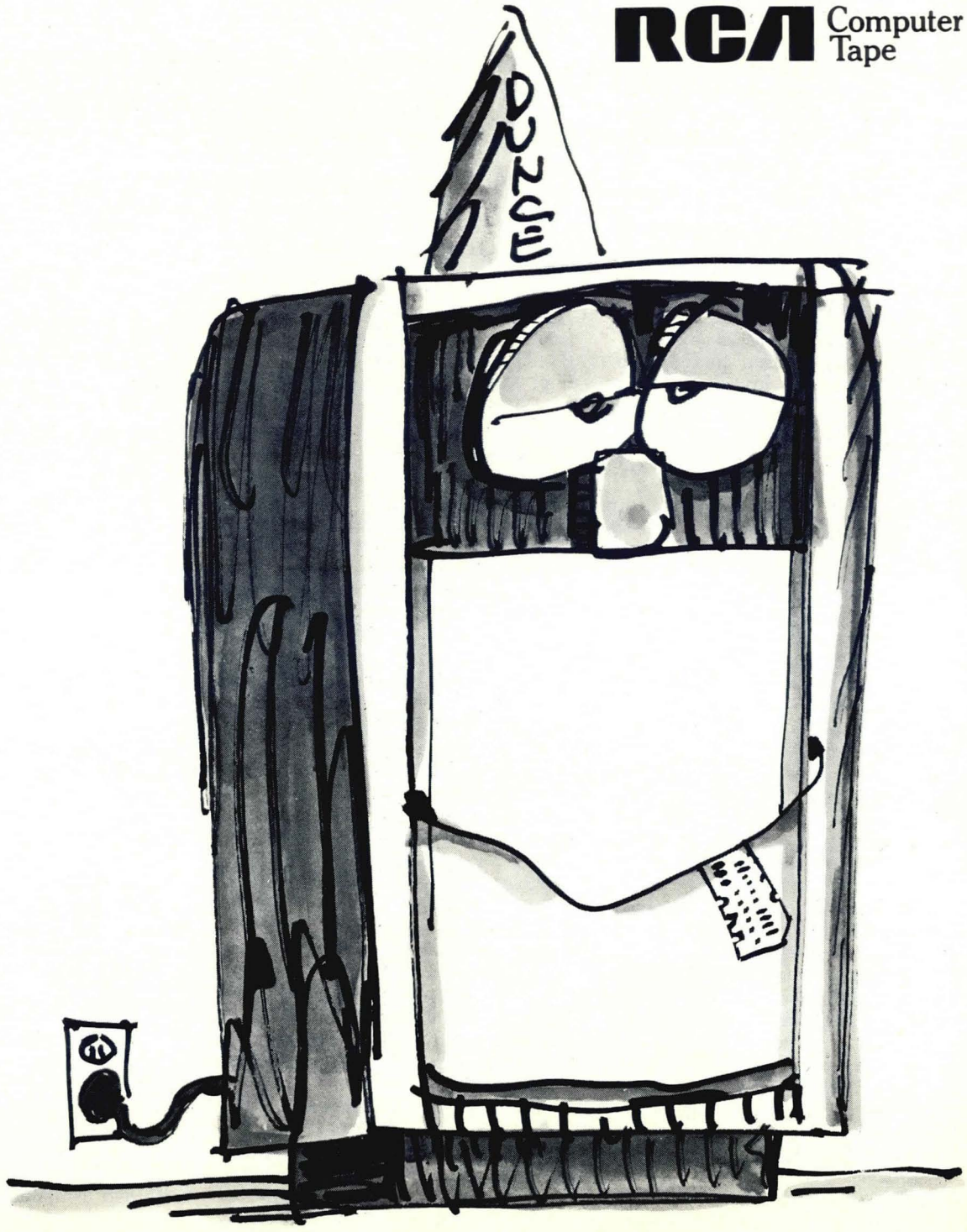
An intelligent solution is clean tape. RCA Computer Tape.

It starts cleaner because every inch of every reel is tested and certified in the most impeccable of white-room conditions. (We don't think statistical testing is good enough.) And it stays cleaner, longer.

Result: Fewer dropouts and more efficient computing.

Smart computers need clean tape. Write RCA Magnetic Products, 201 E. 50th St., New York 10022. Clean tape is all we know.

RCA Computer Tape



CIRCLE NO. 31 ON INQUIRY CARD

CORPORATE AND FINANCIAL NEWS

VIATRON REPORTS TO FINANCIAL ANALYSTS

Viatron Computer Systems Corp. announced contracts in excess of $50 million for semiconductors and made other announcements covering product pricing, production, finance, and executive changes. The information was disclosed at the first in a planned series of meetings with financial analysts.

Viatron stated that it had recently leased an additional 158,000 square feet of space from E.G.&G. for increased manufacturing and support activities. Production in the current facility was said to be 600 units per month – up from 400 per month.

Replying to criticism that System 21 was unprofitably priced, the company reiterated its determination to maintain its low price structure, stating that "current direct costs of manufacturing, including current variances, are substantially below the retail price of the machines," and "more than adequate to support the current price structure."

The production contracts cover an 18-month period in which Viatron's semiconductor vendors, including Texas Instruments, Motorola, and American Micro-Systems, Inc., will supply a major portion of its processed MOS wafers and arrays. The contracts were said to reflect prices below the company's original estimates.

In response to questions on Viatron's financial condition, it was reported that for the first time in its short history, the company is not concerned about money. Viatron anticipates that cash flow through sales and normal lines of credit will provide an adequate supply of cash reserves for the foreseeable future. When Viatron will show a profit was said to depend largely upon the ratio of systems sold to systems leased. The company's announced goal is to sell all of its machines, and it was reported that virtually all production is now being shipped against sales orders. The company also expects that export sales will soon account for approximately 25 percent of all shipments.

In response to a question regarding the effect of competition moving in on Viatron's market, it was pointed out that the market is significantly larger than Viatron and potential competitors will be able to meet in the near future. However, a hint as to what may be on the horizon came in a reference to the Japanese as future competitors.

The executive changes included an announcement that Mr. R. Bowen, formerly a v.p. at the National Bank of North America, has been named v.p. for internal financial control. Mr. Lloyd O. Ireland is no longer with the company. It was stated that company growth dictated that a new financial management team be formed.

REPORT ON FIRST QUARTER MERGERS

Merger activity during the first quarter of 1970 held at about the same level of the first quarter a year earlier, according to a survey and analysis by W. T. Grimm & Co., a Chicago-based financial consulting firm specializing in mergers and acquisitions. For the first quarter of 1970, 1453 merger announcements were recorded, down somewhat from the 1474 recorded during the first quarter of 1969. The final quarterly count should show only slight variation from the above figure.

Equity-type transactions continued their popularity during the first quarter. Equity securities were used in 54% of all transactions versus 64% for the same period one year ago. Cash and debt transactions constituted 32% of all mergers contrasted with 27% for the first quarter last year. Combination transactions of equity and non-equity, including combinations of convertible debt securities and equity, constituted 14% of all transactions versus 9% last year.

Tender offers during the first quarter of 1970 declined to 19 from the same period in 1969 when 57 were recorded. This represents a 67% decline from the same period last year and continues the decline in tender offer activity which began in the first quarter of 1969. Tender offer activity is most affected by tight money conditions and low stock prices of many acquisition-minded companies. These adverse conditions must improve before tender offers again become a significant factor, Mr. Grimm stated. Implementation of current proposed legislation affecting tender offers will likely further dampen activity, he added.

Sales of corporate divisions, subsidiaries, or product lines increased to 230 in the first quarter, up from 145 a year ago. This represents a 58% increase. In 1969 during the first quarter, sales of divisions constituted 10% of merger announcements while for the first quarter of 1970 they accounted for 16% of merger announcements.

Incentive transactions – where the purchase price is based in part on future profits – continued to show widespread acceptance in the first quarter of 170, with 130 such transactions recorded, against 128 for the same period a year ago. Both the first quarters of 1970 and 1969 showed that incentive-type payouts were used in approximately 9% of all merger transactions.

Of the 40 industry categories covered by the Grimm study, only seven industries showed significant gains in merger announcements over the first quarter a year ago, and four industries showed important decreases in merger activity. The most important gain in activity was recorded in the office and business machine group with 21 merger announcements in the first quarter, up from 6 last year for the same period. The leading category in numbers of merger announcements was general services with a toal of 293 announcements against 260 a year earlier. Of the general services, 71 merger announcements were accounted for by health services and 40 by computer services.

The Grimm survey of merger activity showed that cancellations of announced mergers rose to 148 in the first quarter, up 44% from the 103 recorded for the same quarter in 1969. The growth in cancellations recorded continues about the same rate of increase established for 1969.

IBM RAISES RATES ON U.R.E.

One to ten percent increases in monthly rental and maintenance charges for most unit record equipment were announced by IBM. They affect 48 of IBM's approximately 600 machine types. IBM also announced increases in charges for hourly per-call equipment maintenance service. The changes will be effective July 1. Purchase prices are not affected.

FORT LAUDERDALE SPAWNS ANOTHER ONE

To the list of formidable Fort Lauderdale computer firms add the name of Modular Computer Systems, Inc. Modular, founded by a team of seasoned computermen could prove to be the most significant new entry in the real-time computer market in recent years. Kenneth G. Harple, Modular's co-founder and president and former executive vice-president of Systems Engineering Laboratories, outlined the new company's corporate objectives to MODERN DATA by citing the industry's need for "highly productionized system building blocks that can be manufactured, tested, and sold as products as opposed to highly customized, one-of-a-kind devices." This unique Modular concept, Harple continued, "will also be extended to include the computers as well as the company's standard software products."

Although full product details will not be announced until next month, a complete family of computers known as MODCOMP I, II, III, and IV are being readied for introduction, according to Raymond L. Marlatt, director of marketing. In addition to developing computers, including peripherals and software, Modular is developing a line of measurement, control, and communications building blocks to permit a wide range of systems to be configured from standard products. Modular will devote its efforts primarily to marketing complete systems for real-time, on-line data acquisition, control, and communications. However, the company is looking for substantial sales of its computers and other products to OEM customers.

Marlatt, who was sales manager for Datacraft and, prior to that, regional manager for SEL, expects firm orders by July and first shipments during the fourth quarter of this year.

Modular now has 36 employees and expects the employment level to more than double before year end when the firm moves into its new 40,000 square foot manufacturing facility in Fort Lauderdale.

TALLY FILES SUIT AGAINST LEASCO

Tally Corp. has filed suit against Leasco Computer, Inc. for payment of over $78,000 of overdue accounts. Tally alleges it has been denied payment since 1968 of the balance owing for sales and deliveries of Tally equipment delivered to the customer site at Leasco's request. Tally says it entered into an agreement in 1966 with Leasco Data Processing Equipment Corp., the predecessor of Leasco Computer, Inc., for the leasing of Tally data transmission systems by Tally customers. Leasco Computer, Inc. assumed all the liabilities of Leasco Data Processing in 1968, which included the alleged balance of payments owing to Tally.

IBM, COGAR ANNOUNCE SETTLEMENT

IBM and Cogar Corp. announced in a joint statement that IBM's lawsuit against Cogar and its employees has been settled. IBM last July 9 instituted a lawsuit against Cogar and 67 of its employees alleging Cogar's use of IBM trade secrets. The settlement, entered into without any admission by Cogar of the allegations in the complaint, provides assurance that IBM's proprietary rights in its developments are fully protected. IBM and Cogar also announced that they have entered into a patent cross-license agreement.

RECENT ENTRIES IN THE COMPUTER FIELD: **Bridge Data Products, Inc.** of Philadelphia will design, develop, and manufacture computer peripheral equipment . . . **Command Systems Corp.**, Arlington, Texas, an independent firm specializing in applications engineering for minicomputers, has been established by Kordell, Inc., of Arlington and Radiation Research Associates, Inc. of Fort Worth . . . **The Computer Company**, a new firm described as a full-service data processing organization, has begun operation in Richmond, Va. . . . **O'Brien**

BOX SCORE OF EARNINGS

Company	Period	Revenues	Net Earnings (Loss)	Earnings (Loss) per Share
California Computer Products	6 mos. 1/4/70	10,357,880	231,883	.10
	6 mos. 12/29/68	9,511,404	495,544	.22
Cognitronics	Yr. 12/31/69	2,966,461	(630,048)	(.43)
	Yr. 12/31/68	1,827,746	(66,893)	(.05)
Computer Dynamics	Yr. 12/31/69	1,138,000	(121,700)	(.13)
	Yr. 12/31/68	602,129	59,553	.07
Computest	9 mos. 2/28/70	8,229,314	580,278	.62
	9 mos. 2/28/69	4,709,598	276,795	.30
Data Packaging	Yr. 11/29/69	15,282,628	1,208,389	.77
	Yr. 11/30/68	7,779,925	439,151	.29
Fimaco	Yr. 12/31/69	2,059,933	(11,367)	(.02)
	Yr. 12/31/68	1,908,537	51,942	.09
I.O.A. Data	3 mos. 12/31/69	904,259	40,064	.05
	3 mos. 12/31/68	420,871	38,564	.07
Informatics	9 mos. 12/27/69	14,027,000	(1,681,000)	(1.13)
	9 mos. 12/28/68	7,514,000	316,000	.25
Information Displays	Yr. 12/31/69	2,516,809	176,721	.27
	Yr. 12/31/68	1,803,157	89,519	.14
Interdata	Yr. 12/31/69	5,602,966	257,695	.16
	Yr. 12/31/68	2,231,455	(648,621)	(.55)
Int. Tel. & Tel.	Yr. 12/31/69	5,474,743,000	234,034,000	2.90
	Yr. 12/31/68	4,724,355,000	216,058,000	2.79
Leasco	3 mos. 12/31/69	130,005,000	10,128,000	.62
	3 mos. 12/31/68	113,378,000	13,212,000	.82
R.C.A.	Yr. 12/31/69	3,221,679,000	151,283,000	2.32
	Yr. 12/31/68	3,158,781,000	154,743,000	2.37
Standard Computer	Yr. 12/31/69	2,268,527	(2,350,183)	(1.88)
	Yr. 12/31/68	735,216	(1,423,185)	(1.20)
Sterling Computer Systems	9 mos. 1/31/70	2,356,594	445,126	.19
	9 mos. 1/31/69	1,672,593	338,465	.14
Superior Computer	Yr. 5/31/69	936,772	(214,604)	(–)
	Yr. 5/31/68	633,087	(129,475)	(–)
Tally	Yr. 12/31/69	10,977,252	(1,822,970)	(–)
	Yr. 12/31/68	10,391,719	(2,572,204)	(–)
Vernitron	52 wks. 12/27/69	43,467,081	121,330	.04
	52 wks. 12/28/68	40,863,813	3,978,135	1.30
Wyle Laboratories	Yr. 1/31/70	101,593,000	1,281,000	.36
	Yr. 1/31/69	71,378,000	2,655,000	.78

and Lowe, Inc., a health industry computer services firm, has been formed in Washington, D.C. The company is a subsidiary of Computer Learning and Systems Corp. . . . **Hefte Industries,** to be headquartered in San Jose, Cal., will supply sales representation on the west coast to manufacturers of computer peripheral equipment . . . **Hygain Technologies, Inc.,** Westport, Conn., will specialize in the packaging, marketing, and installation of campus-developed computer programs . . . Los Angeles-based **I/C Engineering Corp.** will undertake new product development related to the industrial instrumentation field . . . **Ridall Associates, Inc.** has been formed by Data Systems Analysts, Inc., to offer consultation services to commercial and industrial clients in the areas of planning and managing computers and management information systems . . . Sanders Associates will form a subsidiary company — **Sanders Data Systems Inc.** — to handle its electronic data processing and communications business . . . **Transworld Data Systems, Inc.** has been formed in Paoli, Pa. to act as the exclusive international marketing organization for selected U.S. EDP/peripheral systems companies. TDSI will take responsibility for all phases of export marketing including direct sales, systems support, and maintenance. Other offices of the company are in London, Munich, Paris, and Boston . . . Xerox Corp. has formed **Xerox Computer Services** to provide a time-sharing accounting service for small businesses. Its first facility will open in Los Angeles, and additional centers are planned for other cities in 1971.

MERGERS & ACQUISITIONS: **Academy Computing Corp.,** a time-sharing and software company headquartered in Oklahoma City, has agreed in principle with **Data Network Corp.** of NYC to acquire **Com-Tel Network Corp.,** Dallas-based time-sharing marketing subsidiary of Data Network . . . **Analysis and Programming Corp.** has acquired the Washington, D.C. operation of **Levin-Townsend Service Corp.** APC has offices in Greenwich, Conn.; NYC; Chicago; and Bethesda, Md. . . . **Arcata National Corp.** has formed a new division, Arcata Communications Services, from the acquisition of four companies: **Communications Consultants, Inc.,** San Francisco; **Westcom Corp.,** L.A.; **Tele-Dynamics, Inc.,** Seattle; and **Phone Consultants, Inc.,** NYC. In addition, Arcata has reached agreement in principle on terms by which **National Communications Planning Service, Inc.,** Chicago, and **Phone Consultants, Inc.,** Miami, will also be merged into the new division . . . **Auerbach Corp.** has acquired **Automated Systems Corp.** of Washington, D.C. for an exchange of privately held stock . . . **Automatic Data Processing, Inc.,** a computer services company, has reached an agreement in principle to acquire **Data-Way Corp.,** a privately-owned, seven-year-old Westbury, L.I. data processing firm . . . **Information Equities Inc.** of San Francisco (formerly Information Management Inc.) has sold its consulting services and proprietary software products to **Bergstrom Paper Co.** of Neenah, Wis. for an undisclosed amount of cash. I.E. will continue its hospital data processing activities . . . **Boothe Computer Corp.** and **Levin-Townsend Computer Corp.** have signed a letter of intention to continue negotiations looking toward the merger or consolidation of the two computer leasing companies . . . **Computer Investors Group, Inc.** of Larchmont, N.Y. has announced that its subsidiary, **CIG International Capital Corp.,** has purchased for cash the 50 percent interest in **Computer Investors Group of Canada Ltd.** owned by **Great Universal Stores of Canada Ltd.** . . . **CRC Computer Radix Corp.,** NYC, acquired a 30% interest in **On Line Services,** a computer software firm . . . **Cummins Engine Co.**'s acquisition of **Management Information Systems, Inc.** will become the **Mainstem Corp.** . . . **Data 100 Corp.** has formed a new subsidiary, **Data 100 Systems, Ltd.,** to consist largely of the computer peripheral business recently purchased from **Scientific Furnishings, Ltd.** in Chichester, Sussex, England . . . **Datamation Services, Inc.** of NYC has agreed in principle to sell **Computer Systems and Education Corp.** to **Northeast Computer Systems, Inc.,** of Hartford. Conn. . . . **Electronic Assistance Corp.** of Red Bank, N.J. purchased an 80 percent interest in **Auto-Trol Corp.** of Denver, Colo., a manufacturer of digital graphic and data systems . . . **General Automation, Inc.** has acquired **Elektronische Rechenanlagen gmbH,** or ERA, based in Aachen, West Germany. ERA develops computer-based systems for automated manufacturing and scientific data acquisition . . . **Heuristic Concepts Inc.** of Westwood, N.J., and **Hallmark Communications, Inc.** of Abilene, Texas have agreed in principal for Hallmark to acquire H.C. . . . **Intranet Computing Corp.** of L.A. has acquired the **Data Systems Division of Datametrics Corp.** in Van Nuys, Cal. . . . **Modern Data Techniques, Inc.** of Denville, N.J. has agreed to acquire **Arisa Computer Services, Inc.** of East Orange, N.J. . . . **Pharos Systems Inc.** of Bethesda, Md., information-sciences consulting firm specializing in criminal justice and highway safety systems research and development, has acquired **Justice Management and Systems Technology** of Anaheim, Cal. JMST is a consulting firm involved in the law enforcement, corrections, and court fields . . . **Planning Research Corp.** has reached a preliminary agreement whereby **William E. Hill & Company, Inc.,** NY-based management consultants, will become a subsidiary of Planning Research . . . **REMAC International Corp.** of Gaithersburg, Md. has purchased all assets of **Jonker Corp.** and will provide service to all former Jonker customers. Jonker had previously filed for bankruptcy . . . **Systems General Corp.,** an L.A.-based national computer and systems technology company, announced final agreements for the acquisition of two companies, **Dealers Exchange, Inc.** of L.A. and **Electromec Computing and Technical Services,** of Santa Clara. Systems General also announced agreements in principle to acquire two more firms: **Coordinated Data Systems, Inc.** of L.A., a professional marketing organization involved in software services, computer time sales, and computer leasing services; and **Don West Agency, Inc.** of L.A., an employment agency . . . **Technitrol, Ind.** has purchased **Honeywell, Inc.**'s memory test equipment business, including its manufacturing assets and patent rights, for $500,000 . . . **Tracor Computing Corp.,** of Austin, Texas has acquired **H. J. Gruy and Associates, Inc.** and **Gruy Management Services, Inc.,** with headquarters in Dallas. The Gruy companies provide geological. engineering, financial appraising, management, and computing services to the petroleum industry . . . **University Computing Co.** has acquired **Computer Composition Co.,** a Dallas graphic arts service specializing in computerized typesetting . . . **Wellington Computer Systems Inc.** has acquired 100 percent of the stock of **Aries Data Centers, Inc.,** a subsidiary of **Aries Corp.** Aries provides programming services and processing, mostly in a real-time environment.

It's made time-sharing a graphic art.

The new time-share terminal. Hewlett-Packard's answer to the graphic time lag. HP's graphic terminal picks up where the Teletypewriter leaves off and provides a revolutionary new capability: in-house graphic plotting of all time-share computer data. Instantly. Accepts time-share EIA ASCII inputs from the Teletypewriter..

The HP 7200 Graphic Plotter generates visual presentations of mathematical and engineering functions, no matter how sophisticated. Or it plots business computations like bar graphs and pie charts. It can spot a trend, prove a theory, compare data, generate engineering designs. It lets the time-share user get more use out of a terminal because he can get more use out of the numbers. He instantly comprehends typewritten data in smooth, clear plotted form.

HP's versatile new Terminal for time-share systems plots points or lines. Each data point is defined by its X-Y coordinates and the 7200 is a vector plotter, plotting absolute coordinates from all inputs. The position of the plot is adjustable and any preprinted grid or blank paper can be used. No special training is required to operate the 7200.

Check out Hewlett-Packard's new 7200 Graphic Plotter. It's available through time-share services. Call and learn how simple it is to plot computer-resolved problems—points, curves, circles, lines, ellipses, contours, bar or pie-charts. You name it. Look into expanding your time-share capability. Any time-share service that hasn't heard about the 7200 should talk to us.

HEWLETT hp PACKARD

GRAPHIC RECORDERS

11920

DC DATASCAN

ARMY RESPONDS — Senator Sam J. Ervin, Jr. (D-N.C.) has commended the Army for acting to stop the use of a computer data bank to compile an identification list of people suspected of certain political activities. However, the Chairman of the Senate Constitutional Rights Subcommittee said that "the Army's attempt to explain all their files on civilians raises more questions than it answers." Referring to a list of 16 questions put to the Army as part of a Subcommittee study of privacy and constitutional rights, he said, "The Army has not yet answered all our questions, nor have they yet discussed all of their data banks of information about civilians." In a letter to Secretary of the Army, Resor, Senator Ervin restated the Subcommittee's request for an explanation of the exact authority of the Army for their data collection: "While the Army is to be commended for the prompt action to remedy, at least partially, this unjustified interference into domestic political activities, this does not explain how the Army was permitted to engage in such activities in the first place. The preservation of our civil liberties cannot depend on the lucky discovery of illegal programs." In a speech given in the Senate, Ervin termed the Army's domestic intelligence-gathering a case of "military overkill," and suggested "the Army regroup, redefine their strategic objectives, and re-identify the enemy. Under our Constitution, that enemy is not the American citizen."

DATA BANKS PRIVACY STUDY — The National Academy of Sciences' Computer Science and Engineering Board has received a $149,500 grant from the Russell Sage Foundation for a nationwide 2½-year-study of data banks and personal privacy. The Data Bank Project will collect information about computerized data systems, circulate a questionnaire nationally to a broad sample of government and private data banks, survey the computer hardware and software available to carry out public policies toward citizen's rights in computerized record systems, and conduct on-site visits to a sample of data banks.

The project will be directed by Columbia Univ. Prof. Alan F. Westin. A group of advisors, including Ralph Nader, will assist.

AUTOMATIC VOICE NETWORK — The overseas portion of the Dept. of Defense AUTOVON (AUTOmatic VOice Network) was completed recently when the last five of 17 overseas switching centers of the Defense Communications System (DCS) became operational. AUTOVON provides DoD with a worldwide system for handling both voice and graphic communications on an automatically-switched basis.

TDA PROGRAM — To minimize the time lapse between planning and accomplishing tactical air operations, the Air Force Systems Command's Systems Div. (ESD) is developing a "testbed" program called Tactical Data Automation (TDA). The program is a "long term application of computerized automation techniques to tactical air command and control planning and operations." ESD, together with the Mitre Corp., is developing "distributed" DP hardware and software to be used with a large central processor, smaller satellite computers, and finally mobile computers. These can be used by frontline tactical air commanders for last minute changes of battle plans if required. By spreading the information handling process among smaller computers, the central processor would then be free to perform more complex tasks such as battle order preparation, trend analysis, report generation, and replanning.

WOMEN GAIN FROM AUTOMATION — A major effect of technology on employment has been the opening of an ever-widening range of jobs to women, concludes a recent Labor Dept. report prepared for the U.N. Between 1958 and 1968 the number of women workers increased 51 percent among clerical personnel and 34 percent among factory workers. The report cited such white-collar jobs as programmer, systems analyst, console operator, auxiliary equipment operator, and tape librarian as examples of the positions opened to women by computers.

IN BRIEF

The Securities and Exchange Commission has proposed a change in its rules to permit the books and records of brokers and dealers to be maintained and preserved on microfilm.

Computerized food programs may soon help supply hospitalized soldiers with a greater variety of tasty foods. Data processing systems to improve and support Army hospital food service are under development at Walter Reed General Hospital. Programs include recipe file, daily census list, and recipe delivery schedule.

A roll-to-roll printer specifically designed for producing duplicate microfilm copies, developed by the National Bureau of Standards, is described in NBS Technical Note 516. The 9-page publication is available from the Commerce Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, for 25 cents. Request NBS TN-516.

COMPUTER STOCK TRENDS

	COMPANY	EXCH.	VOL. (SHARES IN 100's)	1970 HIGH	1970 LOW	PRICE 4-3-70	NET CHG. FROM MONTH AGO	EARN./SHR. (LATEST 12 MONTHS)	P/E RATIO
SUPPLIES & ACCESSORIES	ACME VISIBLE RECORDS	OTC	--------	46.0	35.2	45.4	7.4	1.88	23
	ADAMS MILLIS	NY	266	24.3	11.2	12.1	–1.3	0.96	12
	BALTIMORE BUS. FORMS	OTC	--------	21.0	16.0	17.0	0.0	0.92	18
	BARRY WRIGHT	AM	308	32.2	12.7	13.1	–2.1	0.86	15
	CAPITOL INDUSTRIES	AM	691	56.2	29.0	44.0	–2.7	1.82	24
	DATA DOCUMENTS	AM	53	44.4	26.0	27.6	–4.7	1.77	15
	DATA PACKAGING	OTC	--------	28.6	18.2	20.0	–2.4	0.77	26
	DENNISON MFG.	NY	677	54.7	16.5	19.1	0.0	1.53	12
	DUPONT	NY	2299	176.4	92.4	99.0	–0.1	7.35	13
	ENNIS BUS. FORMS	NY	215	45.0	14.7	16.1	–0.5	0.92	17
	GENERAL BINDING	OTC	--------	30.4	25.4	28.0	1.0	0.76	36
	GRAPHIC CONTROLS	OTC	--------	17.2	13.6	14.2	–0.2	1.10	12
	LEWIS BUS. FORMS	OTC	--------	20.0	16.6	16.6	0.0	0.86	18
	MEMOREX	NY	7149	173.7	65.0	117.0	–5.5	1.83	63
	3 M	NY	2747	118.4	94.0	106.3	–0.1	3.21	33
	MOORE CORP. LTD.	TSE	--------	38.0	34.5	37.4	0.0	1.26	30
	REYNOLDS & REYNOLDS	OTC	--------	48.4	42.4	44.4	–2.4	1.27	34
	SAFEGUARD INDUSTRIES	AM	457	18.4	10.0	13.0	–3.0	0.76	17
	STANDARD REGISTER	OTC	--------	30.4	26.4	28.6	0.0	1.93	14
	UARCO	NY	204	39.2	25.3	35.4	–1.0	2.21	15
	WALLACE BUS FORMS	OTC	--------	41.0	36.0	39.4	–0.4	2.16	18
SOFTWARE & SERVICES	APPLIED DATA RESEARCH	AM	804	40.0	7.4	7.5	–2.5	0.16	43
	APPLIED LOGIC	OTC	--------	18.4	9.6	10.4	0.2	0.07	148
	ARIES	OTC	--------	8.0	3.0	3.4	–0.4	-------	----
	AUTOMATIC DATA PROC.	AM	2514	47.6	21.7	40.6	–0.6	0.56	71
	BOLT, BERANEK & NEWMAN	OTC	--------	11.2	8.4	8.6	–2.2	0.32	25
	BOOTHE COMPUTER	OTC	--------	25.4	20.4	23.0	–0.4	1.62	14
	BRANDON APPLIED SYS.	OTC	--------	9.4	4.6	5.2	0.0	-------	----
	COMPUTER APPLICATIONS	AM	234	25.7	6.0	7.7	–0.7	(d)1.74	----
	COMPUTER ENVIRONMENTS	OTC	--------	14.0	8.4	9.0	–3.4	-------	----
	COMPUTER EXCHANGE	OTC	--------	8.4	6.0	6.2	–0.2	0.08	75
	COMPUTER INVESTORS	AM	419	23.0	7.4	10.5	1.5	0.41	24
	COMPUTER METHODS	OTC	--------	2.4	1.4	1.6	0.0	-------	----
	COMPUTER PROPERTY	OTC	--------	15.2	12.0	13.4	–1.2	0.76	18
	COMPUTER SCIENCES	NY	3149	34.6	19.4	21.0	–3.0	0.81	25
	COMPUTER TECHNOLOGY	OTC	--------	12.6	3.7	3.7	–2.4	0.12	25
	CTC COMPUTER	OTC	--------	19.0	7.0	7.0	–6.4	-------	----
	COMPUTER USAGE	OTC	--------	8.4	5.2	6.6	0.6	(d)1.58	----
	COMPUTING & SOFTWARE	AM	1532	75.6	37.0	49.0	–12.6	1.26	38
	COM-SHARE	OTC	--------	14.6	5.0	7.6	–3.2	-------	----
	CYBERMATICS	OTC	--------	14.2	10.2	12.2	–1.6	-------	----
	CYBER-TRONICS	OTC	--------	15.0	8.2	10.6	–2.0	0.11	90
	DATA AUTOMATION	OTC	--------	24.0	14.2	14.4	–5.2	-------	----
	DATA DYNAMICS	OTC	--------	3.7	2.6	2.4	–1.3	-------	----
	DATA NETWORK	OTC	--------	2.7	1.6	1.6	–0.7	-------	----
	DATA PROC. FIN. & GEN.	AM	1304	123.2	19.5	20.0	–4.7	2.66	7
	DATA SYSTEMS ANALYSTS	OTC	--------	5.4	2.6	4.4	–0.4	0.06	66
	DATRONIC RENTAL	OTC	--------	8.0	4.1	6.2	0.4	-------	----
	DEARBORN COMPUTER	AM	450	57.6	18.0	20.0	1.2	1.60	12
	DECISION SYSTEMS	OTC	--------	4.1	3.1	3.6	0.2	-------	----
	DIGITAL APPLICATIONS	OTC	--------	6.6	3.6	3.6	–1.2	-------	----
	DIGITEK	OTC	--------	4.4	2.7	4.0	–0.4	-------	----
	DPA, INC.	AM	466	19.5	6.2	6.2	–0.7	0.86	6
	EFFICIENT LEASING	OTC	--------	5.0	2.6	3.4	–1.2	-------	----
	ELEC. COMP. PROG. INST.	AM	316	34.2	7.6	9.0	–1.3	0.14	64
	ELEC. DATA SYSTEMS	OTC	--------	161.0	144.0	159.0	2.0	0.39	407
	GREYHOUND COMPUTER	AM	222	35.5	11.1	11.4	–1.0	1.05	10
	INFORMATICS	OTC	--------	20.4	13.0	13.4	–3.0	0.09	144
	INTL. COMPUTER	OTC	--------	7.4	3.4	6.2	–0.8	0.07	89
	INTL. COMPUTER SCIENCES	NAT	--------	3.7	2.2	2.3	–0.2	0.20	11
	LEASCO DATA PROG.	AM	2710	46.0	16.4	17.0	–3.7	2.71	6
	LEVIN-TOWNSEND	AM	2611	67.4	7.1	7.4	–5.0	4.03	1
	LMC DATA	OTC	--------	3.5	1.6	2.6	0.0	(d)0.01	----
	MGMT. ASSISTANCE	OTC	--------	4.0	2.0	2.4	–0.5	(d)2.07	----
	NATIONAL COMP. ANAL.	OTC	--------	8.4	5.6	5.6	–1.6	-------	----
	PLANNING RESEARCH	NY	3305	53.2	23.7	32.7	–12.5	0.68	47
	PROGRAMMING METHODS	OTC	--------	27.0	17.0	18.0	–4.4	-------	----
	PROGRAMMING SCIENCES	OTC	--------	33.4	15.0	15.0	–14.0	-------	----
	PROGRAMMING SYSTEMS	OTC	--------	5.4	3.2	3.6	–0.6	0.16	18
	SCIENTIFIC COMPUTER	OTC	--------	3.5	2.4	3.0	–0.3	0.12	25
	SCIENTIFIC RESOURCES	NY	2810	24.4	6.5	8.0	–1.5	(d)0.78	----
	STRATEGIC SYSTEMS	OTC	--------	3.6	2.1	2.2	–0.4	-------	----
	SYSTEMS CAPITAL	OTC	--------	8.0	5.0	5.4	0.0	-------	----
	TIME SHARE	OTC	--------	7.0	5.0	5.1	–0.5	0.13	38
	URS SYSTEMS	AM	2274	31.2	9.5	10.0	–11.6	0.78	12
	UNITED DATA CENTERS	OTC	--------	4.6	2.4	4.0	–1.0	-------	----
	UNIVERSITY COMPUTING	NY	8650	185.0	35.3	35.7	–15.0	2.50	14
	US TIME SHARING	OTC	--------	13.4	7.4	10.2	0.6	-------	----

(d) Deficit
* New listing in this issue

All security prices and net change are expressed in dollars and eighths of dollars (e.g. 62.2 is 62¼). Trading volume is not given for over the counter stocks. ALL DATA COMPUTED BY SCANTLIN ELECTRONICS, EXCLUSIVELY FOR MODERN DATA.

	COMPANY	EXCH.	VOL. SHARES IN 100's)	1970 HIGH	1970 LOW	PRICE 4-3-70	NET CHG. FROM MONTH AGO	EARN./SHR. (LATEST 12 MONTHS)	P/E RATIO
PERIPHERALS & COMPONENTS	AMP	NY	3359	58.0	32.5	53.6	1.4	1.89	28
	AMPEX	NY	2946	49.7	32.4	35.1	0.6	1.44	24
	APPLIED MAGNETICS	OTC	--------	25.2	18.2	19.6	–4.6	0.39	48
	ASTRODATA	AM	2008	34.3	8.3	11.5	1.0	(d)0.23	----
	ASTROSYSTEMS	OTC	--------	9.2	5.6	6.0	–0.6	0.34	17
	BUNKER RAMO	NY	3199	18.5	9.4	13.0	0.1	0.53	24
	CALCOMP	AM	1269	41.4	18.2	26.4	–2.1	0.31	83
	CHALCO ENGRG.	OTC	--------	5.0	3.0	3.2	0.0	-------	----
	CODEX	OTC	--------	35.0	15.0	16.6	–3.6	0.26	61
	COGAR	OTC	--------	94.0	68.0	69.0	–10.0	(d)1.27	----
	COGNITRONICS	OTC	--------	13.6	8.2	9.0	–2.0	(d)0.22	----
	COLLINS RADIO	NY	1052	74.6	20.4	26.2	2.5	1.66	15
	COMCET	OTC	--------	50.0	32.0	36.4	–1.4	-------	----
	COMPUTER COMM.	OTC	--------	36.0	27.0	31.4	–0.4	-------	----
	COMPUTER CONSOLES	OTC	--------	22.0	11.4	13.4	–3.6	-------	----
	COMPUTEST	AM	501	33.5	14.2	26.4	4.2	0.64	40
	CONRAC	NY	323	66.3	20.3	24.2	1.1	1.26	19
	DATA 100	OTC	--------	16.6	10.4	10.4	–2.6	(d)0.99	----
	DATA PRODUCTS	AM	2426	28.7	12.3	18.3	–0.2	0.35	51
	DATARAM	OTC	--------	15.4	10.4	11.4	–2.4	(d)0.46	----
	DATASCAN	OTC	--------	27.0	19.0	22.4	1.0	-------	----
	DIGITRONICS	OTC	--------	13.6	8.0	8.6	–0.4	0.18	44
	ELEC. ENGRG. OF CAL.	AM	132	36.3	9.0	10.2	–0.6	0.10	100
	ELEC. MEMORIES & MAG.	NY	2528	40.3	21.4	25.7	–3.3	0.87	28
	EXCELLO	NY	817	40.3	22.0	26.2	–0.1	2.63	9
	FABRI-TEK	OTC	--------	8.2	5.4	5.4	–1.1	0.16	34
	FARRINGTON MFG.	OTC	--------	17.3	5.0	5.4	–8.0	(d)0.06	----
	GERBER SCIENTIFIC	AM	685	38.3	20.2	26.5	–6.5	0.68	38
	GRAPHIC SCIENCES	OTC	--------	42.2	18.0	19.0	–5.4	(d)1.37	----
	HI-G	AM	--------	16.6	9.5	15.0	–0.6	-------	----
	INFORMATION DISPLAYS	OTC	--------	20.0	14.0	16.4	–1.6	-------	----
	ITEL	AM	--------	25.5	12.6	15.0	–1.3	0.86	17
	LOGIC	OTC	--------	19.0	14.2	11.6	0.6	-------	----
	MILGO	AM	7290	84.4	17.7	72.3	3.4	0.74	97
	MOHAWK DATA SCIENCES	AM	5561	89.1	55.4	60.4	–4.4	1.45	41
	NORTH ATLANTIC IND.	OTC	--------	7.6	5.6	5.6	–1.2	-------	----
	OPTICAL SCANNING	OTC	--------	52.0	24.0	32.0	–4.0	(d)0.45	----
	POTTER INSTRUMENT	AM	2436	46.0	23.6	39.7	0.3	0.85	45
	RECOGNITION EQUIP.	OTC	--------	83.4	45.4	48.4	–8.4	(d)0.51	----
	SANDERS ASSOCIATES	NY	1074	63.7	14.5	15.0	–3.5	0.59	25
	SANGAMO	NY	584	35.4	19.2	21.6	–2.2	0.60	35
	SCAN-DATA	OTC	--------	53.0	24.0	24.0	–6.0	-------	----
	SEALECTRO	AM	90	15.6	6.6	8.1	–0.3	0.20	40
	SYKES DATATRONICS	OTC	--------	9.0	7.2	8.0	0.6	-------	----
	TALLY	OTC	--------	23.0	17.4	19.0	–2.4	(d)2.73	----
	TELEX	NY	10625	159.4	90.2	133.7	6.3	1.56	85
	TEXAS INSTRUMENTS	NY	2507	140.2	94.6	116.4	0.2	3.06	37
	TRACOR COMPUTING	OTC	--------	7.4	4.5	5.4	–0.6	(d)0.47	----
	VARIFAB	OTC	--------	4.6	3.2	3.2	–0.6	-------	----
COMPUTERS	BECKMAN	NY	955	63.4	41.6	42.0	–1.5	1.46	28
	BURROUGHS	NY	7587	172.6	120.6	144.1	–1.4	3.32	43
	CONTROL DATA	NY	5766	159.2	52.0	52.4	–11.3	3.19	16
	DATACRAFT	OTC	--------	20.0	6.0	12.4	–2.0	-------	----
	*DATA GENERAL	OTC	--------	34.2	32.4	32.2	-------	-------	----
	DIGITAL EQUIPMENT	AM	3348	124.0	54.4	98.0	–2.4	1.06	92
	ELECTRONIC ASSOCIATES	NY	447	26.2	7.5	8.6	–0.6	(d)0.86	----
	GENERAL AUTOMATION	OTC	--------	42.0	20.0	20.0	–13.4	(d)0.63	----
	GENERAL ELECTRIC	NY	8335	98.2	67.5	74.2	–0.1	4.21	17
	HEWLETT-PACKARD	NY	3781	45.7	40.2	44.7	–0.5	1.01	43
	HONEYWELL	NY	3098	157.2	107.6	127.4	–1.2	4.15	30
	*INTERDATA	OTC	--------	12.6	12.6	12.6	-------	0.06	210
	IBM	NY	6382	387.0	291.6	326.4	1.2	8.21	39
	LITTON INDUSTRIES	NY	4678	83.4	24.0	24.4	–2.2	2.36	10
	NCR	NY	3397	171.6	108.0	130.6	–5.5	4.11	31
	RCA	NY	5897	52.1	29.2	30.6	–1.3	2.32	12
	RAYTHEON	NY	2172	51.2	26.4	27.6	0.0	2.35	11
	REDCOR	OTC	--------	34.2	25.6	30.0	–3.4	0.14	214
	SCIENTIFIC CONTROL	OTC	--------	8.6	2.0	6.2	0.6	(d)2.43	----
	SPERRY RAND	NY	3932	55.4	33.6	36.0	–1.2	2.27	15
	SYSTEMS ENGRG. LABS.	AM	2003	50.7	26.1	36.5	0.3	0.76	47
	SYSTRON DONNER	AM	278	32.3	13.5	20.2	–1.6	1.07	18
	VARIAN ASSOCIATES	NY	2584	37.2	22.3	22.6	–4.0	0.93	23
	VIATRON	OTC	--------	50.4	27.2	35.2	3.4	(d)0.83	----
	WANG LABS.	AM	1188	120,4	36.6	43.6	0.1	0.77	55
	WYLE LABS.	AM	662	9.4	6.2	6.4	–0.6	0.53	11
	XEROX	NY	13622	115.6	85.0	87.0	–6.6	2.03	42
AVERAGES	COMPUTER STOCKS			43.7	23.5	28.2	–6.6%	0.94	30
	DOW JONES INDUSTRIALS			792.37	784.65	791.84	+1.0%	3.59	14

CORPORATE PROFILE

Featured this month:

SYKES DATATRONICS, INC.

(over-the-counter)

375 Orchard Street
Rochester, New York 14606

OFFICERS AND DIRECTORS: Robert F. Sykes, Director and Pres.; John R. Sykes, Director and V. Pres., Research and Planning; Donald E. Cieslak, V. Pres., Engineering; Alexander Schobel, V. Pres., Sales; Martin F. Birmingham, Director; Frank M. Hutchins, Director; Albert J. McMullen, Director; Charles F. Smith, Director; Robert V. Gianniny, Director and Secretary; Robert H. Randolph, Treasurer.

BACKGROUND: Sykes Datatronics was incorporated under the laws of the State of New York on September 3, 1968. The company is developing products for information storage and retrieval applications. The company's first product, the COMPU/CORDER* 100, was introduced in May, 1969. The COMPU/CORDER is a magnetic tape transport intended for use as a peripheral storage device for minicomputers and information retrieval applications.

Robert F. Sykes, president, is a 1947 graduate in mechanical engineering from Bucknell University and was awarded a master of business administration degree in 1949 from Harvard University. Before the formation of Sykes Datatronics in 1968, he was president of the W. C. Sykes Co., Inc. of Rochester, general contractors. From 1949 to 1955, he was employed at Eastman Kodak as a senior engineer.

John R. Sykes, vice-president/research and planning, is a 1951 graduate of Rensselaer Polytechnic Institute with a degree in physics. From 1962 to 1968, he worked at the Eastman Kodak Research Laboratories, Physics Div., as head of the Digital Systems Group of the Information Technology Laboratory.

FACILITIES AND PERSONNEL: The company, headquartered in Rochester, N.Y., employs 105 people and has 27,000 square feet of manufacturing and office space. The COMPU/CORDER is marketed through seven manufacturers' representative firms which employ a total of 47 salesmen. Product demonstration centers are located in New York, Boston, Dallas, Atlanta, Chicago, Los Angeles, and Washington. A distribution organization has been established in Japan and another is being organized to service the European market.

PRODUCTS: The basis for the formation of Sykes Datatronics was the belief of the company's founders that information storage and retrieval systems must be built by combining photographic technology with magnetic technology in order to achieve the desired flexibility and economy. Consequently, the company set out to build information storage and retrieval systems composed of magnetic tape storage devices, video displays, microfilm units, control computers, and data entry keyboards. The company does not plan to build either the control computers or the microfilm displays but is concentrating its resources on developing those system components which are not currently available from outside sources.

*Trademark

The COMPU/CORDER 100 is now being marketed to manufacturers and users of minicomputers and eventually will be incorporated into the company's own systems. The COMPU/CORDER is a direct access, cassette-loaded magnetic tape transport at $2,950. It offers greater storage capacity and faster access time than the punched paper tape units commonly used with small computers, yet it sells for considerably less than the price of a high-speed paper tape reader-punch combination. The company reports that several other products are in the planning stage, but officials are reluctant to comment on them until the products are ready for sale.

CURRENT POSITION: Production of the COMPU/CORDER 100 began last December. Approximately 140 units have already been delivered and 370 units are currently on order. As a result of an unexpected level of interest from original equipment manufacturers, the company made certain modifications to the COMPU/CORDER by including operational features of specific interest to minicomputer and systems manufacturing firms.

OUTLOOK: Among the major categories of potential customers for COMPU/CORDER, the three prospects considered the most lucrative to the company include minicomputer manufacturers, systems design firms, and users of minicomputers.

The growth of the market for low-cost peripheral devices should parallel the explosive growth of the minicomputer market. According to MODERN DATA's research staff, there are now about 10,000 minicomputers in use worldwide which includes 72 models offered by 32 firms. MODERN DATA expects the number of installations to increase to 55,000 by 1975 and to 140,000 by 1980. The company expects its COMPU/CORDER to be used by several minicomputer manufacturers in lieu of conventional punched tape equipment for loading programs and data into their computers and for storing output data. The company expects some 1,970 units to be delivered by the end of 1970, with sales reaching about $5,820,000.

FINANCIAL SUMMARY: The company managed its own public offering of 280,000 common shares in the second quarter of 1969. The issue was over-subscribed at $8.00 per share and yielded proceeds to the company of just over $2 million. The company is capitalized at 2,000,000 shares authorized, of which 829,000 shares are outstanding. Public shareholders own 34% of the outstanding stock. The high, low, and closing price of the stock on April 3, 1970 was 8 bid, 8¾ asked. The company ended its second fiscal year on February 28, 1970. The operating results and financial condition for the first two years are summarized as follows:

	Fiscal 1969 (Ended 2-28-69)	Fiscal 1970 (3rd Qtr. 11-30-69)
Revenue	0	0
Net Income (loss)	(69,172)	(664,427)
Net Income (loss) per share	(.13)	(.80)
Total Assets	129,813	1,689,551
Total Current Liabilities	3,986	73,316
Deficit to date	69,172	664,427
Total Net Worth	129,813	1,689,551

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cspi

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209 Middlesex Turnpike, Burlington, Massachusetts 01803

THE SYSTEMS SCENE

A DASH OF MICROSPECTROPHOTOMETRY

Remember hard-wired computers? Then came the Great Leap Forward: Software, Programmers, Bugs, Schedule Slippage, High Turnover. The most exciting thing I've seen recently is a hard-wired computer developed by Nuclear Research Associates (New Hyde Park, N.Y.) to aid in detection of cancerous cells.

The system, referred to as the NRA 200S Cyto-Screener, is presently used to pre-screen sputum samples. Careful analysis of sputum cells can be helpful in making an earlier diagnosis of lung cancer. This is particularly desirable because present methods (mostly X-ray) can only detect more advanced cases and the resultant survival rate is tragically low. The five-year survival rate in cases of lung cancer detected by routine X-ray examination is only 7%.

My founding in Sputum Cytology is somewhat less than somewhat, but application of similar technology to early detection of cervical cancer (through examination of Pap smears) has been extremely successful in decreasing uterine cancer deaths. Nuclear Research looks forward to similar results from widespread use of their Cytec kit and subsequent sputum analysis.

Classical methods of analysis are too slow and expensive ever to become widely used; there just aren't enough trained personnel. The NRA system alleviates this problem by screening out most of the negative specimens, leaving only a small percentage of suspect cases for the cyto-technologist and pathologist.

As part of his physical examination, the patient collects a sample (he coughs into a special container) over four days. The specimen is then processed to insure uniformity so that small samples will not be biased. Next, a special carrier fluid is added and the sample is introduced into the machine.

Screening is performed at the rate of about one sample per minute. Each test passes from two to four thousand cells of a particular specimen through the system. Individual cells, immersed in carrier, flow through a 70 micron channel past the objective of a flying spot scanner. Serial analog signals are collected at two optical wave lengths and converted to digital data. Each cell is analysed for size, shape, optical density, nucleic acid content, and relative size and geometry of the nucleus and cytoplasm. Cells are classified normal or non-normal. Non-cellular debris is not classified. Based on frequency of non-normal cells, a specimen is declared normal or passed on for human analysis. The system is checked and calibrated each day. Eight standard cells can be simulated electronically and passed through the pattern recognition facility. The entire system (mechanical, optical, A to D, pattern recognition and output subsystems) is then checked against a number of control samples. These samples are made up either of normal cells, pure cancer cells or seeded normal specimen where density of cancerous cells is rigidly controlled. (I was assured that there is no danger to operator, technician or columnist.)

As a means of quality control, samples are checked at random by a cyto-technologist. Seeded samples are passed through the system from time to time as a further check.

Results to data are extremely favorable. It is such a pleasure to see a system that works and can hope to justify its development cost. Smokers may soon find their chances of survival increased drastically (from negligible to poor.)

Why is the machine hard-wired? Whatever the answer is, it's not flattering to the software world. Academic advantages of a software solution would have been considerable, particularly since NRA hopes to develop similar systems for cervical and blood cells. The upsetting thought is that perhaps there is simply more professionalism to be found among engineers than among programmers. ▲

The Systems Scene is a regular monthly column written by Jerome Wiener and Thomas DeMarco of **Mandate Systems, Inc.** Readers are invited to submit comments and questions on new developments in systems to: **The Systems Scene, MODERN DATA, 3 Lockland Avenue, Framingham, Mass. 01701**

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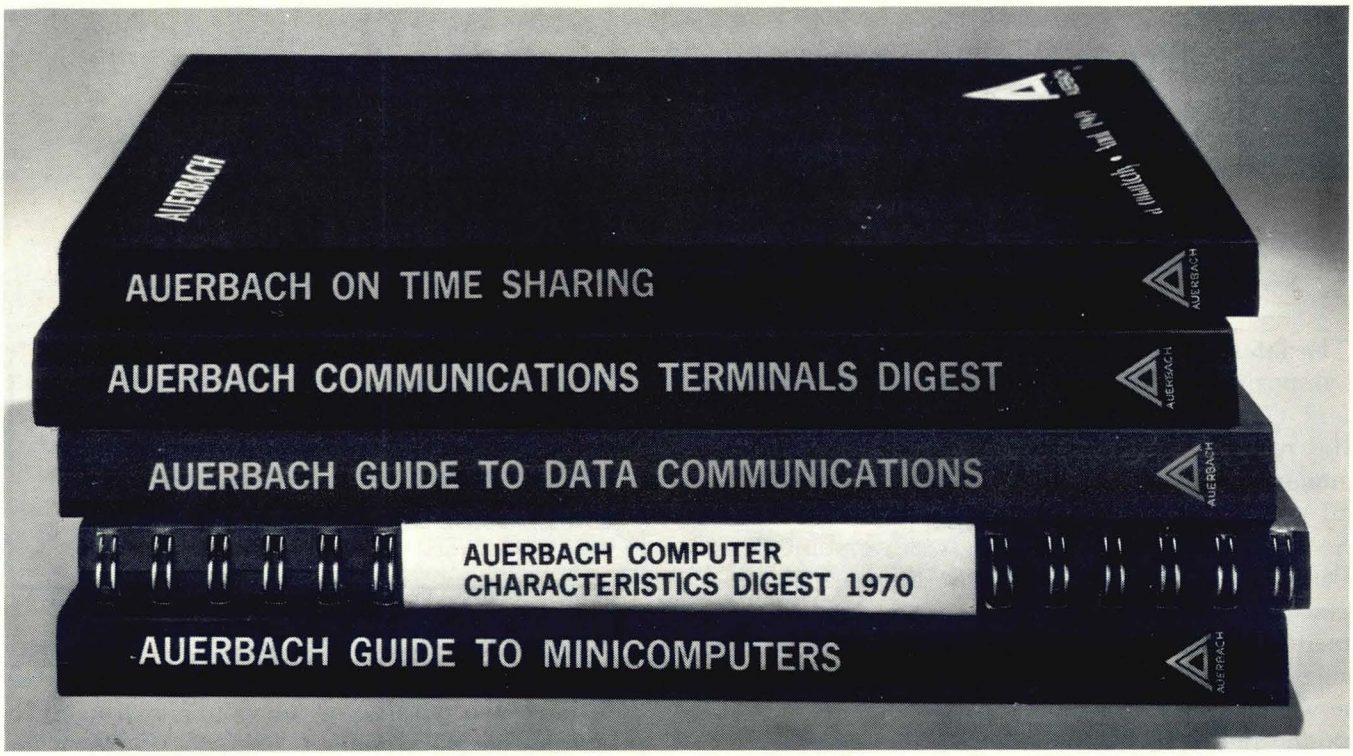

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ON-LINE

A NATIONAL CAD/CAM INDUSTRIAL COUNCIL?

The latest word from the 1969 Defense Industry Symposium on Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) is the recently published Panel 14 Report. Senior management members of the AIA, AOA, ASTME, EIA, NCS, NSIA and the Office of the Assistant Secretary of Defense (I&L) were appointed as Panel 14 "to identify," amongst the various conclusions and recommendations made by the thirteen Symposium working panels, those requiring further study or amplification. Their conclusions now constitute "the Panel 14 Report" as it will, undoubtedly, be forever called.

Panel 14 recognized that merely to make recommendations to the file was an exercise in futility and elected to take a next step themselves without committing their organizations' endorsement. In deciding to act, Panel 14 took into account the times when industrial technology seems to evolve slowly, and the times when the combination of circumstances are just right for rapid strides forward. CAD/CAM technology, they felt, has placed industrial technology on the brink of another major advance but they also felt that CAD/CAM development has run ahead of industrial managements' understanding of it and its potential.

Panel 14 found the other thirteen Panels in the Symposium consistently suggesting that a focal point in industry is needed to focus nationwide attention to CAD/CAM technology, furnish leadership and to coordinate and expedite its development and use. Panel 14, however, deemed it undesirable, to place the burden of CAD/CAM sponsorship on the government; quite the contrary. The Panel recommended, as a first step, that a voluntary National CAD/CAM Industry Council be formed external to the government. They recommended that the six industrial organizations participating in the Symposium provide members to form the initial Council and that it be impowered to extend its membership to other individuals, associations and societies as appropriate.

On-Line is a regular monthly column concerned with various developments in computer technology particularly in the areas of computer graphics and computer-aided design. The author, Thurber J. Moffett, is a nationally-recognized expert in interactive graphic systems. Readers are invited to submit comments and questions regarding subjects covered in this column to: **On-Line, MODERN DATA, 3 Lockland Avenue, Framingham, Mass. 01701**

The members of Panel 14 then drew a proposed charter for the Council they had recommended and stated the purpose of the Council as being to promote the development of CAD/CAM technology. The role of the Council would be to facilitate communication and sponsor and coordinate between component organizations and portions of the government, industry, and the academic society; and to identify and define specific problems whose solutions are imperative to advance the technology's utilization. This would include the seeking of government funding when found necessary to achieve that goal. The Council's authority would arise solely from the prestige generated by the wisdom of its counsel, the extent of leadership it exercises, and the cognizance of its recommendations accorded by industry and government.

Needless to say, Panel 14 has said a mouthful. Whether a Council such as they propose will come into being by decisive action on the part of the six industrial organizations represented on Panel 14 is, at this point, doubtful. This should in no way reflect on the validity of the Panel's recommendations or the necessity of the industrial community to act upon them. Looked at another way, Panel 14 was a group of this country's best industrial management making a strong and, perhaps, overdue case. If the industrial associations the members of Panel 14 represented, through haggling over details or jockeying for position, fail to act positively and promptly, 'twould be a pity. A group of plain interested citizens may then just have to get together and do it. ▲

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SOURCE DATA AUTOMATION

AN SDA EXAMPLE

SOURCE DATA AUTOMATION is a monthly column written by Lawrence A. Feidelman and the staff of **FAIM Information Services, Inc.** Questions from readers on any aspect of SDA will be answered, as space permits.
Address all questions to: **SDA, MODERN DATA, 3 Lockland Avenue, Framingham, Mass.**

The previous two articles have dealt with the concepts of Source Data Automation and types of SDA equipment categories. We would like to review the basic reasons for Source Data Automation by presenting a typical example of the Source Data Automation approach.

PROBLEM

The example is meant to portray a situation in which SDA can be beneficial and not to indicate all the problems encountered with SDA selection and implementation—that we leave to later articles and hopefully to reader comments. Hoping that we can safely present an example without offending anyone—we project ourselves into the data processing center of a large manufacturer of well-known "widgets."

The data processing center has many business functions, some of which are:

(1) Processing employee payroll and expenses;

(2) Processing accounts payable documents;

(3) Generating bills for collection;

(4) Keeping track of work schedules and completion of products;

(5) Ordering raw goods.

Fig. 1 shows the information flow and data volumes of the company's present accounts payable system. Note that data is keypunched before computer input. The total estimated volume is 37,000 punched cards (400 characters per card). The data processing center requires 70 total keypunch operators (35 each on a two-shift basis) to convert such data into machine readable language.

The controller of the company has complained of: • *High data processing costs;* • *A cash flow problem;* • *Customer complaints;* • *Invoice errors.*

The data processing manager retorts that: • *He can't hire enough trained keypunch operators;* • *His present space and budget make it impossible to acquire more keypunch machines;* • *A large amount of computer time is spent on inputting data;* • *People do make errors.*

Is the solution: • *A new data processing manager;* • *More money and space for more keypunch machines;* • *A bigger and faster computer;* • *"That's life";* or • *Self-reflection and a good look at the computer data input and the likely possibility of using Source Data Automation as a new technique of handling data?*

If this hypothetical problem is similar to yours and you recognize it as a problem, then we are on

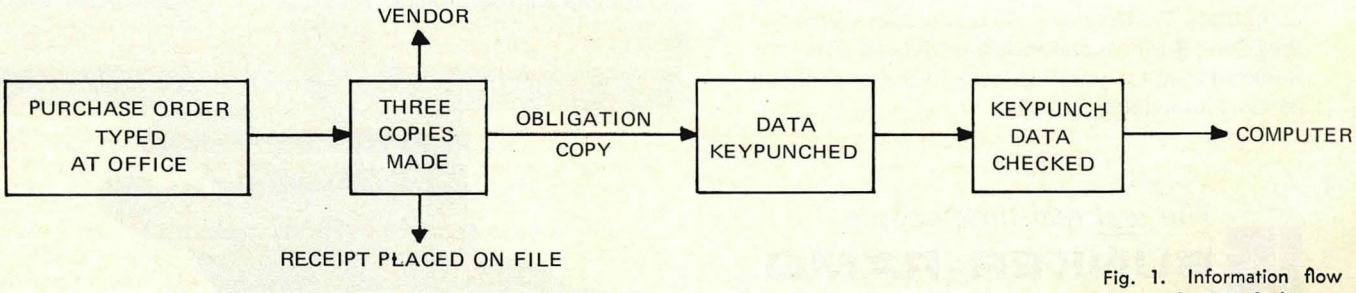


Fig. 1. Information flow and data volumes of the accounts payable process used as example.

our way. If you don't have such a problem, then you're in good shape. If you have such a problem, but don't recognize it as such, think about it.

SOLUTION

An investigation is started to estimate the cost of input data preparation – maybe the first time it was ever accomplished. Using a FAIM-developed algorithm for determining the data input preparation costs for this type of facility, a monthly cost of $60,000 is estimated. (Almost three quarters of a million dollars per year in just keypunching data!) The investigation proceeds to other ways of doing the same function and this leads to Source Data Automation.

Utilizing a keyboard-to-tape system with operator visual verification is estimated at $40,000 monthly. Employing an optical character reader system is estimated at $15,000 to $30,000 per month, depending upon the amount of typing required at the data processing center. (These costs being based on many operating assumptions which will be described in later articles.) The important point, however, is that this installation's cost of data input preparation could be cut by ⅓ to ⅔, depending upon the SDA device used.

Further areas which re-enforce these results for replacing the keypunch operator by Source Data Automation are:

(1) Increased computer input data rate;

(2) No card reader problems;

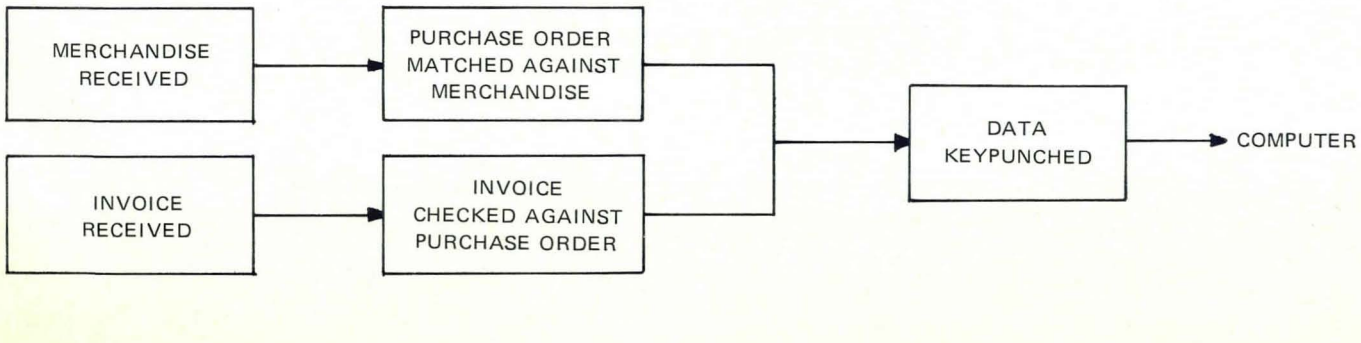
(3) No bulky cards to handle;

(4) Elimination of card-to-tape conversion;

(5) Decreased response and turnaround times.

Based upon this brief economic analysis, our businessman has decided to perform a detailed analysis of his data processing facility for the purpose of selecting the proper SDA device. He is now aware of significant savings that can occur and the monthly cost variation dependent upon his selection. This latter point leads him to conclude that the cost of this analysis, as compared with past random selection, is minor in relation to actual data preparation cost savings. The methodology of performing such an analysis will be described in the next article. ▲

DATA TYPED	DOCUMENTS	CHARACTERS PER DOCUMENT	CARDS
1. PURCHASE ORDERS	1,000	40	1,000
2. INVOICES	2,000	80	2,500



COMMUNICATIONS CLINIC

GO FORTH AND MULTIPLEX

Communications Clinic is a regular monthly column written by the staff of **Berglund Associates, Inc.** Questions from readers on any aspect of communications and its integration with computers will be answered, as space permits. Address questions to: **Ralph Berglund, Data Communications Editor, 1060 North Kings Highway, Cherry Hill, N. J. 08034.**

The present interstate tariff rates for voice circuits are roughly 1.5 times those for 150 bps circuits. Considering that the bit rate capability of the voice circuit is anywhere between 16 to 64 times that of the 150 bps circuit, one instantly grasps the economic potential of multiplexing. A relatively ancient art, multiplexing was for years only a tool of the common carriers, or right-of-way companies, such as the railroads. In the middle sixties, however, the demand for more circuits at lower cost led to the use of multiplexing by end users. The first tariffed use of time division multiplexing on AT&T private line circuits was by the Associated Press in 1966. This breakthrough in tariff provisions, coupled with the demands of the time-sharing service suppliers for low cost channels, brought a number of multiplex equipment suppliers into the marketplace in the late '60s. In 1970, multiplexing is a clearly established art, with enough installations to have proven operational validity and enough suppliers to have a buyer's market. However, there remains yet an insufficient understanding among prospective users as to the technology, the application generalities, and the economics, so many who could benefit, do not.

There are two fundamental techniques of multiplexing in widespread use today – frequency division multiplexing (FDM) and time division multiplexing (TDM). In FDM, each bit stream is converted to tones by its modem, and all tones are electrically summed together and connected to one circuit, as shown in Fig. 1. This is analogous to striking a number of piano keys simultaneously. One's ear is able to hear all the tones, or to select out one tone. Similarly, the receiving apparatus in an FDM system has a set of filters, each designed to "hear" one particular tone in the composite terminal and to forward it to the receiving modem.

In TDM, each bit stream is converted to high speed – a speed fast enough so that all bits from all inputs are sent before the next bit (or character) of any channel begins. This is illustrated for a bit system in Fig. 2. In that system, the "commutator" moves from A to N fast enough to have returned to A before the next bit is generated by the A data terminal.

Another analogy is that of a conveyor system. Assume ten assembly lines each producing ten sets per hour, and suppose we wish to move these 100 sets per hour to the warehouse. We could do it

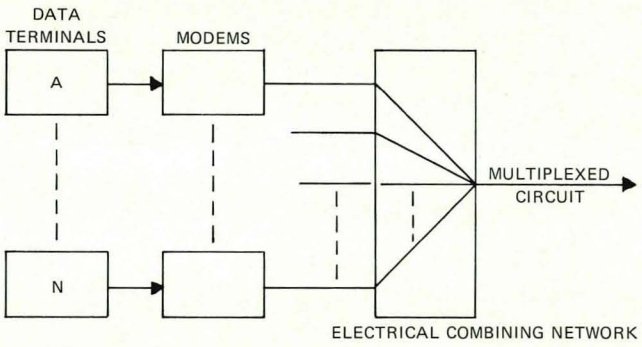


FIG. 1. FDM SYSTEM

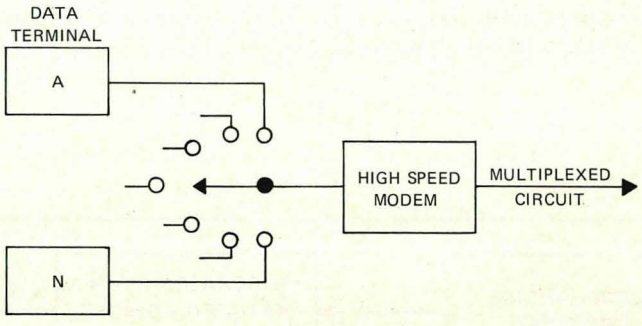


FIG. 2. TDM SYSTEM

with ten conveyor belts each running at ten sets per hour – or we could do it with one belt operating at 100 sets per hour. The ten belt approach would be analogous to FDM, wherein we create a number of individual channels, each operating at the input rate. The single belt approach would be

the equivalent of TDM. Here we have one channel operating fast enough to clear all the inputs.

Understanding the basic technical aspects of TDM and FDM will help in understanding two aspects of application principles. In an FDM system, the receiving filters must be able to "hear" their tone. To keep the cost of these filters reasonable, any two successive tones must not be too close to each other. If they are, the filter cannot discriminate between them and errors will result. Hence, between successive tones in an FDM system, there must be an unused amount of frequency or bandwidth. On the other hand, the mixing and "hearing" in a TDM system is a digital process, resulting in tone (i.e., the modem output) only after muxing (multiplexing) and before demuxing. Since we operate with essentially one tone, we can use the whole bandwidth of the multiplexed channel and need reserve guard bands only at the top and bottom of the bandwidth.

Therefore: TDM is more efficient in bandwidth utilization than FDM – or, with TDM we can get more channels on a voice pipe than we can with FDM. For example, one manufacturer offers an FDM system which will provide twelve 150 bps circuits from a C4 conditioned voice pipe. Another manufacturer's TDM system will provide 18 such circuits by using a 2400 bps modem. In the case of FDM, the 12 circuit system is at its peak capacity. However, in the TDM system, by changing to a 4800 bps modem the system capacity is 36 circuits.

If TDM is a greater capacity system, why consider FDM at all? The answer is in the economics of smaller systems. For a few circuits, or in a system with widely scattered drops, FDM has, so far, been cheaper. Considering the few-circuits case first, in TDM the hardware is per-system oriented rather than per-terminal oriented. That is, almost the entire set of hardware must be there whether the system is one line or 36 lines. FDM, on the other hand, is per-terminal oriented. Basically, if one terminal is to be accommodated, install one unit of hardware; if two terminals, then two units, etc. Typical FDM pricing is about $500 per channel, whereas the cheapest TDM pricing we have seen is about $5000 per initial installation, plus $150 per channel. This system breaks even in purchase price with FDM at between 14 and 15 channels. Anything less than this will be less expensive in FDM.

The above logic applies to the multi-drop problem as well. If we started out in Los Angeles with 15 channels, this might suggest TDM. But if each of these channels were terminated in a different city, we would have a cost of 5150 per city in TDM, vs. 500 per state in FDM (actually closer to $800 for a **single**-channel station).

Therefore: FDM is more economical than TDM for a "small" number of lines, or for "widely distributed" terminals. This conclusion is qualified with quotes because it is a function of actual situation numbers. Depending upon the number of terminals and their distribution, some combination of TDM and FDM might be most economic.

There are, of course, other application criteria. A TDM signal can be fed directly into a computer and demultiplexed with software. An FDM signal, being of an analog system, cannot. TDM systems which have to handle a mix of terminal speeds may actually be inefficient users of bandwidth. This is because the TDM system is operating fast enough to clear the fastest terminal rate. If some terminals connected are slower, the TDM system is spinning its wheels on these. The FDM system, however, is organized according to the terminals connected, and wastes no additional bandwidth simply because some terminals are faster than others. As digital systems, a line hit or noise burst on a TDM system may throw the system out of phase, thus causing errors on all channels. AN FDM system would suffer errors only during the noisy intervals, and only on those channels where the noise frequency is concentrated. Similarly, if there is a hardware failure in a TDM system there is a greater probability that all circuits will go down than there is in an FDM system. This is because of the per-system orientation of TDM vs. the per-terminal orientation of FDM.

The cost justification computations for multiplexing are similar to those we have shown in past Clinics for facility selection. For example, let us calculate the mileage breakpoint for a four 150 bps channel FDM system. One manufacturer lists such a system at $3100 per end, or $6200 total. Assume a monthly cost of $210 allowing for depreciation, servicing, and cost of money. This, plus the cost per month of X miles of a voice frequency circuit, must equal the monthly cost of four 150 bps circuits of X miles.

FDM SYSTEM		INDIVIDUAL CIRCUITS	
Equipment	$210.00		
2 Telco Service Terminals	$27.50	8 Telco Service Terminals	$275.00
$237.50 + $3.30 x 25 + $2.31 (X–25) =		$275 + 1.925X	

X = 33.1 miles

That is, for a distance greater than 33.1 miles, a four 150 bps circuit FDM system will be less costly than renting four individual circuits. (calculation based on full duplex service, and the interstate tariff). In a given application, however, the mileage is known, and the user simply tests to see if multiplexing is cheaper. As the example shows, it doesn't take much to justify it, so, as the badges said at FJCC—"Go Forth and Multiplex." ▲

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I've been called many things in my life — but never before have I been referred to as +30601079219THYE 03 11 0669 (at least not to my face — and in front of my working associates). The cover of MODERN DATA's January 1970 issue did it and I'm holding Babbage directly responsible. Whether or not this tale of woe turns you on to the tune of $10, would you kindly ask your chief of circulation to please use my name as well as a number.

Submitted by:
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Sanders Associates, Inc.
Nashua, N.H.

"ONLY" DIAGNOSTICS

In one of the larger installations of the British motor industry, feelings were running high between the systems analysts and the programmers, who were considered a militant and uncooperative bunch. So, rather than risk a brush with the surly chief programmer, one senior systems analyst decided to try his hand at writing his own programs in RPG. After weeks of furtive coding and secret compiling, the day of the first test arrived and the analyst recognized his output as what the programmers call a core dump!!

Undaunted he checked through and through his program, making a small alteration here and a small change there, and in it went for another test run. Several tests later a wild-eyed, ruffled-haired systems analyst staggered in to the programming section: "You must help me!" he cried, "I've looked and looked through this program and I can't see anything wrong with it, yet the logic is perfect and the cards are punched correctly."

Taking the crumpled listing from the distraught man's hands, the chief programmer glanced through it and suddenly a smile began to spread across his face. "What did you do about these?" he asked, pointing at the listing. "Oh those," said the analyst, becoming annoyed. "You don't worry about those, they're only diagnostics."

Submitted by:
Brian C. Dudley
Westmount, Ill.
(who we suspect is a programmer!)

FATE LANDS DATE FOR FORMER MATE

A few months ago after his divorce, reports the *Philadelphia Inquirer*, Walter Davis, 33, decided he would try to select another mate with the help of a computer.

He put his requirements for a wife on a questionnaire, told about himself, and sat back to await the results while the computer ran through 30,000 prospects.

The computer came up with four possibilities. At the head of the list was his former wife who had filed a similar form with the same mate-selecting computer.

From the Univac News, Vol. IX, No. 11.

Submitted by:
Walter H. Schmitt,
Univac Div. of Sperry Rand Corp.,
Philadelphia, Pa.

For the no-space age, the compact communications interface.

The wide open spaces are back.

Because now there's a way to clear out a whole roomful of interface hardware. So you can save on space. And on hardware costs. And on line costs.

All without modifying your IBM System/360 software one bit.

All with a single standard six-foot rack.

How? Easy. With the Ultronic Communications Interface Processor. It marries your terminals, software, and communications and lets you feed high-speed multiplexed data directly into your CPU without modifying existing software.

Which means you don't have to de-mux first. So you can scratch all those multiplexers you don't need any longer. And all those expensive adapters, too.

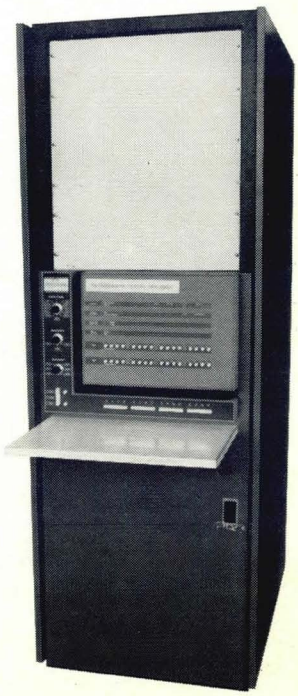
Since the CIP can handle up to 176 channels of multiplexed lines with almost any mix of low-speed terminals, you can scratch a lot of line costs, too.

The Ultronic Communications Interface Processor is a completely turn key operation. It's backed by a service organization of over 300 technicians in 56 major cities. If you ever run into trouble, we won't have to run very far to get you out.

We know communications systems at Ultronic. Because we run one of the world's largest. So we have the on-line experience to help you plan the system you need. And all the hardware you need to build it. Everything from modems to TDM and FDM, to video terminals. And the CIP.

To find out more about the Ultronic Communications Interface Processor, just drop a line to Ultronic Systems Corporation, Mount Laurel Industrial Park, Moorestown, N.J. 08057.

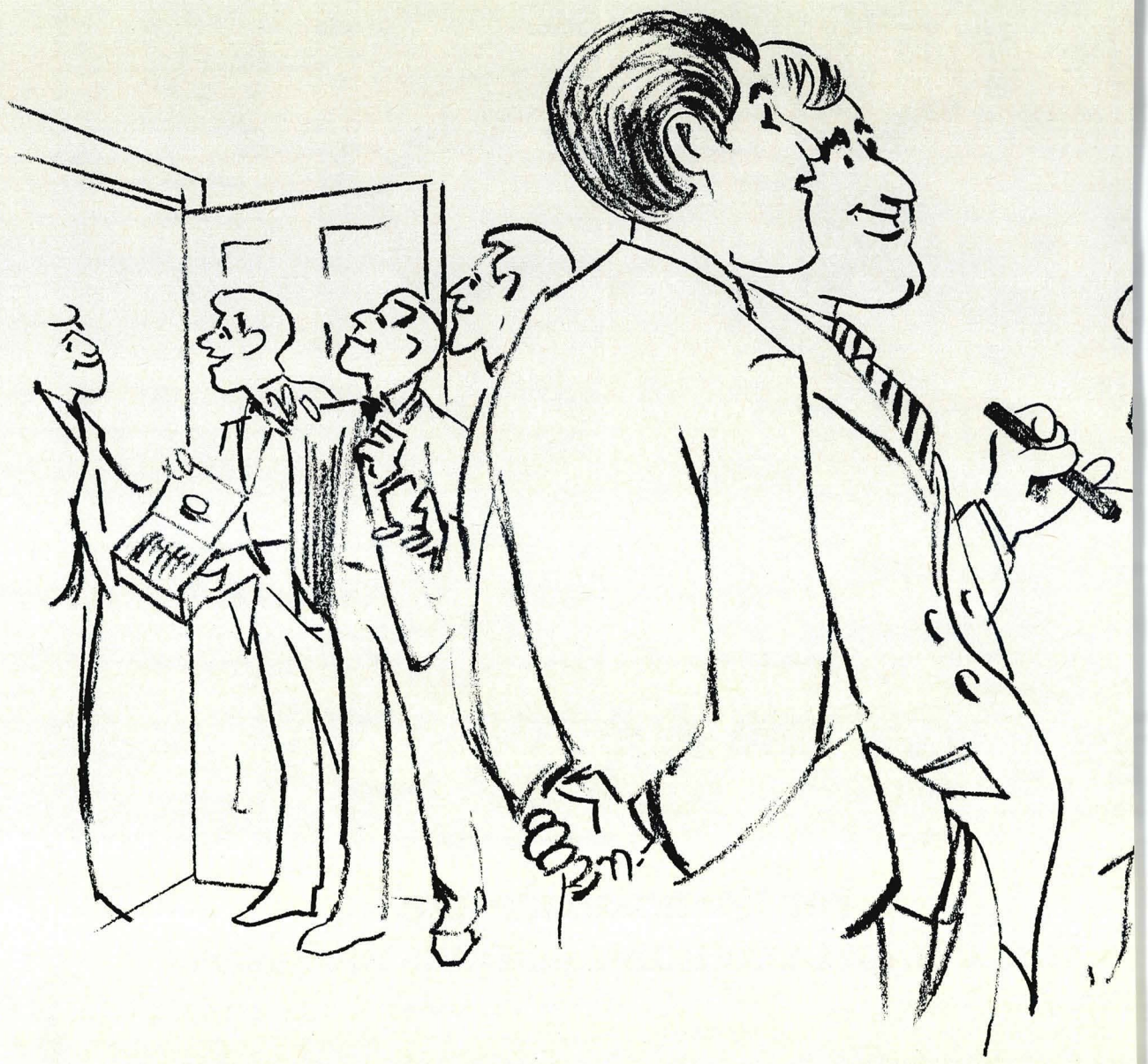
You'll be surprised at the way the CIP can broaden your horizons.



ULTRONIC SYSTEMS

SYLVANIA

GENERAL TELEPHONE & ELECTRONICS



MAC Jr. has all the Except price.

Our new arrival is something to crow about. Tagged at just $7,900, this 16-bit multi-application computer has all the famous MAC features. Including a bright future.

It's handsomely endowed. With a standard 4K memory (expandable to 8K), MAC Jr. has characteristics you'd expect only in larger, costlier computers. Like 4 standard priority interrupts (expandable to 16) with automatic store and restore, and 1-micro-

family features.

second cycle time.

Reliable and tough, too, like its rugged parent, MAC 16—the highly expandable computer already at work in dozens of complex control jobs. MAC Jr. is even program-compatible with MAC 16. And has the same peripherals.

Does a small, powerful, low-priced computer fit into your plans? Get acquainted with this lusty newcomer by circling our number. Our MAC Jr. is crying for challenges.

Lockheed Electronics

Data Products Division/A Division of Lockheed Aircraft Corporation 6201 E. Randolph St., Los Angeles, California 90022

CIRCLE NO. 41 ON INQUIRY CARD

DR. DONALD B. BRICK, Pres. • Infoton, Inc., Burlington, Mass.

TECHNOLOGY PROFILE

INTERACTIVE CRT DISPLAY TERMINALS

Part I — The Technology & the Market

The ability to access a central data bank at the touch of a button is one that computer users will elect in great numbers in the next few years. As the cost of data storage declines, they will convert the dollars saved into added memory capacity to store larger quantities of information about their business operations.

The swift and easy retrieval of such information is the principal strength of a CRT display terminal (See Fig. 1) . . . the ability to provide a great deal of information very quickly, and in a more descriptive format than is possible with a hard-copy printing device.

THE TERMINAL MARKET

Estimates of CRT display terminals currently installed worldwide vary. Manufacturers are imprecise, and doubt exists if certain special-purpose types should be included.

EDITOR'S NOTE: This article, the first of a three-part series, updates our original Technology Profile on CRT Terminals which appeared in the July, August, and September 1968 issues of MODERN DATA. Now out-of-print, the original series generated thousands of requests for reprints and follow-up surveys.

The purpose of this updated series of articles is to present background information on the characteristics and uses of interactive CRT display terminals together with a comprehensive listing of companies supplying them. This article (Part 1) discusses the present and future of the terminal market, terminal interfacing techniques and problems, and software requirements. Part 2, appearing in June, will cover the hardware characteristics of alphanumeric and limited-graphic terminals, with a tabulation of the important characteristics of each terminal now being marketed. Part 3 (in July) will describe and tabulate terminals with full graphic capability.

Our market intelligence suggests that there are over 75,000 CRT terminals being used today. Of these, over 35,000 are alphanumeric displays used by financial firms for stock quotations, and another 30,000 are used for reservations applications. Alphanumeric displays installed as substitutes for teletypewriters terminals, although now becoming popular with the development of competitively-priced equipment, number no more than 2000. We judge that there are no more than 1000 CRT displays with graphics capability in use today, and most are employed by the Federal Government, universities, and a few large corporations.

Alphanumeric terminals are functionally of two types. Unbuffered (or character-oriented) displays do not have a memory for retaining the binary-coded characters of a message, and characters are sent to the computer as they are keyed-in. Buffered (or word-oriented) displays retain the character codes, and editing and formatting operations can be performed on a message before it is transmitted to, or after it is received from, the interfacing computer.

Buffered displays were more prominent in the 1960s, especially in management information systems for inventory control, accounts receivable, distribution management, and general business information retrieval. With the increasing use of conversational-mode computer systems, we expect that the 1970s will be the decade of the unbuffered terminal.

Until recently, the increased use of both types of terminals was limited by their price, which ranged from $8000 to $15,000. The growing use of time-shared, on-line computer systems and the dramatic cost reductions in components based on metal-oxide semiconductor (MOS) and large-scale integration (LSI) circuit technology have caused reduced prices and increased demand. Because the market is so sensitive to pricing, we would expect the use of display terminals to rise dramatically with further price reductions. Assuming continued growth of the national economy, we estimate a rise in the installation of display terminals of at least 50 per cent a year annually through 1975. This will mean 600,000 or more displays in

operation within five years, priced mostly between $4000 and $5000 each. Therefore, the 200,000 displays to be installed in 1974 will mean a sales volume of $800 million. We further expect that three-fourths of the displays installed in the next five years will be character-oriented, and that the remainder will be word-oriented. We have charted these estimates by area of application to the year 1972 in Fig. 2.

Most new applications will evolve from the concept of minimum data entry with maximum intelligent response. With the introduction of improved systems incorporating less costly terminals, the fields of medicine, finance, process control, purchasing, and accounting will be the principal beneficiaries of such applications. For example, a financial account executive can get advice in moments with such a system (even while his client is on the telephone). With instant response and the availability of detailed information on particular securities, the executive can devote his time to making intelligent decisions on actions to be taken.

Buffered displays will continue to be used in applications that rely on the use of a formatted message, such as an order entry system. Protected formats, tabulation (both forward and backward), insertion and deletion by line and character, and full or partial message transmission are all editing features that buffered terminals will provide. These will be needed to guarantee the accuracy of a composed message before it is sent, as it is far more difficult to correct operator errors at the interfacing computer than at the terminal, the source of the message.

For many reasons the off-line use of buffered display terminals will expand, but primarily because the off-line accumulation of data reduces data transmission costs. Data can be gathered during working hours on low-cost, high-density magnetic tape cassette storage devices, and transmitted to a remote computer in the evening, when communications rates are lowest.

Unbuffered terminals will be highly popular with conversational-mode computer users, where a high degree of interaction with the computer program is desired.

The presentation of 1000 or more characters in a varying number of positions offers the broadest user appeal for both buffered and unbuffered displays. The greatest demand is for screen formats of 64 to 80 characters per line and 12 to 20 lines per terminal. Users are also unwilling to purchase terminals with character capacity or editing features not needed for their application. They require equipment which is modularly designed, with features added as needed by simple in-the-field modifications. Other users require selective

Immediately prior to founding Infoton, Inc. in 1964, **Dr. Donald B. Brick** was employed at Sylvania Electronic Systems as General Telephone and Electronics Corp.'s fourth senior scientist and as scientific director of advanced technology. He has directed a variety of work in information processing, information theory, communications research, and related projects; authored over 25 technical papers; and filed several patents. He has also been a lecturer at Northeastern University and a consultant to the RAND Corp., IRA Systems, Inc., and Syracuse University Research Corp. Dr. Brick received his A.B., S.M., and Ph.D. degrees in applied physics from Harvard University.

Edward N. Chase has been involved in the design and programming of interactive display equipment since his graduation from Harvard University in 1962, at which time he joined Charles W. Adams Associates. Mr. Chase was technical editor of Adams' Computer Display Review from its inception in 1966, to 1968. He is presently employed as a software and display specialist for the Dynamic Processes Branch, Air Force Cambridge Research Laboratories; and is independently preparing a booklet, DISPLAY TERMINALS, which will describe the important characteristics of all remotely-configured CRT terminals for which pricing information is available.

Fig. 1 Typical CRT display terminal. (Infoton VISTA 1)

hardcopy and would prefer a printing terminal priced under $1000 with a speed of 50 to 80 characters per second; but they will pay more if provision is made for attaching a CRT display. We expect that within two years combined display/printing terminals will be produced for $2500, or $60 a month rental.

Eventually the ideal alphanumeric display terminal will be a controller for other peripherals such as tape cassettes, printers, and credit- or badge-card readers. Sharing the electronics of the display and peripheral units will significantly reduce costs.

Display terminals with full graphics capability are still a solution in search of a problem. With a few exceptions, they are quite costly, both for hardware and the necessary software. The proprietary nature of such software gives it the value of a trade secret. Until standardized general-purpose software is available from the display manufacturers, we expect the use of graphics terminals will be limited.

INTERFACING

The transmission of data over lines between terminal and computer is accomplished by modulator-demodulators (modems), which convert the binary ones and zeroes of the character codes to audible tones, and vice versa. Modems may be devoted to only one terminal, or can be multiplexed to many terminals at a slower character transmission rate (measured in baud, which is approximately equal to bits per second) for each.

The acoustic coupler is a modem used mostly to connect displays to commercial time-sharing systems through the handset of the common dial-up voice telephones used in offices and homes (See Fig. 3). Couplers can be operated in either half-duplex or full-duplex modes: in full-duplex operation, messages can be sent simultaneously in both directions; but in half-duplex operation, messages must be sequenced in each direction, as transmission can take place in only one direction at one time.

Rates of data transmission and errors limit acoustic couplers. Error rate is high because the coupler is connected to the public switched network, which was designed for voice transmission and is subject to impulse noise introduced by exchange and industrial power switching. The remote display application must allow for this source of error. Hardware error detection techniques that include transmission of signals back to the computer or terminal to verify correct receipt of the message are commonly used to assure that the data is accurate. These techniques include message check sum and parity features which can be incorporated into the modem or built into the terminal.

If the display application requires data rates greater than 110 baud (teletypewriter terminal speed), an acoustic coupler can be operated at 300 baud and still perform within its design limits. A few sophisticated couplers can be used above 300 baud; several available claim 1800 baud operation over the public switched network.

Hardwired modems (See Fig. 4) are connected directly to the phone lines and match the data rate of the display terminal to the characteristics of the telephone facility. One modem containing a transmitter and receiver is used at each end of the transmission path. These are capable of half- or full-duplex operation. Recent tariffs permit a non-Bell modem to be coupled to the public switched network through a telephone data-access arrangement. This costs two to four dollars per month and includes a telephone modified with a data switch to permit either voice or data transmission. The resulting competition in modem manufacture has reduced costs; also, display terminals with built-in modems are now available. These provide the por-

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DATA ACQUISITION SYSTEMS

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06914

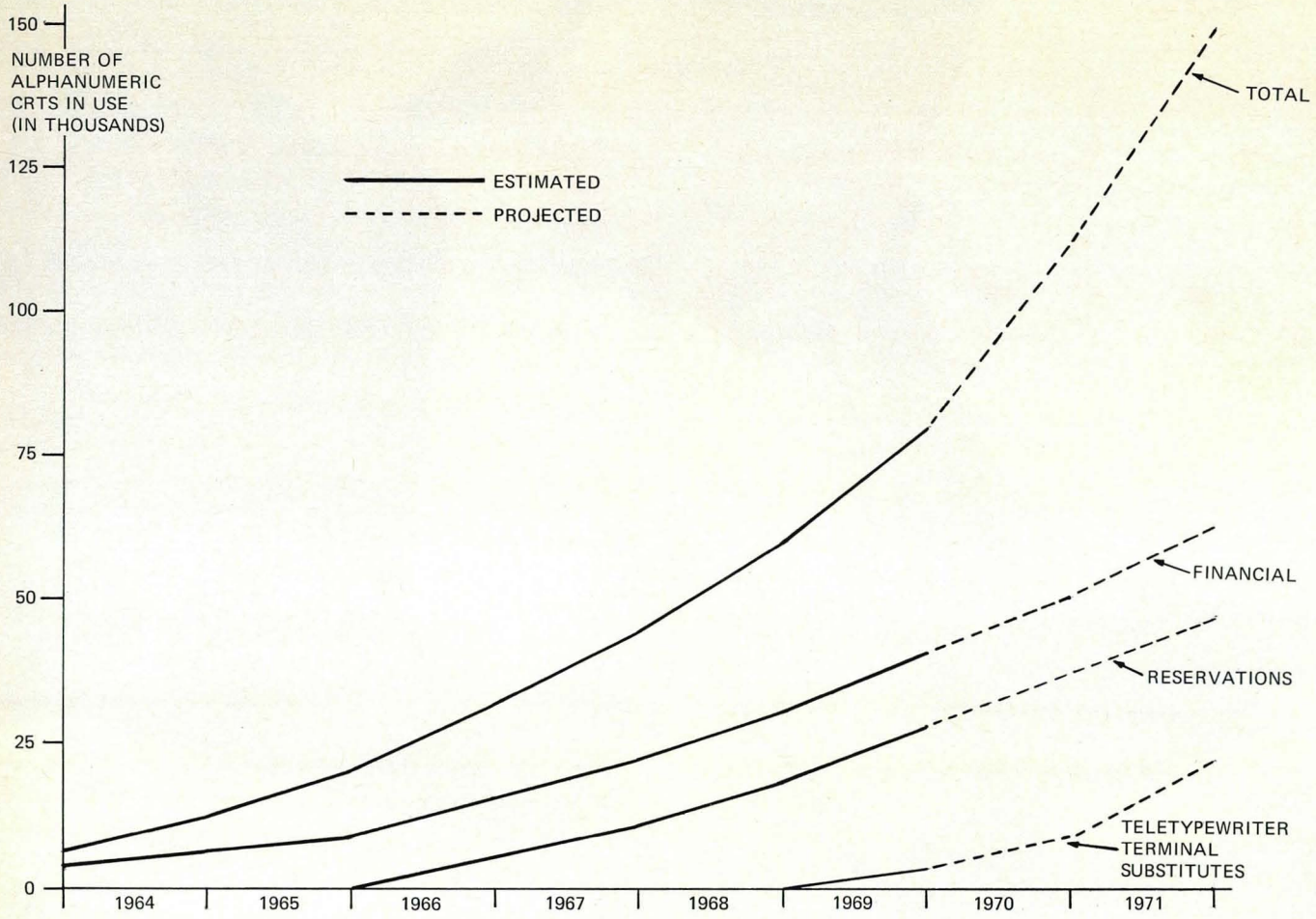

Fig. 2 Alphanumeric CRT Terminal Installations by Major Applications.

tability of acoustic couplers by directly tying to a telephone with a data-access arrangement.

Modem suppliers advertise units of 300 to 1800 baud for use on the public switched network. With improved circuit design, 2400 to 4800 baud modems will soon be available. For most applications, alphanumeric keyboard displays need no more than 600 baud, so these faster modems will be more useful with graphic displays that require large blocks of data for complex presentations, or where faster transmission can reduce long-distance dial-up costs.

Hardwired modems (and multiplexing modems) are also connected to lines leased especially for their use, avoiding the noise of the public switched network. Leased lines are used where the system requires lower rates of error, higher rates of data transmission, or faster response (about 3 to 6 seconds) than can be accomplished with the public switched network. They are costlier, however, and must be justified by the need for higher operational efficiency.

Many applications use one released line with several display terminals. Two common configurations of such shared-line use are **polling** and **multiplexing.** In the polling configuration, a single point-to-point line connects a series of terminals. The terminals in this system must be individually addressable and capable of storing a block of data. The polling is initiated by the computer when it sends a request code and terminal address. The terminal recognizes its address and sends back its message (which may be that it has no message). After receiving the message, the computer advances to the next terminal. If sufficiently high-speed lines are used, each terminal will appear to have its own dedicated line. Polling reduces the number of modems and the length of line required to reach all terminals, and this in turn reduces costs.

Fig. 3 Typical acoustic coupler. (Anderson Jacobson ADAC 242)

Fig. 4 Typical hardwired modem. (International Communications Corp.'s Model 3300/36)

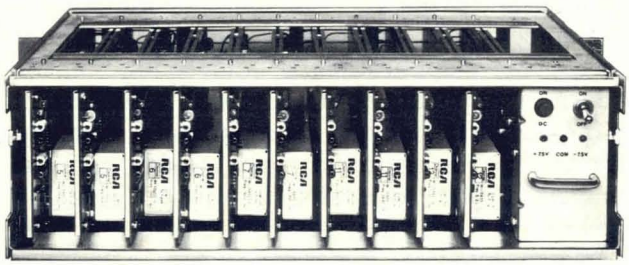

Fig. 5 Typical multiplexer for point-to-point lines. (RCA's Model CDM)

A multiplexing unit is shown in Fig. 5. Multiplexing is used where displays are geographically clustered, as within a plant or a city. The multiplexer assigns a separate channel to each terminal, with the maximum number of multiplexed channels dependent on data transmission rates for each channel and for the modem. With a 9600 baud modem, a large multiplexer can make a single leased line the equivalent of 75 lines at 110 baud.

Intermixing high- and low-speed lines, synchronous or asynchronous transmission of characters, dial-up controls, error checking, and monitoring are among the features available with multiplexers. Most systems are modular and can be expanded by adding channel cards. Certain multiplexers can also be used on a point-to-point line as in the polling configuration, but with this method the terminals have independent dedicated channels and computer polling is eliminated. Since using a large number of channels per line can mean a significant reduction in line costs, multiplexing equipment frequently pays for itself in 6 to 12 months.

The time-shared computer, to which display terminals are often interfaced, has a communications front-end designed around a minicomputer and accommodating from 8 to 500 input channels. These front-ends are flexible enough to interface with mixed data rates. Some units can handle channels with varying data rates by responding to a preamble (special code word) which is sent, for a brief time, to permit the unit to sense the channel timing and set itself to receive at the correct rate. Front-ends also accept half- or full-duplex and synchronous or asynchronous channels. Some systems with demultiplexing capability reduce hardware costs by eliminating the multiplexer at the computer site.

The minicomputer software in these front-ends can check for format and transmission errors, request retransmission of messages in error, change the character coding, and perform other useful functions. Relieved of these tedious tasks, the main processor has more computing power available for the application.

Whenever terminals are connected to computers through a complex network, there are procedural steps to follow and pitfalls to avoid. The implementation of regional or nationwide networks requires careful analysis and planning to ensure optimum performance at minimum cost. Advice is available from consultants, who can help with programs to analyze optimum network configuration for leased lines, distribution of multiplexer locations, inward-WATS and outward-WATS service, and leased-line routing.

SOFTWARE COMPATIBILITY

The ability to interface a display unit with a given computer central processor is not a guarantee of software compatibility. With the IBM System/360, for example, the compatible device would have to replace an IBM 2260 or 2265 display unit without any reprogramming in any user program. This level of compatibility is extremely difficult to achieve because it requires the compatible display to be nearly a duplicate of the original. (Some manufacturers, such as Imlac and International Computer Terminals Corp., achieve this level of compatibility with a minicomputer connecting their displays to the CPU. All data going to and from the terminals passes through the minicomputer, and can be appropriately modified to achieve application program compatibility.)

Because applications programs are designed to perform a particular task on a particular terminal, caution must be exercised when making substitutions. An airlines reservation system, for example, is designed to display certain forms to the user, and to accept data in a certain way. In building the software for such a system, assumptions are made about the terminal such as the number of characters per line, the number of lines per unit, or the existence of protected formats. To be compatible effectively at the application program level, a substitute display must not "hang up" on any of the expected features, but must be able to react to commands from the application program exactly as the original, or in a way that will not alter the system's human factors. Commands that do not affect system operation can be assigned substitute features or ignored.

Terminals that are IBM System/360-compatible are accessed by the programmer through the operating system using simple, basic commands such as "read" and "write." The operating system performs the input/output functions along with interrupt handling, message control and routing, data translation, and buffer management.

Access is at the basic (BTAM) and queued (QTAM) levels. BTAM, or **B**asic **T**elecommunications **A**ccess **M**ethod, provides I/O support for IBM 2260 series CRT displays. It generates channel programs, handles I/O interrupts, and dynamically assigns buffer areas. It also has control and error recovery routines. Execution of the channel program proceeds asynchronously with the application. Start and completion codes are made available to the application program to determine the start and completion of the I/O operation.

QTAM, the Queued Telecommunications Access Method, also supports the 2260, and provides message processing and control in a communications system. Message routing specified by the user is controlled by QTAM asynchronously with message processing. QTAM support provides the user, in macro form, with all the routines necessary to drive the display. These include display polling and addressing, I/O message control, dynamic allocation of main storage for buffering, editing, translation and control of I/O messages, routing of messages to destination queues, and maintenance and control of all queues.

To be compatible at the BTAM and QTAM levels, a display must react to a set of commands generated by either method in the same way that the 2260 reacts, and without rejecting any communications response. If a superset of 2260 features is contained in the compatible display, marcros can be added to the operating system to permit the use of these features. This could mean adding a set of translation tables, but this is not difficult and allows taking advantage of the display's extended hardware features.

Displays used in commercial time-sharing systems are primarily teletypewriter-compatible terminals requiring no software changes. However, a display offers such advantages as faster and quieter operation, and most teletypewriter-compatible displays also have a movable cursor as well as a key to erase the screen.

INCREASED COMPETITION AHEAD

We predict dramatic price reductions for CRT display terminals over the next two years as component costs are reduced and competition increases. We also feel that many of today's terminal manufacturers will fall by the wayside. Survivors in the industry shake-out will be characterized by 1) personnel with the genius and initiative to respond quickly to technological change; 2) a strong marketing capability; and 3) the business sense to build competitive equipment.

Although the cost of buffered alphanumeric displays will exceed by one-fourth that of unbuffered ones due to memory and logic for editing, over-engineering will not be tolerated. A terminal price difference of less than $500 will determine vendor selection; and we can expect higher reliability, increased ease of maintenance, and lower costs in all types of displays from the use of MOS/LSI electronic components.

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Next month . . . .
Part 2
Alphanumeric CRT Terminals

A NEW MINICOMPUTER FROM INTERDATA

After increasing sales by 250% over 1968, Interdata's "no-longer-little" Oceanport, N.J. manufacturing facility tools up for yet another assault on the minisystem market.

The Interdata Model 1 Processor is a physically small, high-speed, modular processor designed for industrial monitoring, process control, data collection, and data communications applications.

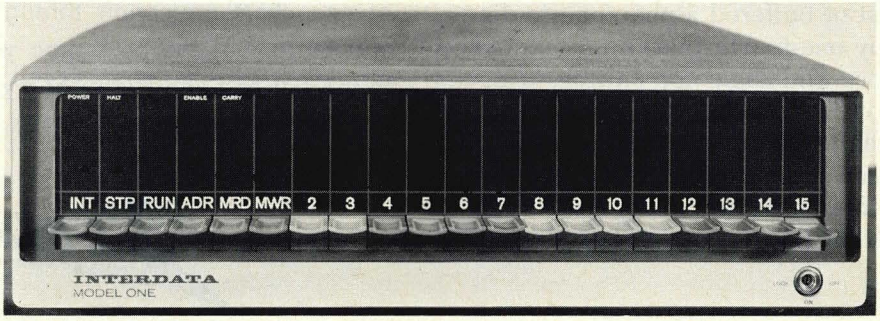
The Model 1's memory system uses 2048-byte core modules and is expandable to 16,384 bytes, with parity as an option. Cycle time is one microsecond. Plug-compatible, Read-Only-Memory modules may be intermixed with core in 2048-byte increments. The memory is organized into 256-byte pages, with the current page and page zero directly addressable by the primary instruction word. All remaining pages are addressed indirectly.

The processor's eight- and sixteen-bit instructions include test and skip options for byte handling and loop control, as well as bit manipulating instructions. An auto-indexing feature enables the system to use a maximum of 8192 core registers.

INPUT/OUTPUT

There are several ways of handling input/output transfers between the Model 1 and up to 256 devices. For simultaneous transfers and processing, a maximum of four Direct Memory Access (DMA) channels can be added to the processor. The DMA channels cycle-steal memory and operate at a maximum rate of 500,000 bytes per second. Two kinds of DMA channels are available: a high-speed selector channel, which uses standard Interdata device controllers; and a universal DMA channel for applications involving custom channel design. The instruction set includes eight I/O instructions in addition to read block, write block, and the pulsed I/O instruction. The former instructions can transfer data at speeds up to 400,000 bytes per second; the pulsed I/O instruction can specify any combination of three control pulses, thus simplifying special interface design.

Four hardware priority external interrupt lines are standard—up to eight are available—and all interrupt lines are individually maskable. A serial I/O port for TTY data is controlled by the standard one mil-



The Interdata Model 1—a 1.0 usec 2KB processor for industrial control systems, remote data collection, and batch terminal controllers.

THE INTERDATA MODEL 1 – SPECIFICATIONS

Word Size: 8 bits
Arithmetic: Two's complement
Number of Internal Registers: 7
Number of Instructions: 47
Addressing Modes: Direct, indirect, with auto-indexing
Immediate Instructions: Standard
Typical Execution Time:

Add:	3	usec
Load Immediate:	2	usec
And Bit:	2.5	usec
Sense Status:	2	usec

Memory Size: 2048 words expandable to 16,384 words
Memory Cycle: 1 usec
Read-Only-Memory: Available in modules of 2048 words
Interrupts: 4 hardware levels standard, expandable to 8
Maximum Number of Input-Output Devices: 256
Input-Output Transfer Rates:

Programmed:	83,000 bytes/sec
Read/Write Block:	400,000 bytes/sec
Selector Channel:	500,000 bytes/sec

Power-Fail Protection: Optional
Real-Time Clock: 1 millisecond interrupts, standard
Logic: DTL, TTL, MSI used; 0 volt to +5 volts, positive logic
Dimensions: 5 1/4" H x 17 1/2" W x 17"D, RETMA standard
Weight: 45lbs.
Power: 115 vac + 10%, 50/60 Hz single phase, 150 watts

lisecond real-time clock, which also provides a real-time interrupt for application-oriented software.

HARDWARE & SOFTWARE COMPATIBILITY

Model 1 software includes a monitor in addition to assembler, editor, debugger, loader, and diagnostic and applications packages. For present Interdata users, the company provides a Model 1 Simulator and Assembler which can be run on an Interdata Model 3 or 4. Also important to present users: all the systems modules and device controllers that were designed for the Models 2, 3, and 4 are plug-compatible with Model 1.

PRICING

The basic Model 1 Processor with 2KB of 1.0 usec memory, 4 priority interrupts with masking, serial I/O controller (TTY or 103 data set), real-time clock and power supply is priced at $4,650 for single units; under $4000 in quantities.

For more information on the Interdata Model 1, Circle No. 117 on Inquiry Card.

DIGITAL AUTOMATION: Today and Tomorrow

We have barely opened the door to the age of automation. And it is definitely coming. But for the forseeable future, at least where "human judgment" is involved, more automation means more productivity, not less employment.

"Automation" is a word that is bandied about today with almost the same frequency as "space." It's applied to everything from getting out of drying the dishes with a dishwasher, to a plant designed to machine a complete engine block "untouched by human hands."

We've all heard at one time or another of how automation will someday take over all human production. But for the automation engineer, the man whose job it is to bring all this about, there is one major hitch: human beings are still the most capable machines in existence, and it is doubtful that we will ever be able to develop a machine as clever as ourselves. Since most attempts at automation are efforts to imitate or improve upon what the human being has already learned to do, this leads us to a differentiation for purposes of this article.

The differentiation is between "manual dexterity" automation and "human judgment" automation, and the former is much farther along the development cycle than the latter. In fact, the machine outclassed man years ago in most manual-skill jobs.

In the early 1950s, Ford Motor Co. activated the first automatic engine-producing plant in Cleveland. Utilizing very expensive machine-tools and "transfer machines," this plant was designed to perform automatically the entire machining on an automobile engine block. Although this was indeed a complicated task, it still represented automation which I would class as manual dexterity automation. This article deals with the "human judgment" kind of automation, where instead of trying to substitute for manual and manipulative skill, we are trying to take over jobs from the human mind: jobs involving a number of continuously-measured parameters and conditions which must be subjected to some abstract calculations (or reasoning, if you will) in order to generate feedback commands that are largely different every time, rather than repetitive.

This is where the digital computer comes in. Why just the digital computer, rather than the analog computer, or the "controller," or the "transfer machine?" Mainly because the digital computer, like the human mind, has memory. It can remember something it has learned before, and use it later to influence what it does in the future. Memory, however, is not judgment.

"CLASSIC" AUTOMATION

The kind of human judgment automation represented in the classical picture of a central computer operating a factory, or controlling a process, or directing and controlling a complicated test, is still far ahead of us. In this context, the steel industry isn't automated. Rolling mills are still almost entirely controlled by hand, and annealing and open-hearth furnaces continue to be controlled on the basis of after-the-fact manual analyses. Even the paper industry isn't automated: few plant managers are willing to turn their plants over to a digital computer when downtime can cost $5,000 an hour. Granted, several paper plants have automated their Fourdrinier machines – the front end where pulp and water first mix to start the paper rolling – but full staffs are still required for the majority of operations.

Computer-controlled automation is definitely coming, however. While it finds acceptance very slowly, it has already arrived in several industries and is on the verge of being implemented in several others. One successful area has been "power dispatching" in power-company distribution networks. Each separate power company balances out the electric power it accepts with the power it passes on to interconnecting power companies. By directly connecting a digital computer to monitor power flow throughout the system, the computer can provide predictive control for power generation to keep this trade-off in balance. Such systems are in use, and more are being considered.

Another field that has been automated within the last three

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years is the testing of automobile carburetors. Every carburetor coming off the production line must be tested for proper operation at several throttle settings, and must have idle settings properly adjusted. This task has historically been performed by a trained tester working at a specially-built test stand. In a typical plant producing 7,000 carburetors daily, 50 test stands and 150 test operators were required for final testing and adjustment. Now a computer controls the testing. Special lead-screws move in and set the carburetor idle screws under direct time-shared digital control. Man has not been taken out of the loop, but now each operator handles six test stands instead of one. As he connects the fluid lines and clamps each carburetor onto a fixture, the computer is automatically given control and, for the next 2½ minutes, the carburetor is tested at various settings and properly adjusted. If the computer is unable to adjust the carburetor properly, it locks the carburetor to the stand so that it cannot be removed until the operator has also attempted adjustments, or has signaled its rejection into the computer accounting system.

The significant point is that if the central computer fails, plant output falls from 7,000 to 1,000 units per day. Computer automation has truly arrived when production managers have accepted this degree of reliance on the computer.

DIGITAL DATA ACQUISITION

Another area where computer-controlled automation has been accepted for several years is in the collection and formatting of multiple-source electronic measurements: the so-called "digital data acquisition system." A typical application is the static load-testing of a newly designed airframe. One thousand strain guages are attached to various parts of the structure while it is systematically loaded to determine the amount of deformation at various points on its surface. One thousand separate electrical signals are collected, calibrated, calculated, converted to engineering units, formatted, and printed. Eventually, not only the digital data acquisition, but the complete control of aerodynamic fatigue-testing will come under computer-controlled automation.

Any process in which a large number, or rapid sequence, of measurements needs to be digested in order to permit making the next control decision, is a candidate for computer-controlled automation. The operations that haven't been automated yet are usually cases where the machine isn't sophisticated enough to replace human judgment; where we find ourselves faced with the following kinds of situations.

- In some chemical processes, shutting down and letting stuff freeze in the lines is tantamount to replacing the plant. Yet we can't let some pressure vessel go out of control. When do we take drastic action? How can we determine if only the sensor generating an out-of-limits signal is malfunctioning, rather than the process? A trained human observer is readily able to perform the multi-variate cross-checking to make these types of judgment decision, but when we try to program the same decision-making processes on a computer, we are frequently amazed to discover how complex a relatively-simple human decision really is.

- In automating processes with a computer, we are replacing human observation of a meter reading with automatic electronic encoding of a sensor output voltage. But a human is a great interpolator, and considerably more qualified to differentiate between a meaningful signal and electrical noise. The use of simple time constants to smooth-out the noise can degrade the parameter measurement and, consequently, degrade the response. To avoid this, digital interpolation by the computer is often added to the analog filtering performed by the gauge. However, we still have the problem of the machine arbitrarily rejecting performance that the human observer would accept. And production managers are very unsympathetic about this.

- Finally, there is always the problem of what happens when the computer itself breaks down. If we provide for full manual backup, we can justify the computer only if it pays for itself in increased product output. But the need for full manual backup indicates something less than full automation.

JUDGMENT BY APPROXIMATION

In the next ten years we shall see computers become as essential for the control of production processes as they have become for commercial data processing tasks in the last ten years. Based on our developing solid-state technology, we can expect a 10-to-1 reduction in the size and cost of "process control" digital computers. In a package the size of an orange crate, and at a cost of less than $10,000, the process engineer of tomorrow will have available a computer capacity which would have cost him $500,000 a short time ago.

But one thing will not have changed: the judgment of the human mind will still be superior to the judgment of even the most sophisticated and capable computer. For the foreseeable future, the most skillful applications of "human judgment" automation will be only attempts at approximating what the human mind could still do better if it had the time. ▲

THE SPD 10/20 SUPERTERMINAL

A new company offers a complete minisystem in one package as its first product.

International Computer Terminals Corp., presently in the process of relocating in Marlboro, Mass. from Framingham, Mass., considers itself unique in that it has no financial problems, does not plan a public stock offering, and its first product, which involves no "future technology," is available now.

THE COMPANY

ICTL was formed in early 1969 by two former Raytheon executives, Jean Tariot and James Upton, who share the credit for originating and developing the Raytheon "DIDS-400" commercial display. The company's vice president – marketing is M. R. Clement, Jr., formerly Sperry Rand – Univac's director of technical marketing. The other key members of the team are from Raytheon, Honeywell, Sanders Associates, Digital Equipment Corp., and Itek.

SPD 10/20 • FUNCTIONAL CHARACTERISTICS

Processor

Type:	Binary parallel, byte-oriented
Addressing:	Single address with indirect
Instruction Word:	16 or 32 bits
Data Word:	12 bits
Memory Word:	16 bits
Arithmetic:	Two complement Add: 3.2 usec. Subtract: 3.2 usec. Compare and branch: 3.2 usec. Jump: 3.2 usec. Memory increment: 3.2 usec.
Addressable Registers:	Accumulator, character, line

Memory

Type:	Ferrite core
Speed:	1.6 usec. cycle time
Size:	1024 words, 16 bits 2048 words optional
Instruction Set:	(58 instructions) 17 data manipulation 11 cursor control 20 test and/or branch 6 input/output 4 miscellaneous control Addressing for 16 external devices
Special Features:	Remote loading mode (optional) "Auto-exec" logic for intermixing Interrupt and program threads Point graphics mode
Communications:	Synchronous to 4800 baud Asynchronous to 2400 baud Half or full duplex RS 232 standard

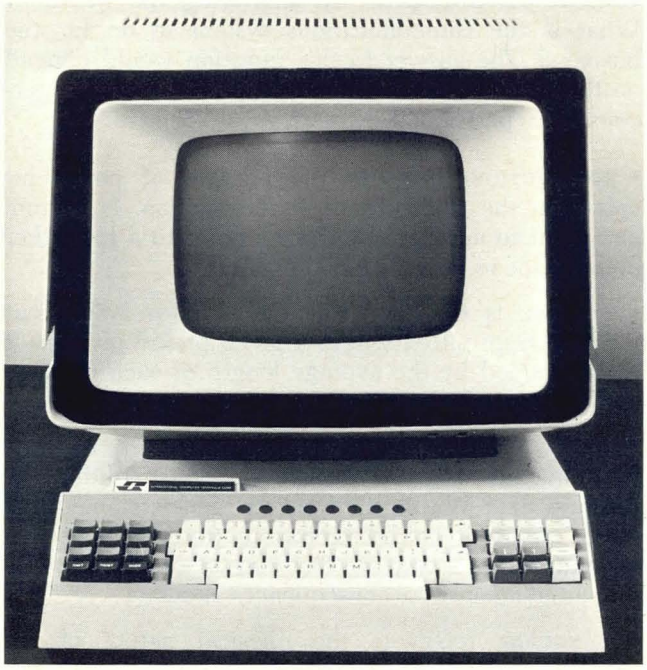
THE PRODUCT

The company's first product is the SPD (for Stored Program Display) Model 10/20, an alphanumeric display which contains a complete general-purpose computer. With the SPD 10/20, a time-sharing user can perform almost all editing and format checking functions off-line. He can connect to time-sharing services and elect to operate it as an IBM 2260, UNISCOPE 100, Teletype ASR 33, or as any other standard CRT or hard copy terminal – but with added capabilities not possible with the other terminal. For operators of dedicated systems, the SPD 10/20 can be remotely loaded with the programs that define its characteristics. Thus, a central site can support and control its terminals by providing the desired set of functional/transmission characteristics or operating environments.

CONFIGURATIONS

Because each SPD 10/20 display has its own memory and interface logic, it may be connected directly to a central processor within a site or to any communications line modem. By using the programmable features of the display, it has been possible to design a low-cost multiplexer which can connect to a half- or full-duplex line modem and interface to as many as 16 displays. Multiplexers can also be cascaded to connect up to 64 displays at a site. Since distances between multiplexers and displays can be as great as 1,000 feet, modems for communications within a site can be eliminated and displays can be conveniently positioned. In designing a terminal network using the SPD 10/20, the customer need not specify operating characteristics in the detail required by

many other terminals, since almost all functional aspects are controlled easily by its stored programs. The customer can change communications procedures, entry formats, control procedures, etc. at any later time by adjusting the program. This ability to be changed and upgraded to match experience and new requirements should be especially attractive to the user. Interfaces between the terminal processing unit and external devices



International Computer Terminals Corp.'s SPD 10/20—an "intelligent terminal" combining alphanumeric and point-graphics capability with the power of a built-in general-purpose mini.

such as the keyboard, hard-copy printer, and multiplexer are made through controllers. By this means, any local peripheral can utilize the communications capability, buffer memory, or program memory associated with the display. It is also possible to select configurations of multiple keyboards per display, multiple printers per display, multiple displays per keyboard, etc.

Character capacity of the display is operator-selectable – 960 or 1920 characters (a maximum of 64 characters per line is provided in either case), and a point graphics capability is provided for displaying bar charts and other point-plotted arrays.

The electronic keyboard may be located up to 15 feet from the display module. It contains a 64-character ASCII configuration, 12 editing and cursor keys, 8 indicator lights, and 12 special function keys for program interpretation including transmit, field identifier, and print keys.

PROGRAMMING CONSIDERATIONS

The order code structure for the SPD 10/20 has been selected to optimize local terminal functions, to allow efficient functional duplication of terminals made by other manufacturers, and to optimize communications characteristics. Interrupt functions are handled by a proprietary "auto-exec" feature which uses hardwired logic to intermix display functions, communications interrupt processing, and background program execution. Standard SPD 10/20 software will include terminal emulators, assemblers, program load and dump routines, and other miscellaneous utility routines.

PRICES

ICTC's pricing policy for the SPD 10/20 reflects the company's intention to provide competent maintenance, software, and systems support regardless of the number of displays purchased or leased by a customer. A single, standard SPD 10/20 (including display, keyboard, computer with 1024 words of memory, and half-duplex communications interface) costs $9,000; however, in quantities between 5 and 9, this price is reduced to $7,100. And in quantities greater than 400, the single-unit price is reduced by more than 50%. Similarly, an SPD 10/20 dual display system, which provides two independent keyboards and 960 chars./display with one 2048-word computer and half-duplex communications interface, is priced at $11,390 in single units; $6,590 in quantities between 100 and 200.

For more information
on the SPD 10/20
Circle No. 111 on Inquiry Card.

NEXT MONTH
Part 2 (Contined)
Cost Considerations and Future AT&T Developments

ROBERT M. HINKELMAN, • Staff Supervisor AT&T Co., Camden, N. J.

PLANNING A DATA COMMUNICATIONS SYSTEM

Part 2: Common Carrier Facilities

This is the second of the series of five articles. The first article in last month's issue provided an introduction emphasizing both the cost and technical aspects. This second article discusses technical, cost, and future developments of data transmission facilities. The article stresses services and facilities provided by the Bell System. However, the general ideas are more broadly applicable. The article is divided into two sections. This issue discusses communications criteria, facilities, and services. The second section which deals with cost, interconnections, and prospects for the future appears in the next issue.

The intent of this article is to orient the data processing manager, the decision-maker, to data communications. Emphasis will be on the types of common carrier facilities available and some of the factors involved in selecting one method over another. In other words, the "what" of data communications rather than the "how".

Next month, Part 2 of this article will discuss the relative cost considerations of the various types of data communications. Without in-depth explorations of specific tariff rates, cost comparisons will be made between the various services. Also, a look will be taken at what future offerings are forthcoming from the Bell System. Finally, some new ground will be broken by discussing what aids are available to a company planning a data communications system and, briefly, how the Bell System is equipped to supply support in this area.

To begin, a review of the "Seven Criteria for Communications" will serve as a point of departure. The criteria could just as conveniently be called the "Seven Criteria of Data Communications," for the recognition of those factors is essential to the molding of an efficient, cohesive information system. Each should be critically examined and assigned a priority in the construction of the system. Reference will be made, directly and indirectly, to those criteria throughout the article.

SEVEN CRITERIA FOR COMMUNICATIONS

• FUNCTION is defined by answering the question: What is the communications system to do for the business? The answer to this question would depend on the information to be moved or the specific operation to be performed.

• DISTRIBUTION refers to the number of points involved in the transmission of information. Is it from one point to another point? One point to a few other points? One to many? Many to many?

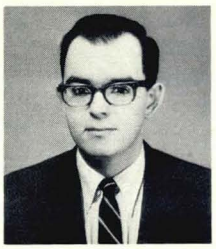
• VOLUME is the total amount of information that must be transmitted within a given period of time. It is determined by the average length of each message and the total number of messages.

• URGENCY is the fourth criterion. Must the message be delivered at once? Within the hour? Within the business day? Within the week? Urgency is one of the most important considerations in the selection of a communications system. The cost of speed must be measured against the consequences of delay.

• LANGUAGE refers to the physical nature of the communications and is determined largely by delivery requirements. Intra-office messages are often spoken or handwritten. Messages between offices can be transmitted in a variety of forms—printed, pictorial, punched tape, punched card, magnetic tape.

• ACCURACY, the sixth criterion, is not as simple as it seems. To be sure, everyone would like 100% accuracy. But errors occur in every information handling system. Experience has shown that errors occur most frequently whenever people are handling information. On the average, people make about one error in every 1,000 characters; while electronic devices make one error in every 100,000 characters.

• COST, the final criterion, is almost always dependent upon the other criteria and is almost directly proportional to them. For instance, an increase in the volume of messages a communications system can handle will generally lead to a corresponding increase



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in its cost. Conversely, at times it may be possible to add traffic to an existing communications system at minimal cost.

Once these criteria have been evaluated, the parameters of a data communications system should begin to come into focus. The seven are not in any order of preference or importance, since this will vary from system to system. It should be noted that "cost" is the final criterion. Ideally, cost should enter the picture after the system has been designed and is ready for implementation. Realistically, however, that is seldom the case, although there are systems that have such a high degree of urgency that cost truly becomes a secondary consideration. While we will examine costs more completely later on, a word of caution here: it is advisable to examine the data communications aspects of a potential system early in the design stages to determine order of magnitude costs rather than waiting until the system design is complete only to find the communications charges prohibitive, or that your objectives cannot be accomplished within the system parameters.

COMMUNICATIONS FACILITIES AND SERVICE OFFERINGS

Facilities, or channels, provided for data communications fall into three basic groups: **narrow band** — a channel with a frequency less than that required for normal voice transmission; **voice band** — a channel with a frequency from zero to approximately 4000 Hertz (cycles); and **wideband** — a channel with a frequency greater than required for voice transmission, usually several times the 4000 Hz bandwidth. The various service offerings to be discussed fall within those categories. The greater the frequency, or bandwidth, of the channel, the greater the information transfer rate and the greater the cost. However, certain leveling affects do take place and these will be examined later.

The provision of data communications falls into two categories: private line service and common user (or exchange) services. Private line services are facilities dedicated to a customer on a twenty-four hour a day basis and, for our purposes, only that customer has the use of those facilities. Those services are provided for a fixed monthly rate, regardless of the usage. The rate is dependent on the bandwidth required, the airline mileage between customer locations — "service points" — and the cost to terminate the facility at each service point. Private line service can connect two or more locations. In the main, a terminal on a private line system can only communicate with other compatible terminals on that same system. Access to terminals not on the private line is accomplished through a relay device or switcher, such as a computer. Private line is available on telegraph (narrow band), voice and wideband facilities.

Common user-exchange services, on the other hand, are open-ended. That is, from a single point, an infinite number of other non-connected points may be accessed by dialing the telephone number associated with the desired terminal. There are three primary common user services: the Teletypewriter Exchange Network (TWX) for narrow-band transmission, the Direct Distance Dialing (DDD) network for voice grade data transmission, and DATA-PHONE 50 for wideband transmission. Charges on the TWX network are both fixed and variable. There are fixed monthly charges for the terminal, a teletypewriter, and the access to the network. If a non-Bell System terminal is used, the billing for it is obviously a separate item. The charges for calling on the TWX network are developed using a declining rate-scale based on the mileage and the time expired in transmitting the message. There is a one-minute minimum charge. The calling rate will vary depending on whether transmission is intra-state or inter-state. In general, the transmission speed on TWX is 100 words per minute.

DATA-PHONE is the method by which data is transmitted over the DDD network. The components of DATA-PHONE are a facility that provides access to the DDD Network, a carrier or customer-provided terminal and a data set. A data set (modem) is the interface between the terminal and the facility; that is, it converts the electrical output of the terminal into a signal suitable for transmission. At the receiving

end, the data set converts the transmission signal into electrical signals acceptable to the terminal. The data set and the terminal are constantly engaged in a querying and responding dialogue that establishes the readiness of both to transmit or receive data or both. That accounts, in part, for the wide variety of data sets available today. As customer terminals differ in operation, the data sets must also differ to assure compatability.

Data sets also vary in the speed at which data can be transmitted and the modulation techniques used to transmit data over telephone lines. A different data set is required, for example, to transmit at teletypewriter speeds of 10 to 15 characters per second, over voice grade lines, than the one needed to transmit at 200 characters per second. In certain situations, a specific type of modulation technique is required and a special data set is provided for that.

Data sets are provided on services other than the DDD network. The primary example is on private line service when there is a requirement to transmit data at speeds greater than the DDD can accommodate or when the volume of data is so great that the charges for private line would be less than the long distance charges or when the DDD connect time is too long. A second example is that of data "behind the PBX," that is, a data set and a terminal on an extension off a local telephone system. In-house data collection and local time-sharing can be handled this way. Plans for data behind the PBX should be discussed in depth with the local telephone company.

Wide Area Telephone Service (WATS) is a dial-up service that provides selected access to the DDD Network at a fixed monthly rate independent of usage. The Continental United States is divided into six geographical regions, or bands, and each state has one or more intra-state bands. The first band consists of those states that border on the state in which you contract for the service. For a fixed rate, any number of calls can be placed to those states using Outward WATS. Inward WATS is provided to receive unlimited calls from those states. The second band consists of those states that border on the Band 1 states. Calls may be placed or received from both bands with Band 2 WATS service. This concept is repeated for the remaining bands. Intra-state WATS permits unlimited calling only within all or part of a state. (For more details on WATS, see MODERN DATA's Communications Clinic, Feb. 1969 issue, page 20.)

The last area to be surveyed is that of wideband facilities and services. I stated earlier in this article that wideband meant a facility several times the bandwidth of a voice grade line. The most common wideband service uses a bandwidth of 48KH (Kilohertz). It is capable of an information transfer rate of 40,800 or 50,000 bits per second. Wideband facilities are often referred to in terms of their "voice grade equivalency", or how many voice grade circuits could be derived from this one 48KH channel. The equivalency is twelve voice grade circuits — a circuit group or simply "group." Wideband services are also provided at "half-group", or six voice grade circuit equivalent, and at the "supergroup", or sixty voice grade circuit equivalency.

Wideband services are provided primarily as private line services either point-to-point or switched. Multipoint service is not offered on wideband facilities. Wideband switching is accomplished in telephone company central offices and a variety of switches are offered depending on the number of wideband facilities that terminate on the switch. This type of wideband service is provided and billed in the same manner as voice grade private line service.

It is also possible to subscribe to a dial-up wideband service that has many parallels to the DDD. DATA-PHONE 50 service gives the customer the shared use of a wideband network on a "pay as you transmit" basis. DATA-PHONE 50 is an established network of wideband facilities from coast-to-coast. There are four switching centers in the network: New York, Washington, D.C., Chicago, and Los Angeles. To use DATA-PHONE 50, the customer must subscribe to a wideband facility that interconnects with the nearest switching center. Each terminal is assigned a telephone number and the customer is billed for each call on a time-elapsed basis in the same manner as a long distance voice call. DATA-PHONE 50 and private line wideband service may be used for high-speed digital and facsimile transmission. (For more information on DATA-PHONE 50, see MODERN DATA's Communications Clinic, Aug. 1969, page 50.)

Why wideband? There are many reasons for using wideband facilities. If the customer has a decentralized data processing organization, with data centers in several different locations, wideband transmission can be from computer core to computer core in order to relieve an overload of processing at one center or to circumvent a CPU. Wideband services can also connect a small processing center that collects local data for high-speed, high-volume transfer to a large, centralized operation. High-speed facsimile transmission via wideband service can send critical documents, engineering drawings, or legal papers to a distant point in seconds. Private line wideband services can be made alternate voice/wideband. For example, during the day, the facility can be converted to twelve private line voice grade circuits and at night to one wideband channel.

SYSTEM CONSIDERATIONS

Now, with that general background of the types of common carrier facilities, let's consider various applications and explore some of the system considerations that go into the selection of one method over another. The first article in this series (April issue) described an airlines reservation system. The system focused on a centralized computer that contained flight schedules and available seats on the airline's flights. That information must be available quickly and easily to reservations groups and ticket agents in various airports on a "real time" basis, that is, the system exists in an environment where an inquiry from any of a number of remote locations must be answered in sufficient

time to affect the transaction taking place at the time of the inquiry. Response time is measured in seconds. A reservation is confirmed by the agent while the prospective passenger waits and alternate flights and schedules are obtained at the time of inquiry.

A prime consideration in this system is immediate access to a master information file during a peak period for reservations or a flight check from a crowded airline terminal. In many cases, the inquiry consists of just a few words and numbers. There is a limit to the number of communications devices that have access, although with a major airline the number will reach several hundred. While those parameters could apply to a private line or common user network, most airlines use a private line system to connect outlying locations with the central processor. If a standard "operating time" is used – that is, the amount of time required to dial a ten-digit number as well as the DDD switching time to an off-hook condition at the distant end – of one minute, many inquiries can be processed in less than the operating time. Under present daytime DDD rates, a call is billed at a minimum of three minutes regardless of whether the call took three minutes. The new night time one-minute rate would probably not have as significant an affect here as in other systems. Another significant point here is that the airlines, as common carriers, have been able to share the cost of large-user, high-volume communications services.

Let's get back to private line service. Many points would be included on a single private line. Since inquiries and replies generally are short, no one terminal can dominate the line. The computer will control the line by polling each station to eliminate contention. The terminal user's bid for a transmission represents a positive response to the poll. Polling is done in seconds even on loaded private lines.

What are the cost measurements here in communications? The terminal may be a communications consideration, depending on system needs. That is, if the terminal is a communications terminal and not a business machine terminal that does limited processing, the cost of the terminal can be minimized. The line speed of the system is a significant factor. If transmission speed can be 150 wpm or less, a telegraph grade private line could be used and the monthly charges would be less than for a voice grade private line. The data set costs may be a factor. In general, the higher the line speed, the higher the charges for the required data set. Those considerations must be weighed against the cost of, in most cases, a three-minute DDD call for each inquiry and that is affected by the distance between the terminal and the central processor. The one-minute rate applies to calls out of normal business hours and was not used in figuring time and transmission costs.

Just a word about billing. With private line service, one monthly bill is rendered for facilities and terminal equipment and that bill will be the same month after month. If DDD is utilized, several bills will result. There will be local service bills for the terminal equipment and facility for each location with associated long distance charges or, if WATS is used, a local equipment bill and a WATS bill at the central processor location.

Now, let's consider a different set of circumstances and explore the system considerations. Assume that: (1) the company considering a system is a car rental agency, a credit checking and billing firm, or a company that deals through franchise agents throughout the country; (2) the number of points that need access to the central processor to check credit, inventory on hand, or bill payment records, runs over one thousand; (3) the system has to work seven days a week, all day; (4) the number of inquiries varies widely from point-to-point, some of which are part of the company's organization, some are not; and (5) there exists an urgency about each transaction, but not necessarily to the extent of the airlines system. What type of data communications should be considered?

Where there is, potentially, an infinite number of outlying terminals, several advantages of private line service no longer apply. Private line service, due to monthly mileage charges, would be prohibitive. Moreover, computer polling of the points on a private line in this environment would prove to be wasteful and inefficient. While most service points would regularly access the computer, it is possible that a significant percentage would rarely access the CPU and would not demand the turn-around time of private line. Another significant factor is the possible requirement for human intervention to complete a transaction. For example, a credit checking and billing application could bring a human in to clarify irregularities, such as an attempted overcharge with a credit card. On private line, all other points probably would be denied access to the CPU while the irregularity was processed.

The communications system to be used here is a common user, or exchange, type that provides the full flexibility of the DDD network. Let the outlying stations access the central processor if, and when, they require information. Let the terminal determine and control the sense of urgency and the need to communicate. This type of system can be structured in several different ways. The simplest way is to have each outlying terminal place a local or long distance call to the computer. The data sets provided at the computer would normally be arranged for automatic answering, or "unattended service," and would pass control of the call to the CPU upon receipt of a line signal. At the conclusion of the transaction, the data set automatically disconnects, terminating the call. The computer is merely reactive, performing no initiative function. The responsibility for the call lies with the terminal, and that includes the cost of the call. If the system is franchise-oriented, or the company is attempting to attract users outside his own company, this arrangement has disadvantages.

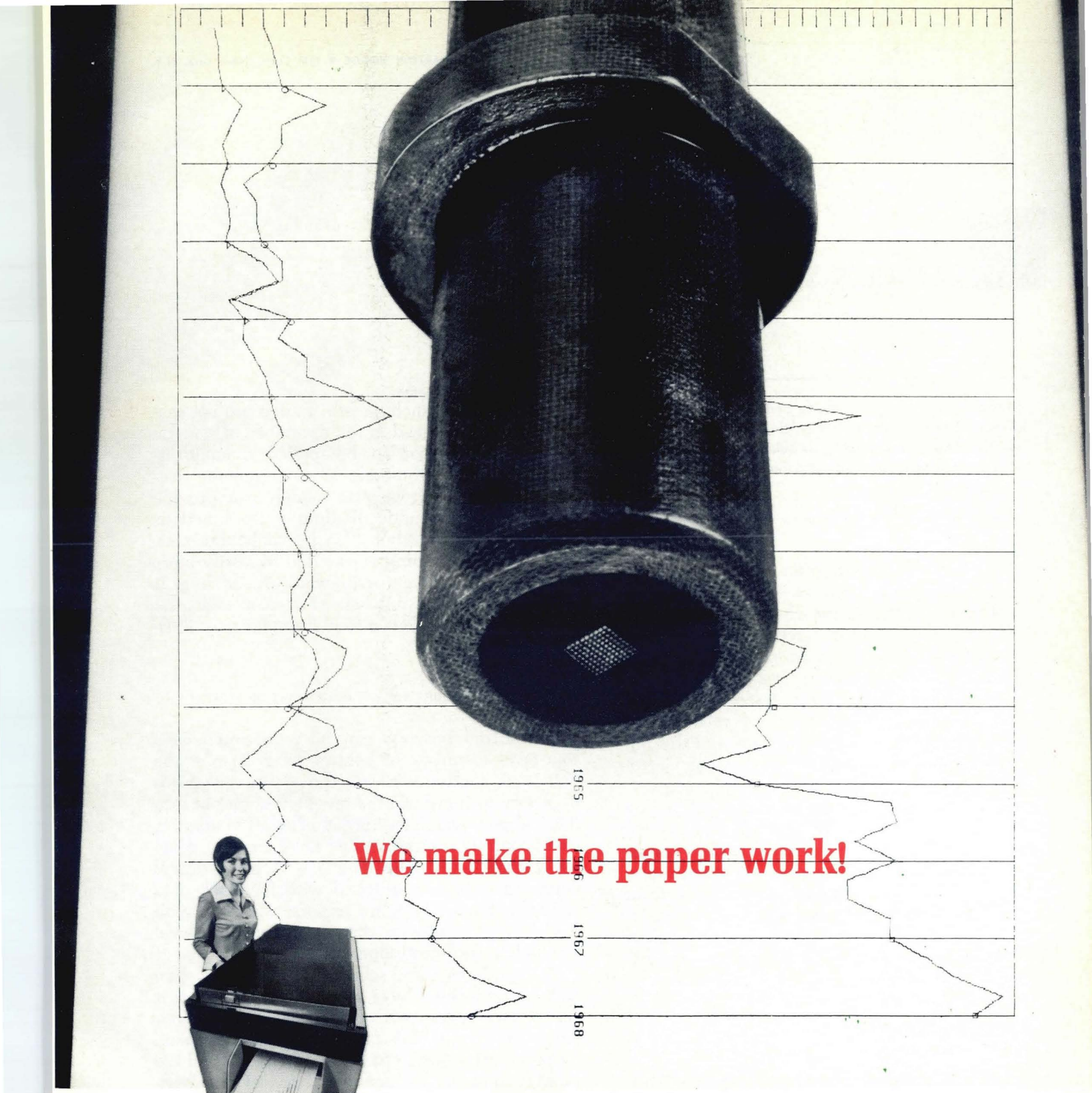
It is possible to reverse this and create an additional advantage, by supplying the communications system. In-WATS lines are an answer. By leasing In-WATS lines in a combination sufficient to reach the company's entire "world", any terminal user need only dial a special In-WATS number at no charge to reach the computer. The call is completed like a DDD call and the same data set functions apply. This system is an aid to billing control as well, since the company contracts for the service for a flat monthly rate.

In-WATS carries with it certain conditions, however, that should be explained. In-WATS calls from all over the country would be concentrated on the telephone company central office that serves the company's locations. They are switched through that office to the company's In-WATS lines to the computer. In most cases, "common control" equipment, that is, equipment used to establish the path of a given call before it goes on to handle a second call, will be used to complete the In-WATS call. If a large number of In-WATS calls hit that office and cannot be completed because of insufficient access lines to the CPU, common control equipment will be tied up and cause a degradation of overall service in that office. To properly design an In-WATS system, the user should have a reasonable approximation of the volume of calls placed to his computer in a given period of time. He should also know the average duration time of a call and the number of calls he anticipates in the "busy hour" – the peak volume time. That data will have to be analyzed by the telephone company before an In-WATS system can be installed.

There are systems in operation today that consist of In-WATS lines, a central processor, and a Touch-Tone telephone at the remote locations. The Touch-Tone sets may be used for normal voice traffic or to access the computer. Once the connection is established on an In-WATS line, the twelve buttons are used to enter numeric and control information. A confirmation of the input, in many cases, is available at transaction time either by receipt of a computer-generated signal or by computer-generated voice response. Touch-Tone sets are also capable of sending to some business machines and communications terminals. The Touch-Tone telephone has proved to be an input device that is versatile and inexpensive.

Conversely, if communications between the CPU and the outlying terminals lends itself to a somewhat standard schedule, if the system is primarily one of data collection, or if the transaction cannot be completed at the inquiry time, Outward-WATS under computer control can be utilized effectively. The computer is programmed to initiate a long distance call to the outlying terminals on the WATS lines, usually on a predetermined schedule. That is accomplished by passing commands to a special data set called an automatic calling unit (ACU). The ACU dials the number of the remote terminal as directed by the CPU and transaction is completed. A polling technique puts the computer in control of the communications system. Answers to inquiries collected early in the day can be transmitted during off-hours after all relevant data are known and processed.

To summarize this section, it should be understood that the segregation of the services described was for illustrative purposes only. It is quite possible that a user's requirements for a single system could include all the methods described and that a mix would provide the greatest efficiency. The important point here is that each service meets a given set of circumstances. The service that is ideally suited for one application could prove to be wasteful in another.



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BUSINESS SIMULATION AND MODELING

Editor's Note: Physical systems and business systems have much in common. In this article, the author shows how the tools and concepts now being used successfully to control processes can also be used to manage businesses.

One can find many similarities in comparing the control of an industrial process with administrative control of a business—primarily because both depend upon the flow and interaction of information.

A considerable body of knowledge has been developed in the process control area based upon the use of suitable models. There, descriptive models lead to an understanding of the key relationships among variables in a complex system, and this understanding, in turn, leads to the development of quantitative mathematical models of the system.

Similarly, a visualization of the input/output characteristics of a business leads to a better understanding of the costs incurred at various points, the information needed to reduce these costs, and the reaction time to order. However, because of their infinite variety and great complexity, descriptive models of business processes—not to speak of mathematical models—are very hard to come by.

BUSINESS MODELS

Fundamentally (and somewhat optimistically), one can visualize a business process as an integral part of a closed information and control system, as shown in Fig. 1.

This suggests that some of the same factors involved in understanding the dynamics and responses of physical systems—and perhaps some of the automatic control techniques as well—have considerable validity for understanding, predicting, and controlling the operations and performance of business systems. The model also points up the need for acquiring process data and other information on a current basis.

Unfortunately, such general models are not easily applied. The need is for a number of generic business models that can be applied to many different business situations having common elements. While such generic models can provide only a qualitative understanding of the functions and modes of operation of a particular business, such an understanding is essential to justify more detailed analytical and mathematical modeling. It is obviously not possible here to develop such a set of generic models, but a few examples may illustrate the idea.

HIERARCHICAL MODEL OF AN INDUSTRIAL BUSINESS

An industrial business can be represented as a four-level hierarchy of control (Fig. 2). On the first level, control is exercised over the operations necessary to transform the raw material input into finished products at the output. The references for these controls are supplied by the second, or process control level. This might well be a digital computer, which is supplied with feedback data from the first-level control sensors, as well as with feed-forward reference data from the third-level production and scheduling control.

The production and scheduling control function may be performed by a separate computer, or it can be an integral part of either the process control computer or the fourth-level business data processor. This latter computer also handles all the input/output accounting operations of the business. Thus, the model represents a dynamic multilevel (hierarchical) control system to which many of the advanced control concepts developed for such systems may be applied.

FUNCTIONAL ORGANIZATION MODEL

Somewhat similar characteristics are displayed in static models of hierarchical business organizations, such as that shown in the illustration of the Functional Organization Model (Fig. 3). Basi-

cally, this is a chart of the hierarchical organization of **people** concerned with the flow of administrative and financial decisions. Here information is the principal ingredient that is transmited from block to block of the structure.

The numerical coding associated with each block serves to identify each group, department, division, etc., so that items of information can be specifically directed and accounted for. Functional organization models (and similar functional product breakdowns) have been successfully applied in computer-based project control and scheduling systems, such as PERT and CPM.

ASSEMBLY FLOW MODEL

The inverse of a product breakdown, which is the flow of parts involved in the assembly of an item, also can serve as a model for control. The illustrated assembly flow (Fig. 4) is, of course, merely a portion of the manufacturing process and it lacks the usual feedback loops for rejects and rework.

However, the model shows the characteristic grouping of activities involved in transporting parts to a common assembly area, where they are subassembled, tested, and collected for transport to a final assembly area. When the appropriate time and cost factors are specified for each of the activities (perhaps on a probabilistic basis), the model should, in principle, be capable of simulating the characteristics of the particular business.

These few examples serve to illustrate that there are many kinds of models, which differ in purpose and use. The detail with which a model depicts a particular production entity depends on the level served in the control hierarchy. For instance, a process unit may be portrayed in great detail on the process control level; for planning and scheduling at the department level, the same process unit may appear only as a simple yield and cost expression; and for corporate planning, the unit may only be an implied item in a plant product shipping schedule.

Thus, models for scheduling differ from models for process control, and these, in turn, differ from models used for design purposes. In general, models intended to aid in the understanding of processes are more detailed than models designed for control of economic operations.

ECONOMIC CONTROL BY SUBOPTIMIZATION

It should be apparent that while the models appropriate for different levels of the control hierarchy may differ greatly, the control problem at each level is essentially the same. Because of the linkages between levels, the control model for one level is influenced by that for the next higher level of the hierarchy. Thus it is possible to view the control problem at various levels as a series of **suboptimizations** occurring within a larger economic control problem at the plant, divisional, or corporate levels. An economic strategy is established for the operation of the plant or facility, assembly line, process unit, etc.

Successful execution of control at a particular level then becomes a tactical problem dependent on the strategy set for that level. The strategy of operation at higher levels of the control hierarchy is relatively long term—being measured in weeks or months, while at the lower levels of control,

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operating strategies may change daily or hourly. Accordingly, tactical methods used in the execution of control must be adapted to these changing time factors.

This pattern of suboptimization within the overall economic problem runs through all levels of the control hierarchy. Thus, the design of a company management information and control system (MICS) must not only accomplish optimum economic control of each level and section, but must also reflect the needs of related sections and levels and, ultimately, the dynamic demands of the company.

SIMULATION OF MANAGEMENT CONTROL FUNCTIONS

For the purposes of simulation and dynamic analysis, it is possible to view a business organization as a complex feedback control system, as indicated in Fig. 1. Using the closed-loop structure as a basis, mathematical business models have been developed which treat the combined human and material resources of the business as mathematical transfer functions, and such dynamic entities as "time lags," "natural frequency," or "dead time," as performance operators.

The system or project objectives represent the directed input of the system, and the progressive accomplishment of the objectives represents the output. The output performance is measured in some way and the results are fed back via an "information conditioning" loop to the input, for comparison with the system requirements. Effective management then consists of the appropriate corrective action (control) to reduce the deviation between the output performance and the objectives.

Based on such mathematical models, computer simulation has been used to analyze performance and time predictions. and also to evaluate the effect of varying the system's resources on future performance and plans. Depending on the refinement of the model, this can provide useful information in support of management decision-making and control procedures.

Within the framework of this feedback control model, the dynamic behavior of management can be understood in terms of mathematical functions that represent planning, staffing, organizing, directing, control, etc. Performance is evaluated against the "reference" input, which is the initial management planning function: the establishment of total project objectives, the definition of the tasks, and the design of the organization to carry them out. The requirements and tasks that provide the input reference may be expressed in the form of step, rate, or exponential functions.

Each task and performing group must be assigned definite input and output performance requirements. Each functional group then will represent a dynamic element of the system. Finally, feedback methods must be devised for monitoring and reporting the progressive accomplishment of the specified tasks. This defines the "management control function."

The management control function, then measures the degree and rate of progress of the project at any desired time. The deviation between the actual and desired performance is applied to the appropriate functional operations through two management channels: (1) an **experience channel** that takes immediate and proportionate corrective action; (2) an **analysis and evaluation channel** which provides a more accurate long-term picture of the operational situation by "summing up" (integrating) the various factors.

Again depending upon the realism of the model, its outputs can provide management with the necessary lead-time for anticipatory action and can lead to the development of a management control plan for monitoring the dynamic performance of a business or project.

OPTIMIZING MODELS

The linear closed-loop approach to automatic control is based on a simple difference error criterion, which is not valid for a majority of present-day control problems. Since the operating error criterion differs from the simple (difference) error criterion, minimization of the latter does not usually result in control optimization. Simple linear circuits cannot, generally, represent the complex tasks of optimization and adaptation.

A more satisfactory approach to optimizing control consists of constructing a realistic model of the process to be controlled. The model may be a physical analog, or **simulation model,** of the system, or it may be no more than a mathematical abstraction residing in a set of equations. Simulation models are not by any means **self-optimizing,** but by incorporating the crucial characteristics of the actual process, they permit controlled experimentation with sets of inputs and decision rules which can lead to optimization. The difference between the classical (linear) closed-loop approach to automatic control (A), which in-

corporates a simple difference-error criterion only, and a simulation-model approach (**B**), incorporating a mathematical model, is shown in Fig. 5.

A digital computer can accurately control the conditions of simulation—any particular run can be replicated exactly, and elements and parameters can be changed precisely to the degree desired. Furthermore, the model may be scaled to run much faster then the real system, making the time for a simulation run negligible compared to the dominant time constants of the system. This permits bypassing such problems as unfavorable dynamics, multiple inputs, and local maxima or minima.

Such controlled experimentation with the model provides the basis for determining the optimizing conditions for the real system in terms of its present state, the desired final state, and a specified performance criterion. The information defining the present state is obtained (See Fig. 5) by measurement of the appropriate system variables. The results of the optimizing procedure (obtained from the model) are transmitted back to the system through the actuators of the controlled system input variables. There are available a number of packaged vendor-written programs and languages for digital simulation of continuous systems or processes, some of which are described later on.

MATHEMATICAL MODELS

Where an analytical formulation is feasible, a mathematical model of the system permits rapid extrapolation of system performance and frequently, automatic computation of the required optimizing conditions. The optimizing control equations may be derived by such powerful analytical tools as the calculus, variational techniques, and dynamic programming.

The mathematical model of the system so obtained is imbedded in the program of a control computer. The input signals to the computer describe the current state of the system (process, plant, or department). The computer calculates the optimizing conditions and transmits the results back to the process for correction (looked at in the simplest terms).

In practice, the analytical formulation of the model depends both on the complexity of the real system and on the extent of knowledge of its system equations. Various cases may be distinguished as follows.

- The model is based directly on the known system equations.
- Knowledge of the system is limited or the equations are intentionally simplified, resulting in a model that represents only the dominant system characteristics. The parameter values then are functions of the system states and the values change with different operating conditions.
- The model does not include the effects of one or more of the system variables because they are either unknown or cannot be satisfactorily measured.
- Background knowledge of the system equations is completely lacking and the model is based on a generalized expression, such as a power series.

Several techniques exist to provide partial compensation for the inadequacies and approximations in a mathematical model. One can use, for example, a **repetitive control technique** in which the optimizing conditions are periodically recom-

puted in accordance with the most recent information regarding the state of the system. The effectiveness of this type of compensation depends on the kind and degree of approximations in the model and is limited by the repetitive period, measurement lags, dead time, and the boundaries of the manipulated variables.

Alternatively, it is possible to compensate for approximations by using a method of **self-checking** or adaptation. This technique involves periodic adjustment of the model parameters to force a "best fit" of the model to observed system behavior in the vicinity of the operating point. This is accomplished by adjusting the parameters to minimize the deviations between the actual processing path and the path predicted by the model for identical operating conditions. The resulting parameter corrections are then automatically applied to the proper terms in the optimizing control equations.

MATHEMATICAL PROGRAMMING

At the higher levels of the control hierarchy—beyond control of individual variables, sections, or process units—it becomes necessary to generalize the optimization problem in terms of alternate use of resources, system objectives, etc. In broadest terms, one may define mathematical optimization as a technique for determining the optimum use (among alternative uses) of limited resources (such as capital, manpower, materials, equipment, etc.) to attain a particular objective (e.g., maximum profit or minimum cost).

Three major elements are necessary for formulating a mathematical optimization problem.

- An **objective** to be maximized or minimized; for example, production rates or operating costs.
- A number of **constraints,** usually stated as inequalities, arising from product specifications, raw materials availabilities, equipment capacities, safety requirements, etc.
- **A set of equations**, or mathematical model, capable of predicting system behavior under varying conditions.

A system or process is considered operating at optimum if any adjustment of a controlled variable would cause either an unfavorable change in the objective or result in violating one of the constraints.

Computer methods for mathematical optimization, collectively known as **mathematical programing,** comprise a gamut of techniques suitable for problems of various complexity. The most widely used technique is **linear programming,** but there are also techniques of non-linear programming, stochastic programming, dynamic programming, and so forth.

Linear programming (LP) has been used successfully throughout the entire control hierarchy to allocate, assign, schedule, select, or evaluate the use of limited resources in a variety of applications. For example, LP techniques have been used for such jobs as optimal blending, batch mixing, bidding, cutting, trimming, pricing, purchasing planning, transportation scheduling, and determining best distribution of raw materials and finished products.

PROGRAMMING SUPPORT

Effective multi-level computer control of a company requires, as a minimum, the following programs.

1. *Real-time monitor or "executive" system,*
2. *Higher-language compiler (Fortran, Cobol, or PL/I),*
3. *Assembler (for a particular computing system),*
4. *General-purpose linear program,*
5. *Information system language.*

Items **1, 2,** and **3** are usually part of the "operating system" for a particular hardware configuration and their need is obvious. A general-purpose linear program can perform a variety of important optimizing jobs within the control hierarchy, as we have just seen. Though perhaps less apparent, a common information system language is needed to achieve effective communications between the various process control, management, and corporate levels of the company. Available system languages and programs can be adapted to this purpose at a reasonable programming cost.

MANAGEMENT INFORMATION AND CONTROL SYSTEM PROGRAMMING

MICS programming tasks can be divided into three functional categories.

1. **Programs for performing control enforcement,**
2. **Programs for evaluating system performance,**
3. **Programs for determining optimum operating conditions.**

Control enforcement includes all functions necessary to control a process: data acquisition and reduction, process manipulation (e.g., control valves), control algorithms (e.g., feedback, feedforward, interacting, nonlinear, adaptive, etc.) and operator communication.

The evaluation of performance, undertaken at higher control levels, consists of the feedback of information on the operating status of lower control levels. It, therefore, includes performance calculations (such as yields and efficiencies), operator or manager exception warnings, supervisor communications, data logging and transmission.

The higher levels of hierarchy also perform a number of tasks to determine optimum conditions for lower level plant operations. Among these optimizing tasks are process modeling (both at control and economic levels), scheduling and inventory prediction, linear programming at various process levels, static and dynamic optimizing calculations, and direct optimizing control (through evolutionary operation).

Further, it may be necessary to develop control models to determine the algorithms required for the control loops at various levels. Plant control models are generally much simpler in concept than those developed for process design, which should be distinguished from the former. Finally, some situations may require simulation of proposed control schemes; this is relatively costly if it is done well. It is frequently preferable to evaluate the control scheme directly through the operating process to avoid the high cost of simulation.

VENDOR-SUPPLIED PROGRAMMING AIDS

The tasks of analysis and programming for the various levels of the control hierarchy are considerably eased by computer vendors and software companies, which have developed many useful techniques of organization, mathematical model solutions, information system languages, and a variety of flexible programming aids. Most aspects of MICS programming have been well explored, and excellent standard programs have been perfected for a variety of business functions, as have linear programming solutions for systems of all sizes, and control algorithms for feed-forward and other complex direct digital control (DDC) functions. There should be little hesitancy in making use of these vendor-provided programs to standardize much of MICS overall programming, since any proprietary aspects lie in the particular data, rather than in the programming system.

A few specific vendor programs useful for MICS programming will now be described, with primary reference to the IBM 1800 data acquisition and control system.

EXECUTIVE SYSTEM

The multi-faceted operations of present-day computers are controlled by executive or operating systems, whose control programs provide such functions as input/output control (IOCS), job scheduling, priority interrupts, fault response (diagnostics), and allocation of time and computing resources. Complete programming systems, further, are usually capable of producing a variety of management information reports—operations accounting, inventory projections, decision models, process-oriented functions, etc.

For the IBM 1800 user, a system known as Time-Shared Executive (TSX), provides a combination of programs for generating, organizing, testing, and executing user-written programs for process control and other applications. TSX includes a process supervisor that controls the execution of process control programs, a Fortran language compiler and an assembler program (both of which can call on a variety of input/output and arithmetic subroutines), and a number of disk utility programs to control the use of auxiliary storage. User-written programs, in Fortran or Assembly language, can be compiled or assembled, tested, and stored on disk while the system is monitoring the process under control.

A 12-level priority interrupt system allows TSX to execute such non-controlled "background" programs as payroll or personnel reports while concurrently monitoring all real-time process sensors. Any process signal immediately interrupts some ongoing program of lower priority. When the process monitoring function has been completed, control is returned to the previously running program. The priority interrupt system can temporarily suspend up to 12 lower-priority programs while the highest-priority interrupt is being serviced by its own program.

The facility to execute several jobs concurrently, **multi-programming,** has been built into the Multi-Programming Executive System (MPX) for the IBM-1800. This is a real-time multi-programming operating system, capable of time-sharing several independent processes with concurrent batch-processed background programs. The system includes control programs for up to 26 unique multi-programming areas, covering a wide spectrum of application. It is considerably more sophisticated than a simple priority interrupt system.

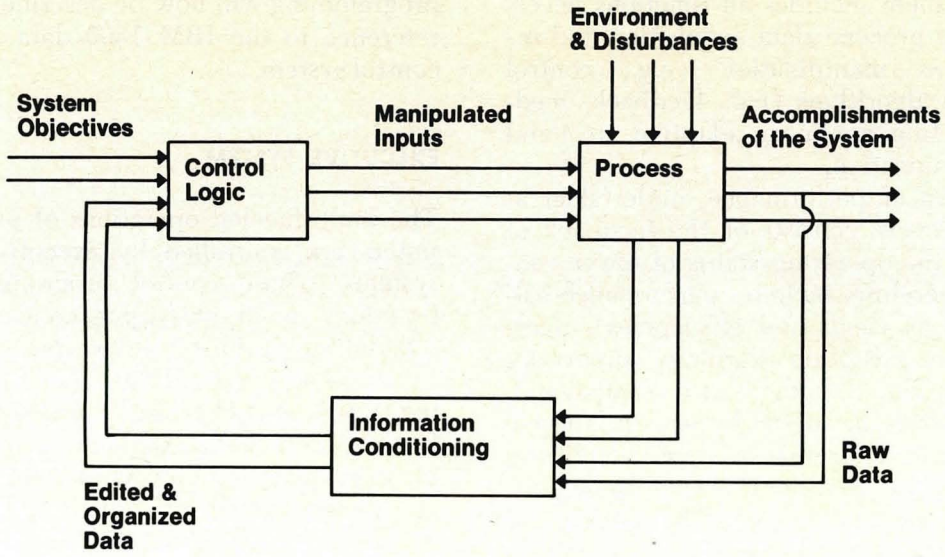

Fig. 1 Generalized block diagram of a control system

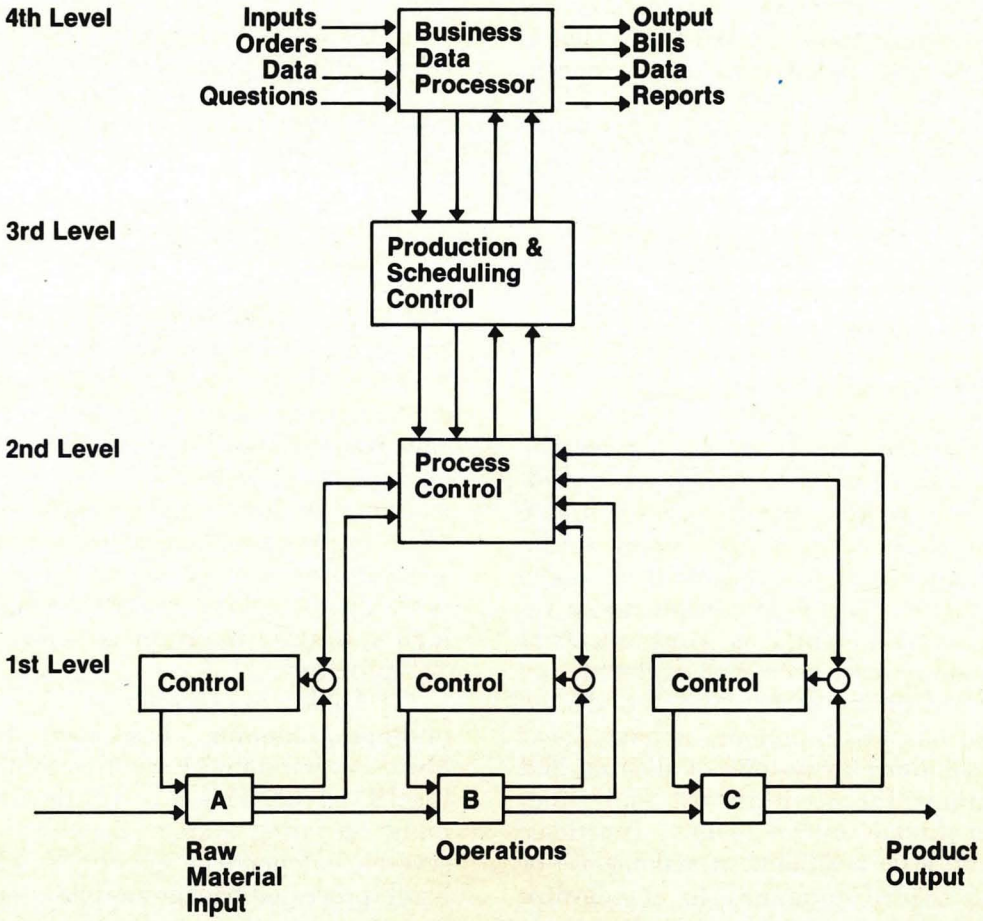

Fig. 2 Hierarchy of control

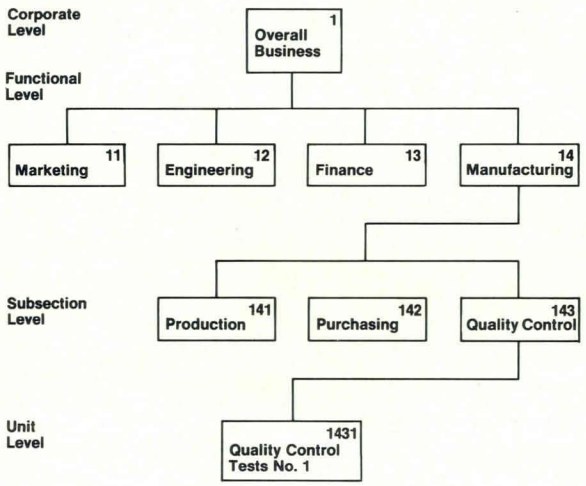

Fig. 3 Functional organization model

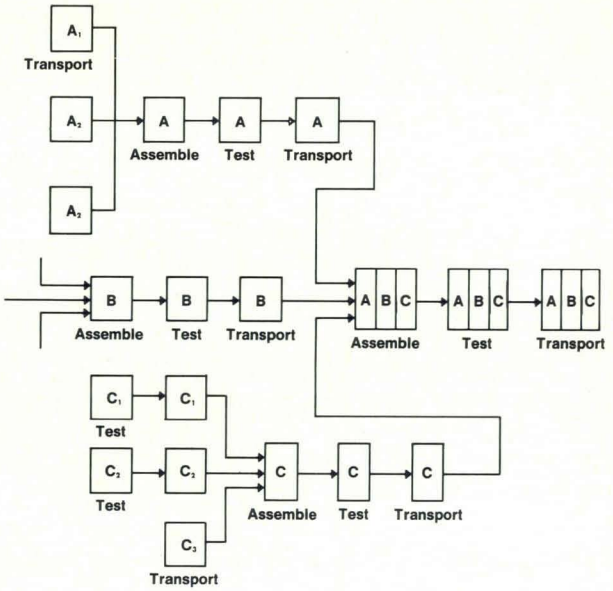

Fig. 4 Parts assembly flow model

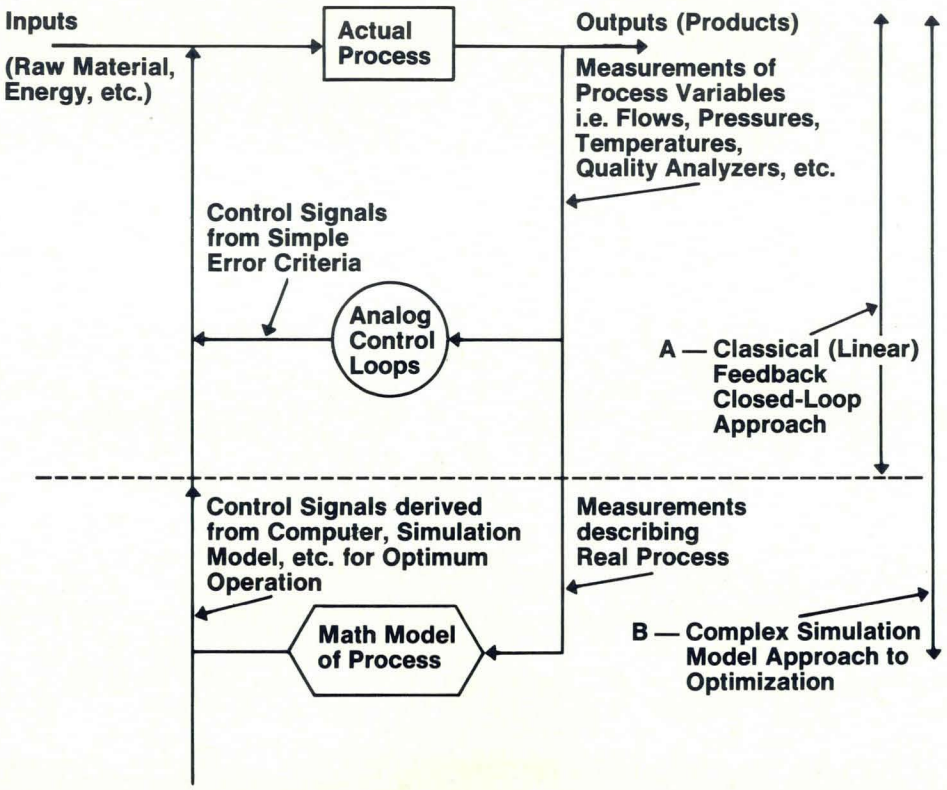

Fig. 5 Optimizing models — a step beyond the classical feedback approach to control.

OPTIMIZATION PROGRAMS

A variety of mathematical optimization programs are available as standard library programs. An example of a library program for the IBM 1800 user is LP-MOSS for linear programming. This consists of a set of programs and subroutines for performing all the data processing and computational tasks necessary for the analysis and solution of linear programming problems of various levels of complexity.

The IBM 1800 user also has the choice of a general-purpose non-linear optimization program, known as COP (Computer Optimization Program). Particularly suited for on-line optimization of a process control system, COP uses a technique of "sectional linear programming" to optimize a non-linear mathematical model. The model and its objective function are linearized about some starting point by use of partial derivatives. Linear programming is then used to find the local optimum about this point. The solution is used for further linearizations and optimizations until an approximate optimal solution is obtained.

PROCESS CONTROL

A "fill-in-the-blanks" technique called PROSPRO permits the 1800 user to describe the process and develop the appropriate control scheme with the help of a pre-written program. Various coding forms allows the process engineer to identify a process variable with its target, a general action or equation, or a control adjustment with appropriate reference lists. The forms substantially reduce the programming effort, provide documentation for the control scheme, and supply process operating data and instructions to the control program.

Another example of programming support for scientific and control applications is the Fortran Scientific Subroutine Package (SSP). The package contains over 100 Fortran subroutines (which are separate programs) in the areas of statistics, matrix manipulation, and general mathematics. In statistics, for example, these subroutines include: analysis of variance, correlation analysis, multiple linear regression, polynomial regression, canonical correlation, factor analysis, discriminant analysis, time series analysis, data screen and analysis, nonparametric tests, and random number generation.

SIMULATION PROGRAMS

Computer manufacturers and software companies have developed a number of simulation languages and programs for the simulation of both discrete and continuous (dynamic) processes. Of interest to control engineers is IBM's Continuous System Modeling Program (CSMP) for System/360 or 1130 computers, which provides a versatile tool for solving dynamic system simulation problems. A block-oriented language is used, with the functional blocks representing the elements and organization of an analog computer. This allows the analyst to formulate and program his problem in the usually familiar analog terms, though actual simulation is performed in digital terms.

In the IBM 1130 version of CSMP, a system model may be developed, tested, and modified in an on-line interactive mode, using console keyboard devices and graphic output displays. The System/360 CSMP is not interactive, but has additional logic and algebraic facilities. The simplicity of the block language enables the user to gain rapid proficiency with the program and make modifications of the model with the minimal programming effort. Although Fortran is used as the source language for CSMP, knowledge of the Fortran language is not required, except when adding additional special elements to the standard complement of functional (analog) elements.

CONCLUSION

The ability to make programmable decisions, formerly made by man, is moving up the hierarchy of management. The growth of direct digital control, control of process units, and of new plants indicate the changing characteristics of management at the lower levels of control. Analysis of business systems and of physical systems reveals that the application of the tools and concepts used in the latter may be applied in the former.

No sharp line separates the levels of control in the management hierarchy. Process control is determined by physical laws, while business control implies meeting objectives, constrained by economic and policy considerations, regardless of the actual manipulations involved. All are part of the dynamic structure of a business enterprise, and all can be formalized and programmed for action by a computer system.

The dynamic process of a management information and control system is continuous, with action the result of decision. Action, in turn, may result in objectives being altered, leading to new decisions and consequent actions. The advent of integrated management information and control systems will not require great break-throughs in mathematical or computer methods, but only the application of already known techniques and procedures. ▲

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OPTICAL PAGE AND DOCUMENT READER

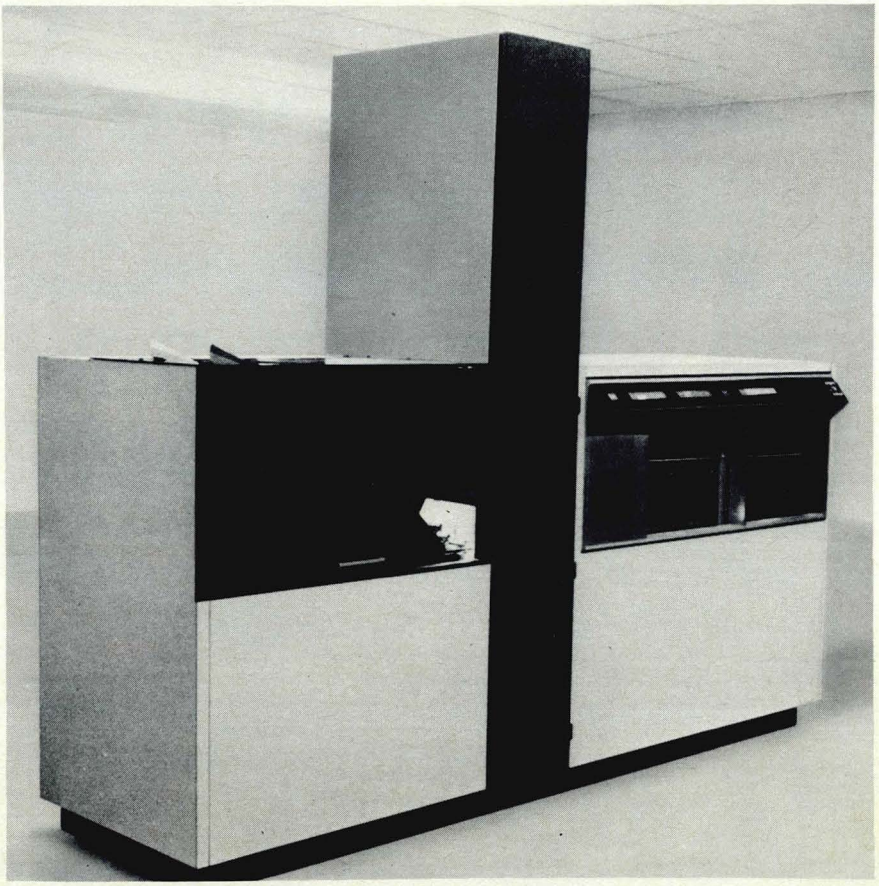
Scan-Optics' new OCR is designed for high-speed, multi-font, multi-form applications.

Users of optical character readers are accustomed to the need to compromise in the selection of a typeface and form size. The latter selection is particularly difficult when it involves choosing between page- and document-sized forms. Although a few page-reading OCRs can be **adapted** for document reading, the conversion is somewhat complicated and the alternate form throughput is relatively inefficient. Consequently, at installations which have both page and document requirements, it is not unusual to find both types of readers, with neither type fully utilized.

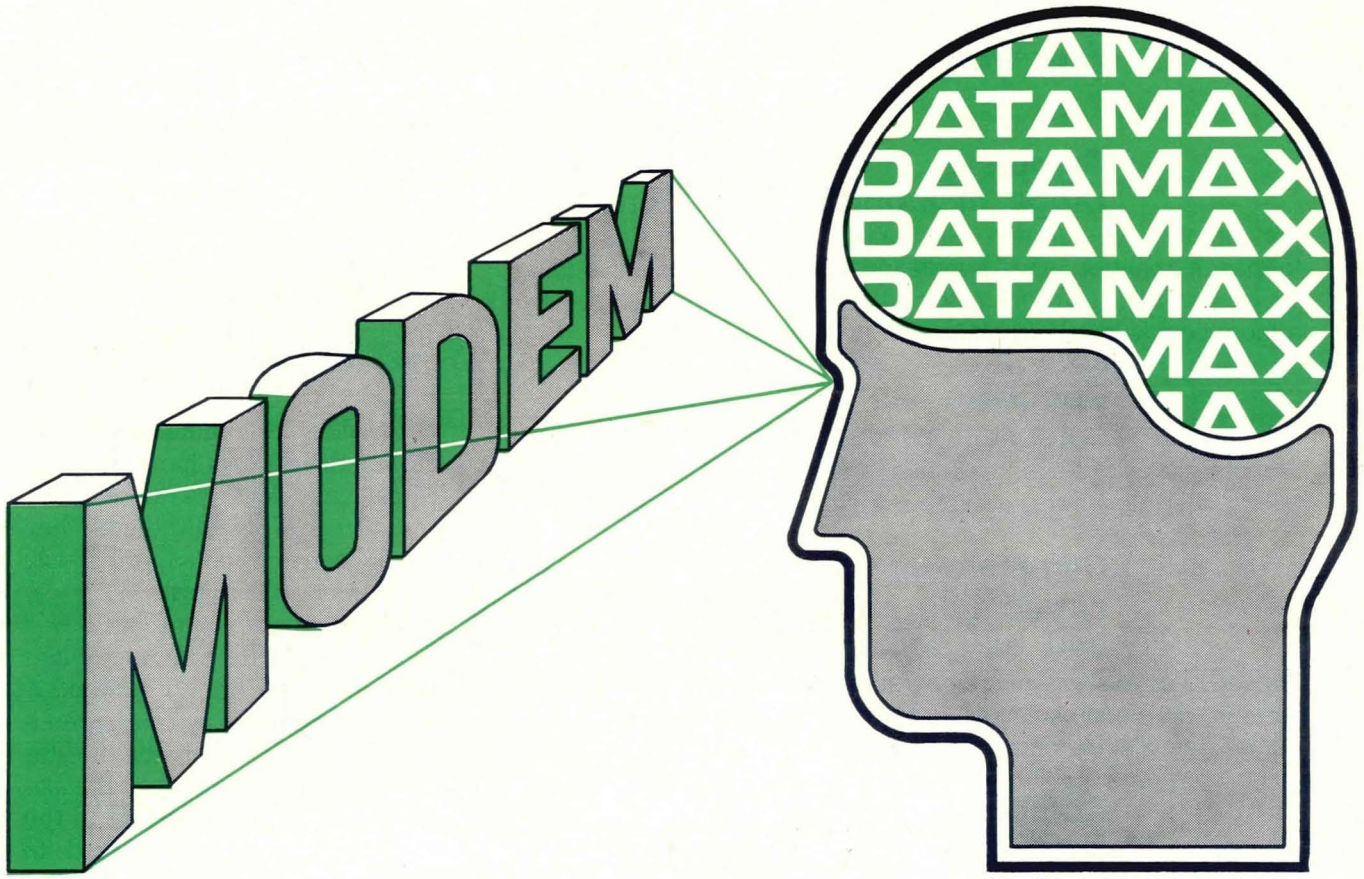
Scan-Optics Inc. of East Hartford, Conn., recently introduced an OCR to meet this problem. The Scan-Optics 20/20 reads both pages and documents at high speeds and with equal facility. In addition, the 20/20 is designed to read upper- and lowercase alphabetics, numerics, punctuation, and symbols in a variety of fonts, including OCR-A IBM 407E, 1403, and self-check 7B and 12E. Options to read other fonts and a hand-printed numeric data option are available on an RFP basis.

PER-PAGE, PER-DOCUMENT, PERFORMANCE

The 20/20 reads high-density pages (e.g., 1800 OCR-A alphanumeric chars./page) at more than 50 pages/min.—and according to Scan-Optics, this makes it twice as fast as any competitive page reader! In turn-around document applications where the number of characters to be read is normally less than 100, the 20/20 reads up to 500 OCR-A alphanumeric documents/min. These are impressive speeds, especially in view of the facts that both these rates are obtained by one ma-



The SCAN-OPTICS 20/20 OCR—the basic system includes a page and document handler, scanner, control computer (HP-2114A) with 4K words of memory, seven- or nine-track magnetic tape transport, and I/O typewriter (IBM slectric). OCR-A numeric is the basic system font.



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DESIGN FEATURES

The design of the 20/20 combines state-of-the-art advances with old-line engineering. Several of the 20/20's hardware features have never been seen before on OCR's, although they have been employed previously for other applications.

The paper transport utilizes 4 perforated belts set into channels in a perforated platen. A pump sucks air down through either the moving belts or the stationary platen such that the paper is either firmly locked to the flat platen or firmly locked to the moving belts. The advantages to this system are several: • Paper starts and stops are practically instantaneous; • Paper spacing is maintained accurately; • An absolute minimum of mechanical parts are used.

The 20/20 scanner differs considerably from the "flying spot" type of scanner employed in most OCR devices. In the "flying spot" technique, a CRT beam sweeps the printed characters and the reflected beam is sensed by a photo-multiplier tube. The Scan-Optics system uses a single "image dissector" tube to "see" the image (register it on a photoemissive surface) and amplify it internally. As a result, the Scan-Optics system eliminates phosphor degradation problems, simplifies the electronics and optics, generates a much higher signal-to-noise ra-

tio, and requires less paper movement at the read station. A side advantage is that the special feature-matching software developed by Scan-Optics to support the image dissector scanner has proved very successful in reducing reading errors.

MARKETING STRATEGY

Emphasizing the 20/20's flexibility over its speed indicates that Scan-Optics would prefer to market the 20/20 more broadly as a source data device than simply as an OCR. This is a subtle distinction, but a very important one—since it does not require any previous OCR commitment from potential customers. The majority of customers that could benefit substantially from OCRs still finds it hard to think of them as practical. In 1969, for example, only about 1000 OCRs were installed, almost all of them for very limited applications. Scan-Optics has, therefore, chosen to emphasize the 20/20's ability to conform to existing source data requirements, rather than its ability to do faster what the prospect may not presently be considering doing at all.

It seems that this strategy is working out well. Ron Haverl, Scan-Optics' v.p. for marketing, revealed that it has already resulted in a substantial number of firm orders for the 20/20 from first-time OCR users. On the other hand, Scan-Optics' strategy for companies that are presently committed to OCR equipment is simply to present direct cost/performance comparisons. "When it comes to **our** OCR vs. **their** OCR, we can just mail them the cost/performance figures and wait for the telephone to ring," says Peter Gray, Scan-Optics' confident director of market development.

First deliveries of OCR-A numeric-only models of the 20/20 are scheduled for August; alphanumeric models for October. At $100K for the basic system, Scan-Optics' new 20/20 certainly merits consideration from companies previously unable to cost-justify an OCR solution to their multiple source data entry problems. Present OCR users included.

For more information on the Scan-Optics 20/20, Circle No. 116 on Inquiry Card.

Ken Falor's *Software Forum* survey of "Report Generators and File Management Systems," originally scheduled for this issue, has been postponed to August.

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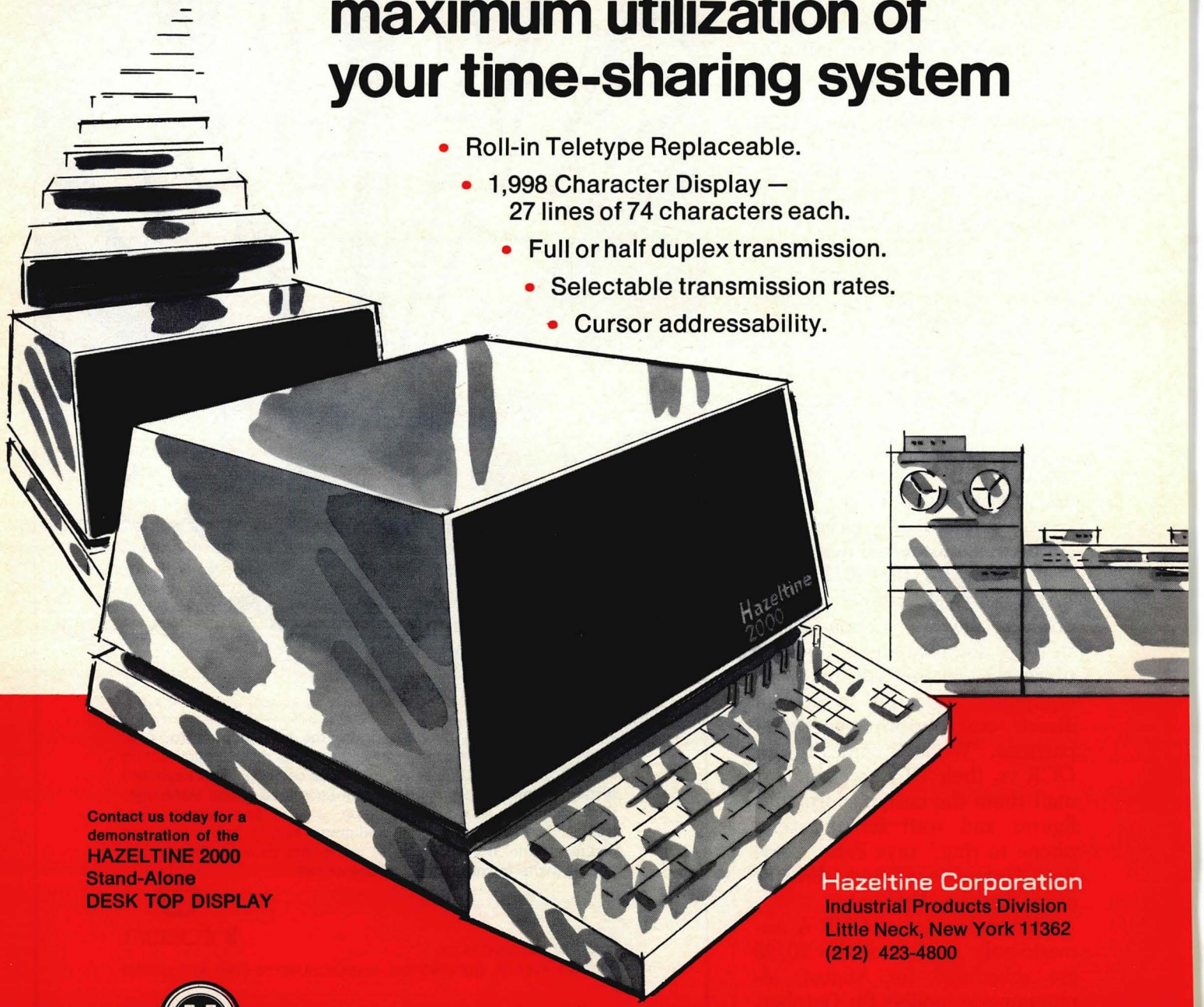

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CIRCLE NO. 53 ON INQUIRY CARD

NEW PRODUCTS

BUSINESS SYSTEM

The TCC/1210 is a general-purpose business data processing system that incorporates a virtual memory concept, providing the user with essentially 256K words of storage. Time-sharing of 1 to 16 local and remote terminals can be handled by the TCC/1210, which will also support a variety of peripheral equipment, including line printers, teletypewriters, card readers, high-speed paper tape readers, magnetic tape transports, and high-speed disk storage. The system is controlled by a Time-Sharing Executive which allows each terminal user (local or dial-up remote) access to all TCC/1210 software packages. Each user has an independent dynamic file for symbolic and relocatable programs as well as data structures. Versatile file-handling processors allow the user complete manipulation of the programs and data structures. *Tracor Computing Corp., Austin, Texas.*

Circle No. 217 on Inquiry Card.

PAPER-TO-MAG-TAPE

A high-speed paper-tape-to-mag-tape converter system converts BCD or ASCII paper tape to 7- or 9-track mag tape at the rate of 500 chars./sec. Paper-tape-to-hard-copy or keyboard-to-mag-tape data entry may also be performed at up to 15 chars./sec. The systems are available for immediate delivery and are priced at $14,950. *Computing Corp. of America, Inc., Englewood, Colo.*

Circle No. 204 on Inquiry Card.

GRAPHIC TABLET

A new graphic tablet for converting hand-drawn data to digital form uses a novel electromagnetic sensing technique incorporating a proprietary printed digital pattern. Pattern accuracy is ±0.005 inch (0.05% of full scale) and linearity is ±0.05% of full scale. The tablet provides a writing surface of 11-¼″ x 11-¼″, and can be used with graphic display terminals such as the Computek Series 400 models or as a stand-alone unit. Two models are offered: the Model 50/10 provides resolution of 10 bits (91 lines/inch or 0.011 inches/line); the Model 50/8 provides resolution of 8 bits (23 lines/inch or 0.044 inches/line). *Computek, Inc., Cambridge, Mass.*

Circle No. 229 on Inquiry Card.

AUTOMATIC DATA ACQUISITION SYSTEM

The Model ADA-183 is a versatile instrument for the recording of data and the automatic preparation of data tapes to be used in conjunction with time-share computation systems. The instrument consists of a multi-range voltmeter which, when connected to the system under test, can sample data manually or automatically. As the data is sampled, it is automatically punched on tape in ASCII code, and can be fed directly into a time-sharing terminal as a data tape. The punching format includes a line feed-carriage return, therefore allowing a teleprinter to print out a listing of compiled data for a permanent record. Software is available for proper formatting to any time-sharing service. The instrument is self- contained in a walnut cabinet 11 x 21 x 11 in. *MMI Instruments Div. of Microwave Magnetics, Inc., Danvers, Mass.*

Circle No. 188 on Inquiry Card.

PORTABLE CRT TERMINAL

A full-scale CRT terminal weighing only 30 lbs. and packaged in a rugged carrying case features high display capacity and complete editing and formatting capabilities. Called ENVOY, it displays up to 1024 alphanumeric characters on a 5″ diagonal CRT. The user plugs it into an ordinary outlet, folds out the keyboard, pops up the screen, inserts an ordinary telephone into the built-in acoustic coupler, and dials his computing center or service bureau. The terminal is available in two models: the ENVOY-600 has a 512-character display capability (16 32-character lines); the ENVOY-640 displays twice as much information (16 64-character lines) and has additional editing and formatting features. The ENVOY-600 sells for $3,200; the ENVOY-640, for $3,700. Delivery is 90 days. *Applied Digital Data Systems, Hauppauge, N.Y.*

Circle No. 178 on Inquiry Card.

ACOUSTIC COUPLER

The I/Onex Model 30 is available in either mahogany or walnut finish and will operate up to 300 baud with any standard phone. Loop current, EIA and IC logic interfaces are standard on each unit. A carrier detector operates upon receipt of a signal of the proper frequency. Operation may be either half- or full-duplex, and a switch is provided to permit operation over any unconditioned two-wire system such as the Bell System Data Access Arrangement. All frequencies and levels are compatible with Bell System 103 Data Sets. The unit is priced under $300. *Sonex, Phila., Pa.*

Circle No. 185 on Inquiry Card.

MINISYSTEM FROM OLIVETTI

Olivetti Underwood Corp.'s Auditronic 770 system consists of a CPU, an alphanumeric and control keyboard, and a mobile print unit. modular add-ons include auxiliary memory, magnetic ledger cards, paper tape and edged card punch and reader, and on-line transmission control. With two mag tape cartridges, memory capacity is 74,000 characters. A display panel above the keyboard calls attention to operational and procedural steps; any ignored signal locks the machine, forcing corrective action. The system is designed for accounts receivable, accounts payable, and payroll applications. Prices begin at $12,550 for the basic unit. *Olivetti Underwood Corp., New York, N.Y.*

Circle No. 225 on Inquiry Card.

COMMUNICATION COMPUTER

A specialized computer, the "Devonshire," is organized to accept and deliver data to and from as many as 253 various types of communications devices simultaneously. Designed to handle pre-processing, concentration, data directions, message switching, remote terminal operations, and other communications jobs, the Devonshire is made up of a communications processor and a programmable input/output controller providing four priority levels: at the first level, input/output devices are serviced over direct memory access channels. Up to four high-speed control units operating at speeds up to 200,000 bytes per second per channel can be accommodated. Each byte is transferred in only one memory cycle. Up to 252 communications lines can be serviced concurrently at a second priority level. The system provides continuous hardware polling of the communications lines without taking up any central processor time. Incoming and outgoing bits are processed within a 1.2 microsecond memory cycle. The third priority level provides processing and instruction sets similar to conventional computers. The final priority is reserved for emergency situations where power fails. The interrupt causes the Devonshire to store critical information and preserve data stored in memory.

Software includes a basic assembler, program update, basic monitor, diagnostic routines, and debugging routines. Applications packages include terminal device I/O routines, communication logical routines, a real-time relocating loader/monitor and secondary storage physical and, logical I/O programs. The Devonshire system is priced from $35,000. *Devonshire Computer Corp., Newton, Mass.*

Circle No. 176 on Inquiry Card.

TIME-SHARING TERMINAL SYSTEM

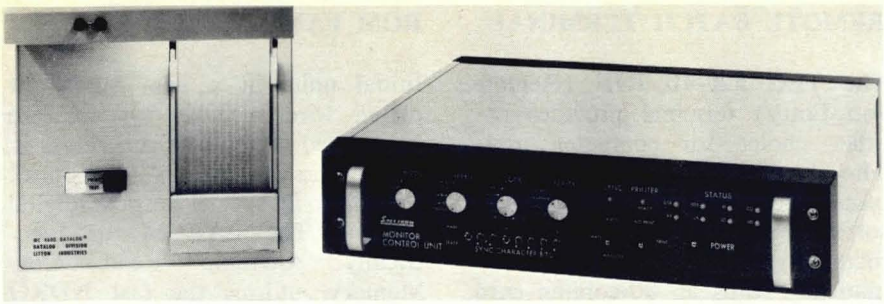
The Corning 904, a time-sharing interactive graphic computer terminal system, combines graphic and alphanumeric display compatibilities with a built-in electrostatic hard-copy device and a system for superimposing slide data over computer generated information. The 904 has been introduced by Corning Data Systems, a newly formed organization within Corning Glass Works. The terminal displays 4,608 alphanumeric characters arranged in 64 lines of 72 characters each. Each character is approximately ⅛-inch high and can be doubled by using the system's Double-Size Character Mode. The image is projected from a special storage CRT with a photochronic glass faceplate developed by Corning. Photochromic glass darkens when exposed to ultraviolet light and erases (regains transparency) in red light. Images are stored at a single pass of the tubes' electron beam, eliminating the need for refresh electronics. Once generated, the display can be viewed continuously, or reproduced as 8½″ x 11″ hard copy by means of an electrostatic printer. Among the optional features available is a Graphical Input Mode using a joystick or mouse, a kit for making overlay slides, and a paper tape punch or reader or both. The Corning 904, with complete software, can be purchased for $19,650 or leased for $670 per month, including service. *Corning Data Systems, Raleigh, N.C.*

Circle No. 175 on Inquiry Card.

DATA ACQUISTION SYSTEM

The DS-869 data acquisition system provides 8 independently selectable channels, expandable to 32; FS input ±1.999V or ±19.99V with autorange as standard feature; sampling 100 channels per second with 0.05% ±1 LSB accuracy; local/remote start, stop; preset scan time intervals up to 1 hour; output to either magnetic tape or teletypewriter. *Techal Electronic Services, Vancouver, B.C., CANADA*

Circle No. 183 on Inquiry Card.



COMMUNICATIONS MONITOR

A communications channel monitor, designed to aid in diagnosing system problems, the "Universal Monitor" connects to the business machine interface of standard modems, automatically synchronizes with the data stream, and prints out a hexadecimal representation of every character on the link. This includes not only test characters, but also sync characters, line control characters, and format characters, all of which are usually nonprinting. The device monitors any five to eight bit code at any speed to 7200 bps and accommodates all line coordination systems. The operator also has the option of automatic or manual switching between the send and receive legs of duplex channels. The complete system consists of four components for modular build-up. A basic system consists of the Monitor Control Unit (MCU) and the Monitor Printing Unit (MPU). The MCU provides synchronization and control, and decodes the monitored information for printing. It also contains the operating controls and indicators for the entire system. The MPU is a high-speed non-impact printer. Each character on the monitored channel is represented by three symbols in the printed record. The numerals 0 through 9 and the letters A through F are used to denote the hexidecimal quivalent of the received character.

The control unit can monitor a multi-line system by manually patching from line to line. For a more convenient arrangement, two other components are offered: the Line Selection Unit (LSU) and the Remote Connection Unit (RCU). The LSU enables push-button selection of any of eight channels for monitoring. LSU may be added without theoretical limit to construct a system serving any desired number of channels. The RCU provides appropriate connectors and electrical isolation to permit bridging the business machine interface without adding cable length or increasing electrical loading. This insures complete electrical isolation from the channel being monitored.

The printer, control unit, and line selector are all available for either rack or shelf mounting. The price of a basic system of MCU (control unit) and MPU (printer) is $7,500. *Spectron Corp., Cherry Hill, N.J.*

Circle No. 195 on Inquiry Card.

COMMUNICATIONS PROCESSOR

The Micro 812, priced under $10,000, can be used as a data concentrator; a pre-processor for time-sharing and information systems networks; or a stand-alone, interactive processing system. Microprogrammed firmware within the 812 receives serial data from up to 32 low-speed devices (with mixed baud rates and multiple formats) and automatically assembles the information into characters which are placed into a circulation buffer within the processor's core memory. The system can accommodate four signalling rates up to 400 baud. The basic 812 configuration includes a micro-programmed processor, power supply, 4K, 8-bit core memory, power-fail interrupt, automatic restart, and real-time clock. The core memory is expandable to 32K, and cycle time is 1.1 usec. Variable word lengths are available for 8-, 16-, 24-, or 32-bit arithmetic load and store instructions. *Micro Systems, Santa Ana, Cal.*

Circle No. 189 on Inquiry Card.

VARIABLE TDM

The On Line Computer Corp. Variable Time-Division Multiplex can take messages from 4 to 128 low-speed lines and automatically insert them in open time slots on a single 1800 baud high-speed line regardless of the low-speed line discipline. Different terminal types from various manufacturers may be handled on an intermixed basis. The lines connected to the multiplexer may have various speeds for proper communications network balancing. Major features are: basic four-line module, expandable to 128 low- and medium-speed asynchronous half- or full-duplex, in increments of four lines; up to four high-speed lines to 9600 baud, full-duplex, in increments of one; optional display features modular by number of low- and high-speed lines served. *On Line Computer Corp., Stamford, Conn.*

Circle No. 187 on Inquiry Card.

MINICOMPUTER

The DCC-112 is a general-purpose computer featuring a 1.2 usec. random access core memory, an arithmetic processor, and a buffered control section. It is a fully-parallel, 12-bit machine with a 4096-word core memory extendable in 4096-word modules to 32,768 words, 8 auto-index registers, program interrupt, a high-speed channel, and indirect addressing. A major characteristic of the DDC-112 is that it is said to be plug, program, and mechanically interchangeable with DEC's PDP-8 computer series. List prices for DDC-112 begin at $5,-900 for the basic model without optional equipment. *Digital Computer Controls, Inc., Fairfield, N.J.*

Circle No. 197 on Inquiry Card.

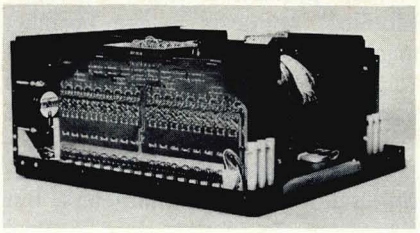
REMOTE BATCH TERMINAL

The TEC 520-40 RJE (Remote Job Entry) terminal provides another choice for computer users who are planning, or now have, remote access multi-programming software to improve CPU usage materially. TEC's new 52-40 automatically reads an 80-column card deck, submits it to a CPU for compilation/execution, and prints the output on a standard 132-column line printer in desired format. The operator need only load the cards and push "GO." The price of $29,-400 includes a 400 card/min. reader, a 300/line/min. printer with 132 columns, an operator control panel, a synchronous or aynchronous serial communication interface, and the programmed controller complete with cables and installation. *TEC, Incorporated, Eden Prairie, Minn.*

Circle No. 184 on Inquiry Card.

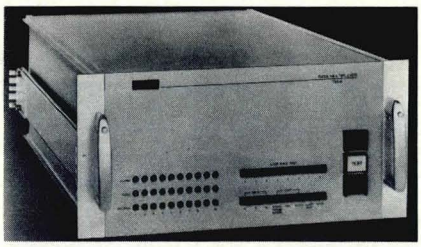
ROM FAMILY

Initial units in a new family of plated wire memory systems are being used for pattern generators in LSI testers as well as for control memories in special-purpose digital systems. The EAROM, or Electrically Alterable Read Only Memory, utilizes the fast NDRO properties of plated wire to achieve a 200ns read cycle. The EAROM is said to be organized to make the write function extremely tolerant of timing, drive current variations, and



line recovery as a tradeoff for high read speed. Even so, the EAROM offers a 1 us write cycle. Loading of a new pattern is by a conventional interface, which may be interlocked or even physically removed for data protection. Initial units will be rack mounted and will be used for pattern generators in LSI testers, as well as for control memories in specialized applications. Smaller systems, packaged entirely on a plug-in printed circuit board assembly, will be available at costs from less than 5¢ per bit to 10¢ a bit, depending on size and quantity. *Memory Systems, Incorporated, Hawthorne, Cal.*

Circle No. 190 on Inquiry Card.



TIME DIVISION MULTIPLEXER

The TM-8 time division multiplexer, capable of simultaneously servicing up to 8 terminals of intermixed data speeds from 1200 to 4800 bps, operates in conjunction with the Codex AE-96 9600 bps voice band modem. Features of the TM-8 include the capability to interface to switched network modems like the Western Electric 202C. The multiplexer is totally transparent so that EIA RS232B modem control signals are passed through the multiplexer in a manner such that no changes in system operating concepts are required. *Codex Corp., Watertown, Mass.*

Circle No. 180 on Inquiry Card.

FAST MINI

The basic cycle time of the Varian 620/f, a 4K-32K, 16-bit/word computer, is 750 nanoseconds, which applies both to the processing of instructions by the CPU and data transfers in and out of the computer's standard core memory. For even faster processing of frequently used subroutines or tabular data, the Varian 620/f can be equipped with an optional read-only memory. Access time to the ROM memory is 300 nanoseconds. Processing of ROM data and programs requires a total of 500 nanoseconds per machine cycle. The Varian 620/f is completely compatible with all existing Varian 620 peripherals. The basic I/O bus is a party line that interconnects up to 32 peripheral controllers. Parallel lines in the bus simultaneously carry data, peripheral address, peripheral commands, status sensing signals, and interrupts. Priority interrupts can be added in increments of eight. The effect of an interrupt is to switch the computer program to an I/O subroutine. This requires clearing the CPU registers before processing the subroutine and restoring the data after the interrupt has been serviced. The DMA mode allows blocks of data to be transferred in and out of memory without program interruption at word rates up to 276 KHz. The main program is simply inhibited while a data word is transferred directly between the addressed peripheral and the computer memory. The main program is then resumed. The total time required to transfer a word of data is 3.6 microseconds. The fastest mode, provided by the Priority Memory Access (PMA) option, utilizes a separate port to memory. The PMA mode transfers data up to 1,333,333 MHz. Four separate fixed priority channels are included with the PMA option. Both PMA and DMA operations can occur concurrently. *Varian Data Machines, Irvine, Cal.*

Circle No. 182 on Inquiry Card.

DATA-INPUT SYSTEM

A data-input system capable of feeding information simultaneously from up to 64 keystations has been announced by Honeywell's Data Products Division. The Keyplex system is designed to replace medium and large keypunch installations. Data entered at a keystation travels through a keystation multiplexer to the processor. The processor identifies the data with its point of origin and compares it in memory to determine whether the data is valid. When the buffer of each keystation is filled, it is recorded on magnetic disk in a predetermined location assigned by the supervisor's station. Data retrieved from the disk is transferred to magnetic tape for processing by an on-site computer, for communication to a remote location, or for printout. The system makes available record sizes variable to 400 characters. Data may be verified immediately after being entered and may be transferred from storage to output without interrupting keystation operators. A one-character display is standard, with a four-character display optional for first deliveries.

An operator can utilize 400 different program formats per application per record, and the source-document formats are not limited because of the number of program levels required by the application. With Keyplex, 400-character record sizes and 400 formats are available regardless of the number of program levels required by the application. Deliveries will commence in January 1971. A 25-keystation Keyplex system is expected to lease from $2,800 to $3,800 per month. Purchase price will be approximately $150,000. *Honeywell Data Products Div., San Diego, Cal.*

Circle No. 177 on Inquiry Card.

EMBOSSER-ENCODER

The series 1500 embosser-encoder simultaneously embosses self-writing characters and punches machine-sensible code holes into plastic credit cards at 1500 cards per hour. The cards produced can be read automatically by data collection devices at the point of transaction either off-line or on-line to computers. The embossed data on the cards is used to imprint invoices and other actions or accounting documents at the point of sale for human legibility, and for input to optical character recognition machines. Also incorporated in the embosser/encoder is a modular device for applying contrasting color to the top of the embossed characters to improve the legibility, appearance, and personal acceptability recognition of the cards. *Data Card Corp., Minn., Minn.*

Circle No. 181 on Inquiry Card.

PORTABLE DATA RECORDER

New data collection device is a portable key-to-tape recorder that combines magnetic tape cartridge storage with Nixie display and communications capability. Called Heurecorder M600, the battery-powered portable data recorder makes it possible to collect, verify, and record data at any remote location, and to transmitt this data using any accessible telephone to a central computer site or a teletypewriter terminal. Among the features of the Heurecorder are telephone modem, rechargeable batteries, LSI circuitry, and IBM MT/ST cartridge for magnetic tape storage. The price of the Heurecorder complete with communications modem is $2,350. *Heuristic Concepts Inc., Westmont, N.J.*

Circle No. 193 on Inquiry Card.

TERMINAL OUTPUT PRINTER

The typeliner, a 100 lpm multiple-copy printout unit, is available with 80- or 132-column capacity. The standard ACII 64-character set is offered with lower case alphabet as an option. All characters are formed with a unique impact print head which provides automatic multiple copy compensation. The Typeliner may be used as an output device for CRT Terminals, as well as for stand-alone remote printer applications, and uses the standard EIA RS-232-B interface. Rental price of the desktop unit is $245.00 per month. *Data Computing, Inc., Phoenix, Ariz.*

Circle No. 198 on Inquiry Card.

DRAFTING SYSTEM

The Boston Digital N/CV Drafting System produces drawings from prepared tapes and can also be used for the verification of numerical control tapes. The integrated circuit N/CV consists of a digital control unit and a 29-½" x 120" plotting area, continuously fed and reversed. *Boston Digital Corp., Ashland, Mass.*

Circle No. 179 on Inquiry Card.

NEW SOFTWARE AND SERVICES

FORTUNE 500 DATA BANK

North American Computer and Communications provides on-line access to FORTUNE Magazine's 15-year data bank of vital statistics on the 500 largest U.S. industrial concerns. The service is available through NACC's time-sharing subsidiary, Comp Utility, Inc. Although representing only ¼ of 1% of the total number of industrials, the 500 account for 64% of total U.S. industrial sales and 74% of profits, and employ almost 70% of all American industrial workers. *Comp Utility, Inc., Boston, Mass.*

Circle No. 238 on Inquiry Card.

INVENTORY CONTROL SYSTEM

Designed for NCR Century Series computers, EMPHASIS, for "Evaluation Management using Past History Analysis for Scientific Inventory Simulation," is in two phases. Phase 1 includes everything except automatic stock replenishment. Phase 2, to be released later, will include the automatic preparation of purchase orders. EMPHASIS is addressed specifically to the manufacturing, food, and hard goods distribution fields. It performs the following functions: 1) analyzes the historical movement of inventory items, taking into account annual usage, seasonal effects, and many other factors; 2) selects an optimum mathematical model for the forecasting of future demands; 3) calculates economical order quantities and reorder points; and 4) analyzes discounts and other vendor pricing variables in order to determine the best replenishment strategy for each item. *National Cash Register, Dayton, Ohio.*

Circle No. 246 on Inquiry Card.

ALGOL, FORTRAN FOR NOVA

Data General Corp. has announced a major new package of software for its NOVA/SUPERNOVA minicomputers which includes a complete Algol 60 and two varieties of Fortran IV. The Algol 60 compiler will generate assembly language code and provide for manipulation of character strings and for unlimited precision arithmetic. The Fortran IV software consists of a full ANSI (USASI) version which will produce assembly language output compatible with Algol and will use the same run-time library; and an ANSI (USASI) basic version for generating interpretive object code in those applications where more complex capabilities are not required. *Data General Corp., Southboro, Mass.*

Circle No. 239 on Inquiry Card.

ANS COBOL SUBSET FOR MOD 25, 30

IBM will make an American National Standards (ANS) Cobol compiler for S/360 Model 25 and 30 users available under a license agreement in the 2nd quarter of 1971. The compiler, a subset of ANS Cobol, also will run on S/360 Models 40 through 75 with at least 32,000 bytes of core storage. The full ANS Cobol compiler for DOS/360 requires a minimum of 64,000 bytes of storage. The new compiler, which will be priced at $150/mo., will offer several language enhancements, including segmentation, table handling, cross-reference listing, and condensed procedure map listing. *IBM, Data Processing Div., White Plains, N.Y.*

Circle No. 245 on Inquiry Card.

T-S CENTER ECONOMIC SIMULATOR

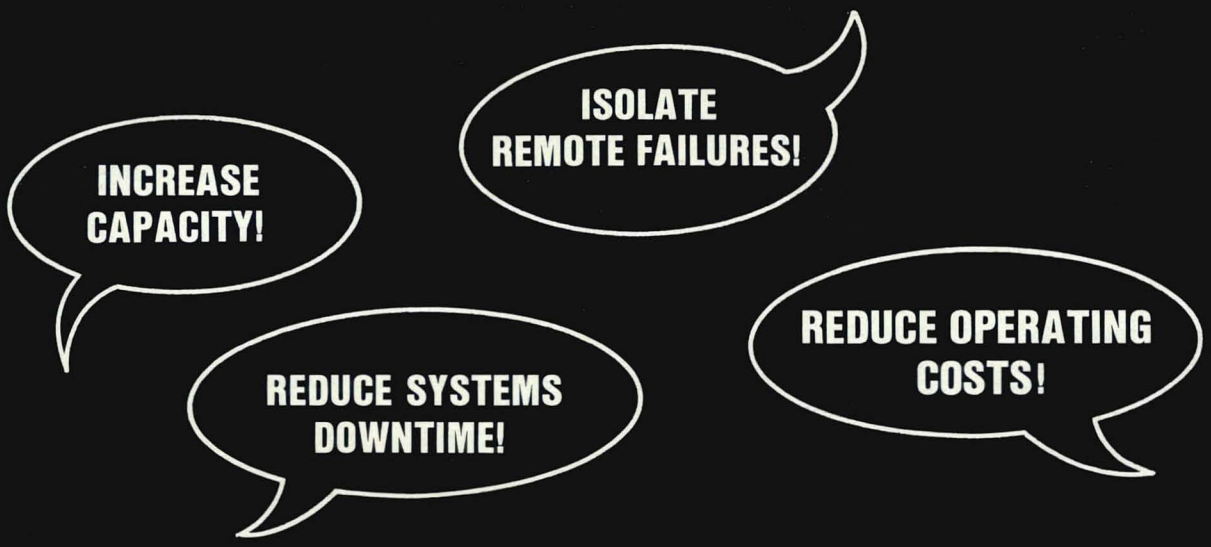
YARDSTICK, a program that simulates the economics of a time-shared computer center, is written in Basic for the DEC PDP-10. The program is designed to provide investors, potential investors, and time-shared computer center managers with projections of the profitability of the time-shared computer enterprise. Based on estimated or actual figures, a 48-month projection of cash flow for the center is generated for sales per user; sales and equipment loading for the center; income from aged accounts receivables; and expenses by month grouped by sales and marketing, computer room, general and office, and payroll. End of the year data for accounts receivables, accounts payable, and interest income is printed, and projected income and expenses are then merged to give a total dollar picture by month. Finally, a trial balance for each year and earnings per share of stock are printed for comparison. YARDSTICK's $25,000 price includes source program listings, complete documentation, and individual tailoring. The program occupies about 6K words of computer core. *Hub S. Ratcliff, Houston, Texas.*

Circle No. 243 on Inquiry Card.

360/85 REMOTE BATCH SERVICE

High-speed remote batch processing time on an IBM S/360 Model 85 will be made available by EDP Resources Inc. The company will market this service in the Northeastern U.S. through an exclusive agreement with Systems Dimensions Ltd. of Ottawa, Canada, owner and operator of the new $12,000,000 computer system. Said to be one of the largest computer configurations in the world, the 360/85 in Ottawa offers an 8-nanosecond CPU and over 2,000,000 bytes of memory. *EDP Resources Inc., White Plains, N.Y.*

Circle No. 241 on Inquiry Card.



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NEW SOFTWARE AND SERVICES

COMPUTER SEMINAR DIRECTORY

The Computer Seminar Directory is an extended and classified guide to more than 220 organizations (colleges and universities, professional societies, trade associations, private educational companies, government agencies, and industrial corporations) that offer seminars, workshops, short courses, conferences, and home study courses in fields related to computer and data processing technology. It includes a subject index to 165 specialized subjects, as well as the name and address of the organizations that offer short courses in each specific field. **The 60-page, softcover book is available with a money-back guarantee for $3.00 per copy. Payment must accompany order.** *Education and Training Institutes, P.O. Box 304E, Dunellen, N.J. 08812.*

DEC BUSINESS LANGUAGE

A new business-oriented computer language called DIBOL, for Digital Equipment Business-Oriented Language, is designed to allow small- and medium-size businesses to make full use of DEC's PDP-8 family of small computers. DIBOL is a Cobol-like language made up of a language processor, a data management system, and a monitor system. Hardware/software configurations using DIBOL geared for specific commercial applications are presently being developed. For example, a small businessman whose input volume is small could use a PDP-8/I computer with 8K words of core memory, three magnetic tape units, and a teletypewriter to handle accounts payable, accounts receivable, and inventory control. Such a system would cost about $30,000. *Digital Equipment Corp., Maynard, Mass.*

Circle No. 240 on Inquiry Card.

NETWORK DESIGN SERVICE

The Datamax communication network design service assists both communications consultants and end-users in configuring computer-based communications networks. The techniques used consider all important design parameters, including line routings, type of remote concentration, data rate, performance, control procedures, cost, and reliability. Network equipment considered includes modems, remote I/O terminals, concentrators, error control systems, and common carrier lines. Cost performance information provided by different vendors is integrated with the common carrier tariffs to compute optimum network configurations. The approach also specifies subchannel bandwidths or polling rates for each multiplexed link in every network configuration considered during the design process. *Datamax Corp., Ann Arbor, Mich.*

Circle No. 236 on Inquiry Card.

EAI datalinks

A Newsworthy Compendium of How EAI Hybrid, Digital and Analog systems help make a complex world relatively simpler.

WELCOME, SYDR, WHATEVER YOU ARE Automatic drafting has a name here at EAI. We call it SYDR, a compaction of System Drawing. Heretofore there was difficulty in providing flexible ways of man/machine interface. Now SYDR provides true automatic drafting. Its general-purpose structure renders any drafting chore in standard format, and is flexible enough to automate highly-complex layouts. Use your digital computer, our unique 430 Dataplotter and SYDR. This intoxicating marriage frees creative manpower for other fruitful work. Economies that translate days into hours, make gimlet-eyed money-watchers shout huzzas from their desk-tops. Draw on our experience with a note to "SYDR", Dept. 206Y.

WHEN TO AUTOMATE YOUR GCS With the conviction that the dollar sign is not the least important symbol used in engineering, we've completed a cost analysis of when one should consider automating a GC installation. Very conservative estimate shows one technician earning $8400 can handle four GCs. This works out to $2100/GC/year/shift. When you have 8 GCs in operation, you must seriously consider installation of an EAI PACE system. Equally conservative estimate yields PACE cost of $2247/GC/year figuring 5-year amortization period, for 8 GC system. And savings increase rapidly beyond 8 GCs. Savings realized from increased efficiency of chromatographer, full 3-shift utilization of GCs, reduction of human error, of system downtime and of delayed analyses have not been taken into account. Nor increased benefits of getting analysis in a more reliable format. Get a copy of this comptroller-convincing cost study; write "GCost", Dept. 206Y.

HOW SOME VERY BIG NESTLINGS LEARN TO FLY Bird watchers this year observed the first migrations of the Boeing 747. Smooth. Clean. Quiet. Qualities that were predicted back when it was a nestling through the use of EAI hybrid computers. Now another nestling, the made-in-U.S.A. supersonic transport, is being "flown" in the Boeing Company's simulation laboratories on hybrid computers. Here, EAI systems are used to optimize SST ride qualities and to predict and minimize turbulence loads. In turbulence tests, the new ship makes a five-minute "flight" in three seconds on the hybrid system. Cost improvements of 150:1, and time improvements of several hundred to one are possible. Bird watchers and budget watchers alike may share in this knowledge by writing "AEROSPACE", Dept. 206Y.

KINETIC DATA MEANINGFULLY SHAPED BY COMPUTER In olden times petrochemical-process design involved finding rate and equilibrium constants for several reactions required a trial-and-error method. Much trial. Much error.

Most process designs involve the solution of ordinary differential equations—in a lumped-parameter system where changes are taking place in time but not space. With the use of analog computers, solutions poured forth. However, distributed parameter systems involve changes in time and space simultaneously—expressed by partial differential equations. Many approaches to PDE solution have evolved for digital computers. But such solutions consume more and more hardware, with ever-present error creeping back in as problem complexity increases.

Hybrid computers clear this difficulty up. Kinetic data are programmed into the analog portion, actual results go into digital computer memory. The analog makes a series of process condition runs, the digital stores the data, matches the results from the plant and computes least mean-square deviations. The "solution" has been found when results of simulation most closely match actual conditions, and no further reductions can be made in mean square deviation values. Optimization is achieved—in time, money and results.

After much struggle, EAI is pleased to offer a software package in this arcane specialty—write to "Kinetic", Dept. 206Y, Electronic Associates, Inc., West Long Branch, N.J. 07764.

REMOTE COBOL

TELE-COBOL allows OS/360 users to receive and transmit data to remote terminals using the Cobol language. The package is intended for companies which are considering switching their installation from Cobol batch jobs to an on-line system. The package consists of an access method, data handlers, and utility programs. The data handlers, which reside in a separate partition from the user program, queue the data arriving from the terminals onto a disk file and signal the proper Cobol program that data is available. The process is reversed for output. The system requires a 30K partition under OS/MFT, supports only switched terminals, and requires IBM 27XX TCUs. Price is $15,000. *Complex Systems, New York, N.Y.*
Circle No. 242 on Inquiry Card.

FINANCIAL T-S PACKAGE

The Financial Business Package (FBP) is a group of Fortran IV programs that have been written to operate on most time-sharing computers. By merely entering ledger disbursements, the FBP will generate: detailed general ledger, year-to-date profit/loss statements, current period profit/loss statements, balance sheets, disbursement vouchers, and a variety of charts. The package will operate with any appropriate terminal device supported by time-sharing utilities. 33ASRs with coupler or modem are adequate for many operations. Paper tape, magnetic tape, or cards may be used for disbursement inputs. *Computing Corp. of America, Inc., Englewood, Colo.*

Circle No. 237 on Inquiry Card.

PERIPHERALS EVALUATION

A new software package, called Peripheral Monitor, is designed to enable S/360 users to monitor, measure, compare, and document the actual performance of their peripherals against the manufacturer's rated (sales information) speeds. Peripheral Monitor is operating system independent and can be used with any IBM S/360 System, Model 25 and up. The program is self-loading and requires only two control cards. After initialization, the system requires approximately 15 seconds for calibration and an additional 15 seconds for each of the peripherals to be measured. Output is a report describing actual performance as compared to rated speed, and the percent of variance. *National Software Exchange, Great Neck, N.Y.*
Circle No. 253 on Inquiry Card.

SALES/MARKETING PACKAGE

SALES-CALL is designed to give marketing management the ability to monitor and help schedule the activities of their sales force. The package provides salesmen in the field with computer-printed reminders of the accounts to be called on during the next time period. These reminders contain pertinent information regarding the account. A computer-generated report of the activity of each member of the sales force is also prepared for marketing management identifying the accounts which have been ignored or not serviced on a timely basis. SALES-CALL is said to operate on any IBM/360 Model 30 or larger computer. The package is sold with complete documentation and self-customizing features which allow it to be used with either a product or service for sale. *System Implementation Corp., New York, New York.*

Circle No. 248 on Inquiry Card.

PAYROLL SYSTEM

Described as a Self-Adapting Payroll System, a new system provides for OS operation as well as DOS and provides a multi-tax feature that permits processing of all state taxes as well as any number of county, city, and special taxes. The system utilizes a profile feature that allows the user to state his company name, deduction names and frequencies, state, county, and city tax formulas, sequence of reports and other information unique to each user. Companies with many divisions and service organizations can produce, during the same run, completely varied and independent payrolls. The system operates effectively with a minimum of one disk drive, two tape drives, and 48K of storage on any IBM 360/25 and above. It is priced at $11,500 with complete documentation. *Occidental Computer Div. of Executive Computer Systems, Inc., Los Angeles, Cal.*

Circle No. 247 on Inquiry Card.

XDS T-S SYSTEM

A new operating system, Universal Time-Sharing System (UTS), allows XDS Sigma 7 computers to perform three computing tasks concurrently: on-line time-sharing for up to 128 users; local and remote batch processing, and real-time processing. Compilers and subsystems operational under UTS include Basic, Fortran, Meta Symbol, Cobol, Manage, FMPS (a linear programming package) and SL-1 (a simulation language). Utility processors include a terminal executive language, an assembly-language debugger, a Fortran debugger, and Edit and other subsystems. Compatible on-line and batch versions of many of these packages will permit users to work in two or more operating modes interchangeably. Programs developed on-line, for example, will be executable in the batch mode of operation, and batch-created programs will be executable from on-line terminals. *Xerox Data Systems, El Segundo, Cal.*

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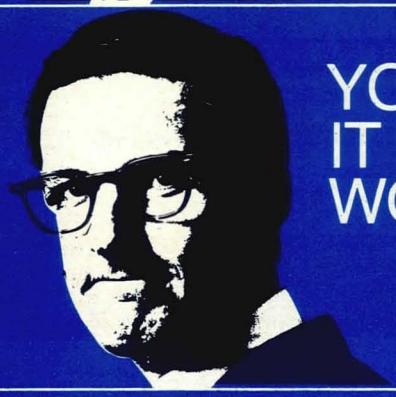
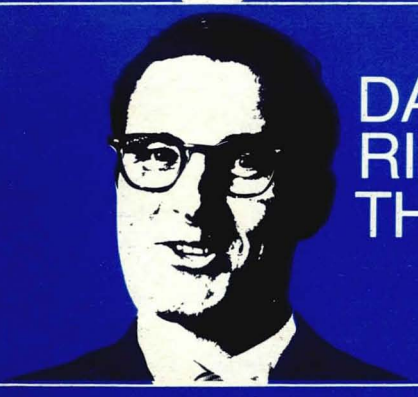
the answer people

YES, WE SURE DO. It includes whatever equipment you need... like Codex 9600 bps modems (with adaptive equalization and automatic error correction), Codex time division multiplexers, all completely assembled into a package ready to install. And if you want engineering assistance, we offer that too.



YOU BET IT REALLY WORKS. Codex 9600 bps modem and time division multiplexer packages have logged thousands of operational hours on such applications as a computer-to-computer link between Chicago and San Francisco for the Midwest Stock Exchange Service Corporation. They're working like charms.



DARN RIGHT THEY CAN. They'll double or quadruple computer input/output rates. Reduce on-line processing time and bring your peripherals up to rated capacities. And they'll make big cuts in your line leasing costs. Thirty-day delivery too.

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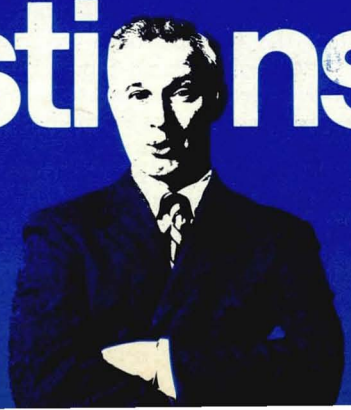

CODEX CORPORATION
150 Coolidge Ave., Watertown, Mass. 02172
Telephone: (617) 926-3000; Telex: 92-2443

CIRCLE NO. 58 ON INQUIRY CARD

NEW LITERATURE

DATA COMMUNICATIONS SYSTEM

An 8-page brochure documents the specifications and software packages supplied with the Varian 520/DC Data Communications System and describes the system's major components. *Varian Data Machines, Irvine, Cal.*

Circle No. 333 on Inquiry Card.

MESSAGE PROCESSING SYSTEM

Eight-page brochure describes UNIGEM, a package of standard subroutines which interfaces between IBM's Information Management System (IMS) and application programs operating under IMS. The brochure includes a 2-page flowchart of functions and examples of original source documents. *United Computing Corp., Carson, Cal.*

Circle No. 331 on Inquiry Card.

12, 16, or 18 BITS?

The relative advantages of 12-, 16-, and 18-bit word lengths used in real-time data acquisition with small computers are discussed in a semi-technical paper. Speeds, memory-addressing, memory-reference instructions, microinstructions, and memory sizes are related to ease and practicability of use of the three computer word lengths. *Vidar Corporation, Mountain View, Cal.*

Circle No. 334 on Inquiry Card.

FIRE PROTECTION SYSTEM

"Firecycle", a fire protection sprinkler system which automatically turns itself off when the fire has been extinguished, is described in an 8-page brochure. Developed for installation in sensitive instrument and electronic equipment areas, the system is particularly applicable to computer rooms. *The Viking Corporation, Hastings, Mich.*

Circle No. 321 on Inquiry Card.

TECHNICAL SERVICES

A 12-page brochure outlines the technical services and computer software available from NCS Computing Corp. Included in these services are: engineering, design automation, computer simulation, project control, computer software, process control, real-time and communications systems, technical applications, and consultation and contract programming. *NCS Computing Corp., Dallas, Texas*

Circle No. 325 on Inquiry Card.

VOICE RESPONSE

Product brochure describes a complete line of modular voice response systems in which data is input via Touch-Tone telephone and output is provided in the form of words or phrases pre-recorded by a human voice and selected by the computer from a stored vocabulary of 31 to 256 words or phrases. *Datatrol, Inc., Hudson, Mass.*

Circle No. 308 on Inquiry Card.

OFFICE COMPUTERS

A 14-page, 4-color brochure describing the Philips P-350 series of computers provides complete information and technical data on this new office computer line. *Business Products Div. of North American Philips Corp., New York, N.Y.*

Circle No. 326 on Inquiry Card.

INFORMATION-RETRIEVAL PROGRAM

A 3-page application abstract describes a computer program that enables time-sharing users stationed at desk-side remote terminal devices to perform data-management and informational-retrieval functions. Called A^{K}SESS, the program is said to be capable of effective use by personnel who have neither computer expertise nor programming ability. *Remote Computing Corp., L. A., Cal.*

Circle No. 327 on Inquiry Card.

COMPUTER OUTPUT MICROFILMER

A 16-page, 3-color brochure describes Information International's FR-80 Computer Output Microfilmer (COM) computer-based system. The FR-80 produces images on film from magnetic tape in any format, merges and records on the same pass, stores initial parameters for different jobs, and allows the user to design forms, layouts, and special symbols at the console. The brochure is illustrated with examples of the FR-80's output. *Information International, Los Angeles, Cal.*

Circle No. 313 on Inquiry Card.

PRODUCT LINE BROCHURE

A four-page illustrated brochure describing Raytheon's total product line includes descriptions of the company's 700-Series models that offer the choice of a central processing unit with either 900 nsec., 1.5 msec., or 1.75 msec cycle time: as well as its extensive line of data conversion equipment. *Raytheon Computer, Santa Ana, Cal.*

Circle No. 317 on Inquiry Card.

SALES PREDICTOR

Booklet describes "Premart," a new technique for predicting sales of a potential new product. *Resource Management Corp., Bethesda, Md.*

Circle No. 318 on Inquiry Card.

DIGITAL PRINTERS

A four-page engineering specification sheet gives detailed specifications, illustrations, and prices for 10- and 20-line-per-second alphanumeric printers. *Datadyne Corporation, King of Prussia, Pa.*

Circle No. 304 on Inquiry Card.

CAPABILITIES BROCHURE

Six-page foldout describes marketing research, new product planning, and sales and marketing services provided by new company specializing in the EDP, industrial control, and communications industries. *Data Motivation, Inc., Park Ridge, N.J.*

Circle No. 307 on Inquiry Card.

STORAGE/REFERENCE EQUIPMENT

A new Data Reference Control System, plus referral/retention products and products for programmers, are described in a 28-page data processing supplies catalog. *National Blank Book Co., Inc., Holyoke, Mass.*

Circle No. 315 on Inquiry Card.

WIDE BAND VS. NARROW BAND

A two-page technical application bulletin entitled "Wide Band vs. Narrow Band Data Transmission . . . and How It Affects Supervisory Control Systems" compares wide band and multiple-channel narrow band data transmission systems in terms of the need and time required for polling, the interruption encountered when transmitting a station command, the adverse affect of differential delay distortion, and the consequence to system integrity on loss of a channel. An "ideal" system is described. *Quindar Electronics, Inc., Springfield, N.J.*

Circle No. 316 on Inquiry Card.

APL "MINI-MANUAL"

A "Mini-Manual" describes a condensed version of APL, IBM's general-purpose computing language. The Mini-Manual, useful as a reference for popular routines, answers questions and includes a summary of the system command keyboard operators and mixed and hybrid functions. The Mini-Manual is in accordance with the standard IBM APL version. *Industrial Computer Systems, New York, N.Y.*

Circle No. 301 on Inquiry Card.

AIDS FOR ARCHITECTS

A 29-page booklet describes the function, applications, and components of an interactive computer graphics system for architects. The configuration, called AIDS (Architectural Interactive Design Systems), integrates a wide range of computer programs that enable architects to perform many design and decision-making functions. Fourteen programs are described and illustrated. *Design Systems, Inc., Boston, Mass.*

Circle No. 306 on Inquiry Card.

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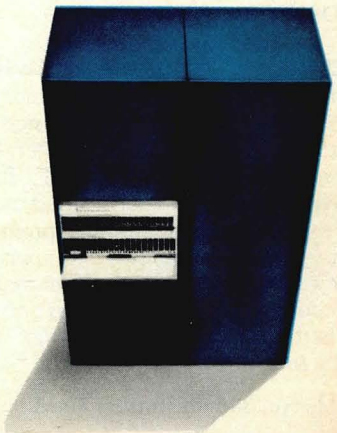
DOMESTIC OFFICES

Eastern Region / 2 Crescent Place, Oceanport, New Jersey 07757 (201) 229-4040 / 60 Hickory Drive, Waltham, Mass. 02154 (617) 899-6287 / 1800 North Kent St., Arlington, Va. 22210 • **Central Region** / 3553 West Peterson Ave., Chicago, Illinois 60645 (312) 463-9080 / 1700 Needmore Road, Suite 305, Dayton, Ohio 45414 (513) 277-1142 • **Southwestern Region** / 300 North Central Expressway, Richardson, Texas 75080 (214) 238-9656 • **Western Region** / 2390 El Camino Real, Palo Alto, Calif. 94306 (415) 328-0783 / 8703 La Tijera Blvd., Los Angeles, Calif. 90045 (213) 670-8386

INTERNATIONAL OFFICES

Canada / Allan Crawford Assoc., 65 Martin Ross Ave., Downsview, 463 Ontario (416) 636-4910 / 157 Saint Charles St. West, Longueuil, Quebec (514) 670-1212 / 376 Churchill Avenue, Ottawa, Ontario (613) 725-3354 / 721 Aldford Ave., Annacis Industrial Estate, New Westminster, British Columbia (604) 524-1161 • **Far East** / Kyokuto Boeki, Kaisha, Ltd., C.P.O. Box 330, Tokyo, Japan (270) 7711 • **United Kingdom** / INTERDATA, Ltd., Station House, Harrow Road, Wembley, Middlesex, England 01-902-3202



The Dual Personality Computer

We designed our new Model 5 with a dual personality. A foreground-background processor with full real-time software is what its all about. Critical foreground operations can never be destroyed by background processing, and both software and hardware were developed with ease of systems programming in mind.

The Interdata Model 5 is the big brother to the most successful family of small to medium 3rd generation computers ever built. Upward compatibility with our Models 3 and 4 is guaranteed, of course.

Powerful Features Include:

- 114 Instructions with built-in floating point arithmetic.
- Priority Interrupt Levels expandable in groups of sixteen.
- Firmware controlled I/O for block transfers without program interruptions.
- Programmable I/O Processor.
- Real-time software including: FORTRAN IV and a background-foreground operating system.
- Up to 4 Selector Channels.

The Dual Personality Model 5 is available at a very personable $15,600. Put the Model 5 to work for you. It's not hard to live with, but could be very hard to live without.

INTERDATA®

The Forthcoming Generation—*Now!*

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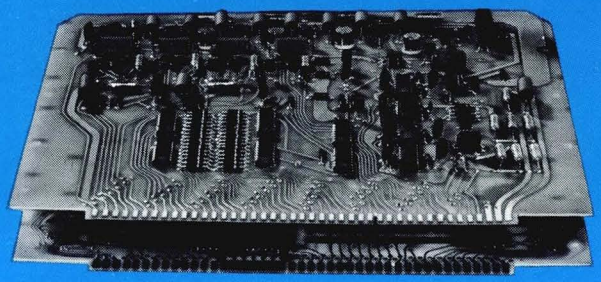
GREATEST BARGAINS IN MEMORY

Dataram Standard Memory Systems Feature: Planarstack construction—manufacturing the core matrix in a single plane on two or more cards, wiring in one operation, then folding and stacking—for maximum economy, reliability. Available in P.C. card sets, sub-chassis or rack mount. DTL and TTL IC logic.

DATARAM STANDARD MEMORY SYSTEMS WITH SUPER-STANDARD PRICE/PERFORMANCE

PDM-12 • 24K of memory $915.
PDM-13 • 36K of memory $1050.
PDM-17 • 72K of memory $1600.

PDM-12 Core Memory Systems
Up to 4K x 6 • 5μs • 135 cu. in.



Also standard in 2K x 6 bit words. For numerical control, optical character recognition, photo type setting and control applications. **CIRCLE RS#19**

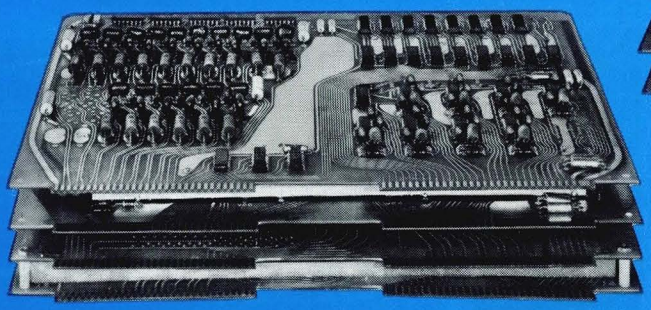
4K x 6 Card Set
$915.
50 UNIT PRICE

PDM-13 Core Memory Systems
Up to 4K x 9 at 3μs

Also standard in 4K x 8 bit words and 2K x 8 or 9 bit words. For special data processing and collection systems, buffering of 7 bit magnetic tape, OCR and photo type setting. **CIRCLE RS#20**

4K x 9 Card Set with Data Register
$1050.
50 UNIT PRICE

PDM-17 Core Memory Systems
Up to 4K x 18 at 3μs



Also standard in 4K x 12 or 16 bit words, and 2K x 12, 16 or 18 bit words. **CIRCLE RS#18**

4K x 18 Card Set with Data Register
$1600.
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DATARAM CORPORATION

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