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August

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CIRCLE 1 ON READER CARD

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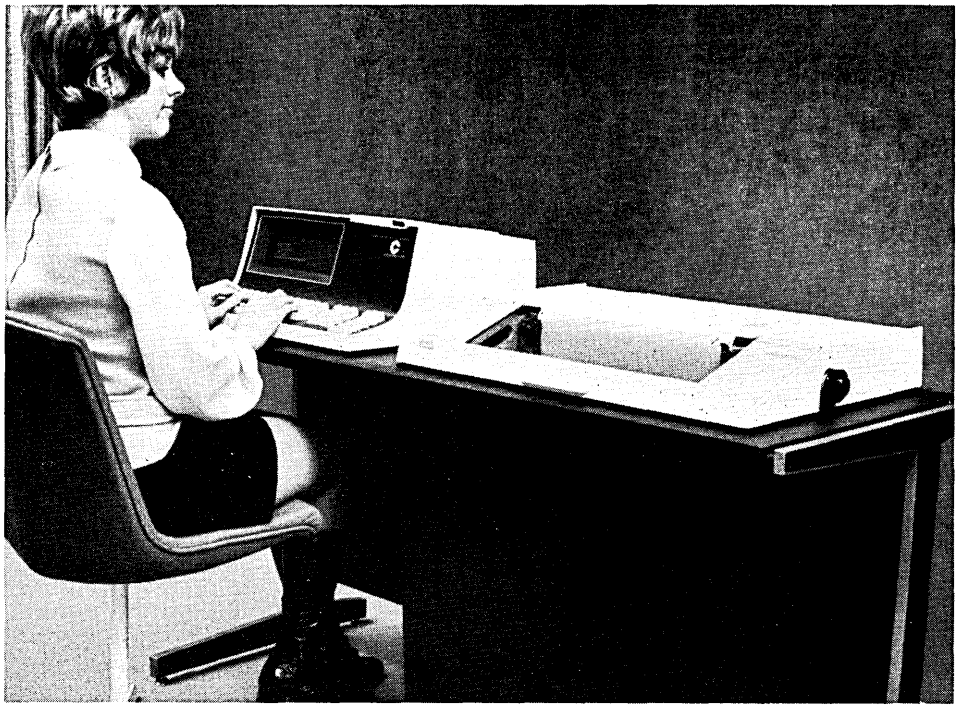

more than 500 Datapoint 2200's are proving that every day

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CIRCLE 15 ON READER CARD

DATAMATION®

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CIRCLE 86 ON READER CARD

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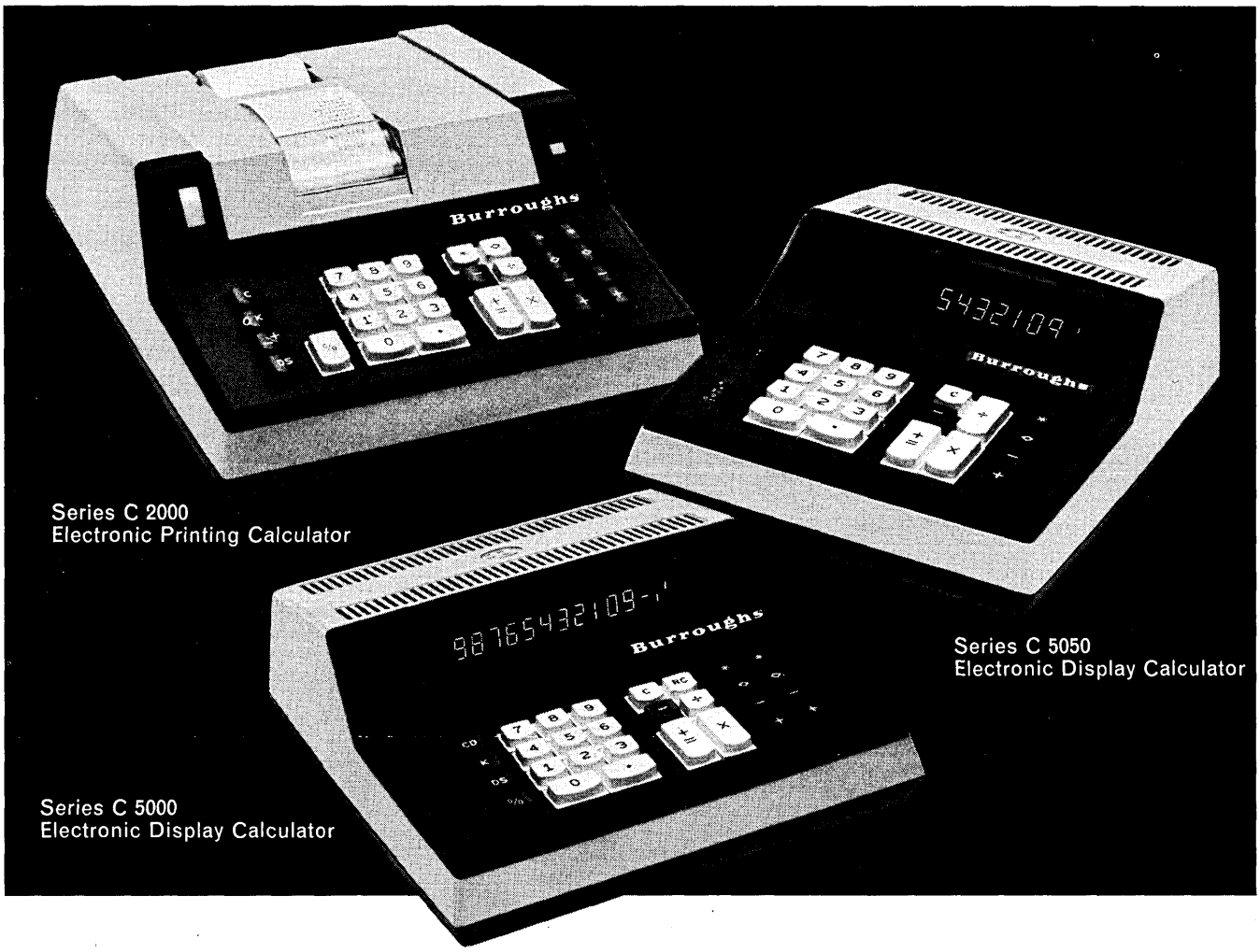

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Burroughs

Look Ahead

AOS: COSTLY BUILDING BLOCKS

In IBM's announcement of its Advanced Operating System, users should keep a sharp eye out for the mounting costs in program products that it may represent. Since unbundling, IBM has put the attendant compilers, sort routines, access methods, etc., on a fee basis. One of the latest moves was changing some utility programs from Class A, or free support, to Class C, which is paid support. Too, in release 21 of OS, users note that the changes for the user were modest, but internal changes to OS (code changes, new names, etc.) were extensive--a portent of decreasing downward compatibility with earlier OS releases. This could, in the move to AOS, spell emulation of certain parts of OS--and more cost for the user.

Philip Bookman of Allied Chemical projects that AOS will actually be a "more flexible, yet smaller nucleus in the function of the system. And within two years, the user will be confronted with many building blocks to choose from and pay for." Consultants, bone up.

THE BEST LAID PLANS ...

IBM quietly killed a plan to shift System/3 marketing from the Data Processing Div. to the General Systems Div., which manufactures the System/3. The company gave no reason internally, but there was speculation the move would open a Pandora's box of legal implications. Other problems were weakened account control (too many IBMers at a customer location) and lack of profits in the S/3 line.

There may be no connection, but that small machine with the 370 architecture--assumed to be the 125--is no longer being touted in Europe. Indeed, there are reports that IBM has killed the 125. Many now look for a big System/3 to take its place, and there is increasing talk of a 128K S/3 machine

HELP FOR THE SYSTEM/3 USER

IBM's remarkable sales success with the System/3 has spawned a large population of first-time computer users and at least two user organizations to help them. Irwin Cohan, founder of the 1,800-member National Association of System/3 Users (NASU), says the 14-month-old organization has 25 active chapters in the U.S. and Canada and 20 in the formative stages. Members swap problems and programs through meetings, a newsletter, and an applications library. They pay $30 a year to the Los Angeles-based nonprofit organization.

Also in Los Angeles, Dave Ferguson's for-profit Group/3 struggles to attract members who are being asked to kick in $20 a month. In exchange they get free consulting advice over a WATS line, a slick quarterly, and special discounts on products hard and soft. Current lure is a $150 Nashua disc pack for $105. Ferguson, holder of the second software patent awarded, has also come up with a 360/20 simulator for the S/3. We've heard that bug-eyed IBM SE's couldn't believe it when the program responded perfectly to their S/3 diagnostics. It should help an estimated 7,000 users of the 20 to convert to a smaller machine...and maybe enable Ferguson and friends to get Group/3 off the ground.

Cohan says some 40% of his members are first users of computers; 25% have upgraded from unit record equipment. IBM won't disclose anything on the computer-using history of its customers. But

Look Ahead

Cohan says unfamiliarity with computers and widely varying prices for software ($200-500 often is asked for similar payroll packages) are the main reason for his membership growth.

MAINFRAMERS: A HEALTHY TURNAROUND

Nowhere is the computer business upturn more evident than in the financial reports of the major mainframers. IBM's 22% rise in second-quarter earnings was the highest of any quarter in its history. Honeywell's earnings rose a whopping 63.6% due to a "solid improvement" in its computer bookings, and usually profitable Burroughs announced a 19% gain over 1971's second quarter. Control Data said its computer operations had returned to the black and, at writing, was ready to announce a second-quarter increase in earnings. Univac's orders are running 25% ahead of last year.

Honeywell's chairman James Binger cautions that the high rate of improvement merely reflects the extent of last year's depressed market. But that doesn't temper the enthusiasm. Said a Control Data executive: "When we talk at lunch and coffee breaks, we talk about business again. That gloomy 'who's next to go' conversation we used to hear all the time isn't topical anymore."

MOTOROLA DEVELOPS, MAY MARKET NEW MINI

Motorola has been quietly developing a new minicomputer, the MDP 2000--an upgraded and reconfigured version of an earlier model, the MDP 1000. The company disbanded its Instrumentation and Control subsidiary which developed the 1000, but quietly continued production of it at the Communications Div. in Illinois, although it is not marketed actively.

The new 2000 machine probably will be. The Communications Div., where it is being produced, declines to comment, saying only that an announcement will be forthcoming. Mototola's Integrated Circuits center in Mesa, Ariz., developed the new model.

MINIMAKERS BATTLE OUTSIDE COURT, TOO

Controversial Digital Computer Controls claims it's No. 3 in the minicomputer business in terms of units shipped. Shipment rate is more than 100 a month, and the Fairfield, N.J., firm says it has oem orders for 400 D-116s, the computer that is compatible with Data General's Nova and over which the latter firm is suing DCC. The company's other product is the D-112, a 12-bit machine compatible with Digital Equipment Corp.'s PDP-8. DCC says the D-112 will account for 8% of the minis shipped this year.

COURIER PLANS 3270-COMPATIBLE CRT

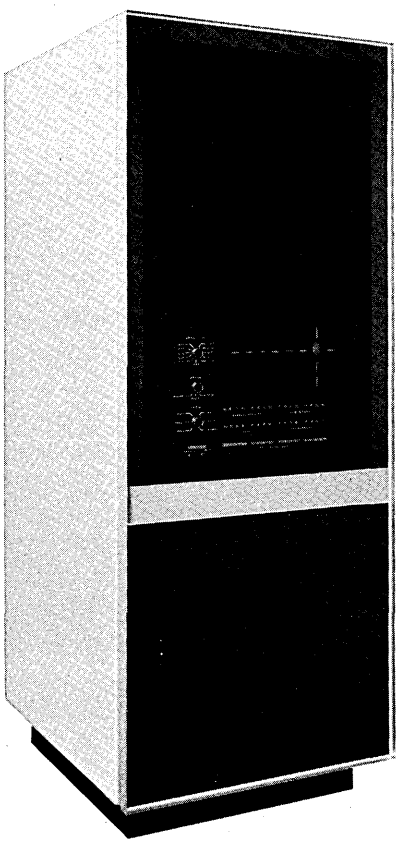
While IBM quotes delivery lags of up to 18 months on its 3270 crt terminal, Courier Terminal Systems plans to announce its own 3270-like device next month. The Phoenix subsidiary of Boothe Computer Corp. says the terminal will be compatible with the 3270, operating in a bisynchronous mode, but having the added capability to store data at a remote site, batching blocks of it back to a cpu periodically.

Courier says its E-60 and E-260 asynchronous crt's match the 3270 in price and performance, "but for those who think bisync is the way to go, we wanted to be able to provide it." A December demonstration is planned at the FJCC, with delivery early in '73.

(Continued on page 115)

COMTEC

CT/90 Programmable Processor... Now with high speed option



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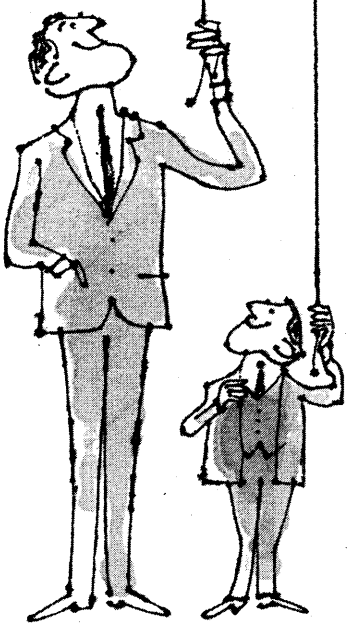

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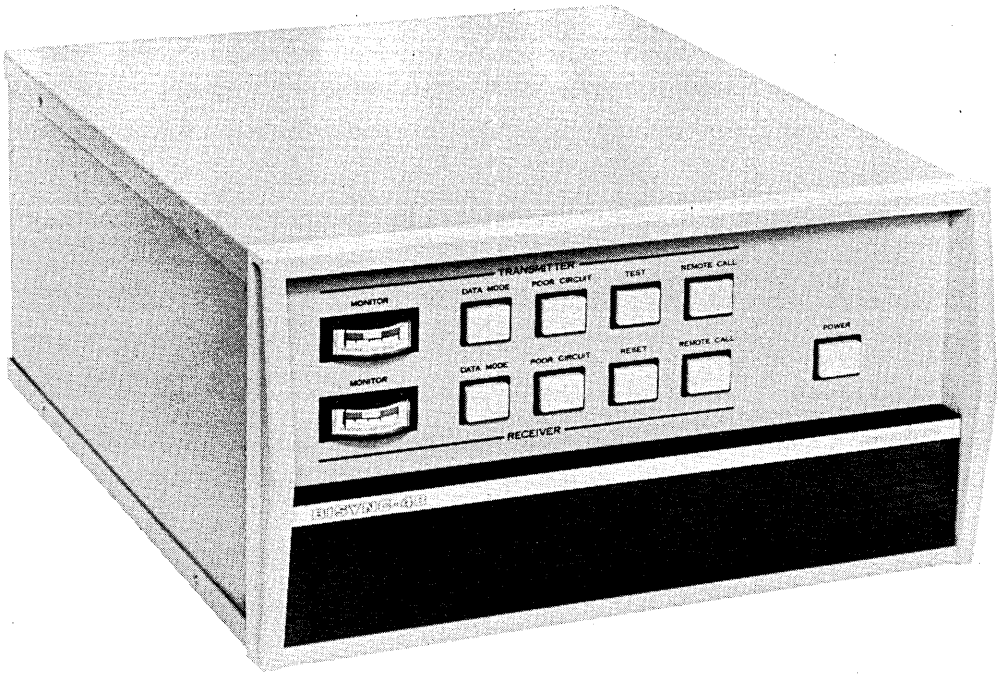

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Because of the BISYNC's unique error control system, line turnaround losses are eliminated.

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- nearly matched conventional 7200 bps modems on 4-wire lines.

The BISYNC-48 is compatible with all computers and terminals using the IBM BSC line protocol. It is currently providing dramatic cost and time savings in hundreds of installations equipped with IBM, UCC, Data 100, Remcom, Mohawk, and M&M terminals—to name a few. The BISYNC-48 can also be used as an ordinary 4-wire modem on dedicated lines and switched to one-call dial-up operation when line problems occur.

Discover the efficiencies the BISYNC-48 will make in your installation. Make one call. To us.

paradyne

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CIRCLE 38 ON READER CARD

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You'll quickly grasp the operating concepts of the Model 20, because it uses a natural but powerful language that lets you work with algebraic symbols, formulas, and English language instructions. And, if you already know how to program, you'll appreciate features that once were exclusive to languages like FORTRAN or BASIC: Enter and Format statements, function subroutines, and callable subroutines with parameter passing.

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For more information or a "hands-on" demonstration, write: Hewlett-Packard, P.O. Box 301, Loveland, Colorado 80537. In Europe: 1217 Meyrin-Geneva, Switzerland.

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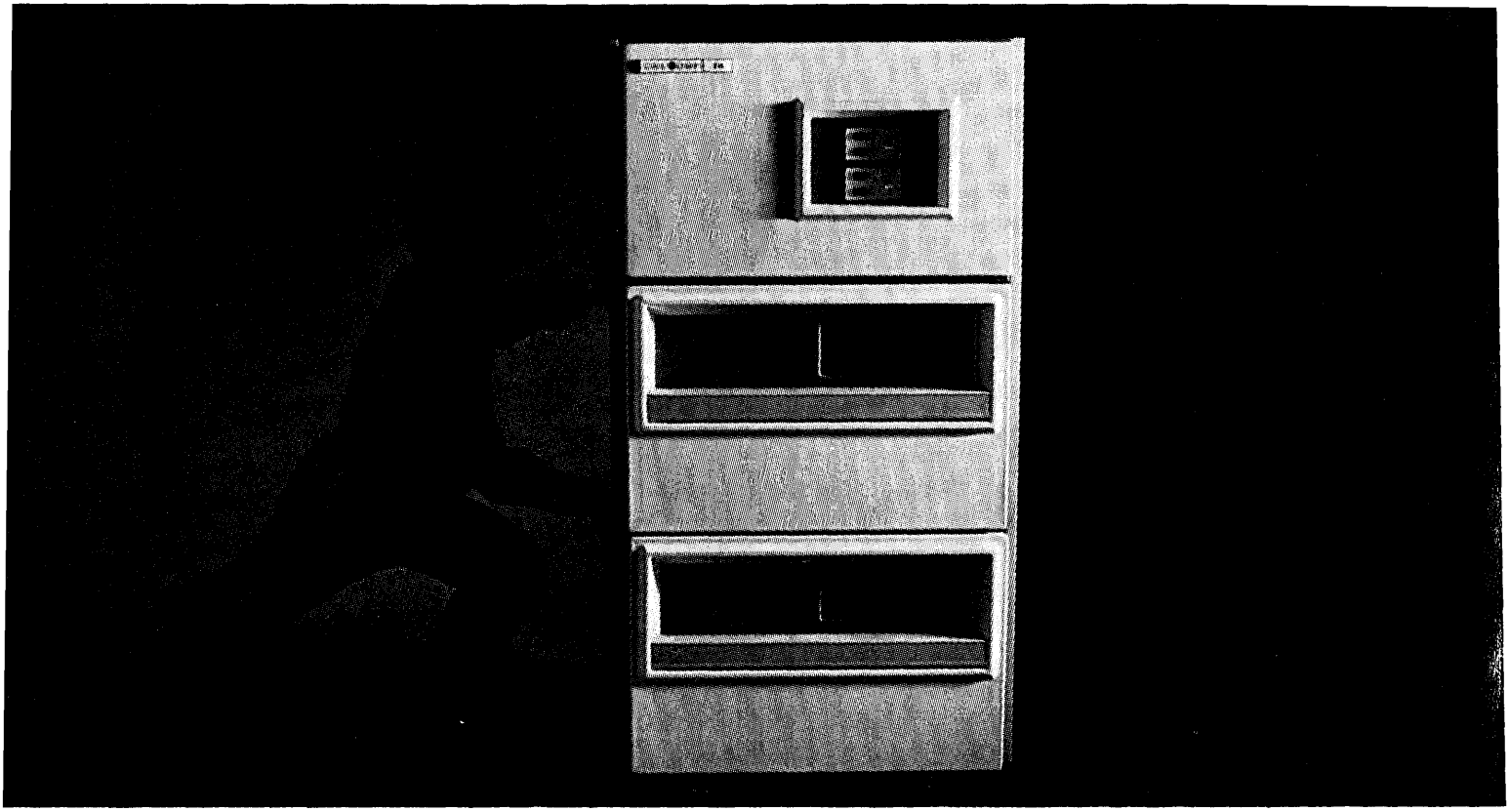
CALCULATOR PRODUCTS

CIRCLE 8 ON READER CARD



The storage space doubles.

The cost doesn't.

Dual Density from Calcomp:

If you store your information on disks, the time comes when the storage system you started with isn't big enough any more.

If you're using an IBM 2314, *their* next step up is a 3330. And maybe even a new computer. But *you* may want to talk to CalComp.

The most realistic step up from an IBM 2314 is a CalComp 1015 Dual Density Disk System.

With it, you double your capacity for only 40% more cost. And you can grow out of your old storage system without growing out of your old storage room.

The floor space remains the same. So do the disk packs.

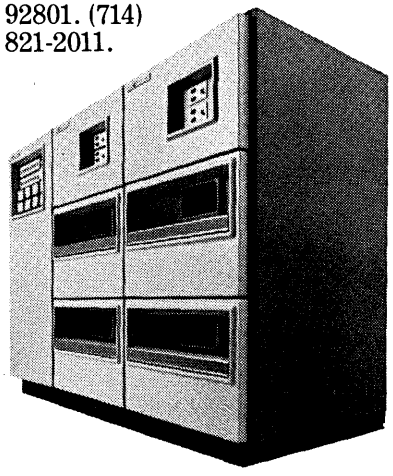
The programming even stays the same.

Naturally the CalComp 1015 is compatible with IBM System 360 and 370 computers.

Next time you look around your computer room, and you wonder where to put all the new storage you need, think of CalComp.

Remember, one small step for your business doesn't have to be one giant leap for IBM.

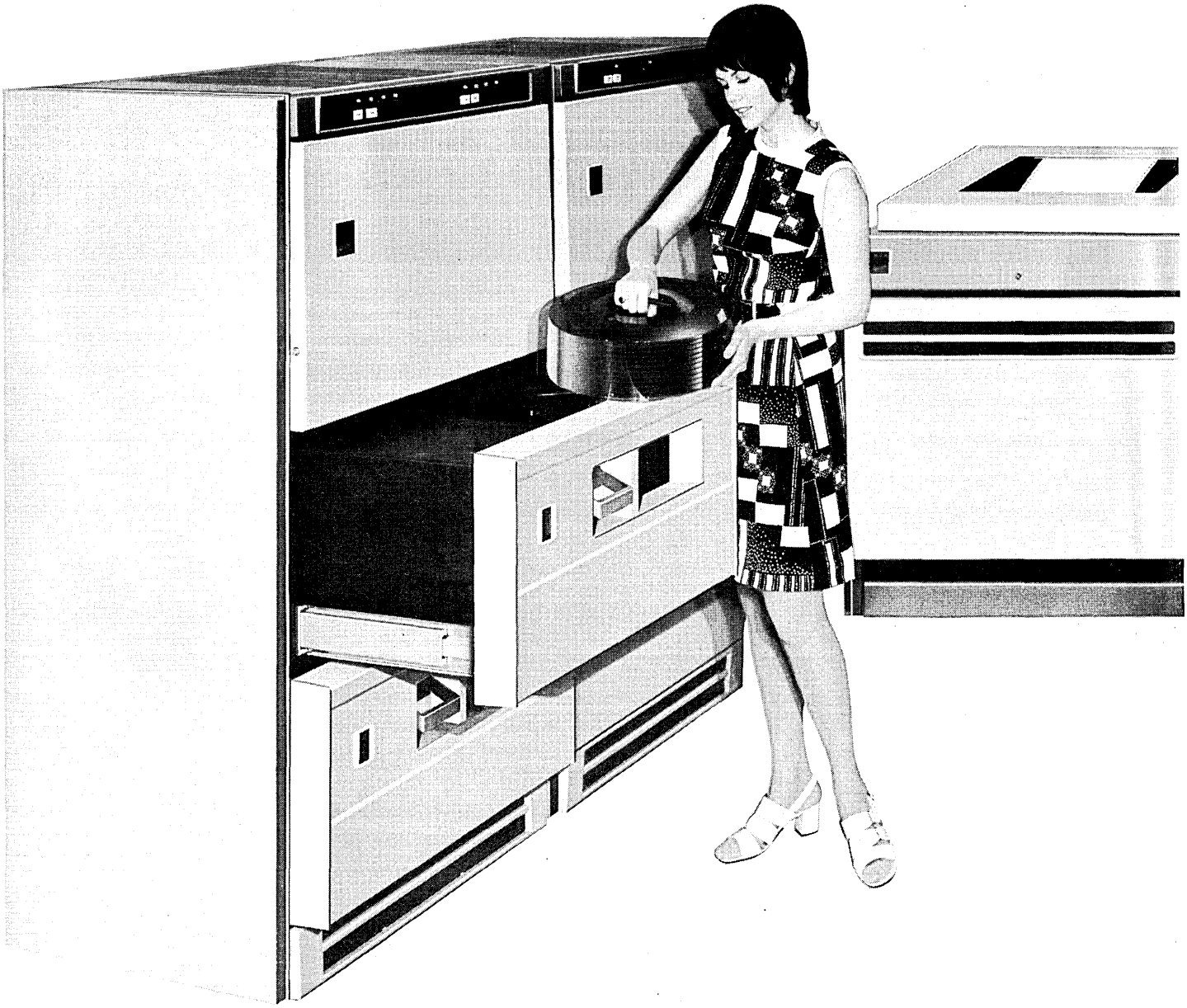
Call your local CalComp office, or contact California Computer Products, Inc., DM-M8-72, 2411 West La Palma Avenue, Anaheim, California 92801. (714) 821-2011.



CALCOMP

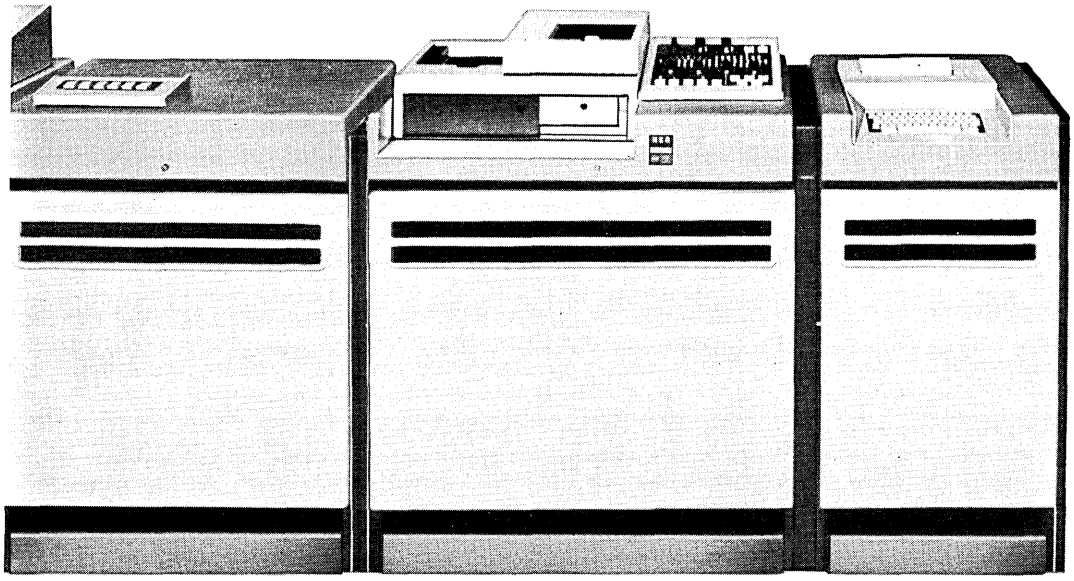
Calendar

EVENT/SPONSOR	DATE	LOCATION	CONTACT	COST
	AUGUST			
3rd Annual Academic Computer Center Directors Seminar	**21-23**	Aspen-Snowmass	E. R. Krueger, Dir. Univ. of Colorado Computing Center Boulder, CO 80302	$150
	SEPT.			
Semiconductor Memories Course	**15**	San Francisco	Cont. Educ. in Engineering Univ. of Calif. Extension 2223 Fulton St. Berkeley, CA 94720	$60, COMPCON $70, others
Sicob 72 Exhibition and Convention Informatique	**20-29** **19-22**	Paris	6, Place de Valois Paris-1er, France	615 F.F.
	OCTOBER			
USA–Japan Computer Conference	**3-5**	Tokyo	AFIPS 210 Summit Ave. Montvale, NJ 07645	$70, members $80, others
Data Processing Supplies Assn. Input/Output Systems Seminar	**3-5**	New York City	DPSA P.O. Box 1333 Stamford, CT 06904	3 days: $75, members $150, others
27th Annual ISA Conference and 6th Data Handling Symposium	**9-12**	New York City	Instrument Soc. of Amer. 400 Stanwix St. Pittsburgh, PA 15222	$5, members $10, others
Computer Science and Statistics: Sixth Annual Symposium on the Interface	**16-17**	Berkeley	Div. of Measurement Sci. School of Public Health Univ. of California Berkeley, CA 94720	$25
ACM SIGCOSIM Symposium on Major Issues Confronting Managers of Computer Resources	**17**	Gaithersburg	AD63 Fred S. Long NOAA Computer Div. Room 2331, FOB 4 Suitland, MD 20233	$20, members $25, others Students free
Project Management Institute 4th Annual Seminar/Symposium	**18-21**	Philadelphia	PMI P.O. Box 43 Drexel Hill, PA 19026	$90, members $115, others
American Society for Information Science 35th Annual Meeting	**23-26**	Washington, DC	ASIS 1140 Conn. Ave., N.W., 804 Washington, DC 20036	$45, members $60, others
International Symposium on Systems Engineering and Analysis	**23-27**	Lafayette	Prof. John E. Goldberg School of Engineering Purdue Univ. Lafayette, IN 47907	Modest
7th Annual ACM Urban Symposium	**27**	New York City	Gordon A. Gebert City College of N.Y. 138th St. & Convent Ave. New York, NY 10031	Not yet determined
Computer Lawyers Group Meeting	**27**	Washington, DC	Robert P. Bigelow 28 State St., 2200 Boston, MA 02109	Not yet determined



An average NCR Century 101 system includes:

- A high-speed memory that can expand as your needs grow (from 16K to 64K)
- A big magnetic disc system for fast, random information access (8 to 58 million bytes or more)
- High-speed printers to fit your requirements (from 450 to 1200 lines per minute).
- Prices from $2,450 to $3,800 per month



The NCR Century 101

It's the low-priced computer with the power of higher-priced systems

Another new member joins the growing family of over 7,000 NCR computers working for businesses of all kinds around the world.

It's the NCR Century 101. More than just another computer, it's a low-priced processor teamed with high-speed, high-capacity optional peripherals. The "101" was specifically designed for businesses which need more than their current EDP system can deliver, and for those considering the advantages of computerizing some of their operations for the first time.

The NCR Century 101 offers a new degree of performance in the small-to-medium range. Its high-speed memory, large-capacity disc system and remote batch processing communications capabilities continue the NCR Century Series tradition of offering a price/performance ratio and upward compatability that is truly outstanding in the industry.

Call the nearest NCR office (or use the coupon, if you wish) for the advantages your business can expect from the NCR Century 101. We'll send, by return mail and with no obligation, our illustrated booklet that explains the important details about the 101 . . . and the other members of the NCR Century family that range from $1,575 to over $20,000 per month. One of them could be just right for you.

NCR
Computers & Terminals

NCR Box 606, Dayton, Ohio 45409
I'm interested in the advantages my business can have with the NCR Century 101.
Please send your free illustrated brochure by return mail, with no obligation.

Name and title

Type of business

Company name

Street

City

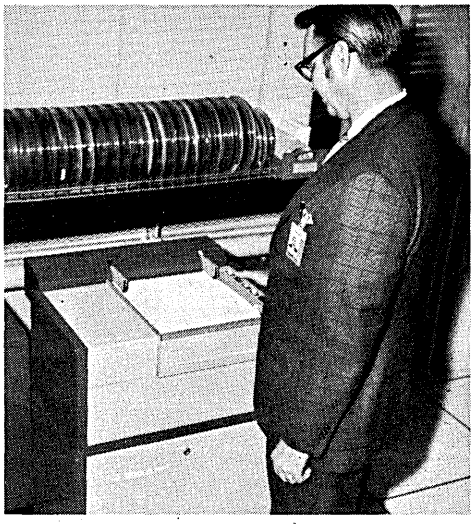
State

Zip

CIRCLE 37 ON READER CARD

"The Gould 4800 printer has been operating on-line with our IBM 370 since January.

And we estimate it's going to save us $63,000 this year."



That's what Flight Test at the McDonnell Douglas Corporation in St. Louis says.

Since their Gould 4800 electrostatic printer/plotter has been working with their IBM 370 Model 145, it's already reduced their computer, labor, paper and maintenance costs compared to their previous plotter method. Which, they estimate, will add up to a savings of $63,334 after one year's use.

McDonnell Douglas turned to the Gould 4800 because they have an immense graphic output workload. And their previous plotter method just couldn't keep up.

They first were impressed with the 4800's software and software support. But now they're impressed with many things.

Speed is better than anticipated. The 4800 produces a 11" x 17" page in 2 seconds. 300 charts in 3.5 minutes. (That's because it prints up to 3000 character lines a minute and plots more than 85 sq. in./sec.)

And because of its speed, McDonnell is able to also use the 4800 for alphanumeric core dumps. Which is a frequent requirement to maintain their 6 segment data base files.

What's more, it's versatile. Can produce both alphanumerics and graphics. Simultaneously. So test data, including grids, data and titling, are produced instantaneously.

It also prints out work loads and manpower scheduling charts. And will be used to plot pressure contouring studies and evaluations.

Other pleasant surprises. It keeps up with the IBM System 370, to support the processing and plotting evaluation of test data from 4 to 12 aircraft, at one time. It's proven 10 fold more reliable than the previous system. It doesn't require back up. Maintenance has been excellent. And interfacing was routine.

What the Gould 4800 is doing for McDonnell Douglas, it can do for you. For more information, write Gould Inc., Data Systems Division, 20 Ossipee Road, Newton, Mass. 02164.
Or call Mr. Bill Koepf at 617-969-6510.

ADVANCED DATA HANDLING SYSTEMS

GOULD

Letters

Out of business

Caution! "Ace Computer Service" missed the following diagnostic (see May, p. 64):

VIDEO TERMINAL TEST

ERROR # 1: FOX QUICK ENOUGH, BUT NOT BROWN

ERROR # 2: DOG COLOR MUST BE UNDEFINED

TEST FAILED—0002 ERRORS

VALERIO FRANCHINA
Rome, Italy

Relative merits

I read with much interest David Goldberg's article on the Legal Protection of EDP Software (May, p. 66). Though it presents a well-reasoned appraisal of the present state of patent, copyright, and trade secret law, I think Mr. Goldberg's premise that it is a settled matter that there should be protection for proprietary rights in computer programs should be carefully examined in view of our constitution.

He alleges that innovations surely deserve some measure of protection, and that our whole concept of patents and copyrights is founded upon it. I suggest to Mr. Goldberg that the converse view has merit: It is old and established law that the basis of the patent power is that of a privilege granted by society in return for a benefit received. "The grant to the inventor of the special privilege of a patent monopoly carries out a public policy adopted by the Constitution and laws of the United States, 'to promote the Progress of Science and useful Arts . . .'." *Morton Salt v. Suppiger,* 314 U.S. 489, 492, (1942).

Mr. Justice Clark said, about Article I, §8: "The Congress in the exercise of the patent power may not overreach the restraints imposed by the stated constitutional purpose. Nor may it enlarge the patent monopoly without regard to the innovation, advancement or social benefit gained thereby." *Graham v. John Deere,* 383 U.S. 1, (1966).

The constitutional mandate to promote the progress of science is not necessarily consonant with the interests of the software industry. The patent and copyright power was promulgated to obtain for the public sector the benefit of invention it would not otherwise gain; to provide a degree of protection to inventors not because they deserved it by some divine right, but because in trade for its franchise society gained revelation of new, unique, and publicly beneficial concepts. Since a protective monopoly often tends to increase the cost of a product to the user, it should be true that the user obtains greater value in return. When we talk of software, if it costs more to obtain, because of a patent monopoly, then there should be something better about it; a greater supply, a higher quality, or some other added value. That the user will obtain this greater benefit is not clear in proposals for extending legal protection of software.

Professor William Baxter enunciated a valid measure when he said: "Innovative activity should be subsidized as much and no more than is necessary to attract to that activity those inputs which, if invested in any other activity, would yield a product of lesser social value." 76 Yale L.J. 267, (1966). Judging from the growth of the software industry, our present system may well be adequate despite the admitted fact that it fails to provide clear-cut and absolute protection. Until the public need for extending the patent monopoly is clear, notwithstanding the private desire for new protections, it should not be augmented.

STEPHEN B. HORTON, ESQ.
Assistant Vice President,
Data Processing &
Information Systems
Ames Department Stores, Inc.
Hartford, Connecticut

Fortran feature

While I agree with many of the comments of Mr. Paul D. Griem, Jr., in the June Forum (p. 140), he has apparently been unaware of some aspects of programming. I not only heard of a FORTRAN compiler with a cross-reference listing, I worked on one. It was, and is, FORTRAN-H, Version II. As I recall, it was delivered with Release 14 of OS/360 back in 1967.

With regard to the EQU statement, it appears to me that the "high-level" languages express directly the functions that the assembly language coder must indirectly achieve via EQU and similar subterfuge.

Finally, I would agree with Mr. Griem's comment to the effect that programmers cling to assembly language only partly for efficiency-of-code reasons. More importantly, as he suggests, suitable languages are not available. The industry has perhaps too strongly emphasized the advantages of fewer (often a single) languages for programmers at the expense of more suitable problem-solving tools for teachers, engineers, clerks, and other consumers of the computer facility.

ROGER W. HOLLIDAY
Palo Alto, California

Happy talk

In reference to Paul D. Griem's article in The Forum, I would like to call your attention to the Jovial programming language.

Jovial has been in widespread use in the command and control areas of data processing for more than 10 years. Among its standard features are:

1. cross-reference listing (called SUSE for Set-Used),
2. equate statement (DEFINE directive), and
3. comments interspersed within statements at any point a blank may appear.

In addition, some, but not all, Jovial compilers contain a conditional assembly capability.

Jovial is relatively machine independent, standardized (by the Air Force), and is available for virtually all medium- and large-scale data processing computers. The language also allows programmers to code in the assembly language of the host computer when special capabilities are not directly available within Jovial syntax.

DAVID A. FEINBERG
Bethesda, Maryland

Gestapo tactics

Re: "IBM Employee Group Seemingly Headless," May, p. 115.

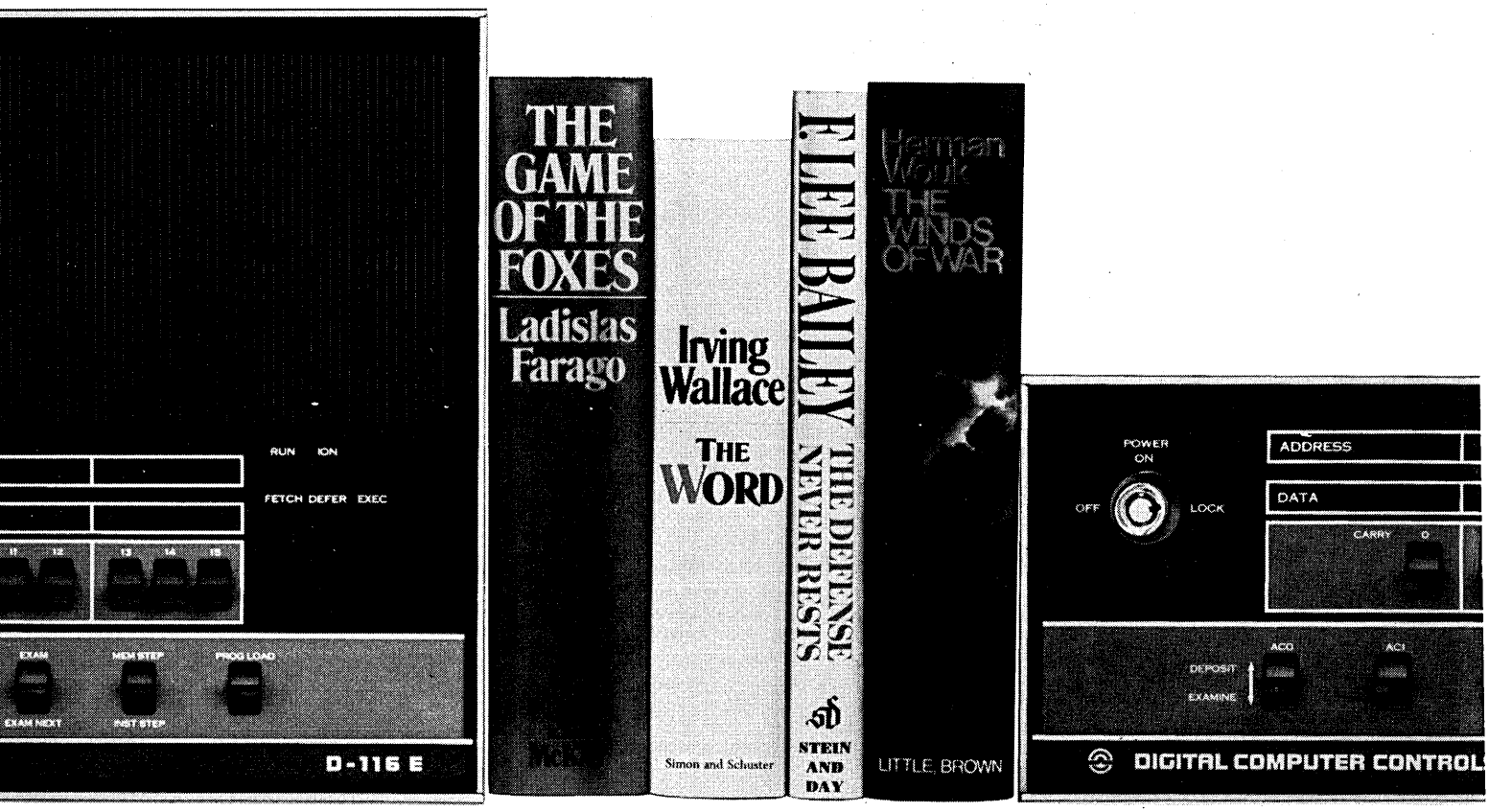
I was somewhat dismayed to hear that the IBM NORCAL Employees' Association was "headless" in as much as the rest of my torso seems to be attached to a large beanbag complete with nose, ears, eyes and, alas, a mouth. To place your article in proper perspective, I would ask that you note my address and phone number [Butler, Cunningham & Fulton; 777 N. First St., 215; San Jose, CA 95112; (408) 275-0255] along with the other information set forth herein.

I resigned from the IBM Corporation, after receiving double severance, effective February 2, 1972. To the best of my knowledge you never contacted me through the post office box; yet other publishers reached my office readily either through the mail or by phone. The above law firm opened for practice Monday, February 14 ,1972, and was listed with the general information operator of Pacific Telephone & Telegraph on that same date. As a practicing attorney, my address and other vital statistics are public information.

The referenced article may have been a bit shallow in research, as a few calls to the AFL-CIO headquarters would readily have produced my phone number and other relative information. Otherwise, your article was very accurate, and in fact it drew much attention if the calls to my office are any index. As of this date [June 13, 1972] I.N.E.A. has about 450 members with all but five members located at the IBM San Jose concentration camp.

Building great, inexpensive minicomputers is our business.

How they're used is yours.



Buy any minicomputer from us and you get an inexpensive, reliable, compatible piece of equipment.

Our D-116, for example. You get a 16-bit LSI/MSI minicomputer that's completely compatible with 1200 series machines. You get a 1.2 microsecond cycle time. You get either a 5¼" or 10½" chassis. And you get total interchangeability.

What you *don't* get is a lot of grief about licensing or proprietary agreements. We don't require them. We don't even want them. We just want to deliver hardware.

Digital Computer Controls, Inc.,12 Industrial Road, Fairfield, New Jersey 07006. Phone (201) 227-4861.

DIGITAL COMPUTER CONTROLS INC
Coming up fast.

CIRCLE 25 ON READER CARD

letters

The tactics IBM used on Mr. Lawrence A. Tate (May, p. 146) are mild compared to the Gestapo exterminations taking place at the San Jose ovens. Herr Learson would have done well in the Wehrmacht.

To update the status of the E.I.P. program (Employee Improvement), as the IBM layoff plan is officially designated, over 750 employees at San Jose have been surplused since the last quarter of 1970. As IBM earnings continue to rise, IBM *domestic* employment continues to decline. The number of S.D.D. employees slated for the 1972 oven stands at 38 by July 1. Some of the employees on the list are now in fact aware of the fact and have contacted my firm for legal assistance. As you know, prior to my departure from IBM, a suit was filed and is approaching trial regarding the firing of a San Jose IBM employee who used the benevolent "OPEN DOOR" policy and was immediately fired. (Ref. DONOVAN V. IBM, #259633, Santa Clara County, Superior Court of California). Further indications of the extent of the two-faced Learson smears are reflected by your own article in which IBM claimed to know nothing of my whereabouts. I enclose one of my firm's announcements sent to over 100 San Jose employees including management.

The facts simply show, and the public file of the above case will verify, that IBM was severely squeezed by the recession but IBM decided to use the opportunity as a pretext to "retire" 8.8% of the workforce. I invite your comment.

BRIAN D. CUNNINGHAM
San Jose, California

Musical note

I should like to take exception to the first paragraph of your May article entitled "Capture and Display of Keyboard Music," by P. H. Knowlton, which states: "Attempts to produce music notation mechanically have been generally unsuccessful."

It appears that the writer is not conversant with the music engraving and publishing fields and is therefore unaware that, in fact, 95% of the music "engraved" for printing in the U.S.A. today is produced mechanically, mostly by music typewriters and, more recently, even by computer-driven phototypesetters.

I hasten to add that the above is not a criticism, since the music engraving field is so small as to go practically unnoticed but for the few directly involved, and it has therefore no public exposure to speak of.

To my knowledge, the revolution did come to music notation in 1948 with the introduction of the first music typewriter; the changeover was completed as early as 1955. Moreover, the first use of a computer for music notation dates from 1953, being then utilized for the layout of music pages.

The first modern digital computerization of layout and line justification, with an accompanying tape-driven music typewriter, dates from the early '60s. 1969 brought us the first completely computerized music typography system (Music Reprographics, Ltd.). It uses two CPS-200 tape-perforating music-typewriters, a Digital PDP-8 (32K) for the main tape processing task, and an interface feeding data to a Honeywell computer that drives a standard Photon Textmaster 713-10 phototypesetter equipped with two Music Reprographics-designed music fonts. A whole library of auxiliary programs is also well under way comprising automatic transposing programs, editing, and parts extraction. The system is just now out of the evaluation state and is currently being accepted by music publishers.

ARMANDO DAL MOLIN
President
Music Reprographics, Ltd.
Oyster Bay, New York

Dr. Knowlton replies: Although many music symbols are machine fabricated, their placement on the musical staff requires intermediate human decision making. In addition, certain notation constructions like beams and slurs are still added in by hand. The ground that has barely been broken is in the interactive preparation of score, the rendering of which requires no human intervention.

By the way, I located a couple of minor errors in my article: The inequality on p. 58 should have read $(T_n+T_{n-1})/2<D\leq (T_{n+1}+T_n)/2$, $T_n>T_{n-1}$. Also, Fig. 9 on p. 59 is upside down.

Incompatibility

As a comment on the June issue in general, I wonder if the rest of the country suffers from the same problems as does the Chicago area. The ads for computer types in the area all expect three years or more of experience on the particular hardware/software package the installation currently uses. It is usually one of the 360 models and some corresponding software package. Many such ads emphasize in the preceding line the chance for advancement, professional status, and complete control and responsibility the applicant would have when hired.

It seems as if there are many companies who think the above requirements are compatible. I certainly do not think so, and ask the following questions:

1. Is this a problem in other areas of the country?

2. How do you or I go about convincing management that a computer-professional doesn't need three-five years on the exact package now installed to be useful?

3. Do we even care—if the company in question really thinks it can make good on all those glowing promises while forcing a man to use an existing package which probably doesn't fit the application?

JOHN L. BEAL
Development Engineer
Lisle, Illinois

Price is no object

Larry Welke's many efforts to define and categorize the software marketplace have been a boon to both buyer and seller. I must take exception, however, to several points in his rather flip article on buying software ("Buyer vs. Seller: Software Packages," May, p. 76).

First, a "reference sell" approach is of benefit to both seller *and* buyer. If the seller has a good product, he will give a prospect a *complete* list of users from which a statistically significant random sample may be selected. If the seller has a poor product, his competition will be only too happy to fill in the spaces on an edited list. Asking each vendor for the names of competitive users who have switched to his system is also a quick way to rank product acceptance. It is a rare software product which has not come bouncing back from an account or two, although they do exist.

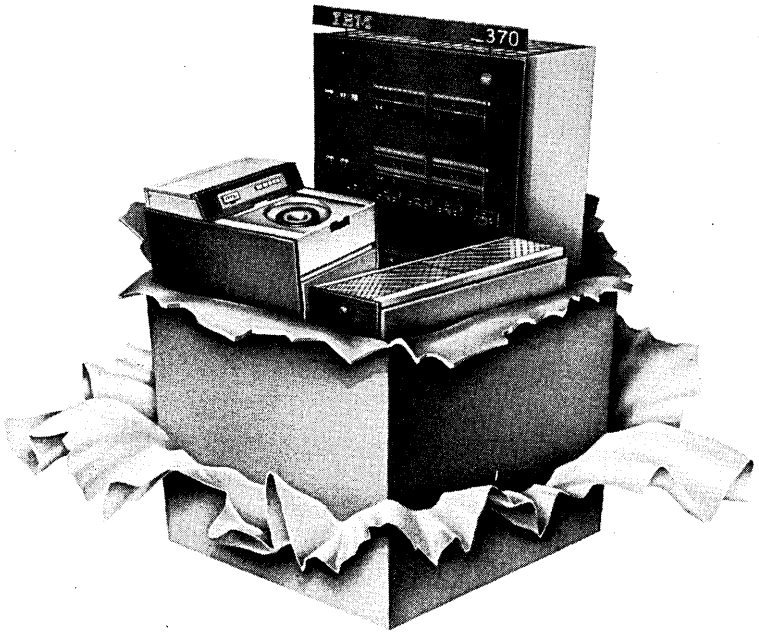
Second, "selecting the most expensive product" and "avoiding the least expensive" may not be a "hedge." A significant portion of a software product's price is the amortization of development expense. A user following the "most expensive" rule will rapidly find himself sharing product development expenses (for a possibly inferior product) with a very select group. Another reason for high product price is the need for large installation and support reserves—of decidedly negative value to the user.

In one area with which I am familiar, namely telecommunications support software, I would rank the two lowest priced products best and worst, respectively, while several products at many times the price are simply mediocre. A very simple price/performance analysis would, in this case, avoid a very expensive "hedge."

ERNEST E. KEET
Norwalk, Connecticut □

DATAMATION welcomes correspondence about the computer industry and its effects on society, as well as comments on the contents of this publication. Letters should be typed if possible, and brief. We reserve the right to edit or select excerpts from letters submitted to us. Write to 94 S. Los Robles, Pasadena, CA 91101.

BREAKTHROUGH!



ITEL's unique new Packaged Lease Program may be the most significant announcement since the introduction of the 370.

Now there's a new way to lease an IBM System/370 from ITEL on a short term basis with complete flexibility and surprisingly large savings. The ITEL Packaged Lease Program lets you lease a complete computer package consisting of System/370, ITEL Disk Drives, ITEL Tape Drives and AMS Monolithic Memory.

Lease terms range from 3 to 8 years, and savings can be as great as 60% of IBM rental!

ITEL's Packaged Lease Program may be the most comprehensive leasing program ever offered. Just look at the advantages of this package: All equipment is from a single source, ITEL. You can upgrade from one model of 370 to another during the terms of the lease. You get advanced technology Disk Drives, Tape Drives and Monolithic Memory. And you get remarkably flexible lease terms.

ITEL has the unique capabilities required to make such a lease: financial resources and expertise. (ITEL has over $260 million in 360 and 370 leases in effect.) Monolithic Main Memory from Advanced Memory Systems, Inc. Disk Drives from our Information Storage Systems Division, which have set the industry standards for reliability. And now Tape Drives.

Get all the facts on ITEL's Packaged Lease Program. **CALL THE PRICE/PERFORMANCE PEOPLE AT ITEL.**

ITEL
CORPORATION
One Embarcadero Center
San Francisco, California 94111
Phone: (415) 989-4220

CUT YOUR COSTS

D-8

ITEL Corporation, DPG
One Embarcadero Center
San Francisco, CA. 94111

Please provide me with more information on the Packaged Lease Program.

Name _____ Title _____

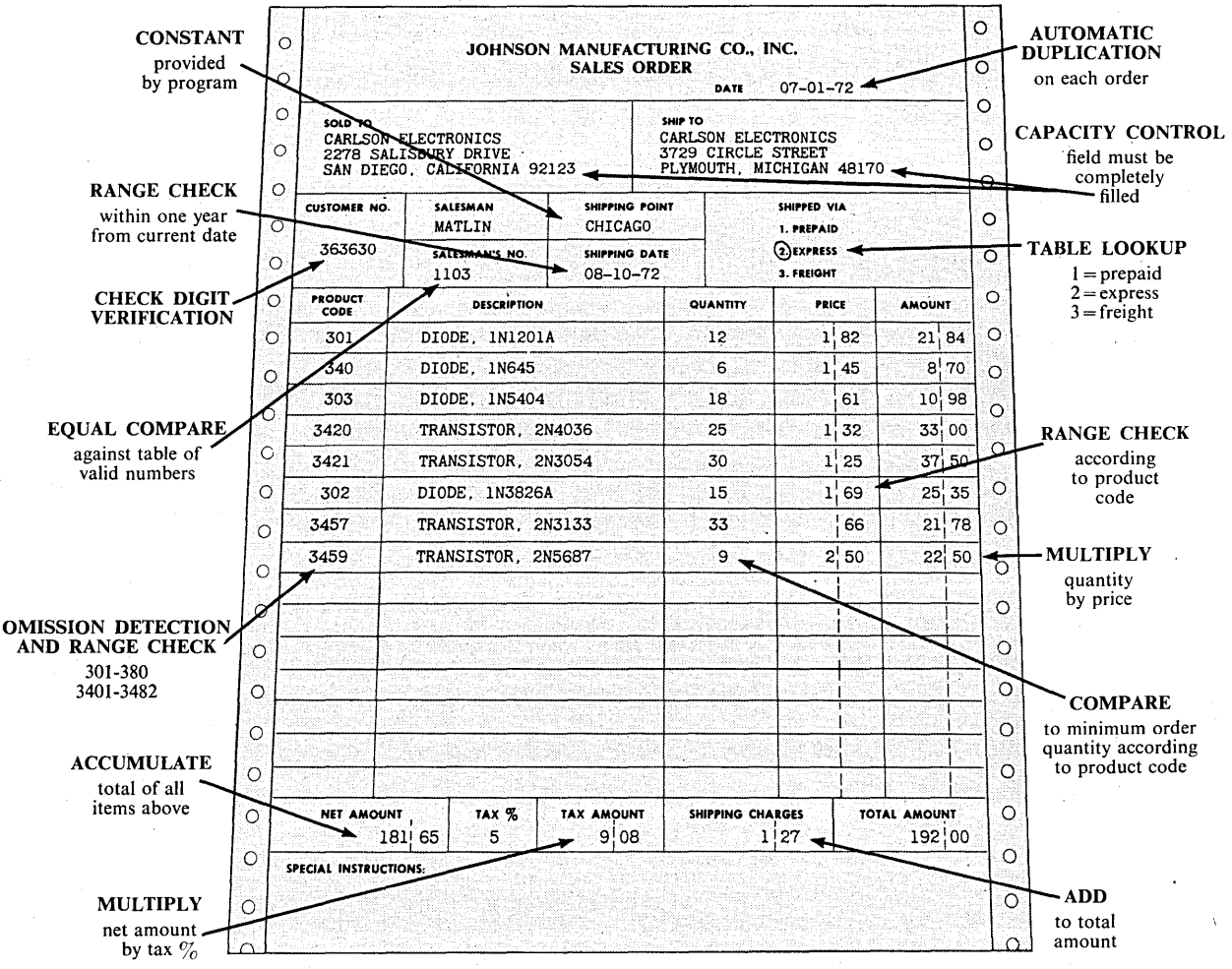
Company _____ Phone _____

Address _____

City _____ State _____ Zip _____

Present system _____

ERROR-FREE ORDER ENTRY FROM SYCOR.



User programmable with T.A.L. (Terminal Application Language)

CRT for display and edit of labels, data and error messages

Cassette storage of control formats and data (400,000 characters)

1200-4800 baud IBM compatible binary synchronous communications

Unattended communications and remote control of peripherals

30 cps to 200 lpm printing on 132-column multipart forms

Proven capability—3700 Sycor Terminals already installed

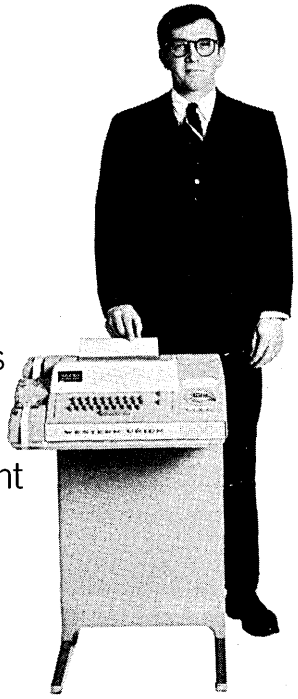
SYCOR INC

100 Phoenix Drive Ann Arbor, Michigan 48104 (313) 971-0900

The Sycor 340 Intelligent Communications Terminal.

Important news for computer

1. Your computer can now reach 100,000 TELEX and TWX subscribers.



Through the combined Telex and TWX networks, your computer or business machine can now communicate directly with over 40,000 TWX and 60,000 Telex subscribers in North America. The list includes every major company on the continent.

The interconnection is possible with interface equipment that Western Union installs in your office. It doesn't matter whether your company uses Telex, TWX or both. We can make the necessary installation to put your data processing equipment on the line.

2. Your computer can now automatically dial, send and receive messages.

Once Western Union has installed the interface equipment, your pre-programmed computer can automatically dial connections, transmit or receive messages. It will also disconnect and reset the circuit. The teleprinter associated with the interface can either be used in conjunction with the computer or separately when you choose to have the computer "blinded."

With the proper interface installation and appropriate programming, your computer can take over a wide variety of different tasks that call for up-dating and access from remote locations.

You can also use your computer to interconnect your own private wire system with Telex or TWX.

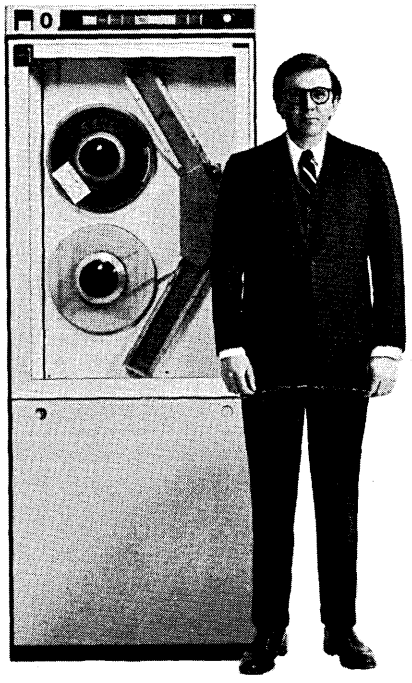
owners from Western Union.

3. Your computer can now transmit data and respond to inquiries.

A Western Union interface installation will enable your computer or business machine to automatically transmit and receive data to and from factories, warehouses, field offices, distributors, customers or suppliers and to handle routine inquiries from these and other Telex or TWX equipped locations.

Western Union Interfaces can be used with virtually any general-purpose digital computer that has a "communications" front-end.

4. Your computer can now perform many different on-line activities.



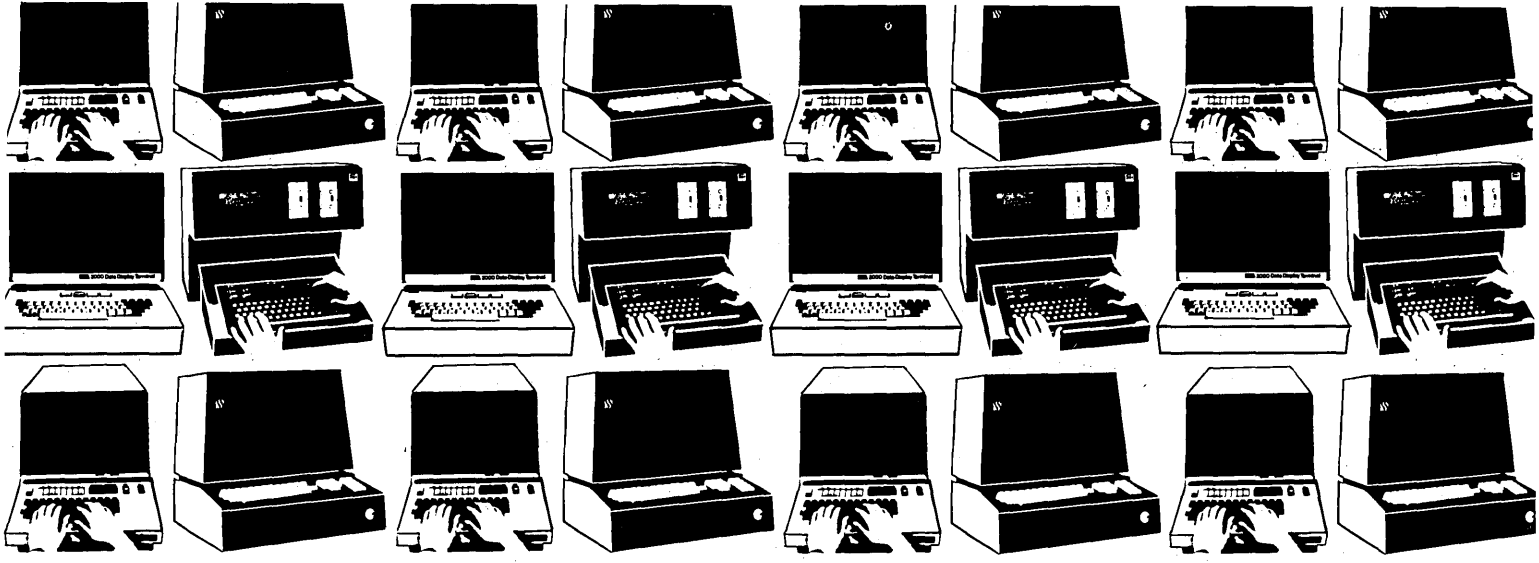
Many companies are already utilizing the Telex/TWX network for automatic data communications. With Western Union interface installations. their data processing systems perform many different functions. A brokerage house uses it to locate lost securities. Railroads use it to locate freight cars across the country. Insurance companies use it to check out risk data on applications. Others use it for handling vendor inventory, processing orders for remote sales offices, and providing time-shared data facilities for many locations.

If you would like to put your computer in touch with the outside world, we'll be happy to tell you more about how it can be done for a modest monthly rental cost.

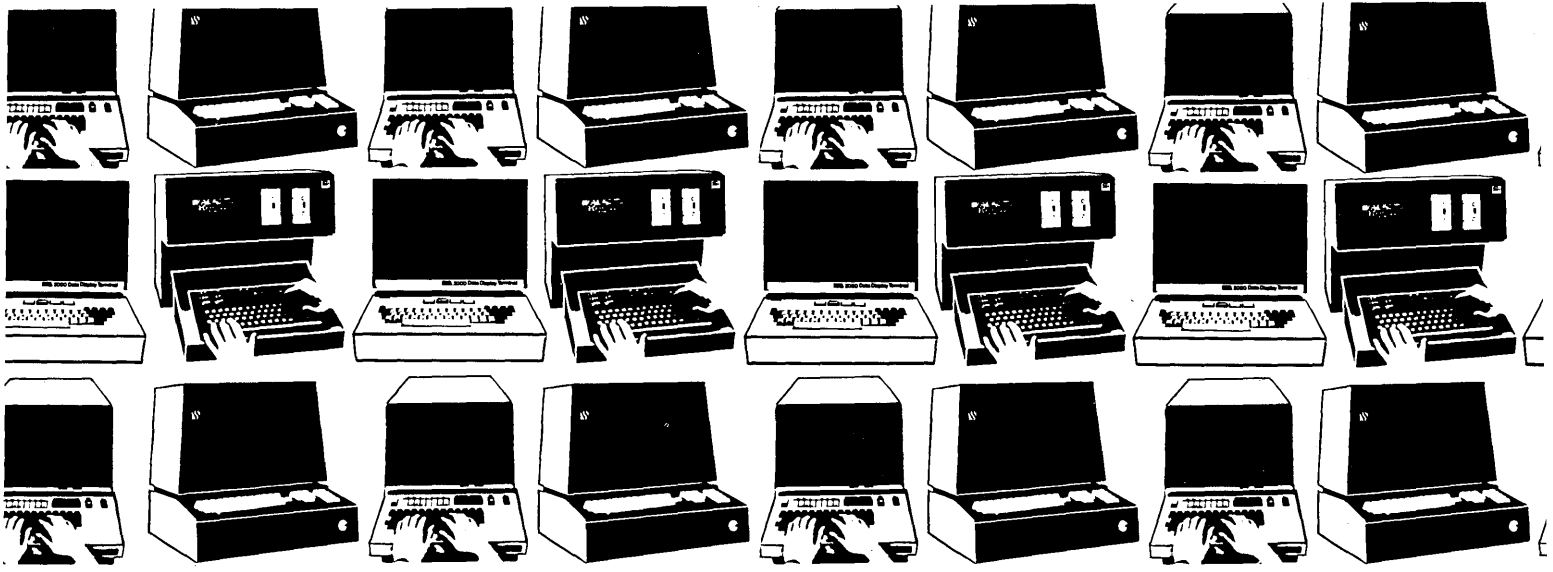
Contact your nearest Western Union office or write, call or wire Kendall J. Mau, Western Union Telegraph Company, 60 Hudson Street, New York, N.Y. 10013. Telex: 127251, TWX: 710-581-2159, Phone: 212-577-3898.

Western Union's TELEX/TWX Network.

Nationwide electronic data communications.



Computer manufacturers know all there is to know about data entry. Right?



Wrong.

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INFOREX

IBM's benediction of programmable front-end computers implies a new struggle in the communications processor marketplace and accelerating growth for data communications in general

The Meaning of the IBM 3705

by Byron W. Stutzman

With the introduction of the 3705, IBM has decisively entered the programmable front-end computer market. After watching Memorex, Sanders Associates, Interdata, Comten, and others carve out chunks of the data communication control market in which its 2701, 2702, and 2703 were major factors, the Colossus of Armonk has begun to move to head off the competition and perhaps gain a leg up. The direction in which IBM moves in the rapidly expanding field of data communications will affect it for years; this long-anticipated introduction of a programmable communications processor is the most significant step that IBM has taken in teleprocessing since the introduction of binary synchronous communication.

Communication control units

In general-purpose computer systems such as IBM's System/360 and System/370 a significant portion of the total value of the computer system is invested in input/output *control units*. The control unit is an intermediate element between an I/O device and the channel which controls the operation of the I/O device (tape, disc, printer) and provides a standard control interface at the channel. A different type of control unit is required for each type of device or class of devices.

In data communications, the "I/O device" is the transmission facility (line and modems) and the transmission control unit is the interface between the computer channel and the transmission facility. Because there is such a great variety of transmission codes, speeds, control procedures, and electronic techniques the control unit for data communication must be a very versatile device—far more versatile than control units for the traditional I/O devices. This versatility has ordinarily been accomplished by providing a wide variety of special-purpose modules that can be attached to a basic transmission control unit module. Until now IBM built all its transmission control units in this fashion.

Until the announcement of the 3705, IBM's line of communication control hardware was comprised of only three major offerings and several systems of lesser market importance, but of significant technical interest. The major items were the 2701 Data Adapter Unit, and the 2702 and 2703 Transmission Control Units. Their capabilities are briefly summarized below:

2701. This is the most flexible unit and its range of line interface options is the broadest of the three units. It is the only communication control unit in the IBM line capable of handling remote communication with the popular 2260 Display Station, and the only unit capable of operating at line speeds above 4800 bits per second. On the other hand, no more than four low-speed or two high-speed lines can be attached to it.

2702. This unit is designed specifically to handle moderate numbers (up to 31) of low-speed (up to 600 baud), asynchronous lines.

2703. The 2703 can handle up to 176 low-speed lines, or up to 24 lines operating at 4800 bits per second. Mixtures of medium-speed and low-speed lines can be accommodated, subject to configurational limitations and a total bandwidth limit of approximately 11.5K characters per second. These units do little more than perform serialization/deserialization, detect communication control characters, detect/generate parity bits and block check characters, and provide an interface to the System/360-370 channel.

Programmable communication controllers

The strategy of attaching specialized hardware elements to a basic transmission control module was satisfactory so long as the number of communication control units in the field was low. The enormous recent growth of data communications has had two results which strongly affect the economics of this situation. First, the great demand for communication control facilities now provides the large market necessary to support high volume production of generalized-function hardware in place of smaller volumes of specialized hardware components. Secondly, the fact that any given user's data communication requirements are likely to be both growing and changing makes it desirable to avoid the long delivery times and inflexibility usually associated with specialized hardware.

Minicomputers have provided the technological base for the development of general-purpose communication control units. Several minicomputer manufacturers have added communications hardware to their product line and, in some cases, have provided programming support for communications applications. In addition, several software houses have developed proprietary communications systems around these machines. These developments posed a threat of increasing im-

portance to IBM's long-established communications product line.

The systems that have been offered as alternatives to the IBM 270x units are of four general classes:

1. Strict plug-for-plug replacements containing only wired logic, e.g., Memorex, Sanders Associates units.
2. Plug-for-plug replacements based on minicomputers, e.g., Tempo, Interdata units.
3. Special-purpose units designed for OEMS or end-users with special needs, e.g., UCC Cope controller.
4. True general-purpose front ends such as the Comten machines.

These devices are listed in the approximate order of popularity. The hard-wired units posed the same kind of threat to IBM's product line as the familiar plug-compatible replacements for magnetic tapes and discs. The computer-based systems, however, possessed dangerous new possibilities. Their flexibility could be used to attach non-IBM terminals to System/360s and 370s and transform their codes and communication control procedures so that the foreign units would appear to the host machine to be IBM units. Worse, certain traffic control functions could be provided in the front end and therefore removed from the host machine. IBM's customers might spend more of their new equipment money on increasing the capacity of their front-end systems, and reduce the amount of money spent on IBM communication terminals and control units.

For the would-be manufacturer of replacements for IBM communication controllers there are formidable technical obstacles to the realization of true front-end processing. The investment required for software support is large and some of the programs would necessarily reside in the host IBM machine where they would be vulnerable to changes in IBM's system programs. The telecommunications access methods available from IBM—BTAM (Basic Telecommunications Access Method), QTAM (Queued Telecommunications Access Method), and TCAM (Telecommunications Access Method)—all assume that a 270x is used as a control unit. Thus, a front end which provides message control and processing services requires that a replacement for the IBM access method be supplied because the front end necessarily does not emulate a 270x. Previously existing application programs which use BTAM, QTAM or TCAM would, of course, have to be rewritten to accommodate the new access method. Suppliers of front ends hesitated to make the software investment and potential users hesitated to rewrite their costly teleprocessing programs to suit the front end. Some front ends were sold in situations where the manufacturer or user could afford a large investment in software; these situations were usually found in large, dedicated information systems. It was not a mass market, but the potential for invading large markets was enormous. IBM recognized this and made a few essays which appeared to be heading in the direction of a programmable front end.

IBM has other communications horses in its stable but they have either enjoyed only limited success or have been sold to markets where the primary reason to buy was not communications requirements. These products are interesting because of their technical capabilities and because they provide some background against which the 3705 can be evaluated.

The 2969. This was the largest communications controller ever offered by IBM. Reportedly a modified System/360 Model 44, it had specialized channels for connections to communication line adapters and to host machine channels. It was fast, expensive, not in the general IBM catalog, and could not be rented—it was a purchase-only, special-order item. It had an operating system designed for airline reservation system use which required that the host machine use the PARS operating system.

The 2715 Transmission Control Unit. This unit is the communication control unit for the 2790 industrial data acquisition system. It can be attached to a System/360 or 370, either directly to a selector or multiplexor channel, or remotely via a data link. The outboard side of the 2715 supports only the highly specialized 2790 communication technique. The 2715 processor is of interest, however, since it is microprogrammed and has an integrated magnetic disc which is used for enqueuing communications traffic. Its functions can be parametrically controlled by loading it with tables, sent from the host machine, specifying the processing to be performed on messages.

System/7. This machine is aimed at the process-control market but it does have features that are particularly appropriate for a front-end processor. A complete set of generalized communications equipment is available. The machine is very fast (400 nsec cycle time), has an instruction set well-suited to communications work, and is capable of rapid context switching—a must for efficient communications processing.

Having a volatile semiconductor main store, the machine is vulnerable to power failures, limiting its usefulness as a remote concentrator where reloading may be slow. However, this disadvantage would seem to be no more severe than it is in the primary System/7 marketplace (imagine your oil refinery control program wiped out due to a transient power failure). For front-end applications this disadvantage is not serious since the control program could be reloaded at high speed from the host machine. The obstacle to using the System/7 as a front end is that IBM has not offered a channel interface for it.

Enter the 3705

On the first of March, IBM announced the 3705, its answer to the programmable communications processor competition. The machine, called a Communications Controller by IBM, has a monolithic processor with a major cycle time of 1.2 microseconds and can be configured with from 16K to 240K bytes of ferromagnetic core storage in increments of 32K bytes. The instruction set is a variant of the System/360 instruction set. Inter-register, register-and-immediate-data, and register-to-storage instructions are available for both character and binary data operations. The 3705 has five program levels (background plus four interrupt levels). There are four separate groups of eight general registers; the two highest priority program levels share a set of registers and the remaining sets are dedicated to individual program levels. Context switching can be extremely rapid since registers do not have to be saved and restored when an interrupt is serviced. This is a particularly valuable feature in a machine that must service interrupts at a very rapid rate.

There is no direct data path between main storage and the communication lines; every character is processed individually by the control program. This is both a weakness and a strength. While individual character processing is slow, it permits maximum flexibility in treating data; the control program supplies specialized processing, not the hardware.

Up to 352 lines may be attached to the 3705 through a limited range of general-purpose line interface units (called line sets) which allow attachment of a very wide variety of lines. For example, one type of line set can be used for asynchronous lines operating at speeds up to 1200 baud through RS232 interfaces. Another type can be used for either asynchronous or synchronous lines operating at speeds up to 7200 bits/second through RS232 interfaces. Other line sets are available for speeds up to 50K bps, automatic calling units, limited-distance line adapters and telegraph lines.

A communication scanner provides the interface between the line attachment equipment and the 3705 processor. Two types of scanners are available. The type 1 scanner interrupts the

processor on every bit transferred; it is cheaper and is intended for use on lines operating at 4800 bps or lower. The more expensive type 2 scanner is used for higher-speed lines and in high-traffic systems where hardware dedicated to character assembly and disassembly is justified.

Similarly, the channel adapter which connects the 3705 to the host system also comes in two models. The less expensive type 1 adapter transfers data in one- to four-byte groups to a System/360 or 370 byte multiplexor channel. The type 2 adapter has a cycle-stealing capability to reduce processor intervention in the data transfer process. It may be connected to a System/370 byte- or block-multiplexor or selector channel.

Programming support for the 3705

There is comprehensive programming support for the 3705. Two different types of 3705 control program are available: a 270x emulator program, and a Network Control Program (NCP) which performs many of the functions formerly left to the access method in the host machine. Four system support programs are provided: NPC generation (actually a macro expansion and assembly process); an assembler which runs on the host system; a loader; a dump program.

To prepare a 3705 control program the user writes a series of macro instructions and optionally adds assembler language routines to implement functions not provided by IBM. With the NCP generation macros the user specifies the configuration of the 3705, the configuration of the network lines and terminals, and the processing to be performed on each block of data. These macros are next expanded into assembler language source text and assembled by the 3705 assembler which operates on a System/360 or 370. The ordinary OS Linkage Editor is used to combine assembled object modules into a load module which can be executed on the 3705.

The Loader is a utility program which is invoked to load the 3705 from the host system. It retrieves the 3705 load module from auxiliary storage and transfers it across the channel to the 3705.

The dump program is used in debugging 3705 programs. A dump program module in the 3705 dumps the contents of the 3705 main storage by sending it to the host system. The host dump program then formats and prints the dump.

An Emulator Program is generated in the same manner as a Network Control Program. The result is a specialized NCP which emulates a 2701, 2702, 2703, or a combination of those units. Unlike the NCP, the Emulator Program is supported under DOS as well as OS. The generation and execution of Network Control Programs is supported only under OS.

Operation of the NCP

An NCP controls the flow of data between the host machine and the network. The standard control functions of the NCP include:

1. Dialing and answering on switched lines.
2. Polling and selecting stations on nonswitched lines.
3. Assembling characters or bits into buffers as they are received from the communication lines, and serializing characters or bits for transmission.
4. Deleting communication control characters that are received and inserting control characters into data being transmitted.
5. Code conversion.

Standard error recording functions of the NCP include recording of 3705 hardware errors, and program malfunctions and line errors.

The units of data transferred between the NCP and the host are the message block or a complete message or a group of messages for a device. These units are delivered to or accepted from the NCP by TCAM, which provides the communications interface for application programs in the host (which must be a System/370). The 3705 effectively replaces the Message Control Program functions of TCAM and allows the host programs to be independent of the characteristics of the devices in the network.

Some observations

The 3705 has many interesting features, but no great surprises for observers of the teleprocessing scene.

The most significant news is simply that IBM has entered the front-end market and its mere presence there means that the market will grow—for the competition as well as for IBM.

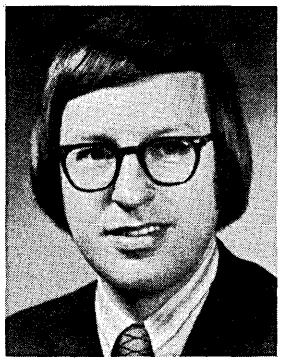
The most significant hardware news is that the System/7 was not used as the hardware base for the system. Many thought that the high speed, character processing capability, rapid interrupt handling and I/O architecture of the System/7 marked it as IBM's eventual front-end offering.

Basing programming support in the host machine is an interesting and valuable feature. It is not new; several of the non-IBM front ends have long had a similar capability and IBM itself first offered a host preparation facility with the System/7.

The rental cost of the 3705 is low enough that it will replace many 2701s, 2702s, and 2703s in installations with more than a handful of lines, especially if the bulk of them are medium-speed (2400 bps) or higher. But to reap the full benefit of the 3705, it must be operated in NCP mode, which requires TCAM and a System/370. This appears to be a marketing tactic. There is no good technical reason why this should be; IBM is simply withholding goodies from its customers until they trade up to a System/370.

The TCAM-NCP interface has very interesting competitive aspects. The channel-to-control-unit interface provided a standard method of attaching I/O devices to the System/360 and System/370. The existence of such a standard interface provided the means for the plug-to-plug-compatible device manufacturers to grab significant chunks of IBM's market. IBM certainly did not plan it that way but it simply had to invent the interface in order to rationalize its own production techniques. Several attempts have been made to eliminate this interface, (e.g., the Integrated File Adapter for discs on the 135) but this technique could not be applied across the board without destroying the compatibility of the 360-370 line.

The TCAM-NCP interface now provides the independents with a well-defined *software* interface. The hardware interface has never been a problem for manufacturers of replacements of IBM communication control units, but the lack of a standard program interface was sufficient to retard the development of front-end processing. Could it be that IBM has now opened the door for suppliers of front-end systems who will attempt to replace the 3705—a market of greater potential value than the 270x? □



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A survey of 52 specialized communications-handling computers from 40 vendors

Communications Processors

by D. J. Theis

Communications processors (CP's) are specialized stored-program computers that handle communications for other computers. They perform the character assembly, polling, data transmission error detection, and code conversion functions, releasing their hosts for full-time data processing. Their importance, and their numbers, are growing. Projections indicate that by 1980 over half of all computer installations will use them.

Survey criteria

We surveyed the manufacturers of CP's to produce the accompanying tables, and chose from among the questionnaire responses four overlapping classes of stored program processors that appeared to be marketed specifically for communications applications. We chose to include message-switching and store-and-forward processors (which may actually be used in stand-alone applications), remote concentrators (which may be thought of as intelligent multiplexors), IBM 270X replacements, and high-level front ends (which *can* replace the 2700s but also offer other capabilities). It is the nature of communications processors that a single device may be suited for several applications and therefore may belong in several of the classes. We have simply indicated on our charts for which applications each device is suited.

Several minicomputer manufacturers offer their standard model with data set interface options, but these were not included in the survey. Although the CP's all do contain computers, their special-purpose front-end hardware and especially their dedicated data communications software set them apart from general-purpose minis. We also excluded processors used primarily as the controller portion of remote batch terminals or of data entry systems, such as key-to-disc systems.

The information in the tables was supplied to us by the manufacturers prior to June 12, 1972. Although we have spent considerable time validating the data and trying to make its interpretation consistent, figures should be checked with the manufacturers directly. We have included a list of manufacturer names and addresses for this purpose. The list has reader service card numbers for the vendors and we have notified them of the likelihood of such inquiries. Prices, of course, are subject to change without notice.

A few words about the application of these devices, especially as remote concentrators and as central-site front ends, are in order.

Remote concentrators

The cost of communications lines goes up as the distance increases, so economies can be achieved by use of a remote concentrator to accept data from low-speed lines and concentrate this traffic onto one higher speed line. In the past this concentrating function has been performed by a communications line multiplexor. The cost of a CP is higher than that of a multiplexor, but its use to multiplex communications data lines, along with the CP's inherent stored program flexibility and modular expandability, offers significant advantages. These advantages are accommodation of interfaces to special terminals; buffering capability which allows a higher concentration ratio than a hardwired multiplexor by smoothing out the peak loads; and accommodation of changes in data rates, formats, codes, communication procedures, and number of terminal devices. The programmable aspects of a CP in remote concentration applications are just beginning, and the impact of this distributed processing approach offers real promise.

Front ends

Besides the stored-program processor, the basic CP configuration has a communications line controller between the modems of the common carrier lines and the I/O channel of the computer. This controller (also called data adapter or modem controller) is not a separate piece of equipment but a few printed circuit cards mounted in a card cage in the CP enclosure. The electrical interface at the modem conforms in voltage level, plug configuration, and pin assignment of data and control signals to the EIA-STD RS-232B or MIL-STD-188B interface specifications. The controller buffers the line functions as well as the data. The information carried in line function words, in conjunction with the timing and control logic, determines the appropriate sampling rate, character size, and stop control format. There are many types of modems used requiring different controller designs unique to the particular modem characteristics.

The most common communications line control equipment is the IBM 2701, 2702, and 2703 data adapter and transmission control units. Several manufacturers offer CP equipment which is a plug-to-plug replacement for

these hardwired units. These replacement units emulate the IBM equipment, requiring little or no change in the central computer's (IBM System/360 or 370) communications control software. Replacing the transmission control units with a CP allows the user to switch over in phased steps, where the first step is an emulator of the existing communications line control unit, which does not require changes in the host computer software.

In many computer systems, I/O controllers are external devices. Similarly, the front-end CP approach is to separate all the data communications control from the central computer. The CP controls and prepares the data from the terminals or other computer systems for use by the central computer. The front end works in parallel with the central computer to increase throughput capability of the overall system.

The execution of the individual basic communications control functions within a CP is relatively simple, but the execution concurrency of all the functions in a well-disciplined manner requires careful design. The data rates from the terminals are fixed relative to the terminal device characteristics and the modem equipment. The data transfer to the central computer is usually by high-speed block transfers. The typical front-end processor does many basic communications control functions, such as line control procedures, character-to-message assembly/disassembly, polling, message queuing, code translation, and error control and recovery.

There are different kinds of line control procedures or disciplines used—e.g., IBM's Binary Synchronous Communications (BSC)—depending on the terminal equipment. The interface between the modem equipment and the front end is activated by the control and status signals, which in turn are driven by the control routines implementing the line control procedure. The control procedure handles character synchronization of the incoming data, following which the character-to-message assembly (or disassembly) is performed. This involves a data organization to handle full message segments or blocks of data. A block of data is variable in length to allow better line utilization.

The front end can periodically poll the terminals, accepting transmission from terminals when messages are ready, and acknowledging when the message is received correctly. Polling is probably the most widely used means of network control because it permits the CP to maintain input data rate control, preventing overload conditions. Polling requires a means of addressing and maintaining status tables for each device such that the front-end processor can accommodate all the terminal-specific information. This allows the central computer to operate strictly in terms of logical, not physical, devices. The front-end processor accumulates different message segments or data blocks and queues them in memory. Queuing refers to the ordered set of messages where each queue has an entry, an exit, and a direction. The CP can also convert message segments from the transmission format to the record or file format used in the central computer.

Although ASCII and EBCDIC are the two most prevalent codes available with terminals today, there are many other 5-, 6-, 7-, or 8-bit codes in use. This is one of the main reasons CP's facilitate servicing many different kinds of terminals; CP software conversion routines provide the code commonality required by the central computer. Code conversion for input and output for several different devices can represent a significant load on a central host computer.

The degree of error detection sophistication required in message validation is highly dependent on the application. For error detection, the front end can generate vertical redundancy check (VRC) bits or longitudinal redundancy check (LRC) characters on Transmit and check them on Receive to determine bit errors or missing characters, respectively. For correction, the front-end processor can request the retransmission of the character, message, or data block containing the error. Sophisticated methods, such as error correcting codes and correction by front-end software, are available, but retransmission is used in most applications because it is the most economical approach.

Other CP features also increase communications reliability. A "fail soft" capability allows the terminals to continue to transmit even though the central computer is down for awhile. Terminal testing provides a means of diagnosing terminal trouble from the central computer site. Activity monitors can be added to display the actual measured performance levels relative to a theoretically achievable level; this provides a profile analysis of total system utilization for defined periods of time.

Many other desirable features are available on front-end CP's. For instance, line speeds can be controlled adaptively by software. Front-end sampling determines the speed and the identity of the terminal and loads the appropriate parameters into the communications control unit so data transmission can begin. These line speed sensing and addressing features can also be used in the remote concentrator.

All of this is done under the control of a front-end operating system, typically called a Network Control Program (NCP). It provides capabilities such as polling, terminal addressing, error detection, code translation, and buffering which were formerly part of the central computer's operating system. A front-end operating system must be designed to switch between many short routine tasks with a minimum overhead penalty. This feature is the key element to achieve high throughput. CP software development has reached the level of maturity where the telecommunication access method software resides in the front-end processor. Software interfaces with the central computer's operating system are required, typically a macro language with supporting I/O logic. Also, system macros are developed which can be added to the system library to allow message-processing programs within the central computer to directly access the data in the front-end processor (i.e., these macros are loading registers in the central computer). The interface software provides application programs with the means to control the queue classes between the central computer and front end. Typically, the main routines are core resident, while the less frequently used modules reside on fast access disc. The primary design goal for such a package is to isolate the application programs from the control functions.

To facilitate software development and performance, special or communications-oriented instructions are added to the repertoire of the CP. As manufacturers gain in data communications control experience, the use of new and better instructions is inevitable. One of the basic operations in communications control is queuing of data and the control information maintained as ele-

(Text continues on page 43)

ABBREVIATIONS USED IN THE TABLES

CRC	cyclic redundancy check
dma	direct memory access channel
LRC	longitudinal redundancy check
mpx	multiplexor channel
ppu	peripheral processing unit
SBT	six-bit transcode
sel	selector channel
VRC	vertical redundancy check
XS3	excess-three code

COMMUNICATIONS PROCESSORS — Summary of Characteristics

Manufacturer	American Data Systems, Inc.	Bolt, Beranek and Newman, Inc.	Burroughs Corp.	Burroughs Corp.	CDC Communications Products
Model	950	IMP/TIP - Series B	DC 1200	DC 1800	M1000
1st installation/number inst.	5/71 inst not given	9/69 27 inst	6/70 inst not given	6/70 10 inst	1968 20 inst
Applications					
Remote concentrator	✓	✓	✓		
270X emulator	✓			✓	
Front-end	✓	✓	✓		✓
Message switching		✓	✓		✓
Store & forward		✓	✓		✓
Computer Compatibility					
Host computers	IBM 360, 370	IBM, Univac, DEC, others	Burroughs, others	IBM 360, 370 only	CDC Cyber & 6000, IBM 360
Channels	sel, mpx, block mpx	dma, sel, mpx, block mpx	Burroughs or common carrier	mpx	sel, mpx, CDC PPU
Max word rate/path width	500K/8 bits	100K bps/1 bit	50K/8 bits	50KB+/8 bits	120K/8 bits
Software compatibility	all IBM	all	Burroughs RJE, others	BTAM, QTAM, TCAM	Cyber OS, IBM OS & DOS
Special software required?	no	Network Control Prog.	no	no	yes ($150-300/mo)
Device emulated	IBM 2701, 2702, 2703			IBM 2701, 2703	
Internal Specifications					
Memory range/word size	8K-128K (16 bits + 2 parity)	12K-32K (16 bits)	4K-32K (8 bits + 1 parity)	4K-32K (8 bits + 1 parity)	48K-192K (24 bits)
Memory cycle/technology	1-usec core	900 nsec or 1.6-usec core	1.5-usec core	1.5-usec core	800-nsec core
Hardwired/microprogrammed	microprogrammed	hardwired	hardwired	hardwired	hardwired/microprogrammed
Communications instructions	translate & test	none	not given	not given	yes
Functions Performed					
Scheduling	✓	✓	✓		✓
Auto line speed sensing	✓	✓	✓		✓
Data packing/unpacking	✓	✓	✓		✓
Auto calling	✓		✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓		✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing		✓	✓	✓	✓
Formatting	✓	✓	✓		✓
Transmission					
Block sizes	1-2048 bytes	10-520 words	variable	variable	80-4096 words
Buffer sizes	dynamically allocated	not applicable	variable	1-256 bytes	80-4096 words
Codes used	ASCII, EBCDIC, SBT, others	SBT	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, others	ASCII, EBCDIC, Baudot
Max active asynch lines/speeds	512 lines, 75-1200 bps	63 lines, 75-19.2K bps	65 lines, 45-1200 bps	64 lines, 45-1800 bps	512 lines, 75-1800 bps
Max active synch lines/speeds	128 lines, 1200-50,000 bps	5 lines, 9600-230.4K bps	65 lines, 2000-9600 bps	not applicable	24 lines, 2400-40.8K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware	hardware/software	hardware/software	hardware
Special checks performed	CRC, LRC, VRC, polynomial	CRC	CRC, LRC	CRC, LRC	CRC, LRC
Back-up and recovery	retransmission, redundancy, software reconfigurator	retransmission	retransmission	software	fully automatic
Prices					
"Standard" configuration	32K, 128 low speed lines, 360 interface, console, power fail, mem protect	63 input ports, host interface, 2 high speed modem interfaces	16K, 16 terminal lines, host interface, console	16K, 32 lines, 2703 emulation software	dual exchange, protected, 64-256 lines
Purchase	$76,500	approx $120,000	$58,320	$92,000	$250,000-$600,000
Monthly maintenance	not given	not given	$147	$352	$1,000-$2,000
Monthly rental or lease	$2,065 (5 years)	not available	$1,248 (5 years)	$2,331 (5 years)	$5,000-$12,000 (1-5 years)

Summary of Characteristics...

Manufacturer	Chi Corp.	Collins Radio Co.	Computer Communications, Inc.	Computer Communications, Inc.	Computer Communications, Inc.
Model	Mark II	C-System	70	71	7000
1st installation/number inst	date not given 1 inst	6/67 50 inst	4/72 18 inst	date and inst not given	12/71 1 inst
Applications					
Remote concentrator		✓		✓	
270X emulator			✓		
Front-end	✓	✓	✓		✓
Message switching		✓			✓
Store & forward		✓			✓
Computer Compatibility					
Host computers	Univac 1108	IBM 360, 370; Univac	multiple IBM, CDC, Xerox	IBM, CDC, Xerox	IBM, CDC, Xerox
Channels	ESI I/O channel	sel, mpx, block mpx	mpx, block mpx	common carrier	mpx, block mpx
Max word rate/path width	100K/6-8 bits	2M/1 bit	500K/8 bits	50K/1 bit	500K/8 bits
Software compatibility	EXEC 8	OS, PARS in CCP	IBM, CDC, Xerox	IBM, CDC, Xerox, others	IBM, CDC, Xerox, others
Special software required?	modified EXEC	yes (no charge)	no	no	no
Device emulated					
Internal Specifications					
Memory range/word size	4K-64K (8 bits)	16K-64K (32 bits)	8K-64K (8 bits + 1 parity)	8K-64K (8 bits + parity)	8K (8 bits + 1 parity)
Memory cycle/technology	1-usec core	2-usec core	1-usec core	1-usec core	1-usec core
Hardwired/microprogrammed	microprogrammed	hardwired	hardwired, microprogrammed	hardwired/microprogrammed	hardwired/microprogrammed
Communications instructions		byte handling	yes	yes	yes
Functions Performed					
Scheduling		✓	✓	✓	✓
Auto line speed sensing		✓	✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling		✓			
Auto answering	✓	✓	✓	✓	✓
Polling		✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing		✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	variable	128-2048 bytes	1-65K bytes	1-65K bytes	1-65K bytes
Buffer sizes	variable	128-2048 bytes	any	any	any
Codes used	ASCII, EBCDIC, XS3, others	ASCII	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, Baudot
Max active asynch lines/speeds	128 lines, 75-9600 bps	45-2400 bps	240 lines, to 9600 bps	240 lines, to 9600 bps	960 lines, to 9600 bps
Max active synch lines/speeds	16 lines, 2000-9600 bps	2000-2M bps	60 lines, 2000-50K bps	60 lines, 2000-50K bps	240 lines, 2000-50K bps
Error Checking & Recovery					
Hardware or software checks	software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, polynomials, etc.	CRC, LRC	CRC, LRC, polynomial	CRC, LRC, polynomial	CRC, LRC, polynomial
Back-up and recovery	--	software	redundancy, retransmission	redundancy, retransmission	redundancy, retransmission
Prices					
"Standard" configuration	24K, 32 lines	dual processors, dual discs and tapes, card reader, line printer	16K, I/O processor, interrupt generator, 360 interface	16K, 2K ROM, interrupt generator, synchronous channel	dual processors, two discs, 16 medium or 64 low speed lines
Purchase	$60,000	$1,000,000	$47,000	$37,500	$280,000
Monthly maintenance	approx $350	$4,000	$290	$225	$1,700
Monthly rental or lease	not available	$27,000 (3 years)	$1,221 (5 years)	$951 (5 years)	$8,300 (5 years)

Summary of Characteristics...

Manufacturer	Computer Control Systems, Inc.	Comtec Data Systems, Inc.	Comten, Inc.	Comten, Inc.	Comten, Inc.
Model	Teleswitcher DCS-5000	CT/90	20	45 and 65	3670 CCM
1st installation/number inst	1/71 10 inst	12/70 10 inst	date and inst not given	9/69 inst not given	date and inst not given
Applications					
Remote concentrator	✓	✓	✓		
270X emulator		✓			✓
Front-end	✓	✓		✓	✓
Message switching	✓	✓	✓	✓	
Store & forward	✓	✓	✓	✓	
Computer Compatibility					
Host computers	IBM 360, 370	multiple IBM, Univac, others	host independent	IBM 360, 370	IBM 360, 370
Channels	sel, mpx, block mpx	dma, sel, mpx, block mpx	common carrier	sel, mpx, block mpx	mpx, block mpx
Max word rate/path width	200K/8 bits	500K/8 bits	29KB/1 bit	200K/8 bits + parity	620K/8 bits + parity
Software compatibility	OS	BTAM, QTAM, TCAM, others	IBM 360	Comten's CTAM	all IBM
Special software required?	yes (no charge)	no	no	yes (no charge)	no
Device emulated		IBM 270X, 290X; Univac CTMC			IBM 2701, 2702, 2703
Internal Specifications					
Memory range/word size	2K-128K (16 bits)	8K-1024K (16 bits + 2 parity)	8K-32K (16 bits + 2 parity)	8K-128K (32 bits + 4 parity)	8K-256K (16 bits + 2 parity)
Memory cycle/technology	2-usec core, semiconductor	800-nsec core, semiconductor	900-nsec core	1.2-usec (45)/750-nsec (65) core	650-nsec core
Hardwired/microprogrammed	hardwired/microprogrammed	microprogrammed	hardwired	hardwired	hardwired
Communications instructions	as required	read block, write block, others	allow interrupt, insert pointer, test parity, etc.	allow interrupt, insert pointer, test parity, etc.	allow interrupt, insert pointer, test parity, etc.
Functions Performed					
Scheduling	✓	✓		✓	
Auto line speed sensing		✓	✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	
Auto calling	✓	✓		✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing	✓	✓		✓	✓
Formatting	✓	✓	✓	✓	
Transmission					
Block sizes	1-400 bytes	1-1M words	variable	any	variable
Buffer sizes	60 bytes	8-256 words	4-64 bytes	4-128 bytes	4-64 bytes
Codes used	ASCII, EBCDIC, Baudot, others	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, SBT, others
Max active asynch lines/speeds	128 lines, to 1200 bps	1024 lines, 40-9600 bps	128 lines, 45-1800 bps	256 lines, 45-1800 bps	384 lines, 45-1800 bps
Max active synch lines/speeds	128 lines, to 19.2K bps	1024 lines, 2000-50K bps	128 lines, 2000-240K bps	160 lines, 2000-240K bps	160 lines, 2000-240K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, VRC	CRC, LRC, VRC	CRC, LRC, VRC	CRC, LRC, VRC	CRC, LRC, VRC
Back-up and recovery	auto recovery from last message each line	multiple cpu's, auto func integrity check, network diagnostics	remote initial loading	commo line "Y" selector, redundant processors	commo line "Y" selector, redundant processors
Prices					
"Standard" configuration	not given	processor, host interface and 64 line adapters	not given	98K, 64 asynch lines, 16 synch lines, disc, card reader, printer	32K; 1 broad band, 16 tty, 16 model 2741, 4 BSC lines
Purchase	$75,000 and up	$70,000	$75,000	$239,000 (45); $285,000 (65)	$94,000
Monthly maintenance	not given	$350	not given	$1,390 (45); $1,660 (65)	$425
Monthly rental or lease	not given	$1,820 (5 years)	not available	$6,600 (45); $7,900 (65)	$1,950 (2 years)

Summary of Characteristics...

Manufacturer	Cybermatics, Inc.	Data Pathing, Inc.	Digital Equipment Corp.	Digital Equipment Corp.	EMR-Computer
Model	Tin Can 1	2100/2104	DECcomm 11D20	DECcomm 11D23	DCS-16
1st installation/number inst	date and inst not given	3/70 100 inst	12/71 30 inst	5/72 8 inst	1970 15 inst
Applications					
Remote concentrator	✓		✓		
270X emulator					✓
Front-end	✓	✓	✓	✓	✓
Message switching	✓		✓		✓
Store & forward	✓		✓		✓
Computer Compatibility					
Host computers	IBM 360, Univac 1108, 418	IBM, Univac, Burroughs, GE	DECsystem 10, IBM 360	IBM 360, 370	IBM, Univac, Burroughs
Channels	sel, mpx, block mpx	sel, mpx, block mpx	dma, sel, mpx, block mpx	sel, mpx, block mpx	dma, sel, mpx
Max word rate/path width	not given	125K/8 bits	250K/8 bits	250K/8 bits	2M/16 bits
Software compatibility	not given	IMS, BTAM	GAM, TCAM, QTAM	GAM, TCAM, QTAM, BTAM	BSAM, BTAM, QTAM
Special software required?	no	no	no	no	no
Device emulated		mag tape controller or crt	IBM 2780, 2848	IBM 2848	IBM 270X or peripheral
Internal Specifications					
Memory range/word size	12K-128K (16 bits + 1 parity*)	16K-32K (8 bits + 1 parity)	4K-128K (16 bits + 1 parity*)	4K-128K (16 bits + 1 parity*)	8K-32K (16 bits + 1 parity)
Memory cycle/technology	900-nsec or 1.2-usec core	1-usec core	900-nsec core	900-nsec core	500-nsec core
Hardwired/microprogrammed	hardwired	hardwired	hardwired	hardwired	hardwired
Communications instructions	none	yes	byte handling	byte handling	not given
Functions Performed					
Scheduling	✓	✓	✓	✓	✓
Auto line speed sensing			✓	✓	
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling	✓		✓	✓	✓
Auto answering	✓		✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	
Routing	✓	✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	1-32K bytes	to 250 bytes	variable	variable	50-500 words
Buffer sizes	variable	to 960 bytes	variable	variable	50-500 words
Codes used	ASCII, EBCDIC, SBT, Baudot	ASCII, EBCDIC, others	ASCII, EBCDIC, SBT	ASCII, EBCDIC, SBT	any
Max active asynch lines/speeds	64 lines, 50-2400 bps		100 lines, to 9600 bps	100 lines, to 9600 bps	250 lines, 75-1200 bps
Max active synch lines/speeds	64 lines, 2400-40.8K bps	10 lines, 1200-50K bps	10 lines, to 50K bps	10 lines, to 50K bps	60 lines, 1200-50K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, parity	CRC, LRC, modulus	CRC, LRC	CRC, LRC	CRC, LRC, character parity
Back-up and recovery	software and storage	dual processor, dual tape, auto repolling	auto retransmission	auto retransmission	fail soft hardware
Prices					
"Standard" configuration	not given	32K, Teletype, 16K drum, mag tape, 4 lines	PDP 11/20, ASR 33 Teletype, clock	16K PDP-11/20, ASR 33 Teletype, 360 interface, clock	cpu, disc, peripherals, commo control unit, line interfaces
Purchase	$50,000	$60,000	$16,400	$30,900	$180,000
Monthly maintenance	not given	$500	not given	$188	not given
Monthly rental or lease	not given	$1,200 (5 years)	not available	not available	$4,200 (5 years)
	* Optional		* Optional	* Optional	

Summary of Characteristics...

Manufacturer	EMR-Computer	General Electric Co.	General Instrument Corp.	Honeywell, Inc.	Honeywell, Inc.
Model	DCS-45	DigiNet 1600	System 75	Datanet 355	Datanet 2000
1st installation/number inst	1971 1 inst	3/71 inst not given	10/71 10 inst	11/70 inst not given	12/72 inst not applicable
Applications					
Remote concentrator		✓	✓		
270X emulator	✓	✓			
Front-end	✓		✓	✓	✓
Message switching	✓	✓	✓	✓	
Store & forward	✓	✓	✓		
Computer Compatibility					
Host computers	IBM, Univac, Burroughs	IBM 360, HIS 6000, others	IBM 360, 370	HIS 600, 6000	HIS 200, 2000
Channels	dma, sel, mpx	dma, mpx	sel, mpx	dma	mpx, block mpx
Max word rate/path width	6M/16 bits	225K/16 bits	800K/16 bits	500K/6-36 bits	42K/8 bits
Software compatibility	not given	TCP OS	OS MVT	GCOS	OS/2000
Special software required?	no	no	no	no	no
Device emulated	IBM 270X or peripheral	IBM 270X	IBM 2803, 3803		
Internal Specifications					
Memory range/word size	32K-128K (16 bits + 1 parity)	4K-32K (16 bits)	2K-32K (16 bits)	16K-32K (16 bits + 2 parity)	16K-32K (16 bits + 1 parity)
Memory cycle/technology	600-nsec core	1.2-usec core	800-nsec or 1.2-usec core, semi	1-usec core	780-nsec core
Hardwired/microprogrammed	hardwired	hardwired	hardwired/microprogrammed	hardwired	hardwired
Communications instructions	not given	SCAN (services low speeds)	yes	yes	stack addressing
Functions Performed					
Scheduling	✓		✓	✓	
Auto line speed sensing		✓		✓	
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling	✓	✓	✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition		✓	✓	✓	✓
Routing	✓	✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	50-500 words	variable	1-32K words	any	any
Buffer sizes	50-500 words	not applicable	16-512 words	variable	dynamically allocated
Codes used	all codes	ASCII	ASCII, EBCDIC, special	ASCII, EBCDIC	ASCII, EBCDIC, ISO, Baudot
Max active asynch lines/speeds	500 lines, 75-1200 bps	128 lines, 110-4800 bps	128 lines, 110-1800 bps	200 lines, 75-9600 bps	120 lines, 45-2400 bps
Max active synch lines/speeds	120 lines, 1200-50K bps	32 lines, 300-50K bps	128 lines, 2400-50K bps	32 lines, 75-50K bps	120 lines, to 10,8K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, character parity	CRC,LRC	CRC, LRC	LRC, parity	CRC, LRC, parity
Back-up and recovery	fail soft hardware	bootstrap loader	retransmit, tine-out, retry	retransmission, reload	mass storage, program reload
Prices					
"Standard" configuration	cpu, disc, peripherals, commo control unit, line interfaces	8K, 30 channels	8K, ASR 33 Teletype, disc, crt, tape, 50K baud DCA	16K, 32 lines	40K, console, 20 synch and 20 asynch lines
Purchase	$250,000	$32,000	$45,000	$152,000	$87,920
Monthly maintenance	not given	$200	$300	$476	$346
Monthly rental or lease	$6,400 (5 years)	$1,100 (3 years)	$900 (5 years)	$2,941 (5 years)	$2,016 (5 years)

Summary of Characteristics...

Manufacturer	Honeywell, Inc.	Informatics, Inc.	Informatics, Inc.	Intercomputer Communications Corp.	Interdata, Inc.
Model	System 700/Model 20	ICS-IV/250	ICS-IV/500	i270n	50 and 55
1st installation/number inst		date and inst not given	1/71 5 inst	7/71 10 inst	4/72 2 inst
Applications					
Remote concentrator	✓	✓	✓	✓	✓
270X emulator				✓	
Front-end		✓	✓	✓	✓
Message switching		✓	✓	✓	✓
Store & forward		✓	✓	✓	✓
Computer Compatibility					
Host computers	any host using BSC	IBM 360, 370; RCA; Xerox	IBM 360, 370; RCA; Xerox	IBM 360, 370	IBM 360, 370
Channels	not given	sel, mpx, block mpx	sel, mpx, block mpx	sel, mpx	sel, mpx
Max word rate/path width	10.4K/1 bit	200K/17 bits	1M/33 bits	24K/8-16 bits	170K/8 bits
Software compatibility	not applicable	OS; TDOS, TSOS; Xerox; others	OS, DOS; TDOS, TSOS; others	IBM	software not supplied
Special software required?	yes	no	no	no	
Device emulated		tape drive or terminal	bisynch tape terminal	IBM 270X	
Internal Specifications					
Memory range/word size	8K-32K (16 bits + 1 parity*)	4K-128K (32 bits + 1 parity)	8K-128K (32 bits + 1 parity)	4K-64K (16 bits + 2 parity)	8K-64K (16 bits + 1 parity)
Memory cycle/technology	775-nsec core, semiconductor	850-nsec core	950-nsec core	1-usec core	1-usec core
Hardwired/microprogrammed	hardwired	hardwired	hardwired	hardwired/microprogrammed	microprogrammed
Communications instructions	stacking	not given	not given	several, incl. SCAN	28 commo instructions
Functions Performed					
Scheduling	✓	✓	✓	✓	✓
Auto line speed sensing	✓		✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling	✓	✓	✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	✓
Terminal recognition	✓	✓	✓	✓	✓
Routing	✓	✓	✓	✓	✓
Formatting	✓	✓	✓	✓	✓
Transmission					
Block sizes	any	1-255 words	1-64K bytes	variable	variable
Buffer sizes	dynamically allocated	15-90 words	variable	variable	variable
Codes used	ASCII, EBCDIC, ISO, Baudot	ASCII, Baudot	ASCII, EBCDIC, Baudot	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, SBT, others
Max active asynch lines/speeds	256 lines, 30-2400 bps	144 lines, 50-1800 bps	640 lines, 33-2600 bps	4 lines, 75-9600 bps	126 (250) lines, 75-1800 bps
Max active synch lines/speeds	128 lines, 2000-10.8K bps	10 lines, 1200-19.2K bps	640 lines, 110-9600 bps	4 lines, 1800-9600 bps	126 (250) lines, 2400-50K bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC, parity	CRC, LRC, character parity	CRC, LRC, character parity	CRC, LRC, integrity	CRC, LRC, CRC 12, CRC 16
Back-up and recovery	down-line loader in ROM, error default to host	mass storage, check-pointing	redundant cpu and memory, checkpointing	redundancy, restart	
Prices					
"Standard" configuration	20K, ROM loader, clock/ timer, 32 lines, disc, ASR 33 Teletype, etc.	"turnkey commo system"	64K/cpu duplexed, duplex communications	8K, mixed lines	16K, 16 asynch lines, 4 synch lines, tty (or 24K, 28 asynch, 8 synch)
Purchase	$53,457	$250,000	$1,250,000	$46,000	$23,500 ($39,800)
Monthly maintenance	$342	$1,800	$4,500	$184	$309 ($422)
Monthly rental or lease	$1,569 (5 years)	$7,000 (5 years)	$29,500 (5 years)	$1,380 (2 years)	not available

* Optional

Summary of Characteristics...

Manufacturer	Interdata, Inc.	IBM Corp.	Jacquard Systems	Microdata Corp.	Modular Computer Systems
Model	270X	3705	RTCS	1660	Modcomp III
1st installation/number inst	1970 6 inst	7/72 inst not applicable	5/72 2 inst	12/71 5 inst	12/70 50 inst
Applications					
Remote concentrator			✓	✓	✓
270X emulator	✓	✓			
Front-end	✓	✓			✓
Message switching				✓	✓
Store & forward				✓	✓
Computer Compatibility					
Host computers	IBM 360, 370	IBM 360, 370	any with BSC	IBM 360	IBM 360, 370; CDC 6000
Channels	mpx	sel, mpx, block mpx	common carrier	sel, mpx	sel, mpx, CDC 3000
Max word rate/path width	7K/8 bits	376K/8 bits	9600 bps/1 bit	100K/8 bits	400K/16 bits
Software compatibility	BTAM, QTAM	TCAM	not given	not given	OS, Scope
Special software required?	no	no	no	yes	not given
Device emulated	IBM 2701, 2702, 2703	IBM 2701, 2702, 2703	IBM 2780, others	--	--
Internal Specifications					
Memory range/word size	16K-64K (16 bits + 1 parity)	16K-240K (16 bits + 2 parity)	4K-32K (16 bits)	4K-64K (8 bits)	4K-64K (16 bits + 2 parity)
Memory cycle/technology	1-usec core	1.2-usec core	1.2-usec core, semiconductor*	1-usec core	800-nsec core
Hardwired/microprogrammed	microprogrammed	hardwired	hardwired	microprogrammed	microprogrammed
Communications instructions	28 commo instructions	I/O instr for commo hardware	local byte swapping	stack control, search, etc.	bit and byte handling, etc.
Functions Performed					
Scheduling	✓	✓	✓		
Auto line speed sensing				✓	✓
Data packing/unpacking			✓		✓
Auto calling	✓	✓	✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	
Terminal recognition		✓	✓	✓	
Routing			✓	✓	
Formatting		✓	✓	✓	✓
Transmission					
Block sizes	variable	1-32K bytes	10-1000 words	variable	1-1024 bytes
Buffer sizes	16 bytes	48-255 bytes	to 2000 words	to 1024 bytes	variable
Codes used	ASCII, EBCDIC, SBT, BCD	ASCII, EBCDIC, others	ASCII, EBCDIC	ASCII, EBCDIC, SBT	ASCII, EBCDIC
Max active asynch lines/speeds	126 lines, 75-600 bps	352 lines, 45-4800 bps	64 lines, 110-300 bps	128 lines, 75-9600 bps	128 lines, 110-9600 bps
Max active synch lines/speeds	126 lines, 2400-40.8K bps	60 lines, 600-50K bps	2 lines, to 40.8K bps	24 lines, to 9600 bps	64 lines, 110-50K bps
Error Checking & Recovery					
Hardware or software checks	hardware	hardware/software	hardware/software	hardware/software	hardware
Special checks performed	CRC, LRC, CRC 12, CRC 16	CRC, LRC, VRC, data format	CRC, LRC, VRC	CRC, LRC	CRC, LRC, VRC
Back-up and recovery	redundancy	retry, auto switch to back-up cpu, etc.	retransmission, time-out, restart	retransmission	retransmission
Prices					
"Standard" configuration	24K, 16 asynch lines 4 synch lines	26 lines at 134.5 bps; 4 lines at 2400 bps	16K, 4 low speed lines, 1 BSC line, tty, tape reader	64 asynch lines, auto restart, Teletype controller	16K, 16 asynch lines, 4 synch lines, ASR 33 Teletype, mag tape
Purchase	$64,350	$72,475 (emul); $92,975 (NCP)	$25,000	$23,000	$39,450
Monthly maintenance	$456	$218.50 (emul); $250.50 (NCP)	$140	$270	$269
Monthly rental or lease	not available	$1,500; $1,925; (2 years)	$540 (5 years)	not available	$908 (5 years)

* Optional

Summary of Characteristics...

Manufacturer	North American Philips Corp.	Omnus Computer Corp.	Prentice Electronics Corp.	Programming Methods, Inc.	Remote Computing Corp.
Model	DS 714	1/C	P-3000	FCF	FRED
1st installation/number inst	1965 45 inst	8/71 1 inst	12/72 inst not applicable	6/71 5 inst	date not given 6 inst
Applications					
Remote concentrator		✓		✓	✓
270X emulator					
Front-end		✓	✓	✓	✓
Message switching	✓	✓		✓	✓
Store & forward	✓	✓		✓	
Computer Compatibility					
Host computers	not applicable	IBM 360, others	IBM 360, 370	IBM, CDC, GE	IBM, Burroughs, Univac
Channels	not applicable	not given	sel, mpx, block mpx	sel, mpx, block mpx	not given
Max word rate/path width	not applicable	833K/8-16 bits	not given	1.4M/8 bits	not given
Software compatibility	not applicable	not given	GAM, BTAM, QTAM, TCAM	CICS, Intercomm, BCCAP	not given
Special software required?	not applicable	not given	no	no	yes (approx $40K)
Device emulated	not applicable	--	IBM 270X, 3705	tape drive	--
Internal Specifications					
Memory range/word size	16K-256K (32 bits + 4 parity)	4K-32K (16 bits)	16K-240K (8 bits)	8K-64K (16 bits)	24K-64K (16 bits + 1 parity)
Memory cycle/technology	2.2-usec core, semiconductor	1.2-usec core	1-usec core, 200-nsec semi	700-nsec core	1-usec core
Hardwired/microprogrammed	hardwired	hardwired	microprogrammed	hardwired	hardwired/microprogrammed
Communications instructions	not given	byte, stack manip., etc.	yes	yes	yes
Functions Performed					
Scheduling	✓	✓	✓	✓	
Auto line speed sensing		✓	✓	✓	✓
Data packing/unpacking	✓	✓	✓	✓	✓
Auto calling	✓	✓	✓	✓	✓
Auto answering	✓	✓	✓	✓	✓
Polling	✓	✓	✓	✓	
Terminal recognition		✓	✓	✓	✓
Routing	✓	✓	✓	✓	
Formatting	✓	✓	✓	✓	
Transmission					
Block sizes	1-16K bytes	variable	variable	1-1024 words	
Buffer sizes	dynamically allocated	variable	variable	32-256 words	
Codes used	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, SBT, others	ASCII, EBCDIC, SBT	ASCII, EBCDIC, SBT	ASCII, EBCDIC, Corres.
Max active asynch lines/speeds	8000 lines, 45-4800 bps	224 lines, to 9600 bps	352 lines, to 9600 bps	256 lines, 25-4800 bps	256 lines, 75-1800 bps
Max active synch lines/speeds	240 lines, 200-9600 bps	224 lines, to 9600 bps	60 lines, 2400-50K bps	256 lines, 300-50K bps	256 lines, 2000-9600 bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware	hardware/software
Special checks performed	CRC, LRC, SEQ, format, etc.	CRC, LRC	CRC, LRC	CRC, LRC	CRC
Back-up and recovery	dual processors, configuration switching	auto restart, remote bootstrap	device switching	fully duplex, auto restart & recovery	retry
Prices					
"Standard" configuration	fully redundant, dual cpu, 2 drums, 5 tapes, 125 lines	16 asynch lines	16K, dual processor, 4K control memory, 40 asynch lines	mix of line speeds with code conversion, drum	48 lines and interface to dual processor B5500/B5700
Purchase	$1,900,000	$10,740	$49,250	$700,000	$100,000
Monthly maintenance	not given	$130	$300	not given	$1,000 (software)
Monthly rental or lease	not given	$225 (5 years)	$1,530 (2 years)	$18,900 (5 years)	$4,000 (3 years)

Summary of Characteristics...

Manufacturer	Sanders Data Systems, Inc.	Scantlin Electronics, Inc.	Scidata, Inc.	Scientific Control Corp.	Telefile Computer Products
Model	Sandac 200	801		5000	T-64-1
1st installation/number inst	1/69 inst not given	9/71 inst not given	7/72 1 inst	1969 18 inst	7/71 9 inst
Applications					
Remote concentrator	✓	✓		✓	✓
270X emulator					✓
Front-end	✓	✓	✓	✓	✓
Message switching	✓	✓	✓	✓	✓
Store & forward	✓	✓	✓	✓	✓
Computer Compatibility					
Host computers	IBM 360, 370, others	IBM 360, Varian 620, CDC160G	IBM 360	IBM, Univac, Burroughs	IBM 360, 370
Channels	sel, mpx, block mpx	not given	sel, mpx	dma, sel	dma, sel, mpx
Max word rate/path width	625K/8 bits	9600 bps/1 bit	not given/8-16 bits	500K/8 bits	30K/16 bits
Software compatibility	BTAM, QTAM	BTAM, QTAM, TCAM	OS	OS, DOS, EXEC 8	BTAM
Special software required?	no	no	no	yes (no charge)	no
Device emulated	--	IBM 2848, 2740		IBM 27XX	IBM 2701, 2702, 2703
Internal Specifications					
Memory range/word size	8K-64K (16 bits + 2 parity)	8K-64K (16 bits + 2 parity)	8K-128K (16 bits)	4K-64K (16 bits + 1 parity)	4K-64K (16 bits + 2 parity)
Memory cycle/technology	2-usec core	750-nsec core	1.2-usec core	980-nsec core	1-usec core
Hardwired/microprogrammed	hardwired	hardwired	hardwired	microprogrammed	hardwired
Communications instructions	not given	bit and byte handling, etc.		not given	external status, command-out, etc.
Functions Performed					
Scheduling		✓	✓	✓	
Auto line speed sensing					✓
Data packing/unpacking		✓	✓	✓	✓
Auto calling		✓	✓	✓	✓
Auto answering		✓		✓	✓
Polling		✓	✓	✓	✓
Terminal recognition			✓	✓	✓
Routing		✓	✓	✓	✓
Formatting		✓	✓	✓	✓
Transmission					
Block sizes	to 1024 words	1-64K words	any	1-4K words	to 4K words
Buffer sizes	not given	1-128 words	1-256 words	1-4K words	to 4K words
Codes used	ASCII, EBCDIC	all 5-8 level codes	ASCII, EBCDIC	ASCII, EBCDIC, SBT	ASCII, EBCDIC
Max active asynch lines/speeds	45-1800 bps	384 lines, 37.5-2400 bps	38 lines, 50-1800 bps	1024 lines, to 1800 bps	64 lines, 45-1800 bps
Max active synch lines/speeds	2000-9600 bps	192 lines, 2400-9600 bps	6 lines, to 9600 bps	32 lines, 2400-50K bps	64 lines, 2000-9600 bps
Error Checking & Recovery					
Hardware or software checks	hardware/software	hardware/software	hardware/software	hardware/software	hardware/software
Special checks performed	CRC, LRC	CRC, LRC	CRC	CRC, LRC	CRC, LRC
Back-up and recovery	--	redundancy, hard/soft restarts	time-variable, check-point/restart	multiple cpu's, retransmission	dual system
Prices					
"Standard" configuration	not given	16K, 64 line interface, 4 synch lines, disc, console	6 lines, printer, mag tape, disc, console, crt, back-up tty	8K, ASR 33 Teletype, interfaces, disc	4 synch lines, 12 asynch lines
Purchase	$60,000	$68,000	$93,600	$40,000	$44,950
Monthly maintenance	not given	$350	$485	$400	$188.79
Monthly rental or lease	not given	$1,500 (5 years)	not available	$1,000 (5 years)	$998.89 (5 years)

Summary of Characteristics...

Manufacturer	Teleprocessing Industries, Inc.	Tempo Computers, Inc.	Tempo Computers, Inc.	Texas Instruments, Inc.	Univac
Model	C2000	I and II	270T	980 DCS	C/SP
1st installation/number inst	7/71 12 inst	12/69 62 inst	8/71 12 inst	6/70 12 inst	date not given 4 inst
Applications					
Remote concentrator		✓		✓	✓
270X emulator			✓		
Front-end	✓	✓	✓		✓
Message switching		✓		✓	
Store & forward		✓		✓	
Computer Compatibility					
Host computers	Univac 1108, 1106, 418	IBM, HIS, CDC, Xerox	IBM 360, 370	IBM 360, 370	Univac 1100
Channels	mpx	sel, mpx, block mpx	sel, mpx	sel, mpx	sel
Max word rate/ path width	50K/18 bits	1.4 MB/8 bits	not given	125K/1 bit	300K/36 bits
Software compatibility	S0 EXEC 8		BTAM, QTAM, TCAM, HASP	all IBM for 270X	EXEC 8
Special software required?	yes	not given	no	no	no
Device emulated	--	--	IBM 2703	IBM 2848	--
Internal Specifications					
Memory range/word size	8K (18 bits)	8K-128K (8 bits)	8K-128K (8 bits + 1 parity)	4K-64K (16 bits +1 parity)	16K-64K (16 bits + 1 parity)
Memory cycle/technology	900-nsec core, semiconductor	900-nsec core	750-nsec core	750-nsec semiconductor	630-nsec plated wire
Hardwired/microprogrammed	hardwired	hardwired	hardwired	hardwired/microprogrammed	
Communications instructions	not given	not given	not given	25, esp. for mult. interfaces	52 instructions
Functions Performed					
Scheduling		✓	✓	✓	✓
Auto line speed sensing		✓	✓		
Data packing/unpacking		✓	✓	✓	✓
Auto calling		✓	✓	✓	✓
Auto answering		✓	✓	✓	✓
Polling		✓	✓	✓	✓
Terminal recognition		✓	✓	✓	✓
Routing		✓	✓	✓	✓
Formatting		✓	✓	✓	✓
Transmission					
Block sizes	not applicable	variable	any	any	variable
Buffer sizes	3-8 words	variable	any	any	variable
Codes used	ASCII, Baudot	any	any	ASCII, EBCDIC, Baudot	ASCII, EBCDIC, XS3, Baudot
Max active asynch lines/speeds	208 lines, to 1800 bps	768 lines, 25-4800 bps	255 lines, 25-4800 bps	256 lines, 45-1800 bps	128 lines, 45-1800 bps
Max active synch lines/speeds	48 lines, to 9600 bps	256 lines, to 50K bps	255 lines, to 230.4K bps	256 lines, 1200-1M bps	128 lines, 2000-50K bps
Error Checking & Recovery					
Hardware or software checks	hardware	hardware/software	hardware/software	software	software
Special checks performed	LRC, VRC	CRC, LRC	CRC, LRC	CRC, LRC, parity, blk sum	CRC, LRC, character parity
Back-up and recovery	--	--	retransmission	auto restart, mag tape back-up	error logging, loop - back testing
Prices					
"Standard" configuration	32 TWX/Data-Phone lines, 32 synch lines, 132 asynch lines	not given	not given	5 commo lines, 2MB storage	49KB, 16 asynch lines, 8 synch lines, intelligent channel
Purchase	$140,000	$50,000-$250,000	$50,000-$250,000	$50,000	$125,640
Monthly maintenance	not given	$250-$1,250	$250-$1,250	$300	$505
Monthly rental or lease	not applicable	$1,000-$5,000 (5 years)	$1,000-$5,000 (5 years)	$1,100 (5 years)	$1,966 (5 years)

Communications Processors

ments in a linked list. Stack control instructions are useful in this kind of operation. High-speed I/O read/write commands are necessary to CP applications; load and store bytes from buffered blocks is another useful type of instruction. Instructions are also used to handle code translation, such as indexing tables, and to look for special

(Text continues on page 44)

Further information on products covered in this survey can be obtained from the vendors by circling the appropriate numbers on the reader service card:

AMERICAN DATA SYSTEMS, INC.
8851 Mason Ave.
Canoga Park, CA 91306
CIRCLE 160 ON READER CARD

BOLT, BERANEK AND NEWMAN, INC.
50 Moulton St.
Cambridge, MA 02138
CIRCLE 161 ON READER CARD

BURROUGHS CORP.
Burroughs Place
Detroit, MI 48232
CIRCLE 162 ON READER CARD

CONTROL DATA CORP.
Communication Products Div.
(MDM Communications Div.)
3519 W. Warner Ave.
Santa Ana, CA 92704
CIRCLE 163 ON READER CARD

CIII CORP.
11000 Cedar Ave.
Cleveland, OH 44106
CIRCLE 164 ON READER CARD

COLLINS RADIO CO.
1200 North Alma Road
Richardson, TX 75080
CIRCLE 165 ON READER CARD

COMPUTER COMMUNICATIONS, INC.
5933 W. Slauson Ave.
Culver City, CA 90230
CIRCLE 166 ON READER CARD

COMPUTER CONTROL SYSTEMS, INC.
13740 Gamma Road
Dallas, TX 75240
CIRCLE 167 ON READER CARD

COMTEC DATA SYSTEMS, INC.
12701 S. Van Ness Ave.
Hawthorne, CA 90250
CIRCLE 168 ON READER CARD

COMTEN, INC.
1950 W. County Road B-2
St. Paul, MN 55113
CIRCLE 169 ON READER CARD

CYBERMATICS, INC.
560 Sylvan Ave.
Englewood, NJ 07632
CIRCLE 170 ON READER CARD

DATA PATHING, INC.
370 San Aleso Ave.
Sunnyvale, CA 94086
CIRCLE 171 ON READER CARD

DIGITAL EQUIPMENT CORP.
146 Main St.
Maynard, MA 01754
CIRCLE 172 ON READER CARD

EMR-COMPUTER
8001 Bloomington Fwy.
Minneapolis, MN 55420
CIRCLE 173 ON READER CARD

GENERAL ELECTRIC CO.
Data Communication Products Div.
#1 Mountain View Road
Lynchburg, VA 24501
CIRCLE 174 ON READER CARD

GENERAL INSTRUMENT CORP.
Electronic Systems Div.
100 Andrews Road
Hicksville, NY 11802
CIRCLE 175 ON READER CARD

HONEYWELL, INC.
200 Smith St.
Waltham, MA 02154
CIRCLE 176 ON READER CARD

INFORMATICS, INC.
Communication Systems Div.
65 Route 4
River Edge, NJ 07661
CIRCLE 177 ON READER CARD

INTERCOMPUTER COMMUNICATIONS CORP.
2201 E. University Drive
Phoenix, AZ 85034
CIRCLE 178 ON READER CARD

INTERDATA, INC.
2 Crescent Place
Oceanport, NJ 07757
CIRCLE 179 ON READER CARD

IBM CORP.
1133 Westchester Ave.
White Plains, NY 10604
CIRCLE 180 ON READER CARD

Summary of Characteristics . . .

Manufacturer	UCC Communication Systems	Varian Data Machines
Model	COPE 1201-00	620-DC
1st installation/number inst	2/68 over 50 inst	1/71 30 inst
Applications		
Remote concentrator		✓
270X emulator	✓	
Front-end		✓
Message switching		✓
Store & forward		✓
Computer Compatibility		
Host computers	multiple IBM, CDC, Univac	IBM 360
Channels	sel mpx	sel, mpx
Max word rate/path width	200K/6-8 bits	200K/8 bits
Software compatibility	IBM, CDC, Univac	not given
Special software required?	yes (no charge)	yes
Device emulated		IBM 2803
Internal Specifications		
Memory range/word size	12K-64K (12 bits + 1 parity)	4K-32K (16 bits + 1 parity)
Memory cycle/technology	1.6-usec core	750 or 950-nsec core
Hardwired/microprogrammed	hardwired	hardwired
Communications instructions	yes	not given
Functions Performed		
Scheduling		✓
Auto line speed sensing	✓	✓
Data packing/unpacking		✓
Auto calling	✓	✓
Auto answering		✓
Polling	✓	✓
Terminal recognition	✓	✓
Routing	✓	✓
Formatting	✓	✓
Transmission		
Block sizes	7-1024 words	variable
Buffer sizes	16-1024 words	variable
Codes used	ASCII, EBCDIC, XS3, others	ASCII, EBCDIC
Max active asynch lines/speeds	not applicable	64 lines, to 1200 bps
Max active synch lines/speeds	30 lines, 2000-50K bps	64 lines, to 50K bps
Error Checking & Recovery		
Hardware or software checks	hardware/software	hardware/software
Special checks performed	block seq. no., protocol seq.	CRC, LRC, parity
Back-up and recovery	mass storage	dual redundant systems
Prices		
"Standard" configuration	20K, console, 4 synch interfaces, card reader	8K, 64 channels, 16 lines, ASR 33 Teletype
Purchase	$118,400	$23,500
Monthly maintenance	$420	$300
Monthly rental or lease	$2,775 (5 years)	$750 (3 years)

(Continued from page 43)

JACQUARD SYSTEMS
1505 11th St.
Santa Monica, CA 90404
CIRCLE 181 ON READER CARD

MICRODATA CORP.
644 E. Young St.
Santa Ana, CA 92705
CIRCLE 182 ON READER CARD

MODULAR COMPUTER SYSTEMS
1650 W. MacNab Road
Fort Lauderdale, FL 33309
CIRCLE 183 ON READER CARD

NORTH AMERICAN PHILIPS CORP.
91 McKee Drive
Mahwah, NJ 07430
CIRCLE 184 ON READER CARD

OMNUS COMPUTER CORP.
1538 E. Chestnut St.
Santa Ana, CA 92701
CIRCLE 185 ON READER CARD

PRENTICE ELECTRONICS CORP.
795 San Antonio Road
Palo Alto, CA 94303
CIRCLE 186 ON READER CARD

PROGRAMMING METHODS, INC.
1301 6th Ave.
New York, NY 10019
CIRCLE 187 ON READER CARD

REMOTE COMPUTING CORP.
One Wilshire Bldg., Suite 1400
Los Angeles, CA 90017
CIRCLE 188 ON READER CARD

SANDERS DATA SYSTEMS, INC.
Daniel Webster Hwy. So.
Nashua, NH 03060
CIRCLE 189 ON READER CARD

SCANTLIN ELECTRONICS, INC.
5454 Beethoven St.
Los Angeles, CA 90066
CIRCLE 190 ON READER CARD

SCIDATA, INC.
3 Executive Park Drive NE
Atlanta, GA 30329
CIRCLE 191 ON READER CARD

SCIENTIFIC CONTROL CORP.
2519 National Drive
Garland, TX 75041
CIRCLE 192 ON READER CARD

TELEFILE COMPUTER PRODUCTS
17785 Sky Park Circle
Irvine, CA 92664
CIRCLE 193 ON READER CARD

TELEPROCESSING INDUSTRIES, INC.
82 McKee Drive
Mahwah, NJ 07430
CIRCLE 194 ON READER CARD

TEMPO COMPUTERS, INC.
(GTE Information Systems)
4005 Artesia Ave.
Fullerton, CA 92633
CIRCLE 195 ON READER CARD

TEXAS INSTRUMENTS, INC.
P.O. Box 1444
Houston, TX 77001
CIRCLE 196 ON READER CARD

UNIVAC DIV.
Sperry Rand Corp.
P.O. Box 500
Blue Bell, PA 19422
CIRCLE 197 ON READER CARD

UCC COMMUNICATION SYSTEMS
1400 UCC Tower
P.O. Box 6228
Dallas, TX 75222
CIRCLE 198 ON READER CARD

VARIAN DATA MACHINES
2722 Michelson Drive
Irvine, CA 92664
CIRCLE 199 ON READER CARD

Communications Processors

characters. Special instructions to generate cyclic redundancy checksum (CRC) are also utilized.

A high-level front-end CP not only provides the basic communications control functions but one or more significant additional capabilities, such as communications file management, load sharing, self-contained message switching, and others. These capabilities often require peripheral devices (e.g., disc) on the front end, as in the case of the load-sharing example, a dual front-end processor configuration. High-level front-end systems are typically tailored to specific application requirements. These systems cost much more because of the customized software development and, often, the end of special hardware interface boxes.

Both current and future data communications problems have solutions which necessitate further development of the front-end CP approach. Front-end systems are going to continue to evolve in many significant ways:

1. As the trend of new terminals and the demand for additional lines continue, front-end systems must be able to accommodate these changes easily (e.g., read in the data entries for the new terminal and/or line, and the system is operational in the new configuration).

2. As much of the application preprocessing as can be partitioned will be performed remotely (e.g., this remote preprocessing capability is presently seen in "smart," or "intelligent," terminals).

3. The front-end CP will be designed to be independent of the central host computer in the "fail soft" sense.

The overall trend is definitely towards distributed processing configurations to achieve higher efficiencies and usefulness. □

Mr. Theis is a member of the technical staff of Aerospace Corp. He has a BS from UCLA and an MSEE from the Univ. of Southern California. He is a registered electrical engineer in the state of California.

Effective data systems have communications built in. Not built on.

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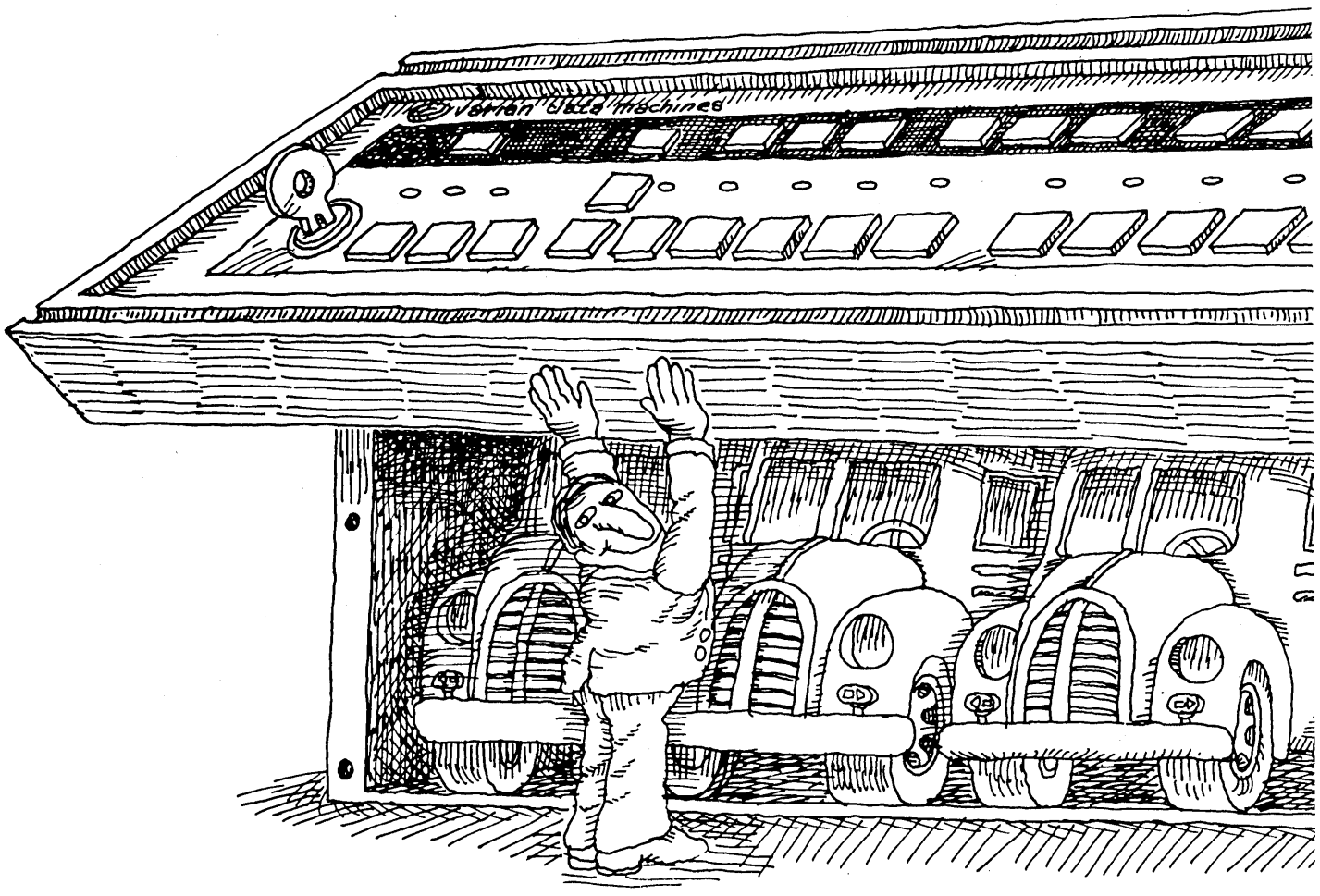
AT&T and your local Bell Company.

It takes more than one bus to get the most out of a 330 nsec mini.

Introducing the multi-bus VARIAN 73.



Our new minicomputer has a whole new architecture. It was designed to take advantage of its 330 nsec cycle time without tripping over its own CPU. Or getting stalled in the bus line. Or any of the multitude of problems that hit the computer user as memory speeds have gone the limits.

VARIAN 73 is compact. A complete 32K system in a seven inch chassis and more in a 14 inch chassis. But fast. 165 nsec microinstructions. 330 nsec full memory cycle (660 nsec optional for less money with core). And direct I/O memory data transfers at rates up to 3 million words per second.

With a memory like this, you can forget the delays. Dualport (standard with either the super fast semiconductor memory or the slower core or any combination of the two). Dual busses which make for faster interleaving of I/O and CPU functions. VARIAN 73 also gives a much more efficient and flexible instruction repertoire. Not only microprogrammed, but with micro-programming you can get your hands on. And a 64-bit control word dictating the flow of data through a 16 register processing section.

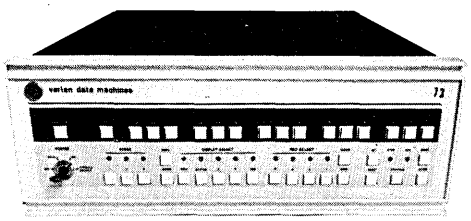
Your designer and programmer can choose from up to seven different I/O channels. And from many varied software combinations (compatible with all previous Varian 620 programs). Or use Writeable Control Store as an option.

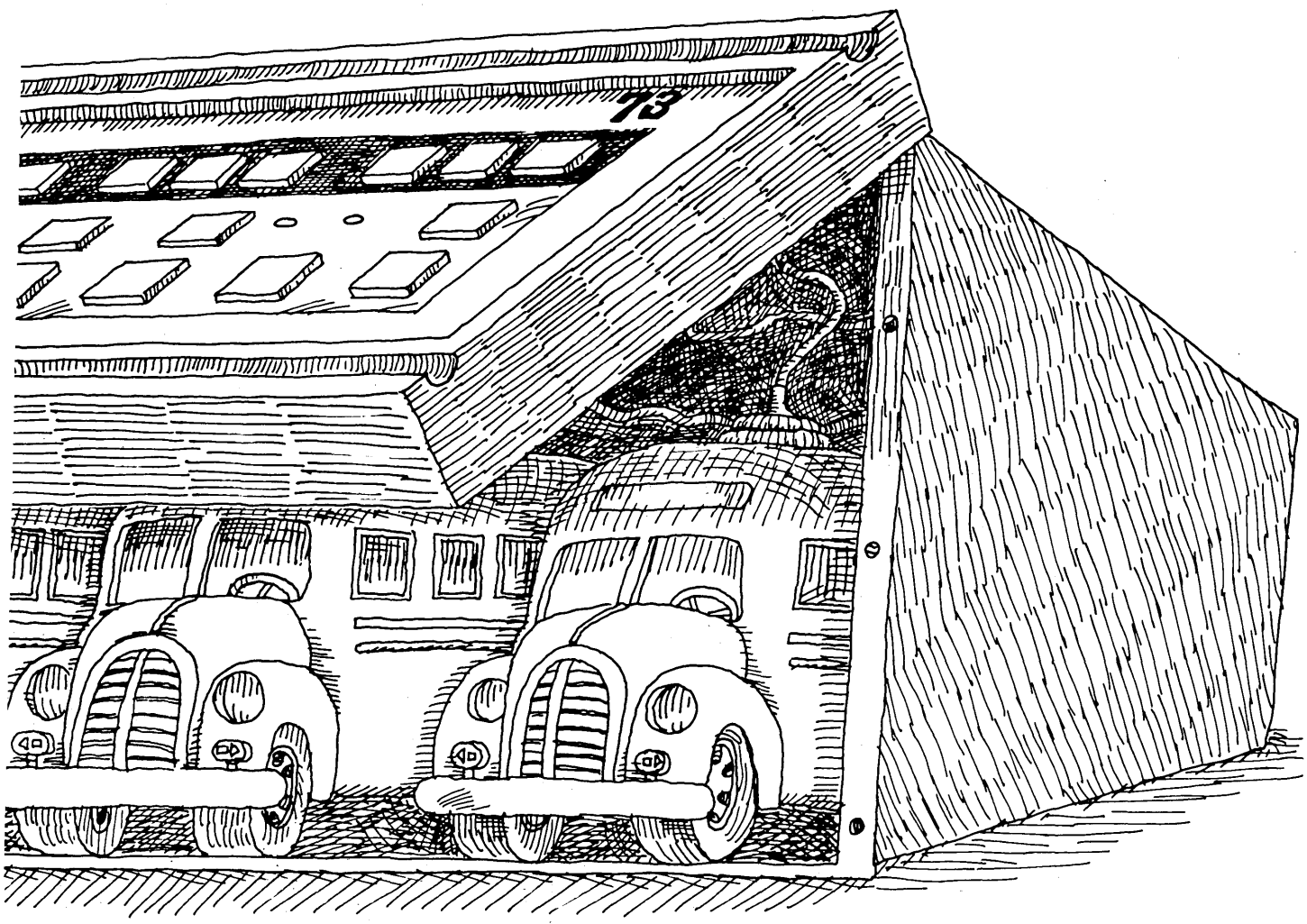
VARIAN 73's faster, more efficient and flexible. With expandable memories and extendable architecture. And simple interfacing between multiple processors and memories. Just install them in the chassis.

VARIAN 73 prices out well below the competition. It's hard to make comparisons since there isn't anything on the market like it. But the nearest minicomputer carries a higher price tag and leaves you stuck on the bus. Which puts them pretty far behind.

Call or write. Varian Data Machines, 2722 Michelson Drive, Irvine, California 92664 (714) 833-2400.

varian data machines





As the air traffic control automation program goes on and on, questions are being raised about the cost and the approach taken in its development

What's Wrong With the Air Traffic Control System?

by Phil Hirsch, Washington Editor

Are we all paying for an obsolete, overpriced, inadequate air traffic control system?

Evidence for the affirmative is provided in a lengthy study commissioned by the Federal Aviation Administration (FAA) and prepared early in 1971 by a group of systems management and software experts. The study has never been released to the public.

The study is titled "Report of the NAS En Route Computer Program Management Review Panel." The authors, who reportedly agreed unanimously, charged that:

The 360/50 and /65 computers supporting the en route portion of the air traffic control system—i.e., the portion outside airport terminal areas—will have to operate at close to 100% capacity to handle the workload.

"This level of utilization is impossible to achieve, so the Federal Aviation Administration may be forced into a major additional (hardware) acquisition on an emergency basis."

The lack of a single overall system management authority within the FAA "is tantamount to a lack of understanding (by the agency) of the problems involved in large-scale systems development." Project schedules don't allow enough time for checkout, installation, shakedown, and full deployment, said the panel; also, not enough money and FAA technical manpower have been committed, the agency managers "have no real concept of systems integration and systems assurance," they haven't really considered design alternatives or future needs for core, cpu, and other scarce system requirements.

The report adds that IBM and Raytheon, the key contractors, are working against poorly defined system specifications. "The document which (FAA) uses as the 'engineering requirements,' from which the statement of work to the contractor is prepared, and to which the contractor prepares his proposal, is more appropriate for the definition phase of a project than the implementation phase . . . There are no *binding* specifications accompanying the engineering requirements (italics in original version) . . . such well known and proven tools as preliminary design review and critical design review are not stipulated." Also, neither IBM nor Raytheon is obligated to help modify their systems after delivery and acceptance, even though substantial modifications in the field are virtually certain.

"IBM's software system—design, implementation, and production methodology—is perhaps 13-15 years behind the state of the art and sharply limits what can be achieved in system growth and efficiency," the report adds. The operating system, which was specially developed, would have been acceptable "five years ago"; it requires "major add-ons" to accommodate modern peripherals. Programming is hampered by long turnaround delays —sometimes 48 hours—because coding changes are tested in batch mode on a computer system that is also used for operational checkout of debugged programs. During most of the development, more than 100 programmers have been using this system. Software documentation—"a good monitoring tool"—is deliverable to the FAA only at the completion of production coding.

The authors of the report summarized their criticism by saying:

"The entire development of the en route system has been plagued by technical and management problems. The quasi-obsolescent hardware, the outdated design of the software, the inadequate production and testing facilities, the ever-increasing use of hardware resources, and the lack of a plan to deploy a quality-assured product, are manifestations of a development without sufficient control. Although IBM can be criticized for not demonstrating initiative in advising FAA of potential system problems and recommending solutions, the ultimate responsibility . . . has to be on the FAA . . . It is vital that FAA acquire the technical and managerial capabilities . . . to deal with a program of this complexity."

FAA officials probably weren't totally surprised by the report because in 1970, the year before this study was made, a House Government Operations subcommittee, headed by Congressman Jack Brooks of Texas, had directed many of the same criticisms at

. . . the outdated design of the software, the inadequate production and testing facilities, the ever-increasing use of hardware resources . . .

the agency. It is probably not coincidental that in December, 1970, soon after the Brooks subcommittee report appeared, Dave Israel was brought in to head up a newly created Office of Systems Engineering and Management (OSEM). He's responsible for planning and coordinating all research, thus not directly involved with contractors. Israel, an MIT whiz kid (class of '51), has been intimately involved with computers, air traffic control, and system engineering for at least 20 years. He worked on Whirlwind, one of the first high-speed digital computers, pub-

lished a thesis in 1952 describing the use of computers to process flight plan data needed by air traffic controllers (reportedly the first detailed analysis of this application), managed software production and testing for the SAGE system, directed systems engineering at Mitre, and participated in the development of SATIN, a forerunner of the present FAA air traffic control system.

Israel insists that the FAA's systems management activity wasn't reorganized when he came aboard, but it is clear from what he said that, at the very least, there's a new emphasis.

A continuing systems management group is now set up; FAA hasn't had one for several years. Furthermore, OSEM not only develops overall plans, in terms of priorities, budget and manpower allocations, but also, as Israel put it, "I've been given a strong hand" to carry out the plans. This execution authority is something the previous group didn't have.

Asked to explain his system development philosophy, Israel was not specific but did indicate that he follows certain approaches which were not in vogue at FAA previously. He relies on "building the critical pieces of a system and then testing the hell out of them" instead of "analyzing a problem to death." Analyses, he added, can be "a rationalization for doing nothing." Also, "you can't award a million dollar contract and pray it will come out all right. You need adequate in-house staffing to monitor it constantly." Israel seems more willing than other FAA r&d officials to accept outside advice. This is significant because, according to the report, Mitre—FAA's chief adviser on the air traffic control system—has been largely ignored.

And Israel recognizes that the developer of a complex system inevitably makes at least a few false starts. What separates the pro from the amateur, he implied, is a willingness to learn from these mistakes and alter the system design when it promises to improve performance significantly—even if costs are significantly increased in the process.

His unwillingness to imply any criticism of FAA, past or present, could be attributed partly to the presence of an agency public relations man throughout our interview. In itself, this isn't unusual, but some other obstacles were encountered in researching this article. For example, I contacted IBM, Raytheon, and Mitre, and was turned down flat by each one. The first two companies insisted they had to obtain FAA's approval before talking to me. Two Mitre officials refused to see me under any circumstances.

On a visit to the FAA's National Aviation Facilities Experimental Center (NAFEC), near Atlantic City, where the air traffic control system is being developed, I was explicitly forbidden to ask any questions of anyone other than Gen. Spencer S. Hunn (retired), the project manager. I felt a little like a hippie carrying a Molotov cocktail into the Pentagon. (Fortunately, contractor personnel are not all concerned primarily with maintaining FAA's public image.)

The primary reason for interviewing Gen. Hunn was to find out whether Dave Israel's system management philosophy had affected FAA's relationships with contractors. Israel, as director of OSEM, has no direct contact with suppliers. Hunn does. As director of the Systems Research and Development Service, he manages most of the contracts related to the air traffic control (ATC) system. This includes communications and navigation, as well as computer systems. The official directly in charge of the latter part of the ATC program is Hunn's assistant, Richard Frakes.

The general reported that the FAA is now considering the use of a time-shared program production system based on os/360. Asked why such a system hasn't been implemented before now, he said os/360 "was a thought that came about many years after the start of this program." He recalled hearing about the IBM operating system "in 1967-68."

Whether this is "many years" after the start of the en route program depends on your point of view. Early impetus for the project resulted from a 1960 Presidential Task Force report. In 1965, IBM was awarded a prototype software contract for the en route system. This version is known officially as Model 1. In 1967, the contract was expanded to include a more sophisticated version, Model 3, the system that the FAA is now planning to use nationwide.

According to the report, "a concerted effort could have been made, when Model 3 was conceived, to use os/360. The added cost . . . would have been trivial compared to the cost of the changes needed to accommodate third-generation peripherals." Elsewhere, the report says that "unless steps are taken as soon as possible" to investigate "alternative software designs, using industry-accepted multiprocessing techniques, the effectiveness of the (air traffic control) system will be significantly injured."

Hunn's defense of the FAA's failure to consider os/360 when Model 3 was conceived is hard to understand; he was in the Air Force at the time and thus can't be blamed. One possible explanation is that the report was completed in 1971, after Hunn joined the agency; today, a year later and despite the report's call for immediate action, the agency is still "considering" a plan to use os/360.

During our interview, Hunn was asked whether the FAA had ever studied the costs and benefits of integrating os/360 into the ATC system. "Oh yes. Last summer we costed out what it would take, not only in dollars but in delay of programming," he answered. Asked for a copy of this analysis later on, Hunn's assistant, Richard Frakes, reported that it wasn't really what the boss had said it was. Rather, Mitre, FAA's system consultant, conducted a survey of industry's use of time-shared program production systems.

The IBM software for Model 3 is scheduled to leave NAFEC in August. It will go to the FAA air traffic control center at Palmdale, Calif., near Los Angeles, for final testing and evaluation. Then, if all goes well, it should be ready for normal operational use early next year.

IBM's legal liability for meeting the software contract specifications will end when the FAA formally accepts the package upon completion of the NAFEC testing cycle. At that point, the programs become federal property. IBM has a separate contract with the Air Traffic Service, a different FAA branch, to conduct the final testing operation on the coast. Under this latter contract, though, the company isn't obligated for any software failures. In fact, IBM will gain rather than lose if the software doesn't perform, since this will mean additional testing.

Current projections call for spending another three-quarters of a billion on computer-related systems and development . . .

One part of the IBM software system is a generalized program called the Universal Data Set (UDS). Essentially, it's a set of instructions for handling geographic parameters affecting the radar signal input. Because these parameters are different at each center, the NAFEC version of UDS is being exercised on a representative, but fictitious, data base. When the software is delivered to Palmdale and other sites, the local parameters will be cranked in.

Gen. Hunn admitted that if this "adaptation" process doesn't work—if, for example, additional instructions are required to take care of conditions inadvertently omitted from the NAFEC version of UDS—IBM won't be required to make any modifications. Likewise, if the field tests generate a need for modifying any other portions of the software system, the FAA, not IBM, will be responsible for implementing them. But the agency's in-house systems personnel have less training and experi-

ence than the IBM crew, so it's at least possible they won't be able to do an adequate job. In that case, IBM could very easily end up with still another contract.

Meanwhile, the FAA's airport terminal automation program is much further along. By the end of the 1972 fiscal year, the 62 busiest terminals will have the latest system, ARTS III, installed. Cost of this project, to date, is about $95 million. A number of observers, including engineers and system designers intimately involved in the overall project, say the en route program could have been telescoped significantly if the FAA had adopted the same basic implementation scheme being used for the terminal program.

There are significant differences, however, between terminal and en route air traffic control—notably, the latter involves a far more complex flight plan processing job, while the former must deal with aircraft much closer to each other. Also, while the computer complex in each en route center receives primary and secondary radar from a number of remote antennae, the terminal system, ARTS III, utilizes only a single radar-beacon complex in most cases. Depending on whom you talk to, these differences make the terminal system more, or less, complex than the en route system.

But what may be most significant in explaining why the ARTS III terminal automation has progressed faster than Model 3d en route automation is that ARTS III was developed by Univac under a turnkey contract with the FAA —while the FAA itself has been the system manager and integrator for Model 3d and its predecessors.

Like the en route system, the one for the terminals uses primary and secondary radar inputs. But whereas the primary radar fed into the en route centers is digitized, ARTS III continues to use essentially the same analog-type primary radar signal air traffic controllers have been relying on for several years. This design substantially reduces the size, cost, and complexity of the supporting computer system, although it's conceded that analog systems eventually run into capacity problems.

An upgraded ARTS III, capable of handling digitized primary radar, is part of the FAA's future plan. An authoritative source, when asked what the effect of this upgrade would be, said the core size of the present processor (a modified Univac 1230) will have to be increased anywhere from 16K to 32K. The present configuration ranges from 24K to 256K. Also, processing primary radar in digital form will require "a tremendous amount of auxiliary memory," he added. The present configuration doesn't have any.

Reportedly, one major reason for digitizing primary radar signals—for both terminal and en route systems—is to get a clearer picture on the controller's crt. He will also be able to reconfigure the picture so that it shows, for example, only those aircraft within a specified altitude range, or those planes flying through a cloud formation. The controller will also be able to project flight paths and attach data blocks (showing flight identity and altitude) to blips representing planes that don't have transponders. But FAA's critics say that these options can be built into the terminal and en route systems even if they use analog primary radar.

The en route system, unlike the terminal system, was designed from the beginning to use digitized primary radar. IBM subsequently sold the FAA a truly awesome system to implement it at each of the 20 air traffic control centers serving the 48 contiguous states.

There are three basic configurations. The smallest, known as the 9020A, is based on a 360/50. A typical 9020A includes 20 32K-byte core units, with two extra units for backup. Auxiliary memory, typically, consists of 12 mag tape units (IBM 2401s), and two 2314 discs each having 7.3 million words of storage. At the busier ATC sites, a 9020D system will be installed. This is based on a 360/65, with an average of 20 32K core boxes and four for backup. Maximum core capacity is 40 core units. Auxiliary memory is the same as the A configuration. Each 9020A and D also has three IOCEs (input/output control elements), containing an additional 32K words of core apiece. Connecting the 9020 with air traffic controller displays at most sites is a Raytheon-supplied "computer display channel" (CDC), essentially a 16K core Raytheon 730 computer controlling several specialized, and very sophisticated, elements that store and massage digital representations of radar pictures. Each CDC also includes up to 120 controller displays. At the largest-volume air traffic control centers, an IBM 9020E system—using a 360/65—will replace the Raytheon processor (but not the Raytheon crt displays).

The FAA is unwilling or unable to state what the en route system would cost if digitized primary radar signals were eliminated. But Dick Frakes recently gave an indication. He estimated that about 20% of the core within the 9020A and 9020D complex holds programs and data related to the processing of digitized primary radar signals. A significant portion of the IOCE subsystem is also dedicated to this job.

Even if an analog primary radar system didn't reduce the size of the 9020 complex one byte, however, there would still be a significant saving because digital radar requires yet another computer, at the radar tower. This one, known as a "common digitizer," is supplied by Burroughs. It costs $170K per copy. A total of 120 common digitizers are to be installed by 1982. That means $20.4 million.

"Just imagine for a moment that FAA took this $20 million and partially subsidized the manufacture of transponders," says a knowledgeable source. "Most, if not all, of the planes now lacking this equipment would be supplied. Beacon radar would then be the primary means of controlling aircraft. The FAA has already announced plans to rely primarily on beacon radar in the upgraded system of the future. If most planes had the equipment now, this transition could be telescoped by several years."

FAA officials gripe, legitimately, about how stingy Congress has been in

Input for the En Route System

Essentially, the en route portion of the National Airspace System will process four kinds of inputs: primary radar reflections, which bounce off the skin of an airplane and are transmitted back to a ground receiver; secondary radar, which triggers a reply signal from a transponder unit inside some aircraft; flight plan data, fed in through a keyboard terminal before the flight leaves; and keyboard-entered data supplied by the controller as the flight progresses.

Today, primary radar is the chief means of controlling aircraft in flight. The air traffic controller watches the trace of each plane on his crt display, and periodically correlates its position with a set of "flight strips" mounted on a rack adjacent to the display. These strips are made up before the plane takes off, and indicate where it should be at specified times during the flight. If the plane's actual position, as shown by primary radar, does not correspond with its planned "flight strip" position, the controller may communicate with the pilot by radio and order a correction. He also uses the radio to move the plane around weather, keep it safely clear of other aircraft that show up on the crt, and correct for other changes in the environment.

The controller's basic problem is that he has too much to contend with. Often, so many planes are in his sector that he can't keep track of individual flight numbers, speeds, and altitudes.

financing air traffic control. But, as suggested by the decision to digitize primary radar, the money that *is* provided doesn't always get spent in the most cost-effective manner.

Further evidence that digitized primary radar may not be much of a bargain is provided by an article in the May 1971 Journal of Air Traffic Control. It describes a two-year test involving a conventional crt, utilizing analog primary radar signals, and add-on hardware which displays the altitude and identification of aircraft equipped with Mode C transponders.

This "beacon numerics" system was tested at the Indianapolis and Atlanta en route centers. The display wasn't as sophisticated as the one planned for the 3d system—the latter will project alphanumeric codes, while the former is limited to numeric data, for example —but the test system did eliminate shrimp boats and the associated controller bookkeeping chores. It displayed aircraft altitude in real time and moved this data, as well as an identity code, across the face of the controller's crt alongside the corresponding radar trace. However, it did not provide automatic tracking.

According to the Journal article, the beacon numerics system was so reliable that pilots were asking the center for their altitudes, instead of vice versa, the more usual practice. Not only was the human workload reduced at both ends of the communication path, but controller-pilot communication channels, which are often overloaded, were freed for other traffic.

"Controller acceptance of this system is so great that we here at Indianapolis Center have even sacrificed some radar flexibility to have more display of beacon numerics," said the author, Albert Fellin. This comment is in clear contrast to those of many controllers using digitized primary radar.

But others note that any type of air traffic control automation, particularly the use of digitized primary radar information, requires the controller to master a number of new procedures together with a new, complicated console keyboard. Essentially, he must relearn his job. Reluctance to do this probably accounts for at least some of the skepticism regarding automation.

When Gen. Hunn and Dick Frakes were asked about the beacon numerics experiment recently, they said they didn't know anything about it. Yet on March 31, 1971, Henry S. Chandler, chief of FAA's southern region, sent a letter to the agency's Washington headquarters in which he said "the beacon numerics system . . . has proven beyond any doubt to be an extremely valuable aid. In view of the history of delays in implementing en route radar data processing, we recommend that the agency immediately study the feasibility of installing beacon numerics on all long-range radars . . . "

Hindsight confers wisdom, and virtue, on the observer, Gen. Hunn indicated at a number of points in the interview, and thus an idea that appears obvious today may not have been apparent when the basic decision had to be made. However, it's questionable whether the general's aphorism applies to FAA's decision regarding digitized primary radar data.

The use of aircraft identification and altitude data, generated by beacon radar and displayed on a crt, goes back at least to the SAGE system, circa 1955. A transponder capable of delivering both altitude and identification information on demand from a ground beacon was being marketed commercially by Airborne Instrument Laboratories in 1965. In short, the technology needed to make beacon radar the primary means of controlling aircraft was available, or at the very least within reach, when the FAA was planning the NAS system.

Gen. Hunn has a point when he talks about the agency's clouded crystal ball. Being able to foretell the future accurately would obviously have helped in the '60s. But the real problem may lie elsewhere—in the FAA's lack of expertise in managing development of a complex system during a period of accelerating technological change.

The IBM contract is one result of this; the Raytheon "computer display channel" contract is even more revealing.

Raytheon has had years of experience as a defense contractor, but nevertheless its FAA performance sets some kind of record. The initial contract was awarded in January, 1967. Raytheon obligated itself to deliver 16 CDCs for a fixed price of $44.8 million. The first system was due Feb. 28, 1968.

At the time this article was written, more than four years later, Raytheon still hadn't delivered an operational model of the CDC, although one was

(Sectors vary in size according to traffic density, but frequently a controller is responsible for 15 aircraft at the same time.) Besides, he must communicate more-or-less constantly with several planes, which not only ties him up but may overload the center's air-ground radio channels. The number of aircraft in the sky is increasing rapidly, so these problems are getting worse.

To help keep track of data on individual aircraft, the controller uses a plastic chip, known as a "shrimp boat," on which he records and updates the identification, altitude, and speed of a particular flight. He puts the shrimp boat on the face of his crt and moves it along with the corresponding target as the latter changes position. But since this whole operation is completely manual, it takes time and can lead to mistakes.

In the new en route system, known officially as NAS Stage A, Model 3d, shrimp boats will be eliminated; so will flight strips (except for backup). The computer complex will correlate flight plan data with primary and secondary radar data automatically, and discrepancies will be flagged on the controller's scope. Thus, instead of having to monitor each flight continuously, he will be able to manage by exception.

Meanwhile, digital codes giving the plane's flight number and altitude will be generated automatically by transponder equipment aboard the plane, and this information will be sent back to the controller via the secondary radar or "beacon" system (both primary and secondary signals are sent out and received from the same ground antenna array). The data will be displayed on his crt, next to the trace representing the aircraft, and will stay with this trace as it moves across the display (unless the controller exercises an option and moves the data off to the side). All commercial and military aircraft are now equipped with "Mode C" transponders capable of delivering both identification and altitude data to the controller via secondary radar. But not all business and pleasure planes have this equipment.

Hopefully, early next year, the first system providing these enhanced capabilities will go into regular operation at the Palmdale center, which controls the airspace over southern California.

Controller at work in the Washington ARTC center, Leesburg, Va.

expected almost momentarily. Meanwhile, the original "fixed price" of $44.8 million has escalated to $124 million.

Raytheon has hung on despite a truly formidable array of problems. In 1969, F. E. Irish, the computer display channel project monitor, wrote to Jay Rabb, then deputy director of the ATC automation program, and said "Raytheon must be given an ultimatum to demonstrate a working display. If this is not done, we can continue to expect the month-to-month slippages that we have experienced thus far."

Later that year, Mitre Corp., FAA's system consultant, made an extensive evaluation of Raytheon's contract performance and recommended that "a course of action leading to an alternate display be pursued vigorously. This recommendation is based on a lack of success of the current display design effort to date, reservations concerning the basic concepts, reproducibility, alignment and reliability/maintainability in the field."

Meanwhile, the original "fixed price" of $44.8 million has escalated to $124 million.

Mitre also alluded to "the extreme difficulty of proceeding with a major redesign activity with Raytheon" because of the company's "commitment to the current design and the current contractual situation." In plainer English, Raytheon was refusing to abandon its original design and the contract had been written so poorly that FAA couldn't insist on a change. Mitre added that "there is at least one commercially available display with performance reasonably close to that required in the CDC." Although not mentioned by name, this was almost certainly a reference to a Sanders system called the ADDS 960. Ironically, Sanders developed it originally in hopes of winning the contract the FAA awarded to Raytheon in 1967.

Fortunately for Raytheon, the FAA didn't see any reason then, and hasn't since, to distribute the letter from Irish, the CDC project monitor, or the Mitre evaluation. But in 1970, there was still more criticism, from the Brooks subcommittee of the House GovOps committee, and the affair did get some press coverage. With the Brooks subcommittee pushing from one side of Capitol Hill, and Senator Norris Cotton (of New Hampshire) pulling from the other, the FAA was finally persuaded to award a contract to Sanders (which is located in New Hampshire). Everybody at the FAA, however, insisted that the Sanders display was not intended to be a replacement for the Raytheon display.

And it wasn't, even though Sanders delivered an operational prototype of its system on time, within a year after receiving the contract. "Sanders' price was too high," an FAA official explained recently. He failed to see the humor in that remark.

Raytheon staved off the Sanders threat by redesigning the CDC and incorporating some, but not all, of the changes recommended by Mitre in 1969. The net effect of this change is indicated by one of several outside evaluations submitted to Gen. Hunn's office in 1971. It concluded that Raytheon's software development system was using poor programming techniques, was inadequately staffed, and failed to encompass field changes. Also, there was lack of coordination between Raytheon and IBM to assure proper mating of the CDC with the 9020 complex; no contract provision obligated Raytheon to maintain the software after delivery, and no error recovery procedures had been provided, to mention just some of the criticism.

Subsequently, FAA decided to use the Raytheon system at only 15 en route centers, instead of all 20 as originally planned. The five busiest sites will use the IBM 9020E configuration—a 360/65 connected to Raytheon controller displays. As one FAA technician put it recently, "if Raytheon falls apart (on the display data processing module at the 15 less-busy sites), the 9020E will back it up."

When I talked to Gen. Hunn May 9, he said the first Raytheon CDC (data processor and display units) intended for operational use would be shipped to the Los Angeles area en route center (Palmdale) "by the 20th of May" from Raytheon's Sudbury, Mass., plant. He was asked about rumors that the system hadn't passed final acceptance tests at the factory—specifically a 72-hour reliability test.

"Those rumors are incorrect," replied the general. "The CDC passed it (the 72-hour reliability test) last week."

Another FAA official, closer to the actual scene, subsequently interpreted things a little differently. The CDC has been "conditionally accepted," he said, pending correction of defects uncovered during the final tests at the factory. Both Raytheon and the FAA know what's wrong, and know how to correct the trouble, but "we haven't yet defined this task in contract terms." That was to occur the following week.

As recently as May 1, the CDC was scheduled to achieve an "initial operating capability" at Los Angeles by Feb. 1, 1973. This is still the plan, according to the source quoted above, but because of the most recent set of bugs uncovered at the factory, final testing on the coast will have to be speeded up; some procedures have to be dropped and the testing crew will have to work on a two-shift basis, instead of one shift as originally planned. Unless these changes are made, he added, the date will slip from Feb. 1 to May 1.

The most ironic aspect of the whole sad Raytheon story is that the FAA could have avoided the delays, the extra expense, and the criticism simply by upgrading the late-model analog radar displays it is now using, to accommodate secondary beacon radar inputs. As demonstrated by the Indianapolis and Atlanta experiments mentioned earlier, this is a far easier job, but even so produces a significant improvement in controller efficiency.

Also, by upgrading the present displays before embarking on a completely new design, the FAA would be in a better position to exploit the technology. About a year ago, at least one manufacturer, Thomas Electronics, introduced a cathode ray tube called the PDM (for "post deflection magnification"). Reportedly, it would reduce the present CDC display's power requirements 90% and cut, by an equivalent amount, the heat generated around each unit. Also, the PDM is said to have a significantly faster writing rate. Excessive heat has cursed the Raytheon system from the beginning, and the problem isn't solved yet, according to one knowledgeable source.

Gen. Hunn and his assistant, Dick Frakes, both confess ignorance of the PDM even though NAFEC has tested it for use in a controller display unit. "It would be ridiculously stupid to replace the present Raytheon crts," added Gen. Hunn. "What are you going to do with the tubes you've already got, throw them away? They're perfectly good."

The most accurate, concise summary of the air traffic control system, as it stands today, was provided in the thorough report done for the FAA last year. But, despite that report and despite personnel changes at the top, apparently little has really changed. It's a little chilling to contemplate the future.

ARTS III, the terminal system, and Model 3d, the en route system, are each waystations on a road that climbs ever higher into the technological mists during the next several years. Among the features to be added in the "upgraded" system are earth satellite communications relays, more sophisticated area navigation equipment, all-weather instrument landing systems, and expanded beacon radar capabilities. The latter improvement involves a

system called DABS (for "Discretely Addressable Beacon System"). It will, among other things, permit the ARTS and Model 3d computers to generate audio-response messages and transmit them automatically to the pilots concerned.

The most dramatic application of this technique will involve collision avoidance. The computer will not only detect the danger ahead of time but will warn the pilots and tell them what evasive action to take.

At a recent three-day conference in Washington, the FAA's associate administrator for engineering and development, Gus Lundquist, said that "in order to provide this higher level of automation, we need an improved surveillance system which has a faster update rate, improved positional accuracy, and high reliability. We believe DABS is the most attractive candidate." MIT is now doing preliminary work on such a system. All of which suggests that the digitized primary radar signal to be used in the "nonupgraded" version of Model 3d—i.e., the system now being readied for Los Angeles and the other 19 en route centers—will become obsolete relatively soon.

Lundquist's comment leads back to a point made earlier in this article: by halting work on the digitized primary radar program last year, the year before that, or the year before that, and investing the money in development of an improved secondary radar system, the FAA might have been able to eliminate the effort altogether and might have been able to acquire the enhanced capabilities of DABS sooner.

The ATC update has been expensive, and promises to become more so. The expenditure to date on the IBM, Raytheon, and Univac contracts totals roughly $410 million. Current projections call for spending another three-quarters of a billion on computer-related systems and development between 1973 and 1982. This is a conservative estimate, which doesn't include some major items, like maintenance and operation, and doesn't allow for what the accountants delicately refer to as "cost growth."

The history of the program suggests strongly that FAA doesn't have the expertise needed to spend this money wisely. Operating an air traffic control system is far different from managing its design and development, especially when development management is intricate, specialized management controls are required, and rapidly-changing technology must be employed.

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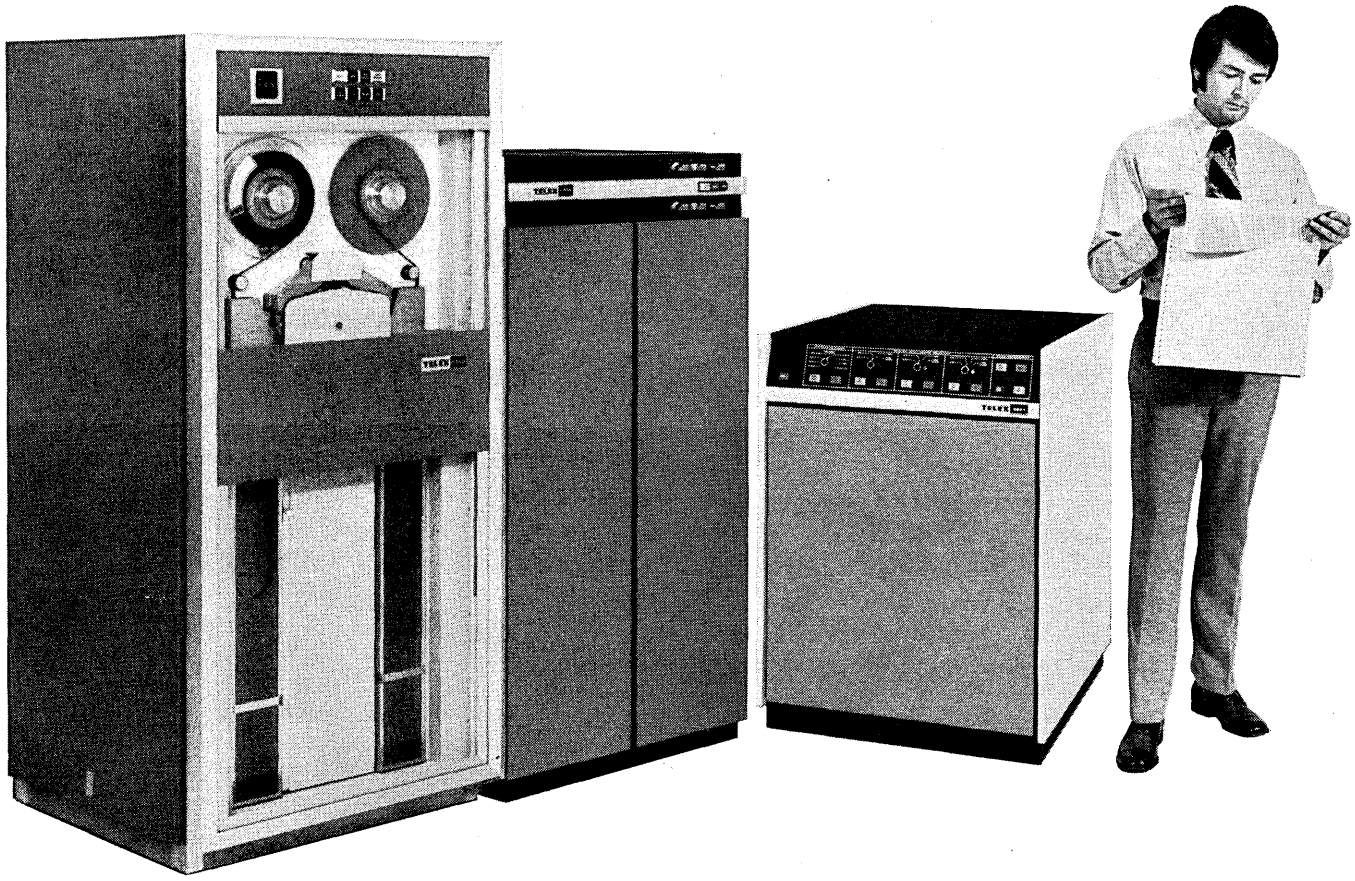

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Attendance up, interest high at the 10th anniversary conference of the Society for Information Display

The SID Conference

by Edward K. Yasaki, Western Editor

Significant price drops in graphics terminals are apparently imminent. Not too long ago, it cost from $50K to $200K for one of those terminals and perhaps at least that much more for the software. Some four or five years ago, use of the storage tube brought down the price of the terminal to below $15K. And since that time, according to Carl Machover, prices are more in the range of $4K to $15K.

"Commercial versions of the plasma panel, together with X-Y displays, are now available from Owens-Illinois," Machover stated in a paper presented at the recent international symposium of the Society for Information Display (SID). "Complete computer graphics terminals will probably come on the market by mid-1972. Plasma panels are attractive because of their potential low cost (projected price in the $1500 range) because the display surface includes the storage, and because the panels are translucent."

Machover, a former SID president and a Fellow of that society, spoke on trends in low-cost graphic display terminals. A former engineer, he is currently marketing vp for Information Displays Inc., Mt. Kisco, N.Y. At the seminar, attended mostly by R&D types, an increasing emphasis could be seen on two new technologies, the liquid crystal and the gaseous discharge displays. The plasma panel falls into the latter category.

Information display is usually thought of as the end product of some machine processing, the intermediate or final presentation form perused by man. But during the keynote session, the discussion got around to a new input method. Keynote speaker H. R. Luxenberg, entertaining questions from the floor, got one on the use of ESP (extra sensory perception) as input to a computer. So he asked for a show of hands: how many thought this would be possible in the next 25 years? The response was about equally yes and no. He then asked to see how many thought this capability would be desirable. Those indicating no outnumbered the yeses by about 70-30.

A longtime consultant and now computer science professor at Cal State Univ. in Chico, Luxenberg spoke of the impact of information display on society in the next quarter century. He spent most of the time defining such terms as information display and society, but summarized by forecasting a decentralization of our population. We won't have to commute to a job or

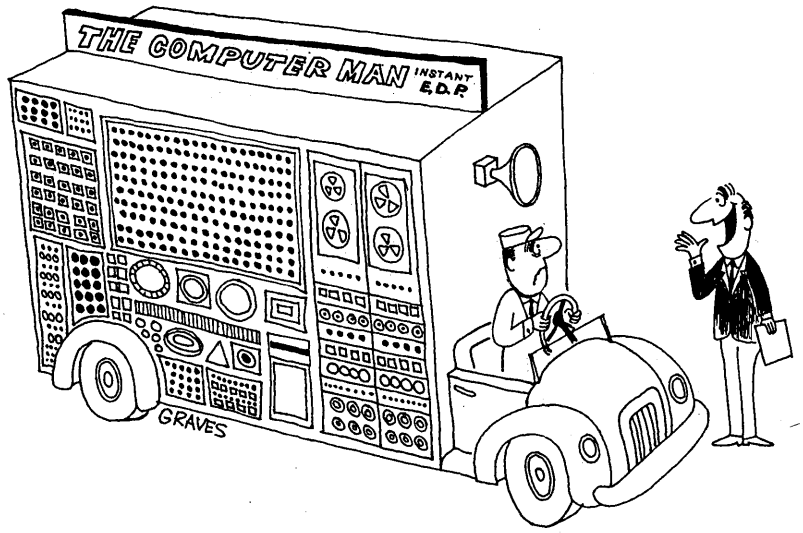
Keynote speaker Luxenberg: How about ESP input?

leave home to do our shopping. "Both large-screen, full-color, high-resolution, permanently installed—and personalized, portable—information display systems will be available," he said.

He also asked, "Will the printed page survive?" His answer: yes, because it's extremely convenient. Students still prefer books over microfiche, he explained, because they can take books to a park and read in the shade. Luxenberg, who is considered the founder of SID, said one of his students prepared a term paper on microfiche—and submitted it in the form of fiche. "I still haven't read it," he said.

Preregistration for this symposium exceeded that of last year, perhaps an indication of an improving economy. And attendance was high, the registration exceeding 650 on this 10th anniversary year for the society. It probably set no record, but was about 30% above the previous year.

Introduced at the symposium were new SID officers, including Carlo Crocetti of the Rome Air Development Center, president, and Robert Klein of Kollsman Instruments, new vice president. The casual observer of display technology might be interested in the Digest of Technical Papers. This 160-page volume, with 800- to 1,000-word condensations of all papers, is available to nonmembers for $15 from the SID office, 654 N. Sepulveda Blvd., Los Angeles, CA 90049. Then, too, there's next year's meeting, scheduled for May 15-17 at the Statler-Hilton in New York City. □



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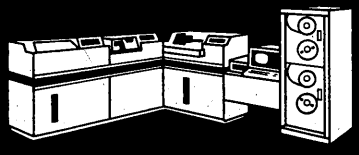

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ASK ABOUT OUR LATEST ADDITION
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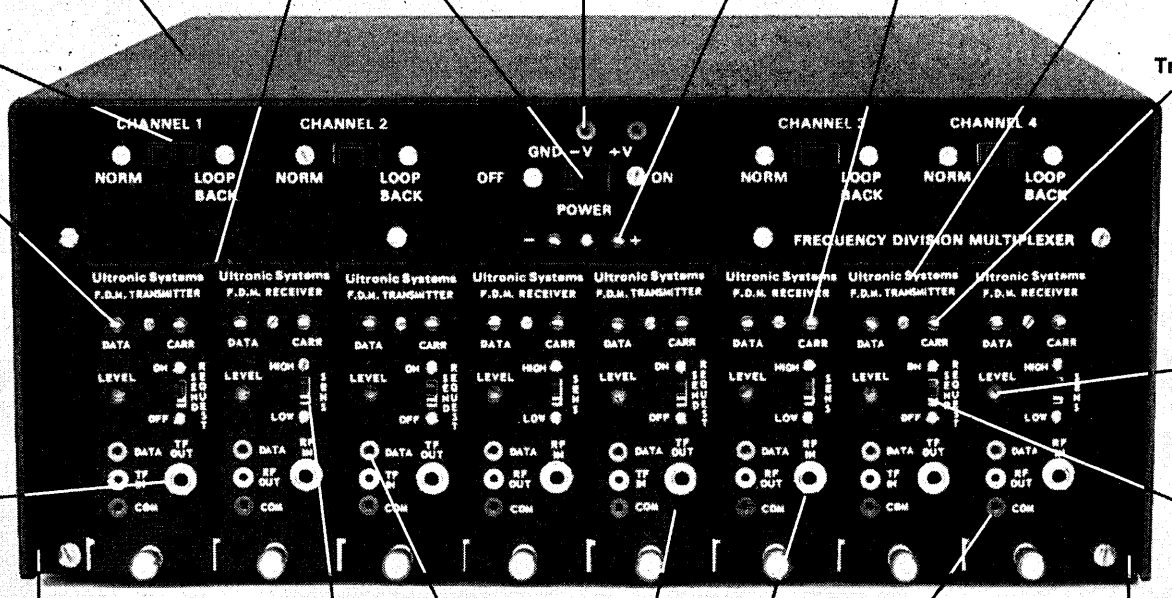

Cabinet that holds 1 or 4 channels. (Also rack mounted for up to 60 channels.) Handles up to 25 channels at 75 bps to 3 at 600.

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Each channel can be run in simplex, half-duplex, or full duplex. EIA and high level neutral or polar interface.

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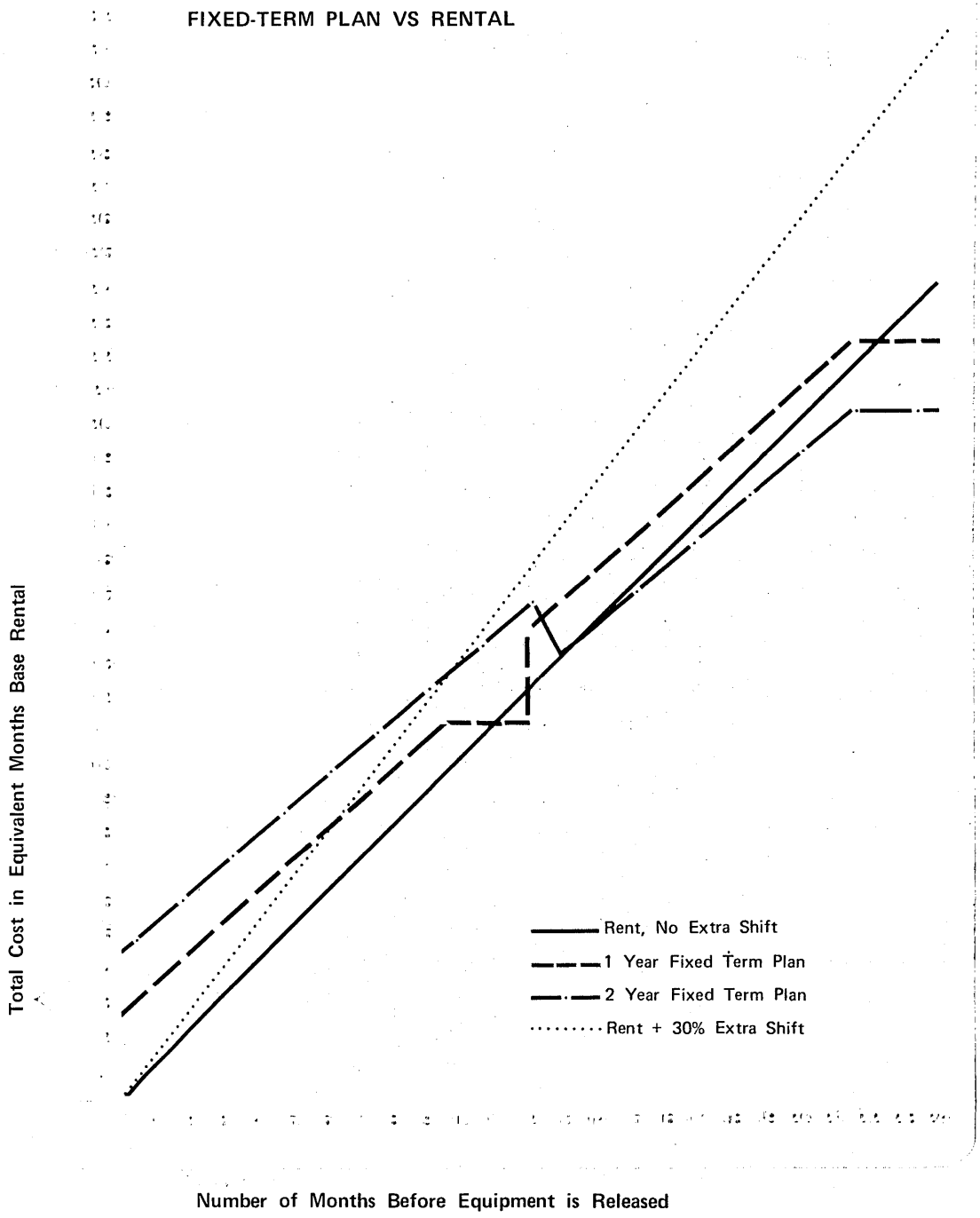
CIRCLE 74 ON READER CARD



Comparing Costs on IBM Rental Plans

The accompanying graph was prepared by Michael J. Erdei, manager of planning and analysis, at Hughes Aircraft Co. as a visual aid in comparing the potential benefits and associated risks of IBM's new fixed term plan vs. normal rental costs.

Normal rental without extra shift charges is shown by the solid line.

The dotted line is normal rental assuming a 30% extra use charge.

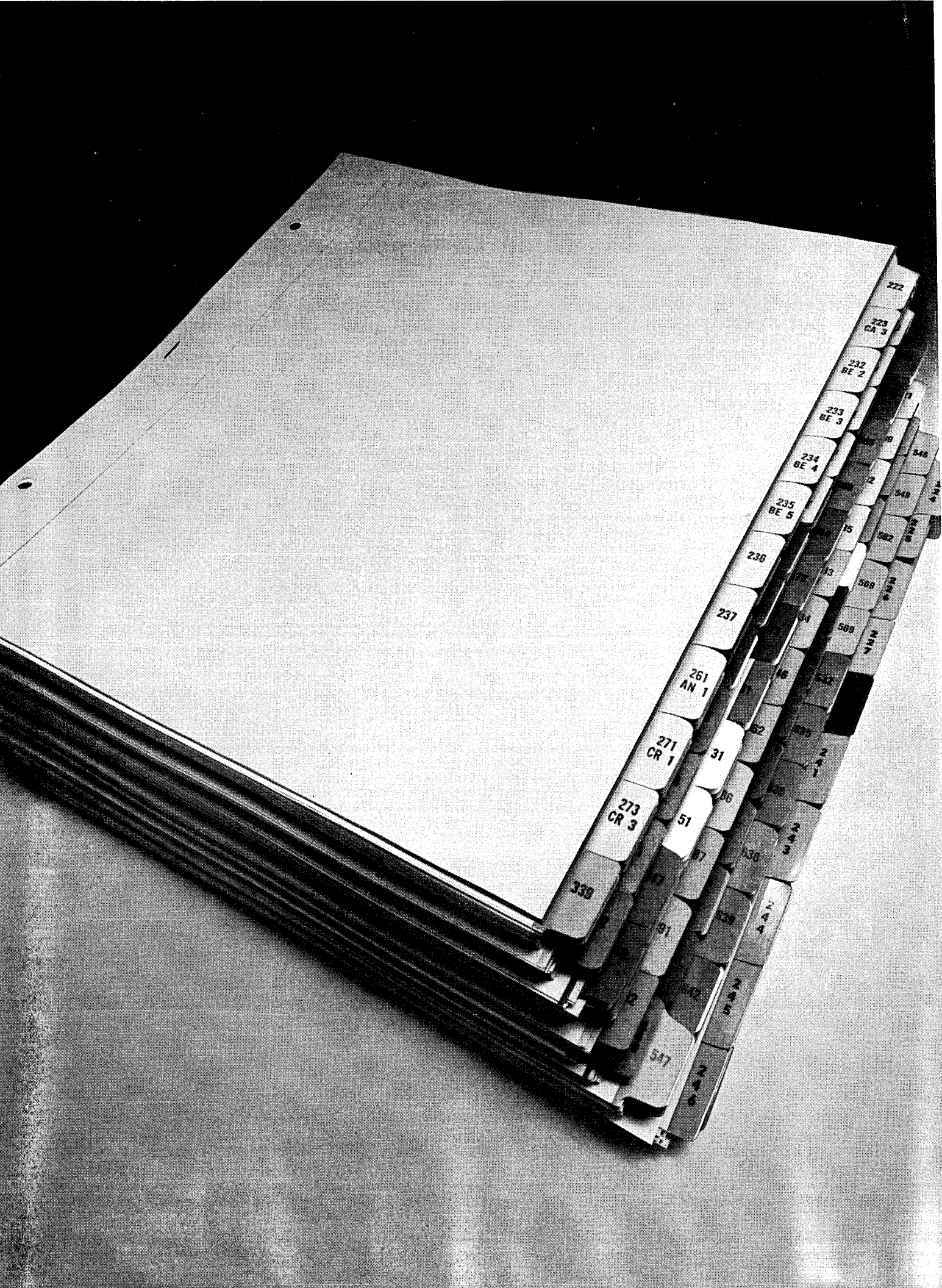
The dashed line is the one-year fixed term plan, renewed for a second year. It allows for both the discount and the termination penalty.

The dash-dot line is the two-year fixed term plan, also allowing for discount and termination penalty.

It can be seen that, for units that do not normally accumulate extra shift charges, such as tape and disc drives, the one-year fixed term plan is cheaper only if the machine is installed for at least 11 months. Before this, the termination penalty is larger than the discount. For the same units, the two-year plan reaches breakeven with normal rental after the 12th month.

The situation is different, however, for units that incur a 30% extra use charge per month, such as cpu, core, or control units. The breakeven point for the one-year plan is six months and for the two-year plan it's nine months.

The graph is most useful if the user knows how long he will keep a given piece of equipment and the expected meter hours per month. □


222
223 CA 3
232 BE 2
233 BE 3
234 GE 4
235 BE 5
236
237
261 AN 1
271 CR 1
273 CR 3
339
31
51
91
547
548
549
582
589
569
2 4 1
2 4 3
2 4 4
2 4 5
2 4 6

We help George Litho publish this 1500 page directory overnight. Every night.

Singer MS 6020 Micrographic System 16 and 6024 Datacraft Computer.

George Lithograph of San Francisco takes on some of the hardest publishing jobs in the country.

One of them is for a customer that needs a 1500-page directory re-set and reprinted every working day.

Easier said than done. But George Lithograph makes it look easy. With our help: with our technology in computerized photo composition.

The schedule is a plant manager's nightmare. Computer data tapes arrive from the customer at 8 PM every working day.

A partial shipment must be ready at midnight.

The complete job must be on the delivery trucks at 5 AM the next morning.

That's the schedule. Here's the way it's met: Copy arrives on 9-track, 1600 bpi data tape, directly from the customer's computer.

The Comgraphics Division of George Litho then loads the tape into its Singer MS 6020 Micrographic System 16.

In less than 2 seconds, each page is set in the desired multi-column format, displayed on a CRT and photographed on 35 mm microfilm, ready for conversion into offset printing plates. There is no cut and paste.

The presses roll at 9:30 PM

The system, because of its flexibility, frees George Litho's customer from programming its computer for multi-column read-out.

By 9:30 PM the presses are ready to roll. By midnight, the drop shipment is on its way. By 5:30 AM the trucks are loading another edition.

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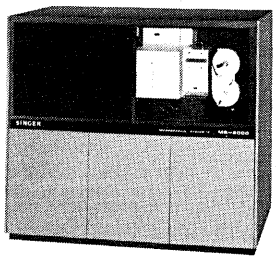
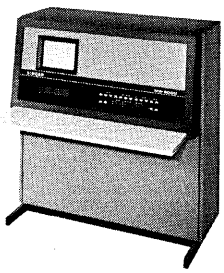
The Singer MS 6020 Micrographic System 16 offers you full input capabilities to establish, update and maintain directories, parts lists, catalog data of any kind.

And one of the best advantages of the system isn't the system at all: it's the Singer people who support it. As James C. Nicholson of Comgraphics puts it: "I've never seen such supplier cooperation. They bend over backwards to give you a system that works."

Singer COM systems. We're ready to help you step into computerized photo composition. For complete information, write: Singer Micrographic Systems, Binghamton, New York 13902.



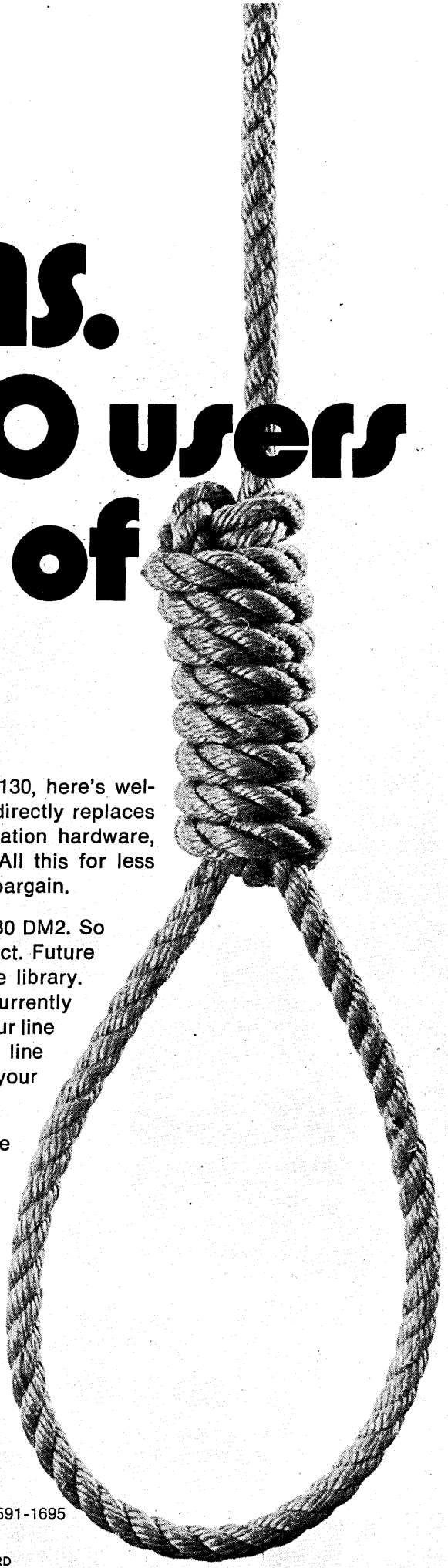


Computer Output Microfilm Systems by SINGER

SINGER Consumer Products, Industrial Products, Aerospace & Marine Systems, Education & Training Products, Business Machines.

CIRCLE 57 ON READER CARD

The GA DMS. For IBM 1130 users at the end of their rope.



If you're at the end of your rope with a throughput-bound IBM 1130, here's welcome news: General Automation's 18/30 Disk Monitor System directly replaces the 1130. With increased throughput, faster memory, 4th generation hardware, expandability, even real-time and communications capabilities. All this for less than you're paying for your 1130. It's a true price/performance bargain.

GA's 18/30 DMS operates directly with programs written for 1130 DM2. So all of your existing software and programming effort is left intact. Future programs are probably already waiting for you in our extensive library. And you'll probably get at least five times the throughput you are currently getting on your 1130. What's more, you'll be able to choose from our line of faster peripherals — like mag tapes, big disks, card readers, line printers and plotters. It all adds up to a system designed to suit your needs for years to come.

The 18/30's role as a superior, economical replacement for the 1130 is a field-proven fact. A General Automation representative will be glad to show you why dozens of customers have already switched to the 18/30 DMS, and what it can do for you. To find out, give him a call. We maintain offices with complete field service and technical support in principal cities in the United States and Europe. And we're growing by leaps and bounds.

For more information on the 18/30 Disk Monitor System, write us today. We'll also send you your very own length of rope and a book, "Knots and Splices." All very handy for people at the end of their rope.

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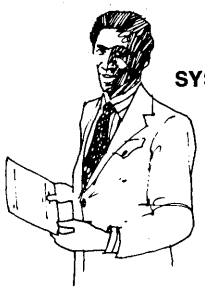
'Discover The Value Of Power'

CIRCLE 52 ON READER CARD

MARK iV® SYSTEMS

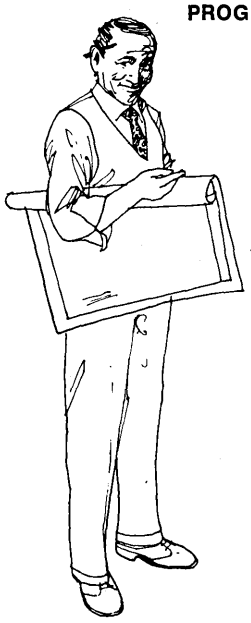
The software products that make computers more successful



SYSTEMS ANALYST: *"Great for designing complete systems."*

The straightforward MARK IV System concept offers unique design facilities and advanced file structures that are fast and easy to work with. The MARK IV System is outstanding for those conversion jobs too.

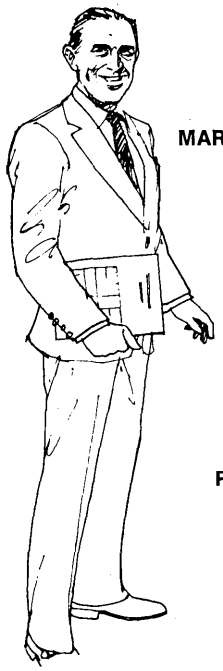
PROGRAMMER: *"MARK IV works!"*



It takes bugs, delays, overtime, etc., etc., out of data processing. *"We used the MARK IV System and completed the job in 35 hours versus the COBOL estimate of six months . . . and the job ran on the second try . . ."*

DATA PROCESSING MANAGER: *"I am impressed with quality products and MARK IV is the best on the market."*

With more than 1,100 improvements in the past 4 years, the 450-plus satisfied users testify to the MARK IV excellence in design, test, and user acceptance.



MARKETING MANAGER: *"Before MARK IV my sales and activity reports were weeks late . . . but not any longer!"*

Tired of making excuses when it comes to activity reporting on new product sales or a new sales territory? MARK IV has solved many a marketing manager's need for fast, detailed or summary reports at a fraction of the cost of COBOL programming.

PERSONNEL: *"I couldn't believe it until I saw how fast I got my reports with MARK IV."*

New reporting requirements no longer take 3 to 6 months to program. Personnel clerks can use the MARK IV System and achieve results within days, personnel managers report.

FINANCE: *"We saved $100,000 last year and put through more jobs on the computer than we had ever done before . . . with MARK IV."*

MARK IV File Management Systems are sold and serviced from offices in 11 major world cities.

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CIRCLE 29 ON READER CARD

News in Perspective

How do clerks, customers, and managers of department stores like electronic point-of-sale systems? Most like it fine, page 68. One executive says within a couple of years they'll be as necessary as the racks on which stores hang merchandise . . .

Will IBM's 3270 data entry device impact the key-to-disc market? Initially, the squeeze will be on the company's own 2260, but some see it hitting key-to-disc systems late next year, 69. . .

Data processing hardware and software shipments to Eastern European nations could multiply twentyfold if U.S. export restrictions were to be relaxed, says the head of a consulting firm that does 60% of its business there. Congress now studies just such a proposal — a new export control bill S3726, page 69 . . .

A superconductor at room temperature? On page 77, Stanford Univ. physicist William A. Little explains a minicomputer-based color graphics system used in his research into superconductivity — that is, a wire with no electrical resistance . . .

Everybody wants a minicomputer — or almost everybody, it would seem, from forecasts showing that $300 million worth will be shipped this year, page 85. That's nearly $100 million more than last year, despite declining prices.

Antitrust

Judgment Wrapped in Cellophane

"It's the ooold cellophane-and-flexible-bag game."

Or so Maxwell Smart might have characterized the decision last month of Federal Judge Walter E. Craig in an antitrust action brought by Greyhound Computer Corp. against IBM. Judge Craig, in deciding in favor of IBM, seemed to be leaning heavily on a 1957 case involving E. I. duPont de Nemours, which centered on cellophane. In this case DuPont held that the cellophane market could not be separated from the whole flexible wrappings market, much as IBM contends its computer business should be viewed as a part of a total information market when market share is being determined.

DuPont won its case in lower courts and in the Supreme Court. IBM has won a first round which started some two and a half years ago when Greyhound filed suit in a Chicago District Court charging IBM with breach of contract, monopolization, and violation of the Sherman Antitrust Law. The suit subsequently was moved to St. Paul, where it was briefly coupled in discovery stages with a still-pending suit against IBM by Control Data Corp., and finally went to trial in Phoenix this May.

The case was heard by a six-man jury, but it was the judge who decided with a directed verdict, granting IBM's motion for same. This fact, say some, could be Greyhound's best line of appeal. Greyhound declined comment on this or any specific appeal grounds but stated emphatically it will appeal.

Prompt appeal

Said a Greyhound attorney: "We are satisfied we have an excellent antitrust case, and we believe the court erred in granting a directed verdict in favor of IBM. We intend promptly and vigorously to appeal to the Ninth Circuit Court of Appeals."

Greyhound's official position in the early days following Judge Craig's decision was, "we have no comment beyond this (above) statement." Nor would the company disclose how much it has spent so far pressing its case; but outside estimates run from $500,000 to $1 million, which is why most observers feel sure Greyhound, with too much invested to stop, will carry the case to the Supreme Court if necessary.

And most legal observers are sure this will be necessary. The Ninth Circuit Court of Appeals, located in San Francisco, can do one of three things. explained one. It can determine that Judge Craig was wrong in not submitting the case to the jury, in which instance the case would go back to the Phoenix district court. Or it can rule that Judge Craig was wrong in his interpretation of the Sherman Antitrust Act and reverse his decision. Or it can uphold the verdict.

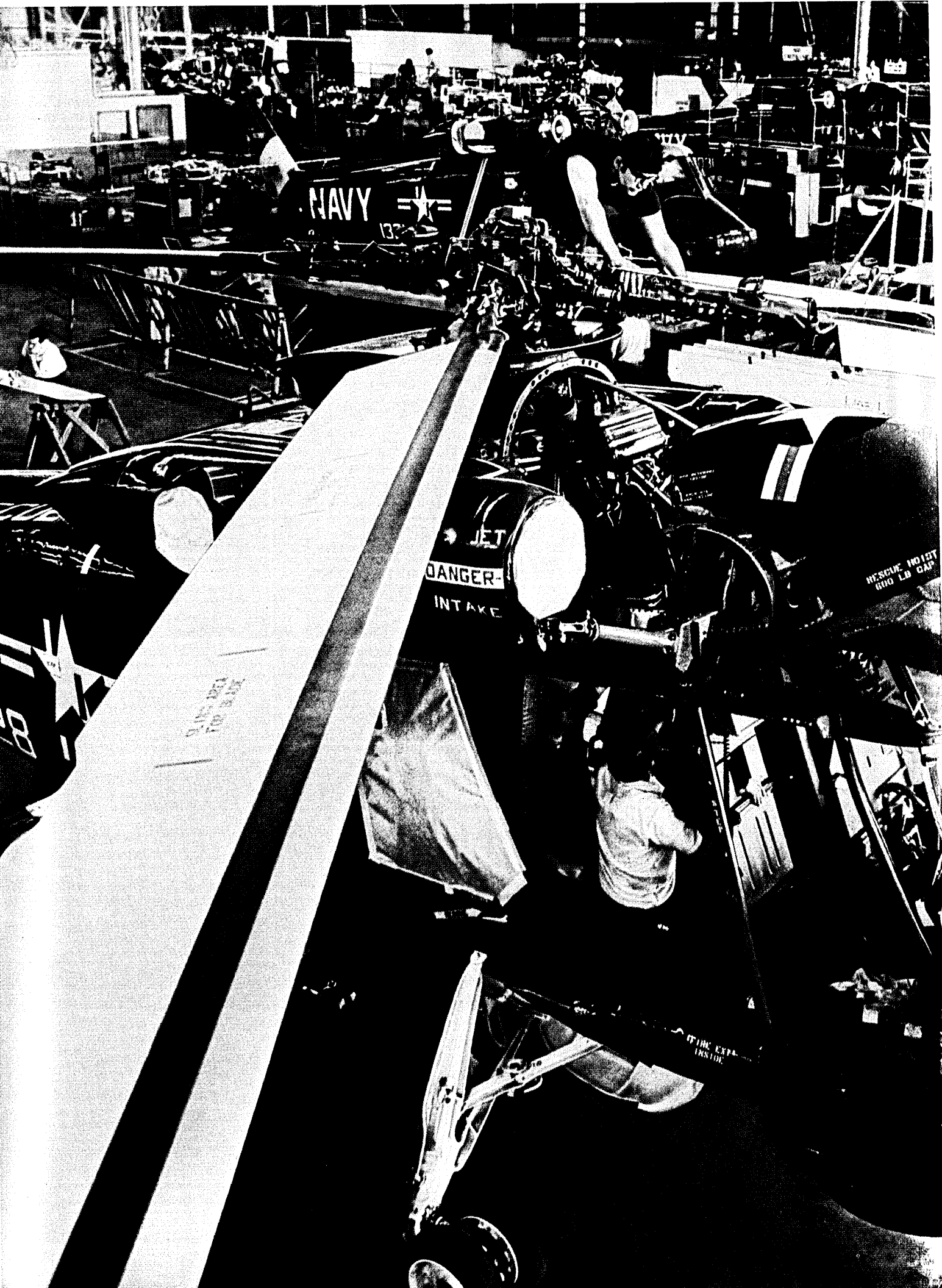
In any event, the loser in the Circuit Court action can be expected to appeal to the Supreme Court, and a final decision has been estimated to be at least three years away. This isn't good news to cliff-hanging leasing companies who probably would have rushed to file suits similar to Greyhound's had Judge Craig's decision gone the other way. Three years can be a long time in their precarious business. An opposite decision in Phoenix also would have brought comfort to attorneys for Control Data Corp., which is expecting its antitrust suit against IBM to come to trial in May 1973.

In citing the DuPont case as a precedent for his decision, Judge Craig discounted earlier decisions in four other antitrust actions. "This court," he said, "is of the opinion that the opinions in Alcoa, United Shoe, American Tobacco, and Grinnell cases do not apply to the circumstance in this case, and rather DuPont is closer to an analogy."

Not size, but use

In the other four cases mentioned, one legal observer said, interpretations of Section 2 of the Sherman Antitrust Act differed from that of Judge Craig in the Greyhound-IBM decision. Judge Craig ruled that "size alone does not constitute an offense under the Sherman Act, nor does the mere possession of monopoly power. It is the wrongful use and exercise of that power which is proscribed by Section 2 of the Act."

In the Alcoa, United Shoe, American Tobacco, and Grinnell cases, two of which preceded the DuPont case, our observer says that lower courts ruled


NAVY
JET
INTAKE

Kaman bought an HP computer system.

It knocked $30,000 off their annual time-share costs.

But that's not half the story. Before Kaman Corporation decided to buy a dedicated computer system from us, they spent nearly five months checking the usual alternatives.

"We chose HP for the price, reliability, storage and the enhancement of BASIC," says Jess E. Sweely, Controller of Kaman Corporation's Aerospace subsidiary in Bloomfield, Connecticut.

"We're using it for administrative and financial applications. We're also going to expand into the manufacturing area—for shop scheduling—as well as financial forecasting, statistical analysis and, ultimately, simulation. And our engineers will be using it for interactive computations in helicopter design and development work, including graphical analysis."

Cost, of course, was a major reason why they decided to get a time-share system of their own. "We were spending a significant amount monthly on outside time-sharing," Mr. Sweely said. "We found out that the Hewlett-Packard system could give us everything we were getting from commercial time-sharing at a fraction of the cost and with far better response time.

"Incidentally, the 2000C gives us so much capability that we're even selling time on the side. And if anyone around Hartford, Connecticut, needs a terminal or two, we'll be happy to talk to them."

But if you need more than one or two terminals, talk to HP. We now have a couple of new systems that make time-sharing from HP an even better deal than ever before. For instance, you can get started with one of our 16-terminal dedicated time-share systems for less than $50,000 (it's called the new HP 2000E). And we also have a new 32-terminal system (the HP 2000F) that offers all the power of our previous top-of-the-line 2000C model—at about one-third less cost.

Let us show you how to cut time-share costs to the bone. And maybe even do a little business on the side. Just give your local HP time-share specialist a call. Or write for complete information to Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

22122

HEWLETT hp PACKARD

DIGITAL COMPUTERS

and the Supreme Court upheld that size coupled with power is sufficient cause for action under the Sherman Act and that the burden of proof is on the defendant to prove it will not use its power wrongfully.

Judge Craig, in his decision, was ruling on two separate issues. One — whether or not IBM was guilty of breach of contract in not providing certain technical services free to Greyhound following unbundling — he decided "strictly on a rule of law." He said Greyhound had failed to establish the existence of "supplemental agreements" assuring free provision of such services.

The second, the issue of violation of the Sherman Act, posed the "more difficult problems to the court," the judge said. His reasons for not submitting these issues to the jury:

"The court is of the opinion that the evidence with respect to the market and the defendant's relative share of the market is insufficient to submit that issue to the jury . . . that with respect to the issue of monopolization by the defendant that the record is insufficient to submit that issue."

So now it's up to the Ninth Circuit Court of Appeals, and maybe it'll depend on how it feels about cellophane. But then computers aren't transparent.

Retail

POS Market Booming Visibly

"It's a computer, and you know how machines are."

The comment was made by a toy department clerk at Bullock's Northridge, a department store in suburban northwest Los Angeles, which, since its opening last September, has been a pioneer user of a store-wide, on-line point-of-sale system.

The statement was in response to a reporter-turned-shopper who pointed to the clerk's electronic register and asked her how she liked it. The above remark was preceded by "it's great when it doesn't break down, but . . ."

The point-of-sale systems market in recent months has been characterized by leading market research firms as "exciting," "rapidly growing," and "booming." Projections of its value in 1975 range from $175 million (Frost & Sullivan, Inc.) to $600 million (Creative Strategies Inc.).

The projections and characterizations neglect one point. Among all on-line systems today, POS systems are probably the most visible to the non-edp-oriented general public and consequently have to overcome an inherent resistance on the part of many to things that are new and "mechanized."

Rudolph Hirsch, vice-president of finance for Bullock's, a Southern California department store chain, is very happy with the performance of the Northridge store's system, which comprises American Regitel terminals hooked to NCR 315s in its downtown store. The firm also has 50% of its downtown store on a similar system and "definitely will put the terminals in chain-wide, although a timetable for this has not yet been worked out," said Hirsch. He said employees at the Northridge store "love it."

And some evidently do. A young bright-eyed clerk in the phonograph record department told our shopper, "it's not as good as sex, but boy is it fun." Another, in outdoor furniture, said "the thrill isn't what it was when it was brand new, but I still enjoy it and it does a lot more things than a cash register could."

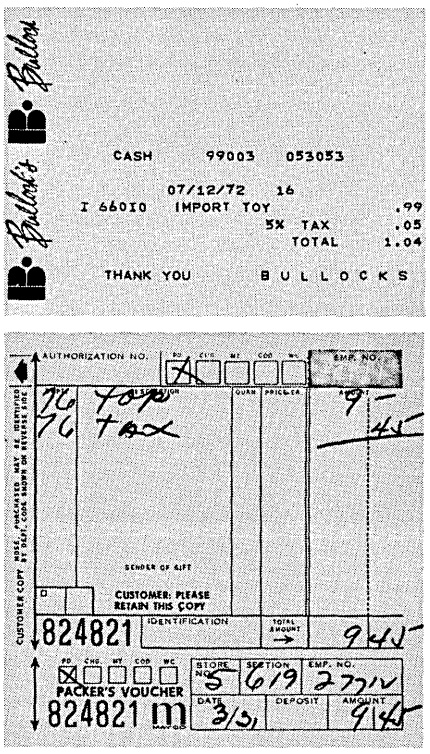
A clerk in woman's sportswear said she likes it because it's easy but added that it bothered some of her customers at first because they felt "they were being checked up on all the time . . . but they've come around. They don't think about it any more."

One customer queried said she thought it was ok, but "I don't like the sales slips. I can't understand them." Another said, "I think it's great, especially the sales slips. I can look at one two months later and see exactly what I bought and when."

The point of point-of-sale systems, says one retail edp executive who hasn't installed one yet but will in the next year and one half, "is not to please customers and clerks but to turn over merchandise. But customers benefit in the end because economies of performance lead to lower prices."

Department store executives are generally agreed that point-of-sale systems will be considered necessities in their field in the next couple of years, as much as the racks on which they hang their merchandise. This from chains that already have systems and some that don't.

Horror stories still abound about systems breaking down at critical times and angry customers stalking out, but they're difficult to confirm and happy users are easier to find. Jim Jones, of The Hecht Company, which operates 10 department stores in the Washington, D.C., area, began installation of NCR 280 terminals and associated point-of-sale equipment in his stores last September. In mid-July he was completing installation in Hecht's downtown Washington store, eighth in the chain to get the terminals. He was "real happy" with the way the system was working. "It doesn't have everything we want, but we feel what it lacks will be added in time and we're delighted with what it does do now."



Computer-generated and human-produced sales slips are different, no doubt about it. Many like the crisp, legible look of the one, but there are still those who prefer the human touch.

Penney back in

J. C. Penney Co., with the scars of its TRADAR experience fading (see June 1, 1971, p. 34), must like the NCR 280 terminals too. The chain ordered 2,000 of them in June and began installing them in four new stores Aug. 1. And this after an evaluation of some six months in a store in Hamilton, Ohio. Mel Garber of Penney's said of the evaluation: "Our TRADAR experience came into play. It was a valuable experience. It taught us what we are looking for." Garber said Penney's also is working with other manufacturers but hasn't reached the in-store test phase with any as yet.

John Freeman, director of data processing for the May Company of California, is looking at a number of point-of-sale systems and contemplates putting in a system chain-wide (20 stores) before fall of 1973. It will represent an investment of between $4 million and $8 million, and "we're not going to be pushed into anything."

He said he has yet to see a point-of-sale terminal that has everything he wants. He listed as what he wants: interface with his 370/145 for credit authorization; disc access with terminal capability available to store management; two-way telecommunications; intelligent terminals with stand-alone capability; and economic justification. "But we're not going to buy any more cash registers."

Freeman was among a small group of Southern California retailers who last month attended the first of 58 seminars to be conducted nationwide by Singer Business Machines on the economies of point-of-sale systems. Singer, generally conceded to be the leading vendor in the point-of-sale market, presented in the seminars the results of a study it had had Peat, Marwick, and Mitchell do of some of its existing installations.

"It was good to hear a vendor talking the retailer's language," said Freeman.

—Edith Myers

Data Entry

The 3270: Where Does It Fit?

In the following multiple choice quiz, contestants should check the answer they believe to be correct. IBM's 3270 is:

1. A keypunch replacement
2. A key-to-disc system replacement
3. A teletypewriter replacement
4. A 2260 alphanumeric display replacement

If you checked any one, two, or three of these, you were not entirely correct. You scored 100% only if you checked all four. That, at any rate, is what a check of IBM and a random sampling of some competitors and users has disclosed.

In a telephone interview, Chauncey Bartholet, IBM's teleprocessing systems marketing manager, said that deliveries of the 3270 began on schedule — in May. "We've been surprised at the range of use and applications that we're finding for the 3270," he said. "Sales are running ahead of what we anticipated."

Indeed, IBM was quoting a delivery lag of from 12 to 18 months on the display terminal system — largely caused by the big rush of orders. "We're determined to reduce that," said Bartholet.

The IBM official said his company expects the 3270 to impact the older 2260 display unit "very heavily" because the new device is much more sophisticated and has a wide range of new applications. Some industry sources have long felt that IBM wants to keep customers dangling on the line with the 3270, but will string out deliveries of the system to avoid heavily impacting the highly profitable 2260 for as long as possible.

"We're finding that the 3270 is a very general-purpose type of device," said Bartholet. "It's being sold across a broad range of customers and applications." He said that the bulk of orders is for the traditional on-line applications of order entry, inventory control, and accounts receivable. And, in fact, the main emphasis on the 3270 is for on-line uses.

While the initial squeeze from the 3270 has been on IBM's own 2260, it is expected eventually to hit some key-to-disc systems, although many key-to-disc manufacturers feel that the 3270 won't be actively competitive with key-to-disc systems till near the end of '73, by which time IBM will probably have announced additional hardware and software enhancements for the system.

For some months now the industry has been rumbling with reports of low-cost memories from the IBM, and while these had not been announced at the time of this writing, many observers anticipate that low-cost memory would increase the competitive position of the 3270 vis-a-vis other data entry devices. Many users still consider the 3270 to be a luxury item.

There are some, however, who believe that IBM will announce a key-to-disc system of its own. In a recent research report, Quantum Sciences Corp. predicted that IBM will enter the field — using its System/7 minicomputer and the 3735 terminal — next year at the high-price end of the data entry market, to avoid impacting IBM keypunches. Others, however, believe that IBM will bypass the key-to-disc field completely, staying entirely with the on-line route of the 3270. It is a safe bet that IBM itself hasn't decided precisely what it will do. The computer colossus is known to have at least one key-to-disc system on its shelf, but whether it will ever be introduced is uncertain.

Bartholet indicated that the 3270 is replacing such mundane devices as keypunches and teletypewriters. (The 3270 comes with a wide range of features, including a card punch keyboard and a typewriter keyboard.) But the 3270 is being sold chiefly for on-line data entry purposes in relatively small clusters — 8-, 10-, and 12-keyboard systems, for instance. On the other hand, Bartholet observed that the device is also being sold in large quantities to some big organizations.

In addition, some other IBM projects — like the CICS and IMS data base programs — are spurring the sale of 3270s as these programs pick up momentum. The new IBM program product VIDEO/370, which is essentially an extension and update of the 2260's DATA/360, is also selling well.

As is often the case with IBM products, many competitors are finding that their 3270-like products sell better as IBM does much of the marketing missionary work in selling the concept. One example of this is Courier Terminal Systems of Phoenix, which has been selling a broad range of on-line terminals. Edward F. Kearns, president, says he believes that his firm's equipment and the equipment of other independents sell well in the market because they maintain a more attractive price/performance ratio than IBM. Courier has delivered more than 2,000 terminals.

One customer said that IBM sales people identified several ways in which his company could use the 3270, but that he sometimes fills some equipment orders with non-IBM products. Thus, he felt that while the IBM 3270 represents stiff competition to many independent manufacturers, it can represent business opportunities for others.

—W. David Gardner

Trade

Exports: Tempest in a Samovar?

Congress was considering basic changes in U.S. export policy last month. Designers of the legislation — who include officials of the dp industry as well as legislators — hope that the bill will be approved soon, also that it will vastly increase the market for U.S. systems in Eastern Europe. The first hope seems far more likely to be realized than the second.

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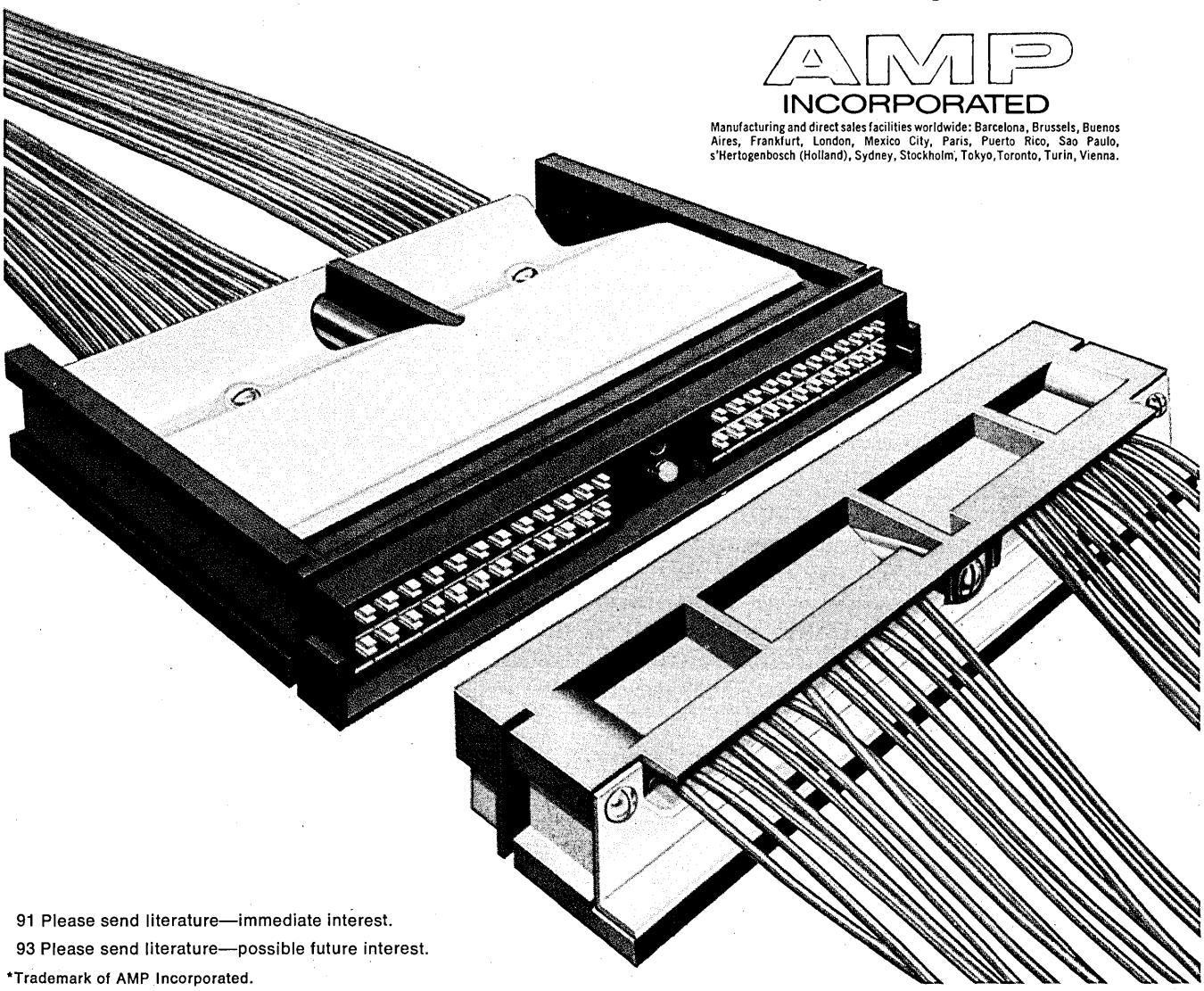

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pending export control bill, S3726; it encourages the Commerce department to relax current restrictions on the sale of U.S. high technology products to communist countries. Even if the restrictions aren't lifted, though, the Eastern European market for our computer hardware and software seems likely to grow.

Recently, Commerce approved sale of a 360/50 to the Soviet Ministry of Chemistry. The installation includes mod 3275 crt's, 2314 and 2319 disc equipment, a 3420 mag tape unit, and a sophisticated communications subsystem, all of which have been proscribed in the past. Meanwhile, CDC has won permission to ship a 6200 to the Joint Institute for Nuclear Research at Dubna, USSR. A CDC official expects a second export license application to be approved shortly — this one covers a 6200 to be installed at the Univ. of Arona, in Armenia.

Reportedly, IBM is now negotiating with the Soviets for sale or lease of "more than $100 million" worth of computers — 360/30s, 40s, 50s, "and maybe some 370/145s," says our source. Ralph Stafford, formerly IBM's head salesman in Eastern Europe and now at World Trade headquarters in New York, is said to be in charge of this negotiation.

Intercontinental Computer Exchange (ICX), a U.S. consulting-marketing-engineering firm that does about 60% of its business in Eastern Europe, is pursuing "several" bids in the USSR, reports president Dale Lewis. One is a $5 million-plus contract involving lease of "several" U.S.-made systems; financing would be supplied by Western European sources. Another pending ICX proposal contemplates purchase by the Soviets of computers and peripherals made by 12 U.S. firms.

Lewis, who previously worked for EAI and CEIR, formed ICX two years ago. Since then, the company has sold "several" systems in Eastern Europe, including the first 360/40 to go into the Soviet Union. That sale, worth more than a million dollars, occurred last year. The system was assembled from used components obtained in "various" places from "several sources."

In a recent interview, Lewis implied strongly that U.S. companies are trying to sell systems behind the Curtain in the wrong way. "They try to deal direct and spend a great deal of time helping prospects define their needs. We are 180 degrees different. Our approach is to form a joint venture with a company that has the contacts and a proven track record in Eastern Europe. We're selling to the Soviet Union, for example, in partnership with a Dutch trading company that has been doing business there for many years. Also, we concentrate on prospects who have a specific idea of what they want."

Probability analysis

Possibly the biggest difference between ICX and other U.S. drummers operating inside the Soviet Bloc is that, as Lewis puts it, "we start with the export license rather than the contract." Before discussing price and other terms with a Soviet prospect, ICX makes a detailed "probability analysis" to find out whether the U.S. government will approve the system desired. "The chances of getting the license have to be at least 90%," he explains; "otherwise, we tell our prospect that the configuration must be altered."

The biggest single factor in determining the "approvability" of a proposed system, Lewis adds, is detailed documentation concerning its end use. "If you obtain enough technical information, you can establish pretty conclusively that the system won't be used for military purposes."

It takes ICX "about 16 weeks, sometimes less" to get an export license for Eastern Europe. Before submitting the application, says Lewis, "we go over to the Office of Export Control and make sure that our application includes all the needed information." Other companies, he indicated, generally don't go through this exercise; frequently, after waiting 16 weeks, they're told to supply more data and submit a new application.

Also, ICX requests a separate export license for each of the components in a proposed system, rather than one overall license. If one or two components aren't approved, it's usually possible to find alternates. U.S. export control officials, in considering approval of these replacements, tend to be influenced favorably because they've already okayed the rest of the system, says Lewis.

Bright prospects

He estimates that if U.S. export restrictions are relaxed, our sales of dp hardware and software to the Communist Bloc could reach an annual level of $50-$75 million 12 months later. This would be roughly 20 times the present level. Second-year volume would be greater — how much greater would depend on our willingness to provide credit. But the Soviets would probably divert their own hard currency from other projects if third-generation computer technology was made available to them.

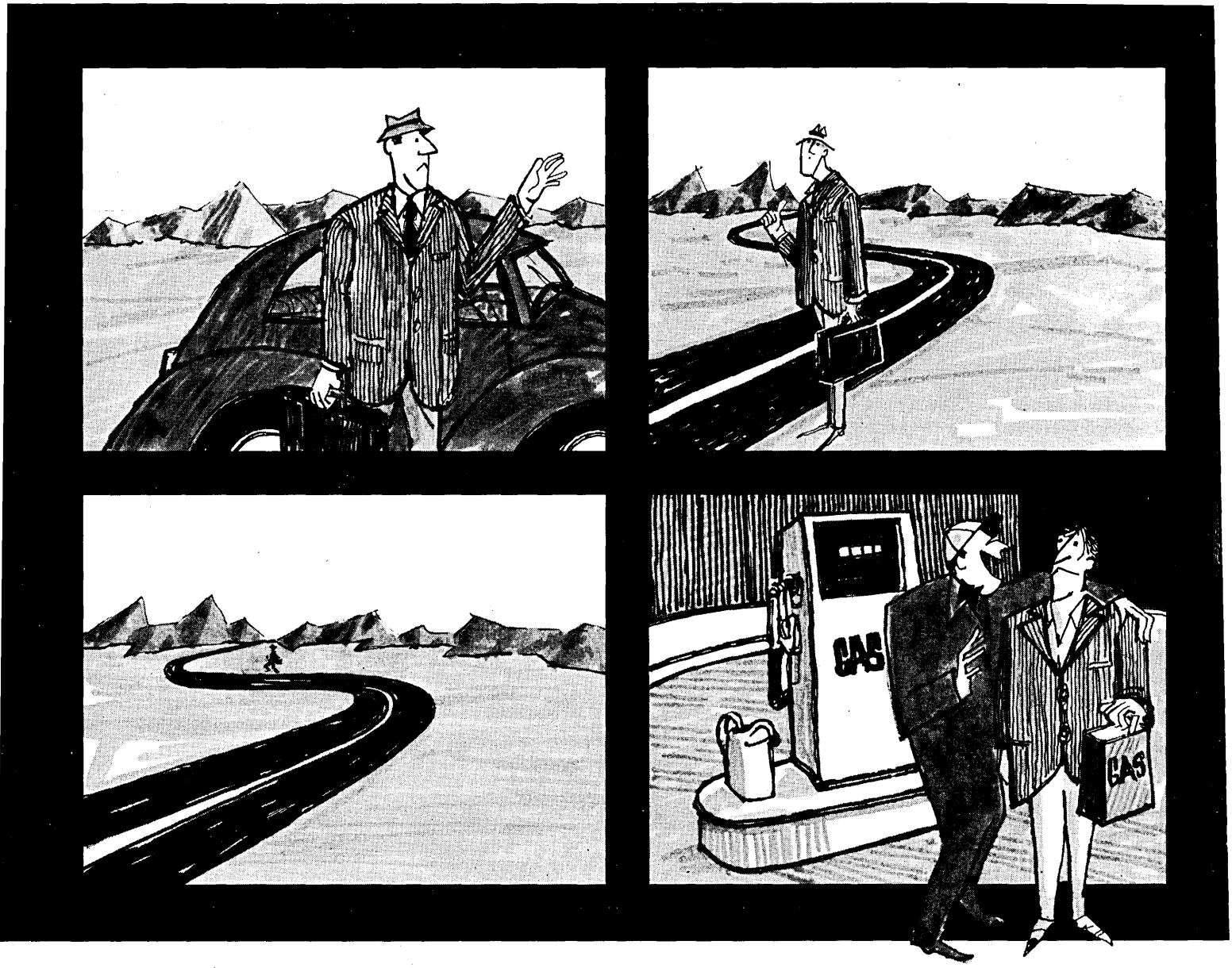
ICL has "a considerable lead" in installations over other Western computer makers selling to the USSR, Lewis added, "but IBM has a considerable lead in customer preference." He indicated that ICL's image is suffering at the moment because of troubles they've encountered with a $24 million installation of 1906A and 1903A computers at the Serphukhov Institute of High Energy Physics near Moscow. Meanwhile, development of the Ryad computer series is reportedly lagging, and this may enable U.S. firms to gain additional leverage. Ryad represents the USSR's principal effort to develop a third-generation machine. On the other hand, Lewis reports that Japanese computer salesmen "are thick as flies" in Moscow.

If S3726, the pending export control act, is signed by the President more-or-less in its present form, it will require the Secretary of Commerce to "remove unilateral export controls on ... articles, materials, or supplies, including technical data or other information, which he determines are available without restriction from sources outside the United States in significant quanitities and comparable in quality to those produced in the United States ..." The only qualification is that the controls can be continued if the Secretary finds that removing them "would constitute a threat to the national security ..."

"Advice" from suppliers

Six months after the legislation is enacted, the Secretary must report to Congress those products still subject to controls "greater than those imposed by nations with which the U.S. has defense treaty commitments." He must describe and justify these restrictions. The bill also requires the Secretary to establish technical advisory committees — one for each product subject to export controls based on national security considerations. Each committee will include representatives of the affected suppliers. Its function is to "advise and assist" the Secretary of Commerce in carrying out the responsibilities listed above.

Skeptics argue that S3726 may not loosen any controls on export of dp hardware and software because the



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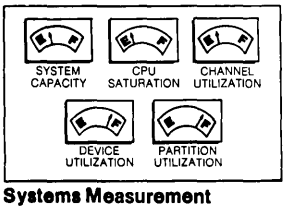

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formal restrictions imposed by the U.S. on these items are not "unilateral."

We, as well as all the other Free World countries that produce computers, subscribe to a list of proscribed exports maintained by a NATO group called the Coordinating Committee (COCOM). None of these items can be shipped to the Communist Bloc (including the People's Republic of China and Cuba) unless COCOM grants an exception.

The United States has its own proscribed products lists which, in some cases, bans the export of additional products to the Communist Bloc. But in the case of dp systems, our restrictions and COCOM's are virtually the same.

The restrictions on U.S. dp system exporters *are* greater, but this is because our government is much less willing than its allies to request the exceptions from COCOM, and takes far longer to arrive at a decision. It isn't clear from the language in the Senate bill that the Secretary of Commerce will be able to consider controls of this type.

Knowlegeable dp industry sources agree that the language could be more precise, but they point out that the bill requires appointment of an advisory committee to help the Secretary of Commerce evaluate the need for continuing those export controls related to national security. This provision clearly encompasses the dp industry, and so systems exporters will, if the legislation is enacted, have a stronger policy-making role than in the past.

However, the export control bill, as finally enacted, may not authorize technical advisory committees. The House version (HR 8180) calls for an extension of the present export control law, with some changes that aren't relevant to this discussion. A knowlegeable source believes that when the Senate and House bills go to conference, the House will agree to removal of unilateral controls but won't agree to establishment of industry advisory committees.

Even if the latter provision is also accepted, however, there is a real question whether the Secretary of Commerce can change the attitudes of those who control the export of U.S. computer systems to the Communist Bloc.

Applications for such shipments go to the Office of Export Control, a branch of the Commerce department. But the decisions are really made by an interagency advisory committee. DOD and CIA dominate this latter group, and their allegedly excessive concern with national security is the main reason U.S. firms aren't able to compete on an equal basis behind the Iron Curtain with suppliers from other countries.

Vico Henriques, director of BEMA's data processing group, explained this problem succinctly when he testified before the Senate Banking Committee last March: " . . .It is the spirit in which the control is exercised (by the U.S. and its NATO partners) that appears to be quite different."

Changing the spirit of U.S. export controllers probably will require more than legislation.

—Phil Hirsch

International

It's Deeper Than It Looks

By itself, the U.K.'s ailing International Computers Ltd. is not an attractive acquisition prospect. But as a vehicle to take U.S. mainframers into the lush European Common Market, it's a different matter, which explains recent overtures by Burroughs and others.

The Burroughs offer, made on the basis of the Detroit company's 2% equity in ICL, was rejected with the speed that is a record even for this turbulent industry. It was followed with reports that technical links might come between ICL and Honeywell or Univac. The companies have not dismissed them as possibilities.

Be that as it may, any major reorganization of ICL requires government sanction. The company not only represents 90% of the indigenous U.K. computer industry, which more than one government has sworn to protect; but the government owns a large shareholding acquired with the money pumped in to create ICL from a series of mergers.

ICL has barely recovered its breath from its latest top management overhaul (see April, p. 90; June, p. 96). This was a process of exorcism demanded from the government and other shareholders before more public money would be sacrificed to the cause of research and development (see May, p. 141). Past money injected for this purpose has seemed curiously to match amounts involved in write-offs. The ministry for industrial development last month offered an interim cash aid of $2.4 million a month up to the end of September '73, or a total of $33.6 million. It can be regarded only as an interim award. Until recently there had been a clear understanding that a government prop covering a five-year period would be provided.

U.S. takeover unlikely

Two questions seem to lead to unravelling the main clues as to what is really going on:

Why should Burroughs — and the other American corporations — have interest in a company for which they have an oft barely concealed disrespect?

Why should a government with a vested financial, as well as political, interest in a company of 20,000 employees have made such an obvious short-term maneuver, especially when ICL is so desperate for help to show long-term security to users and the other stockholders?

Burroughs in the U.K. has millions of dollars of business in the banking market, on big machines, and pathetically little penetration anywhere else. Banking is where ICL is embarrassingly bare. A product rationale would not be too difficult to construct between the two — even without Burroughs gaining control. Though unprofitable, ICL has direct access to more computer customers than Burroughs in the world (excluding the U.S.). Whether it be Burroughs or another house, the prospect of controlling takeover has to be discounted.

Announcing the $33.6 million aid to ICL, Christopher Chataway, minister for industrial development, told parliament: "The government believes that the capability to develop, manufacture, and market computer systems, which ICL represents, should be maintained in this country, so that the company can play its part in a strong industry in Europe."

None of this helped ICL, whose stock fell to below $2.40, pricing its public worth at around $200 million. All this had to happen in the week ICL disclosed a meagre half-yearly profit of $3 million, down to a third of the previous year, which had been considered then as a recovery year. The general economic downturn and low order rate a year ago has been blamed, with an optimistic note of orders now climbing 30%.

Confusion seemed complete when Honeywell's Clarence Spangle flew in to London to talk with Chataway and for the umpteenth time to seek clarification on policies that persistently operate

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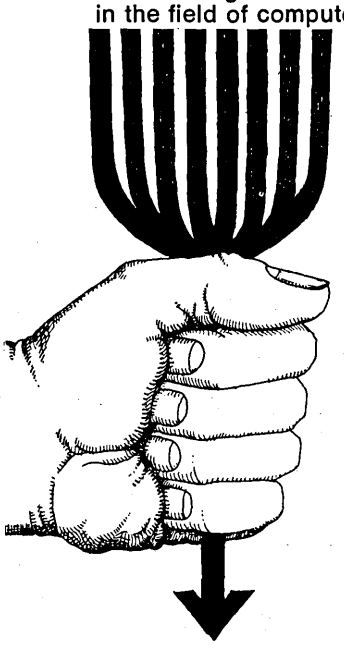

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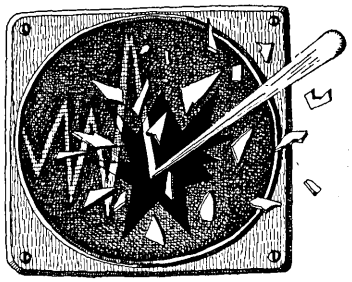

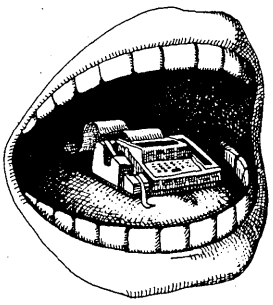

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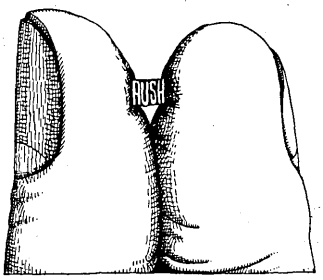

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against Honeywell in the public sector. This time he was armed with good news of further investment by Honeywell in Series 6000 production at Newhouse, Lanarkshire, Scotland, an important area on the industrial development list of the government.

Even though the big-machine market may be 10 times bigger than anyone envisaged a decade ago, the market still has limits in Europe, and a Honeywell interest in squeezing Burroughs out is too obvious for comment.

The same can be said of Univac's careful interest in all this. But it was Burroughs who in effect decided to test the temperature of the water, in terms of interindustry links, because its position in the European market outside of the U.K. is more vulnerable than the other two.

A base in the EEC

What is under negotiation is not just a means to a bigger stake in the U.K. market; it is how to secure a base as a United States corporation in the new European Economic Community. Entry of Britain and others suddenly will expand it to a market of over 200 million with a GNP comparable to the U.S. domestic market. More important, the Community has the clout, through its European Economic Commission in Brussels, to set customs barriers that discriminate against any foreign trader that would appear to threaten any industry within the Common Market. And few industries in Europe are weaker than the computer sector.

Britain enters the Community next year. Not surprisingly, the current cash aid to ICL would carry the company over until some different forms of trading assistance, probably agreed for all the European manufacturers, is thrashed out.

The outline of a united European Economic Community strategy against American competition is beginning to crystallize. It is almost superfluous to say that it has been constructed to aim straight at IBM.

The guidelines were enunciated earlier this year to the European Parliament by Italian commissioner Altiero Spinelli, whose specialty on the commission includes science and technology and covers data processing. It was a statement that brought a deputation of IBM executives (allegedly including six vp's) hurrying to Brussels.

Noting that despite all sorts of alliances between European manufacturers, not a single hardware firm has been able to attain profitability, Spinelli said a European policy to promote the expansion of the Community's data processing companies ought to consist of:

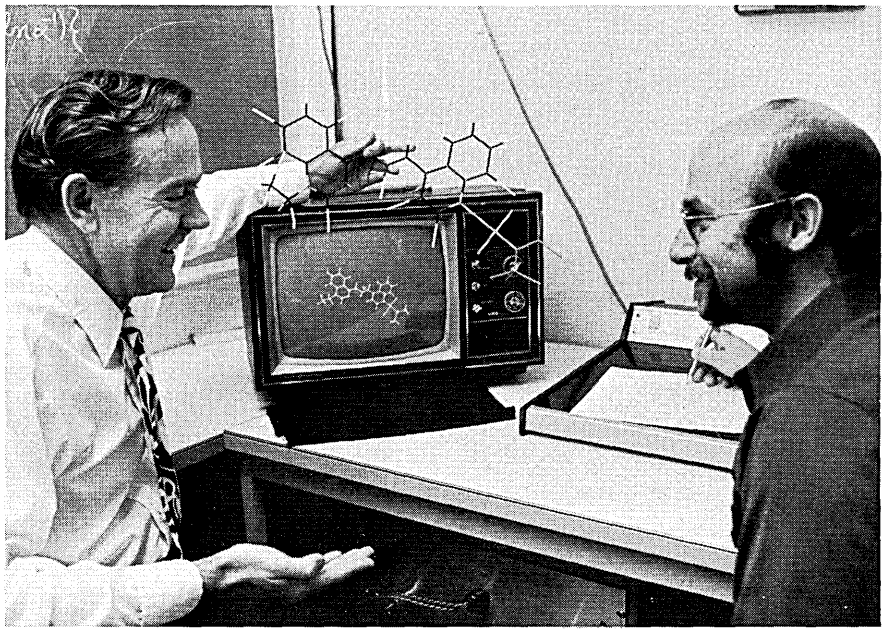
1. support for regrouping across national European boundaries to provide an element of competition at world level;

2. creation of all necessary measures so that foreign enterprises may contribute to the implementation of Community rules and objectives.

Traders and prospective traders in the Common Market should ponder the second statement. Sources close to Spinelli explain that underlying this is a proposition that multinational companies are going to have to open ownership in their companies to Europeans, perhaps somewhat along the lines of ICL, in which both the government and private financial institutions are shareholders. Otherwise they face barriers to trade in the Community. To what extent is not clear, and the source refuses to comment when asked if it would be 51%. This source indicates the statement also implies that public sector contracts from the member nations would be awarded to these companies on a prescribed formula that would take into account the need at the moment of these companies.

The short message for international companies in Europe is that in the future the best way of winning may be to join them.

—Pearce Wright



CONTRAST: Cumbersome stick model atop a display of the same structure is shown by Dr. William A. Little (left). Manipulating the graphics from the data tablet is system developer Carl Berney of Aware Systems.

Physics

Color Aids Study of Superconductor

The requirements of a Stanford Univ. physicist who is searching for a room-temperature superconductor have led to the development of a minicomputer-based color graphics system. Controlled by a 16K Varian 620/f with a 750K-word disc, it uses a standard 14-inch color tv set for which a new deflection system and a special yoke were built. The result is an analog random-access display system that accepts input from a Shintron graphic data tablet, as well as a three-axis joystick. It was developed by Aware Systems, Mountain View, Calif., which sells it for about $60K, including software.

Carl Berney, director of the minicomputer systems house, said the prime mover behind the system was physics prof William A. Little, who is trying to synthesize a chain compound that has an array of metallic molecules surrounded by organic molecules. With the proper combination, you get superconductivity — that is, a wire with no electrical resistance. That's something possible now only at temperatures of -459°F,

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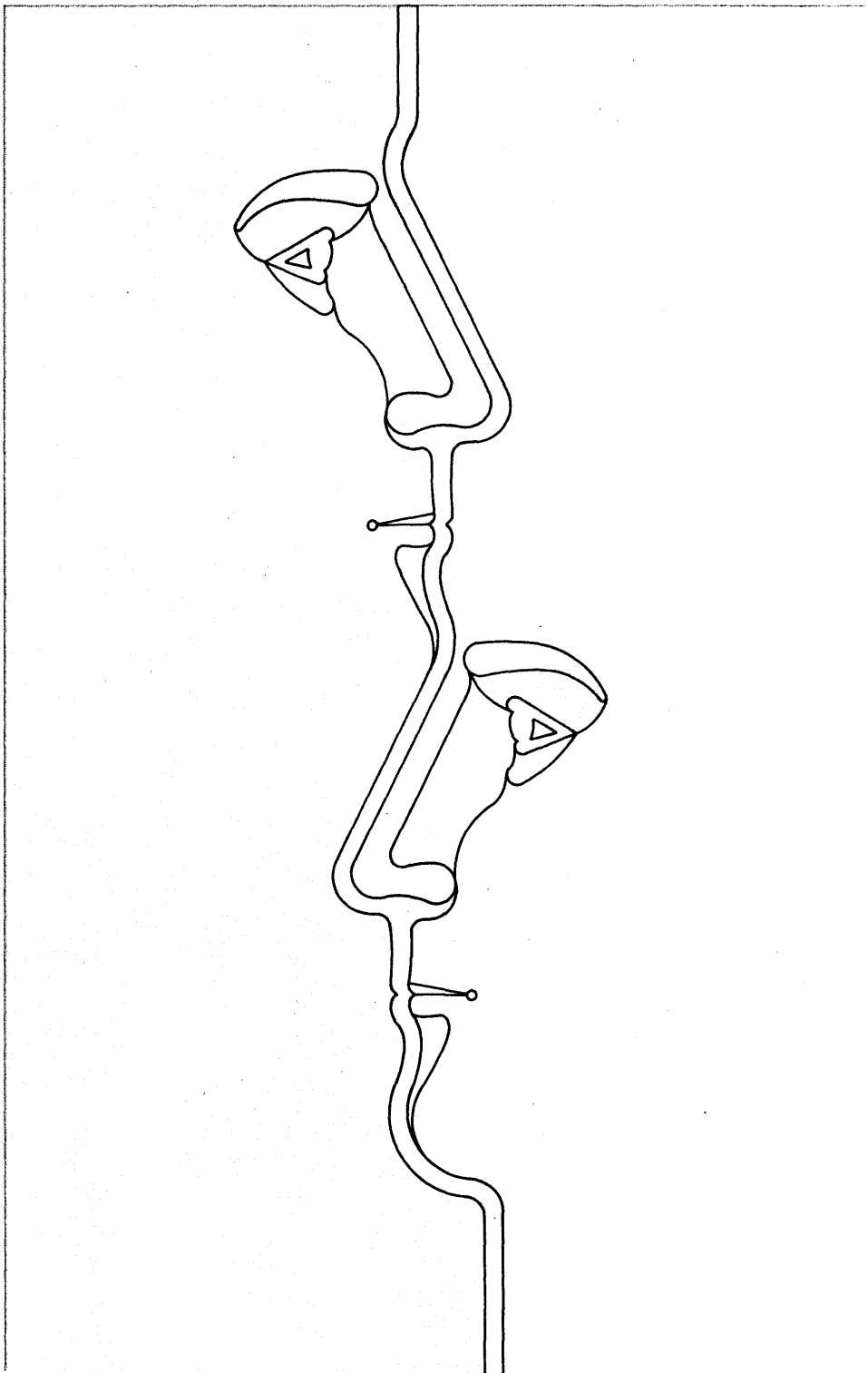

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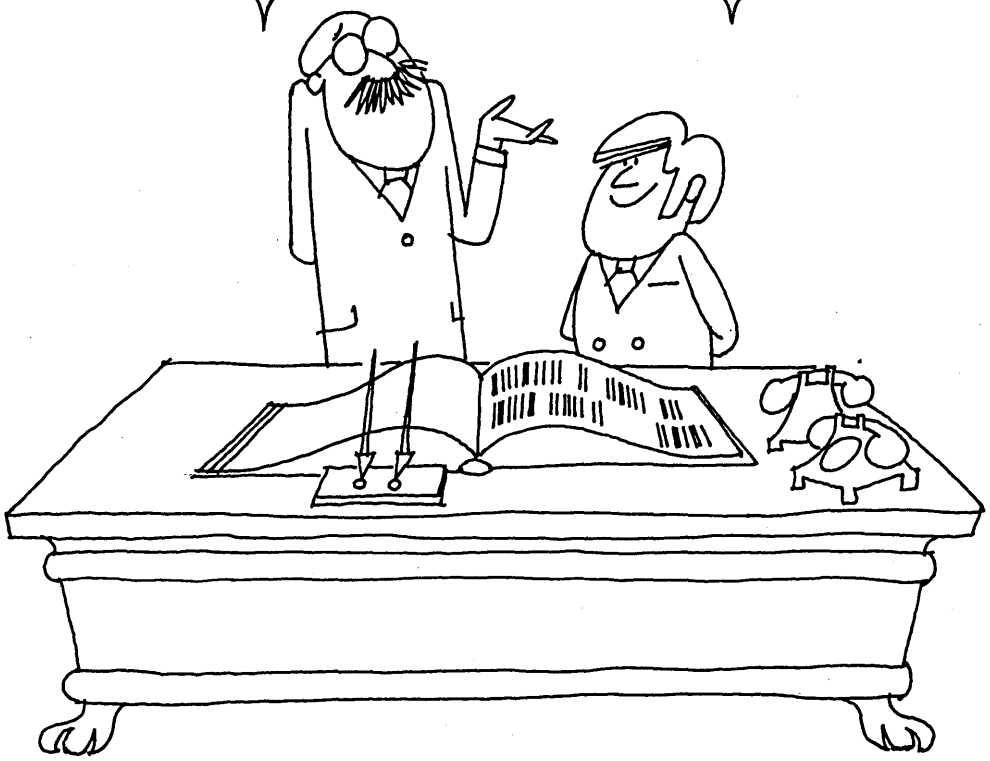

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or absolute zero. The search for this new material has been under way for seven years or so, but Dr. Little says in another year he will have a very good idea whether such a compound can be synthesized.

"We've been able to make the metal chains and the polarizable molecules," Dr. Little explains. "But we've come to the point where we have to fit the things together." To do so requires compounds with the proper binding agents. Traditionally, chemists use stick models, resembling children's toys, to build models of molecules. But stick models are arduously slow, lack rigidity for large models, and fail to show the thicknesses of molecules.

So he now uses his computer graphics system, which can display line drawings of compounds in color — a separate color for each element. It will also rotate the image in real-time about an arbitrary axis determined by the user, enlarge or reduce the image, and determine bond lengths and angles. Atom sizes are shown by colored circles which represent the Van der Wall radii for each atom. The system can hold up to 70,000 atoms, which compares with a model kit with 70,000 atoms that would cost about $70,000. "For $90," Dr. Little adds, "we can expand the system to 140,000 atoms."

What won't work

Pointing to the crt, he says: "What this does is not tell us what will work, but what structures will not work. We know we cannot make a compound with two atoms that ram into each other, where two atoms are too close." The graphics system also does not tell them how to make a given compound, but is does indicate that there's a good chance such a compound can be made. "The danger is that we might ask a chemist to spend many years trying to make a compound when it's impossible to make such a thing. It would simply fall apart. The strains would be so great it would break its bonds." Instead, the system tells them that a compound they try to synthesize has at least a chance at succeeding.

Until now, data on a likely looking compound was manually input to the campus 360/65 for calculation. They might see on the display that a certain compound could be made, but the computation on it by the larger computer might show that the compound, for their

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Start by saving $500 to $1000 per terminal per month, compared with IBM. But compare us to anything you like. System 2400 talks to all mainframes.

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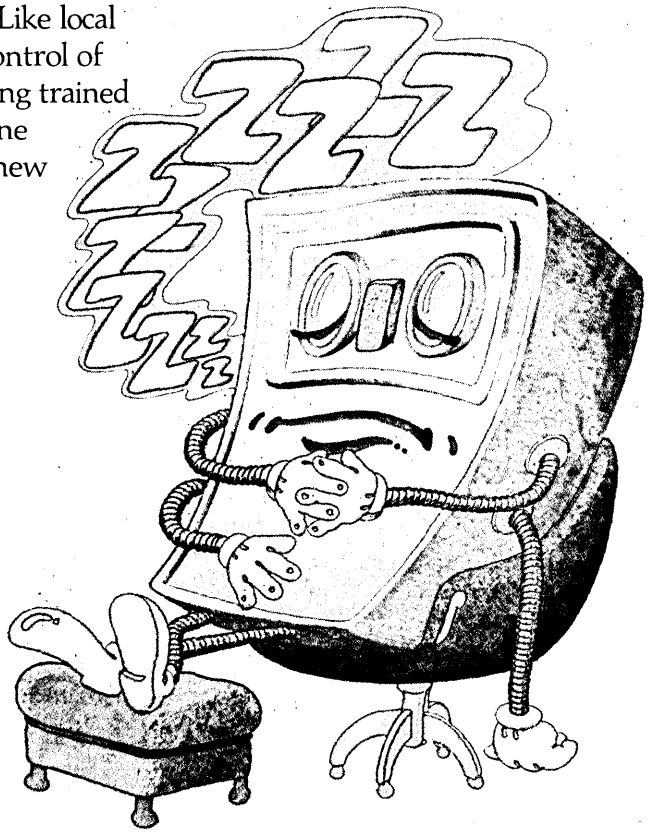

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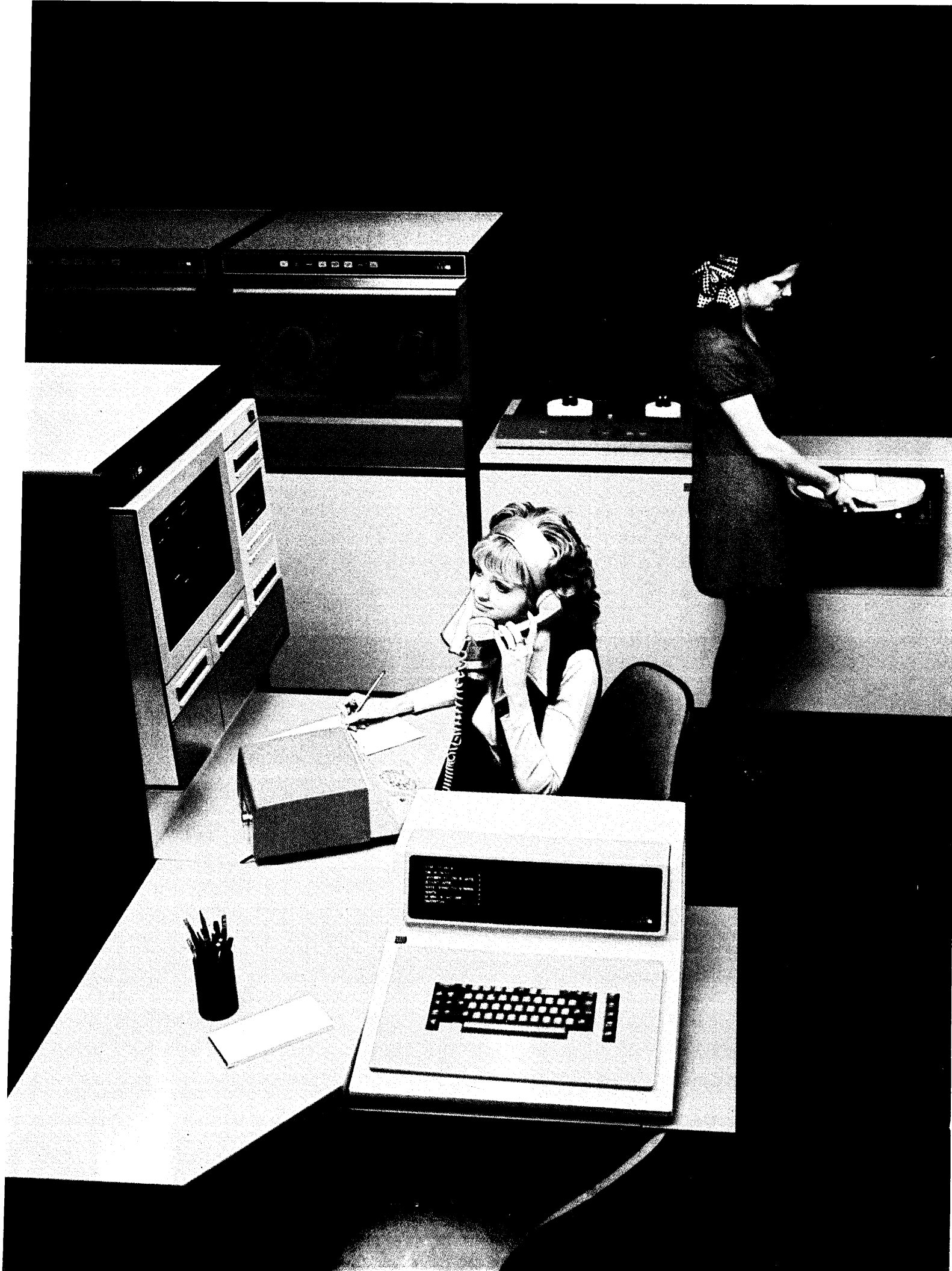

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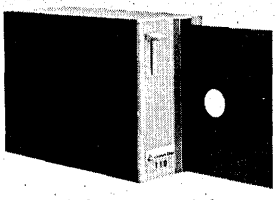
Here's our new Floppy-Disk Drive—a fast, reliable, inexpensive memory device to handle small amounts of data. Forget the cassette! Forget cards and paper tape! Our new CDS-110 Floppy-Disk Drive can replace them in your system for computer program loading, data entry, terminal communications, or auxiliary storage. With all the basic advantages of any disk drive, Floppy-Disk provides random access to drastically reduce your search and retrieval time. Floppy-Disk offers unmatched reliability and convenience. And Floppy-Disk is OEM-priced below $500 to substantially reduce your total system cost. The recording medium is a removable, jacketed, 7½ inch, oxide-coated mylar disk. It's mailable, storable, and disposable (at less than $4.00 each). And look at these performance specs! 1.4 Mbit storage on 64 tracks. 32 or 64 tracks with read only, read/write, or read-after-write electronics. 33.3 Kbit/sec. transfer rate. 40 msec. access time. There's a lot more you should know about the CDS-110 Floppy-Disk Drive. Write to Century Data Systems, Inc., 1270 North Kraemer Boulevard, Anaheim, California 92806 or phone (714) 632-7111.



Modular compatibility with RETMA 19-inch racks: stack two horizontal drives, or group three vertical drives side-by-side.

Century Data SYSTEMS, INC.

A subsidiary of California Computer Products, Inc.

CIRCLE 12 ON READER CARD

purposes, was useless. Soon, however, a direct link from the mini to the computation center will be established, and an on-line mode will be possible.

Minicomputers

Mini Sales Soar While Prices Plunge

Shipments this year by U.S. minicomputer manufacturers will reach almost $300 million, up from $210 million last year, according to Creative Strategies Inc. The Palo Alto, Calif., research firm projects annual increases in dollar revenues of from 20-35% over the next three years, reaching anywhere from $550 million to $800 million in 1975.

In recent years, the unit count of minis shipped has been growing at a 47% compound annual rate, according to Richard J. Matlack, CSI vice president. But the dollar growth is at a slower rate, some 34%, a result of the decreasing prices for minis, he says. Shipments this year should reach 17,000 units, he adds, compared with 10,000 last year.

The company's study shows the average price of a 4K mini has been falling from some $11K in '70 to $7K in '71 (a decrease of 36%), to only $4.8K in '72 (down 31% from last year). As with larger systems, the cost of the mini is becoming a smaller proportion of the total cost of the system, decreasing from more than half in '70 to less than a third in '72.

Industrial automation currently accounts for about half of total sales of minis, and Matlack sees this as an application that will continue to grow. Manufacturers of discrete parts are facing labor and productivity pressures, he explains, and one alternative is to use minicomputer-controlled manufacturing systems. A look at this market for minicomputers is contained in a CSI study released a few months ago.

A more recent study by Quantum Science Corp. confirms this projection. "Factory automation," it says, "leads all industrial equipment sectors in growth potential, increasing 16% per year from $621 million in 1971 to $2.7 billion in 1981." This report, titled "Factory Automation" and looking at various activities, projects a 32% average growth rate through 1981 for nonintelligent robots, a 29% rate for materials handling activities, and a 24% growth for factory data collection.

Another Mini Maker in Boston Area

A new company, Prime Computer, Inc., has jumped into the minicomputer sweepstakes in the Boston area in the shadows of Honeywell, Digital Equipment Corp., and Data General Corp.

Located in Natick, the six-month-old company said it expects to have preproduction prototypes ready later this month and will hire its 50th employee by the fall. President Robert Baron is a former director of engineering and programming at Honeywell's Computer Control Div. Executive vice president Bruce Elmblad formerly was head of marketing at Inforex. With Baron and Elmblad on the board of directors are Jesse Aweida, president of Storage Technology, and David Dunn, partner in Idanta Partners of San Diego, the venture capital firm that bankrolled the endeavor.

"We expect to be number two in revenues in the minicomputer business

When the job is too big for DEC and your budget is too small for IBM, then the answer is the new DATACRAFT DC 6024/5 for $10,900

The new Datacraft DC 6024/5 is aimed at the existing price/performance gap in our industry. Use the new DC 6024/5 to keep from being squeezed into a 16-bit mini or pushed into an expensive 32-bit machine.

For performance we gave the DC 6024/5 our standard 24-bit word length. This means you can directly address 32K words or indirect up to 65K words. Try that with any mini computer and you will see why 24 bits is the optimum word length.

For $10,900 you get a computer that matches the input/output capabilities of systems costing many times more. The I/O structure of the DC 6024/5 combines the economy you want in unit I/O systems with the speed of channel I/O systems: full parallel binary arithmetic; single address, multi-access bus structure; fully buffered I/O channels with shared peripheral units; and multiple CPU capacity.

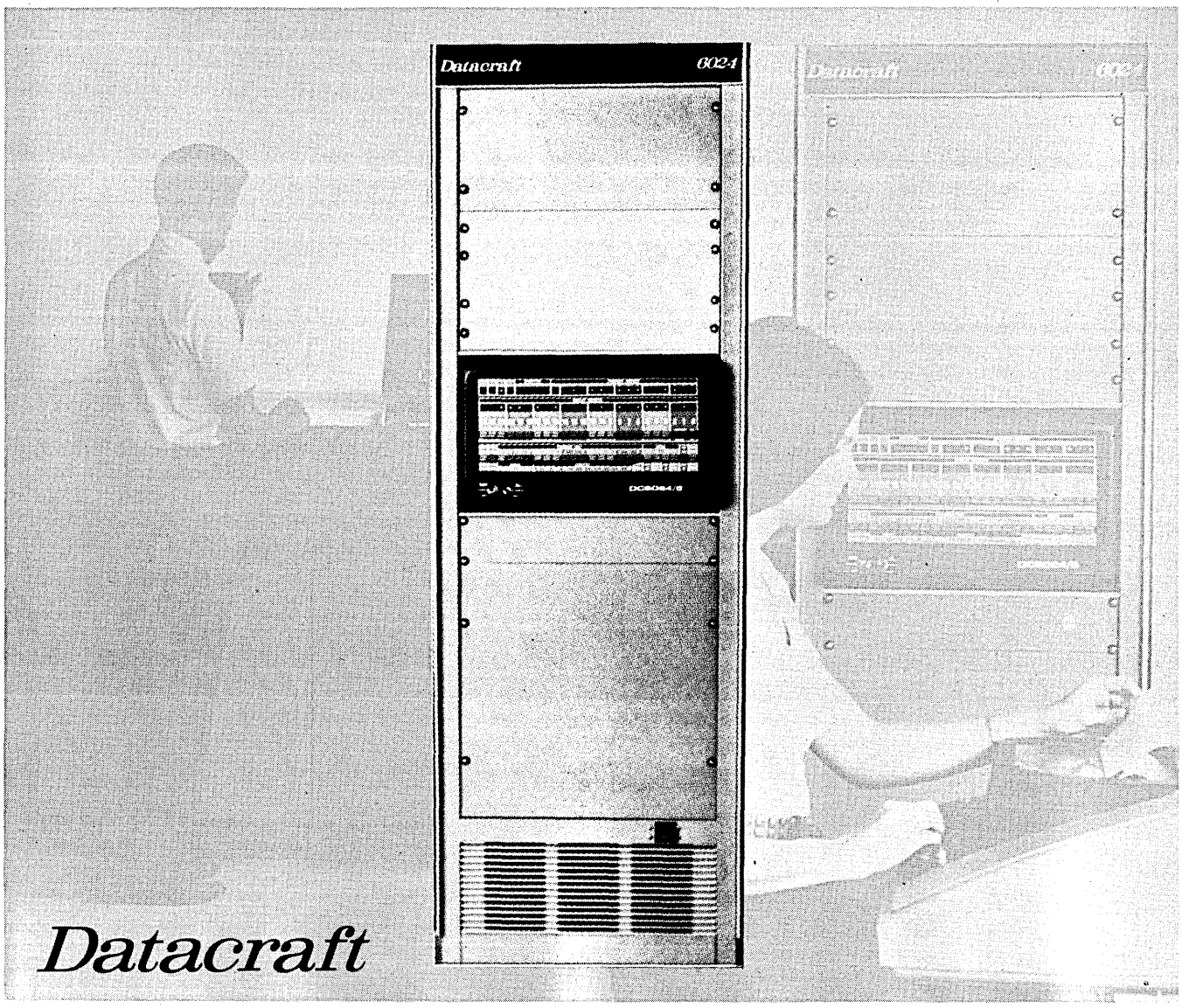
Compare these standard instructions:

INSTRUCTION	EXECUTION TIME
Add/Subtract	2.0 microseconds
Multiply	8.0 microseconds
Divide	15.0 microseconds
Square Root	14.0 microseconds

The Datacraft product philosophy is to have all computer models software and I/O compatible. This means the software systems for the new DC 6024/5 have more than three years of field-proven experience. Peripherals ditto.

OEM or end-user applications — prove to yourself the price/performance advantages of the new Datacraft DC 6024/5. Write for your free copy of the "Datacraft 6024/5 Discovery Kit." The kit contains specifications, prices, performance information, and typical configurations that show just how much machine you are getting for only $10,900.

Write for: DC 6024/5 Discovery Kit, Rm 201, Datacraft Corporation, Post Office Box 23550, Fort Lauderdale, Florida 33307.



within three or four years," says Baron confidently. "We expect to start deliveries in late October." The all MOS semiconductor memory machine will sell for $5900 with 4K of memory. Baron believes that the minicomputer — which he prefers to call a "small computer" — offers several technological advances that will spur its sales.

The machine, called the Prime 200, is compatible with Honeywell's 16-bit minicomputer line and will operate Honeywell software, most of which was developed in the public domain. Baron said Prime will concentrate initially on the traditional markets of the small control computer — oem's, manufacturing, process control, data acquisition, and data communications.

Prime is staffed with employees from Honeywell, Digital, and Data General. Other principals are engineering vice president William Poduska, former director of Honeywell's corporate research center in Cambridge, Mass., who designed the computer; and vice president of sales, S. J. Halligan, former vice president of marketing for Computer Automation, a California-based minicomputer company.

The machine's MOS memory is expandable to 32K 16-bit words and has a 750-nanosecond full cycle memory speed. It will be offered with a disc operating system.

Companies

XLO: What It Could Have Been

Twenty years ago, a small Vermont company called the Bryant Chuck and Grinder Co. published an advertisement that said in effect: We are manufacturers of a 500,000-rpm rotating device. We use it to make a machine that grinds miniature bearings. Can anyone use this technology for something else?

There were two takers, Univac and RCA, who were making drum memories, one of these a 125,000-rpm device. Soon Bryant began to make its own rotating memories, changed its name to Bryant Computer Products, recruited a staff of memory experts, and in the early '60s had one of the most widely known names in the rotating memory business.

Last month, after five years of declining sales, several management shakeups, and another change of name — to XLO Computer Products — its parent, Ex-Cell-O Corp., announced it was shutting down the computer operation. Ex-Cell-O president E. J. Giblin cited price degradation in the computer magnetic memory market.

The announcement came as the computer operation in Walled Lake, Mich., outside of Detroit, had taken off in a new direction while phasing out its rotating memory products. Early this year it acquired Cybermation, Inc., a Pennsylvania firm which makes a remote batch terminal. The terminal was to be incorporated into a remote computing system for which XLO would have supplied a minicomputer, crt terminal, disc cartridge, and fixed head disc drive. The proposed system was announced with fanfare at this May's Spring Joint Computer Conference and through an elaborate advertising campaign.

Compounding the mistake

But Ex-Cell-O, whose second quarter sales had slipped 7.5% and whose earnings had dropped by some $373,000 from the year before, was under pressure from stockholders to allocate its resources to other ventures. The company is a major manufacturer of machine tools and other machinery.

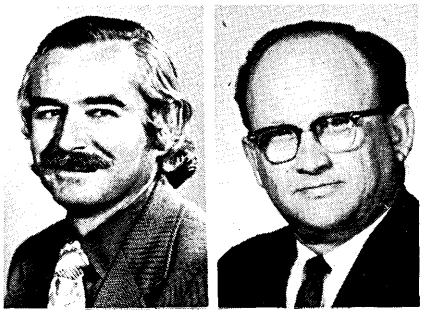
Former employees last month were blaming Ex-Cell-O's "machine tool orientation" for the demise of the computer operation. "They thought a good machine was enough, and neglected systems," said one former employee who asked not to be identified. "We were strong mechanically, but weak electronically," said another.

Many felt the company made a mistake in refusing to support a plan by the computer operation in 1965 to manufacture a removable disc pack drive compatible with IBM's 2311. At that time, the computer products group had examined one of IBM's first 2311s — serial #2 — had plans for a better version of it, but was turned down because the cost estimates were too high. "We'd be a $100 million company today if they'd gone ahead," an XLO executive said recently.

Five years later, when Century Data, Memorex, Potter, and ISS were prospering in the IBM-compatible disc drive market, Bryant acquired Linnell Engineering in New Jersey in an unsuccessful attempt to get a share of the wealth it let slip by in 1965. Said a former Bryant executive: "It compounded the mistake of 1965 by buying somebody else's product and abandoning the philosophy of innovation that had made the company so great."

Firm Blossoms on Software Updates

At a time when companies offering services have found it mandatory to diversify, four-year-old Rand Teleprocessing Corp. in San Francisco remains a holdout. It continues as a software house that has bucked the odds, experiencing a three-fold growth in sales during each of the last three years when business for others has been hardest to come by. It supports its own IBM 370/145 computer installation with in-house work only, foresees another tripling of sales this year over the previous year, and is scrambling continuously to hire more programmers.



NAHUM RAND AND FERD JUNG: Everyone wears beautiful boots.

Software houses were among the hardest hit by the industry's recession of the last two years. One of those that went under during this period was New York-based Computer Applications Inc., an executive of which now heads RTC. He's Nahum Rand, formerly a manager of commercial applications at CAI, but now chairman and president of a company that chalked up sales of $133K in 1969, tripled it in '70, and tripled that in '71.

Rand Teleprocessing specializes in converting and upgrading old programs and in resystematizing them. It has computerized much of this tranformation process, but also has automated the system by which it bids for jobs. Pointing to a printout, RTC general manager Ferd Jung shows the analysis performed on a 7080 Autocoder program that is to be converted to 370 ANSI COBOL. The bidding program takes the source program, runs it through, and comes out with numerous

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statistics. It finds that the source deck of this 7080 program has 1,958 lines of code, of which 123 are address-modified. There are 296 data labels, 357 macros, and there will probably be 235 operations that the translator will have difficulty with, thus requiring manual coding or rechecking. The printout also shows that this program should take about 91 man-hours to recode, of which eight hours will be spent depatching, 29 hours recoding, 16 to get a clean compile, 21 for desk-checking, and 17 to test.

Consistency and standards

In the bidding program, in addition, Jung shows how he can specify the language, the programmer, and his proficiency, and use the output to schedule work for his programmers. "You recall the old adage about the shoemaker's children who go around in bare feet," comments Jung. "We're one of the few shops where everyone wears beautiful boots."

Rand produces 100% code conversion and guarantees its work. "I've seen six programs in one shop that appeared to have been written by six people speaking six different languages," says Jung. "There were no standards, no conformity, no consistency in the way the programs were written. And you can imagine what this costs you in the way of maintenance. When we produce a system of, say, 20 or 40 programs, they all look like they came out of the same mold."

Currently, Rand is converting from 150-250 programs a month. After resystematization, the resulting number of programs is reduced to 30-80. The execution performance of the converted systems varies, but the improvement reportedly can be higher than 20 to 1 over the old systems.

Rand recently completed a complicated system conversion and redesign where the original system ran for 15 hours per cycle on a 370/155 under integrated emulation. The converted ANSI COBOL system runs for 40 minutes on the same computer. Rand's conversion and resystematization tools enable it to transform systems for any pairing of batch/on-line to/from batch/on-line computer systems.

The firm is in the process of merging with New York-based Brandon Applied Systems Inc.

Communications

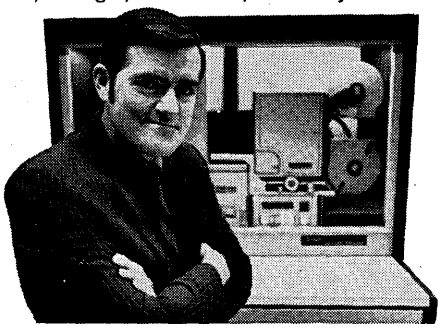
MCI Hits Joint Use of Bell Lines

Microwave Communications, Inc., has submitted a complaint to the FCC opposing authorization of *any* single user group sharing AT&T private-line channels at bulk rates. The complaint includes ARINC, which is leasing bulk private-line channels from the phone company and apportioning them among airlines under a special tariff provision.

MCI said AT&T, by doing business with such entities, is able "to provide service indirectly at rates which it could not justify offering itself." Also, the single-user idea allegedly violates existing tariff language forbidding resale of communications service by a customer of the phone company. MCI believes that if there were no single users, the market for its own bulk communications services would be bigger. Its complaint also cites the growth of communications brokers as having an adverse effect on its business. These are companies which lease bulk voice/data channels from the phone company and then

"COMPUTER PRINTOUT WAS COSTING US A FORTUNE."

(G. E. Richards, Manager, Data Center, The Goodyear Tire & Rubber Company)



Kodak COM system saved Goodyear $250,000 on forms alone.

At The Goodyear Tire & Rubber Company's data processing center in Akron, Ohio, nine computers turn out vast quantities of data for their worldwide operations.

To help distribute and utilize this data faster, Goodyear installed a Kodak KOM-90 microfilmer, which converts computer tape data directly to microfilm . . . at incredible speed. This eliminated the need for 132 printed forms—enough to pay for the company's entire microfilm system.

And Goodyear also reports substantial savings in file space and improvements in file integrity and information retrieval.

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distribute them among a number of "joint users," collecting a profit in the process which usually is called something else.

The brokers' existence is based on a tariff provision that allows joint use of certain private lines, provided the "customer" — the one who contracts with the phone company — is among the users and doesn't reap a profit from the services obtained from the common carrier.

RCA recently announced plans to establish a joint-user network. Hogan Associates and Series 11000, Inc., are two firms already in the business. MCI, in its complaint, said all three operations are illegal because they offer no services to the user that couldn't be provided directly by Ma Bell and aren't being offered by MCI.

FCC can be expected to conduct hearings on the whole subject of single users and brokers of joint-user services which will pose the basic question: Should users of voice/data transmission services be allowed to cut their costs by obtaining communications channels in ways that reduce the monopoly power conferred on the carriers by present tariff rules? It's a key question, one that could drastically affect the utilization of telecommunications for a long time.

Mixed Reactions to Bell Concession

AT&T has told FCC in a letter it is willing to allow conferencing devices and headsets to be directly connected to its dial-up network provided they meet criteria it now is developing.

Reaction to this minor concession to the growing pressures for relaxing foreign attachment restrictions is varied, as are speculations as to why it was made. The phone company made it clear in its letter it doesn't intend to extend its offer to other foreign attachments, but a source close to the FCC who refused to be named but claims to be in a position to influence Bell thinking says it should be. Some feel Ma Bell's strategy is to concede a little now in the hope of not having to concede more later.

Others aren't so sure Bell even means it. "You think the leopard's going to change its spots?" said Henry McNulty of Telephonic Equipment Corp., Santa Ana, Calif. TEC, which makes a conferencing device which would be covered if AT&T makes good on its offer and currently has a complaint against Pacific Telephone Co. on file with the California Public Utilities Commission, doesn't think the Bell letter will affect its case. "If they would implement the intent of their letter right away, we would be affected," McNulty said, "but the big word is IF."

Paul Popano of the California PUC agrees to an extent. He believes the state commission will render a decision in the TEC case before a tariff can be filed and a procedure developed to implement the intent of the Bell proposal and that the decision "will be consistent with what AT&T has proposed."

Another California firm, Phonetele, Inc., Van Nuys, which expects a decision momentarily from the state PUC on its right to connect to the intrastate dial-up network, is confident the decision will be in its favor but doesn't see

the AT&T offer as affecting it. "At best it could have a minor psychological effect on the commission," said Robert Feiner, Phonetele president, "but it is a step forward, a hint that AT&T is willing to move off dead center." Phonetele's 1040, a device which automatically restricts outgoing calls to specified exchanges or exchange area, isn't covered by the Bell offer.

AT&T faces other threats to its position against direct connection of foreign attachments to its networks. There's a plan before FCC submitted by an advisory committee to develop a way of interconnecting PBX equipment directly (Feb., p. 77); and there's a plan by one of its own firms, Rochester Telephone Co., under which the phone company would initially develop certification standards for all kinds of foreign attachments and would test the equipment as well (April 1, 1971, p. 40).

Benchmarks

Competitive Industry? Should IBM be required to release specifications of a new product long before it is announced? The question is being studied by the month-old Computer Industry Assn. formed by eight computer equipment firms and headed by Dan L. McGurk, former president of Xerox Data Systems. The association, which says its goal is to foster a competitive computer industry, reasons that because of IBM's size, any new technology it announces becomes a de facto standard, giving IBM what amounts to a two-year jump on the competition. McGurk said the association will take a stand on other issues, including the Justice Dept. antitrust suit against IBM, standardization, government procurement policies, and a proposal by Bruce Gilchrist and Milton Wessel for a government-sponsored economic study of the industry (June, p. 8). Founding members are CalComp, Memorex, Amdahl Corp., Storage Technology, Telex, Electronic Memories and Magnetics, Itel, and Mohawk Data Sciences. The group hopes to raise $1 million by October by increasing its membership to 20 companies, paying dues that range from $10K-50K, according to size. The Los Angeles phone number is 213/990-0510.

Australasia Bets on CDC: Control Data, which has had TAB operations in Australia since the mid-'60s, has cracked the New Zealand market under a contract to supply the Totalizator Agency Board with the world's first nationwide computerized off-track betting complex. The system, scheduled to go live in early '74, comprises two 3100 and two 1700 computers in Wellington. Bets will be placed by telephone and multiplexed to high-speed lines from the remote sites to the central complex.

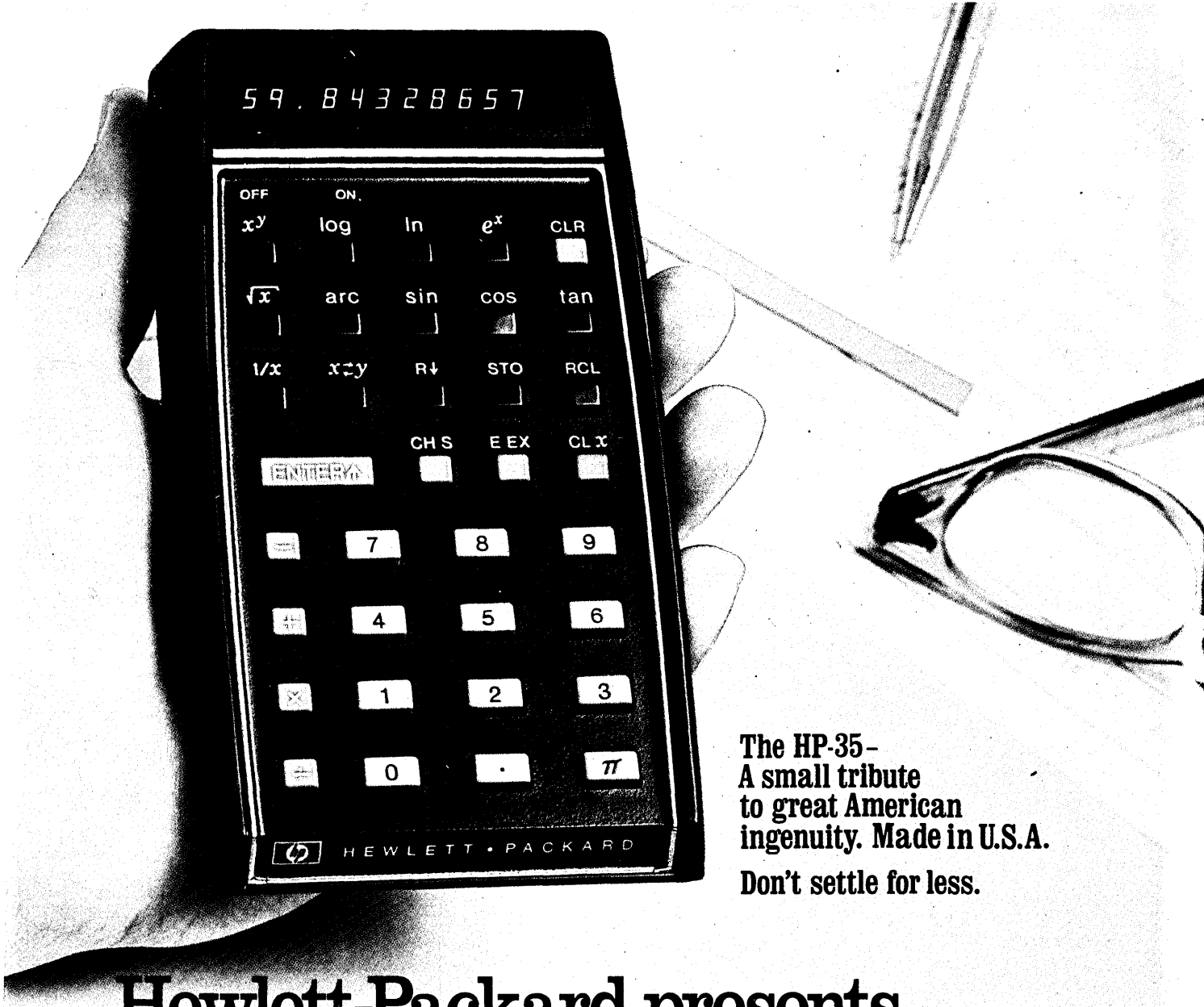
New Breed: The ranks of a new kind of vendor — the lessor/manufacturer — have been joined by Telex Computer Products, which in June announced it has formed a leasing division in Phoenix, headed by Robert R. Russell, a founder of Boothe Computer Corp. The division will lease IBM 360 and 370 cpu's and Telex tape and disc drives, printers, and memories. With liberal arrangements for customer upgrades, the company offers plans ranging from 20-50% below IBM prices. Two other manufacturers, Itel and Mohawk Data Sciences, offer similar plans (Feb., p. 7).

Big Stick: The unity move begun last fall within the software services industry (see Dec. 1, p. 49) has resulted in the merger of the Assn. of Independent Software Companies into the Software Products and Services Section of the Assn. of Data Processing Service Organizations. Earlier disagreement was mostly a matter of emphasis. AISC had been devoting virtually all of its attention to government matters, particularly regarding the in-house government dp services that the organization felt should be provided by independents. ADAPSO/SPSS wanted other matters of mutual interest to be given the attention of the association — most importantly, the image the services companies have with the public as "customer, prospect, investor, or innocent bystander." Presumably, the AISC group is willing to concede this point; and in the merger announcement ADAPSO noted the need "for an interface with the government on the issues of protection, taxation, procurement . . ." and announced plans for a Government Affairs committee within ADAPSO/AISC.

Gag Rule: Irked by a court order prohibiting anyone involved in the Justice Dept.'s antitrust suit against IBM from talking to the press, the Association of Data Processing Service Organizations (ADAPSO) announced it will assume Justice's "public information function" by monitoring pretrial proceedings. But when ADAPSO sent a law student to sit in on a deposition-taking in Baltimore July 13, the session was suddenly adjourned with no alternate date given. ADAPSO said it had checked the court schedule the evening before, and at that time the session had still been scheduled for the next morning. It expected the same treatment at another deposition-taking July 31 in Santa Barbara. ADAPSO president Bernard Goldstein said public reporting of the case is essential if his and other organizations affected by the outcome of the suit are to be able to offer meaningful comment on the judgement. The association said it may take legal action to lift the gag rule, ordered by the New York Southern District Federal Court.

Call 1108: Comain Corp. has been formed in Los Angeles to offer maintenance on Univac 1100 series computers. The president, Murray Stone, a 30-year veteran of Univac and Sperry Rand, said he will offer a 20% discount and concentrate on prospects who own Univac systems. He said about 80% of the estimated 200 installed 1100s are owned. With no customers yet, the company last month was contacting prospects from its Century City office, where the last four digits of the telephone number are 1108.

Mr. Chairman: T. William Olle, author of the document, "An Assessment of How the Codasyl DBTG Proposal Meets the Guide/SHARE Requirements" (July, p. 84), was chairman of the Codasyl Systems Committee which conducted a study of generalized data base management systems. He was erroneously identified as chairman of the committee that wrote the original Codasyl data base report. The chairman of that group was Tax Metaxides of Bell Laboratories. □



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Hewlett-Packard's HP-35 is a new time-and-work saver that can free you from countless hours of tedious computation. This cordless wonder is just a bit larger than a pack of king-size cigarettes and weighs a mere 9 ounces. Yet it *challenges a computer* in handling complex problems, including log, trig and exponent functions with a single keystroke. Best of all, it solves these problems on the spot—whether in the lab, on a plane, or at a job site. All this highly sophisticated, highly portable calculating power costs a mere $395.00. So why settle for less? Find out now what the HP-35 can do to make your job a little easier . . . and a lot more productive. Write today for your free Capability Report.

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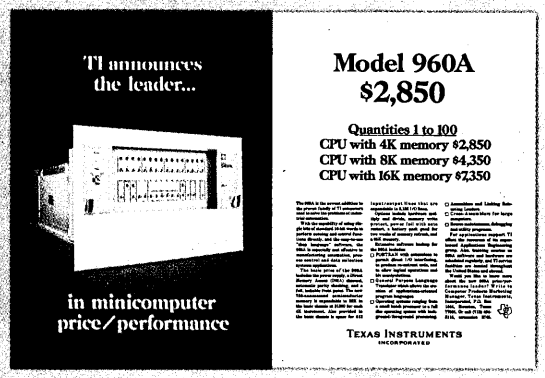
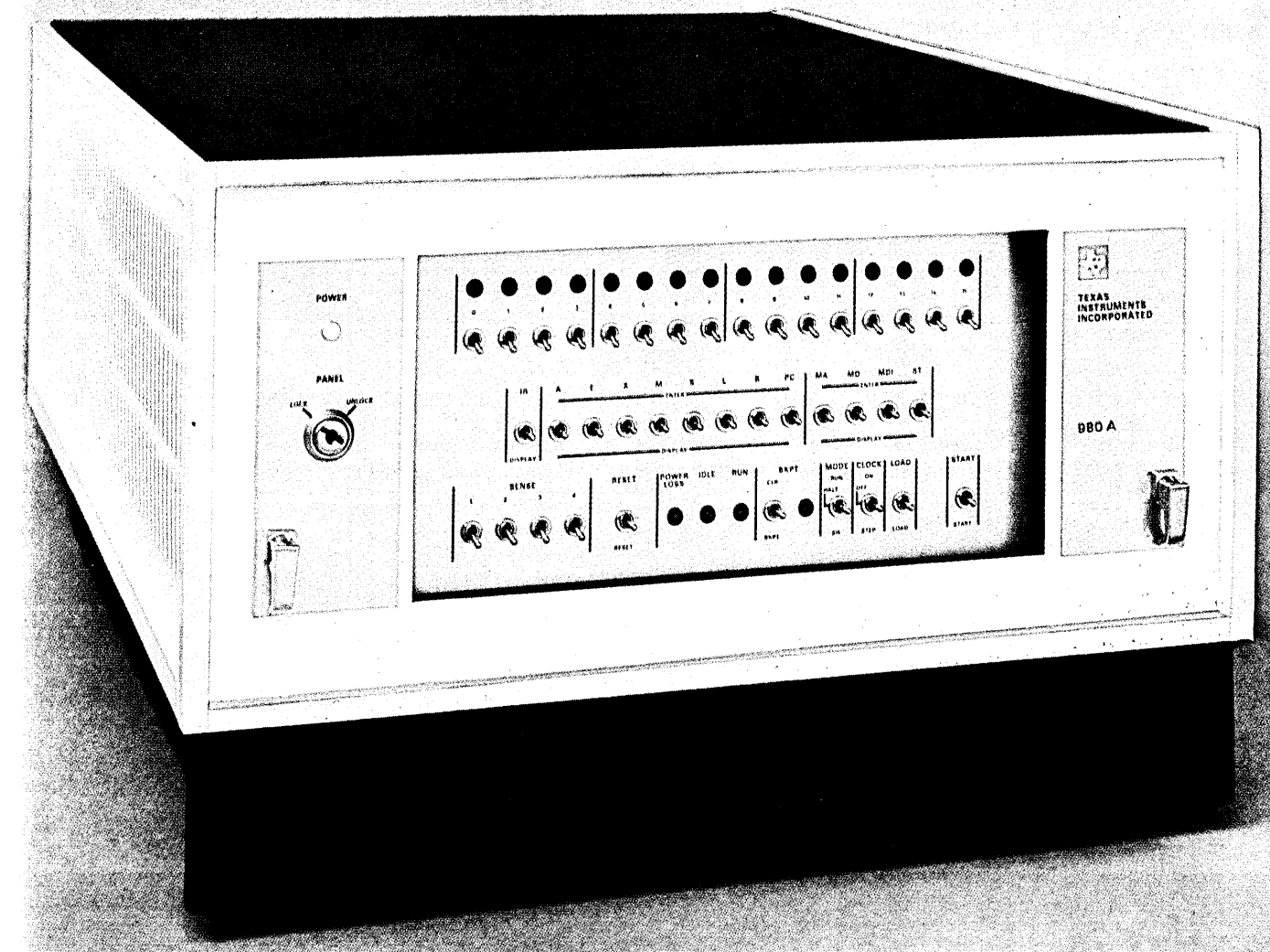
CIRCLE 23 ON READER CARD

In November, TI announced the 960A industrial automation computer





Now, TI announces the 980A... the price/performance leader in general purpose computers

Model 980A
$3,475

Quantities 1 to 100 with hardware multiply and divide and many other built-in standard features

TI continues its leadership in price and performance with the new Model 980A general purpose computer.

The 980A, as with the 960A, is a fast, powerful and flexible 16-bit computer at a low unit price with all the features, built-in and *standard.* Consider these many standard features, compare the price and you'll see why the 980A is the most cost-effective general purpose computer available today.

- ☐ Hardware, multiply/divide with 16 or 32-bit add and subtract
- ☐ 750-nsec add immediate
- ☐ 5.25-μsec multiply
- ☐ 750-nsec, full-memory cycle time
- ☐ Bit / byte / word / byte string data addressing
- ☐ Memory parity
- ☐ Programmable memory protect and privileged instructions
- ☐ Power fail/auto restart
- ☐ Power supply to support 65K memory
- ☐ Memory biasing (dynamic relocatability)
- ☐ I/O bus with 4 ports basic (expandable to 14 in basic chassis, 256 overall)

CPU with 4K memory	**$ 3,475**
CPU with 8K memory	**$ 4,975**
CPU with 16K memory	**$ 7,975**
CPU with 32K memory	**$13,975**

(prices are FOB Houston and do not include illustrated tabletop cabinet)

- ☐ Main chassis semiconductor memory expandable to 32K. (Up to 65K with memory expansion unit: Two weeks memory protect with optional battery)
- ☐ Full, lockable front panel with break point and 4 sense switches
- ☐ Switch-initiated ROM bootstrap loader
- ☐ Auxiliary processor port
- ☐ Direct memory access channel (expandable to 8 ports)
- ☐ Four priority interrupts standard (expandable to 64)
- ☐ 98 basic instructions (16, 32 or 48 bit)
- ☐ 9 addressing modes
- ☐ 8 working registers plus status register

A pre-generated standard software system is supplied which allows the user to generate custom system software. Additional software for the 980A includes:

- ☐ Symbolic assemblers and cross-assemblers for IBM 360/370
- ☐ FORTRAN IV
- ☐ Link and source editors (object and source)
- ☐ Modular executive control routine including disc management
- ☐ TI Language Translator (TILT) to extend FORTRAN, assembly, or create special application languages
- ☐ Service maintenance, debugging and utility programs.

For applications support, TI offers the resources of its experienced Applications Engineering group. Also, training courses on 980A software and hardware are scheduled regularly, and TI service facilities are located throughout the United States and abroad.

Would you like to know more about the new 980A price/performance leader? Write to Computer Products Marketing Manager, Texas Instruments Incorporated, P.O. Box 1444, Houston, Texas 77001. Or call (713) 494-2168 or any of the sales offices listed below.

Arlington, Va. (703) 525-1444 • Atlanta, Georgia (404) 237-8666 • Boston, Mass. (617) 890-7400 • Chicago, Ill. (312) 593-2340 • Cleveland, Ohio (216) 464-1192 • Dallas, Tex. (214) 238-3881 • Dayton, Ohio (513) 294-0774 • Denver, Colo. (303) 758-5536 • Detroit, Mich. (313) 352-5720 • Los Angeles, Calif. (714) 547-9221 • Minneapolis, Minnesota (612) 831-5094 • Newark, N. J. (201) 467-2670 • New York, N. Y. (212) 233-6890 • Orlando, Fla. (305) 644-3535 • Philadelphia, Pa. (215) 643-6450 • San Francisco, Calif. (408) 732-1840 • St. Louis, Mo. (314) 993-4546 • Bedford, England 58701 • Clamart, France 6450707 • Frankfurt, Germany 726441 • Bad Godesberg, Germany 65534

TEXAS INSTRUMENTS
INCORPORATED

Hardware

Hardware Notes . . .

California Computer Products is one firm that is benefiting from the gradually opening Iron Curtain. At the Computer 72 show in Moscow recently, it displayed its model 900/702 flat-bed plotter, tape drive, and controller. It was purchased off the floor—unexpectedly—by the Soviet government Ministry of Chemical Industry, which will use it to produce pipeline drawings. As in all sales of this type, the agreement is subject to approval by the U.S. Dept. of Commerce, and a NATO economic committee, so that the equipment, while still in Russia, is still crated awaiting this approval—which could take as long as six months.

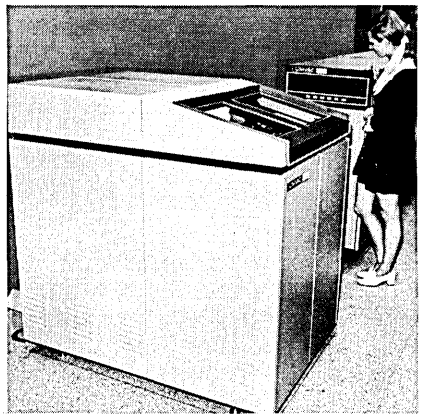
Shortly after this, CalComp showed the Bulgarians an even larger flatbed system, the model 7900/II, at an exhibition in Sofia. It happened again: a Bulgarian government agency purchased the system for a company called Zitwerk, where it will be used—pending U.S. approval—to generate printed circuit drawings.

The IBM General Systems Div. in Rochester, Minn., is using an interesting process to solve the problem of excessive wear on parts it and other IBM manufacturing divisions have experienced. Troublesome parts are taken to a special room where a plasma gun, generating temperatures up to 30,000°F (as hot as the sun's surface), shoots a selected coating from a choice of more than 200 at the part at a speed of approximately 1,000 feet per second. Result? A part in the 5424 System/3 multifunction card unit that previously showed excessive wear after processing only 40,000 cards now is said to show no measurable wear after 1.5 million cards. Users of the model 1288 optical page reader have also benefited: a part in that device that previously showed lots of wear after a few million documents now is said to read more than 100 million documents with no sign of wear.

Mohawk Data Sciences has doubled the size and speed of the memory on its 2400 data preparation and communication system and added a host of new peripherals. Similarly, Honeywell Information Systems has doubled (model 6050/6060) and quadrupled (model 6070/6080) the main memory sizes on the top end of its 6000 line and is offering a 1.5-million-word bulk store for all 6000 models. A crt console for operators and several software packages were also recently announced.

Disc Storage

The 8460 disc file system might be the largest capacity unit ever introduced. It contains two independently addressable modules, each of which can access 46 million 36-bit words in an average of 55 msec. The transfer rate to Univac 418 III, 494, and 1100 series computers is approximately 83,333 words/second—somewhat faster than



the IBM 2314, but slower than the 3330. A dual-access configuration is available that provides two control units and a set of independent lines to each positioner module within the subsystem for simultaneous read/read, read/write, write/read, and write/write operation on any two positioner modules. The controller rents for $1050/month. From one to four disc units, renting for $3950/month, can be attached to the controller. Deliveries begin in October. UNIVAC, Blue Bell, Pa. For information:

CIRCLE 224 ON READER CARD

Batch Terminal

The 4780 batch terminal can be supplied with software that permits it to serve as a 360 work station (a HASP package), CDC User 200, or Univac 1004 equivalent. An RPG compiler is also available. A 16-bit Lockheed SUE minicomputer is the controller, with 108 instructions and a memory cycle time of 900 nsec for 4K or 8K. The standard peripherals are a 600-cpm reader and a 480-lpm, 132-column printer (for 63 ASCII characters). Optional peripherals include tape transports, a crt, punch, KSR 33 tty, and faster line printers. The basic 4K system with standard peripherals rents for approximately $1K per month on a one-year contract. The 4780 will be available in the fourth quarter. REMCOM SYSTEMS, INC., Garland, Texas. For information:

CIRCLE 225 ON READER CARD

Crt Terminal

The VST-5000/BTL crt is a tty-compatible unit that features a four-page delay line buffer that allows time sharers to verify the data before sending it to the computer. The screen displays 18 lines of 72 characters made up from a 128 character ASCII set. The switch-selectable transmission speeds are 110, 150, 300, 600, and 1200 baud. Other features include an audible end-of-line indicator, provisions for temporary transition to full-duplex mode for password handling, automatic page erase with disable option, and tabulating provisions. An output stream is generated that can drive a slave hard copy printer. The VST-5000/BTL sells for $4995, and can also be leased. Delivery is 30 days. VIDEO SYSTEMS CORP., Pennsauken, N.J. For Information:

CIRCLE 226 ON READER CARD

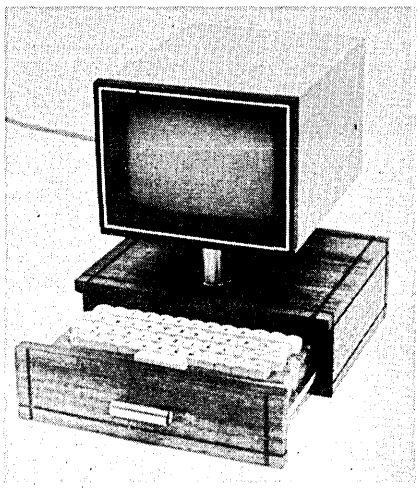
Time-sharing Terminal

The model 930 terminal is a 30-cps thermal printer that prints 5x7 dot-matrix characters from a repertoire of 96 ASCII characters. The print mechanism is said to contain no moving parts except the paper advance drive and print head positioning motor. Priced at $2700, the 930 is unconditionally warranted for one year. COMPUTER DEVICES INC., Burlington, Mass. For information:

CIRCLE 227 ON READER CARD

Executive's Crt

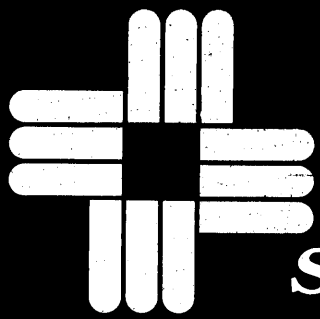
The executive interested in monitoring some computer function in his company would be proud to have the EXECUTERM 6-inch crt terminal sitting on his desk. It's mounted on a walnut base "to match the most prestigious executive decor," and the base contains a 64-character ASCII set. The screen dis-



I want a 16-bit computer that has a REAL–TIME EXECUTIVE with FOREGROUND/MIDDLEGROUND/BACKGROUND capabilities! I want to write my real-time programs in FORTRAN and run them under the executive! I want a complete system with digital and analog I/O, disc, CRT . . . the works! I want to buy from a company that makes the industry's big boys move aside on service, performance, cost! I want software that's ready to handle my benchmarks. I want to see a list of deliveries to smart customers . . . OEM, end-users. . . . lots of applications! I want all this and more . . . and for less money than I'm used to being quoted! Do you know any such company?

SURE,

FOR FURTHER ENLIGHTENMENT . . . send for the MODCOMP facts



modular computer systems

2709 North Dixie Highway, Fort Lauderdale, Florida 33308
Telephone: 305 - 563-4392 TWX: 510 955 9820

CIRCLE 31 ON READER CARD

plays up to 16 lines of 32 characters each in 5x7 dot-matrix form either from a 110 baud tty-type line, or with any other EIA rate up to 9600 baud in full-duplex, echo mode. The unit price is $1760 for a minimum order of 10. If the unit could display tv programs in addition to computer output, the firm might steal a market! Delivery is from stock to 90 days. CAR-MEL ELECTRONICS INC., Los Angeles, Calif. For information:

CIRCLE 228 ON READER CARD

Oem Card Reader

The model 1000 is a faster version of this firm's first product, introduced in March (p. 123). A single rotating mechanism handles the card picking, transport, and stacking; and fibre optics are used to read the card. The unit has been engineered for heavy-duty applications of typically 200,000 or more cards per day. Oem's can buy the completely assembled unit for $1735 each in orders of 100, or the various components may be purchased separately. TRUE DATA CORP., Newport Beach, Calif. For information:

CIRCLE 233 ON READER CARD

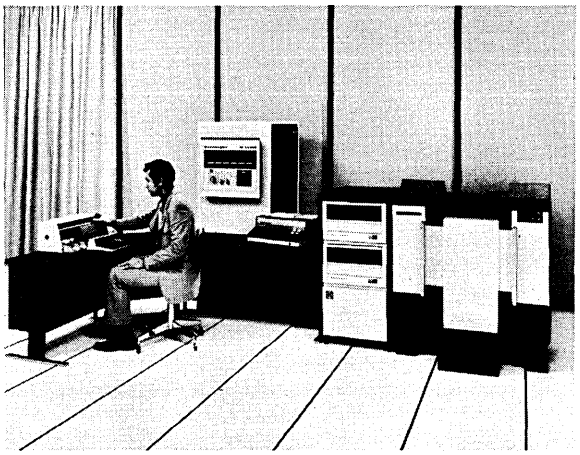
Large-scale Data Entry

The CMC 18 KeyProcessing system is the largest ever introduced by Computer Machinery. It accommodates up to 64 operator stations. A 2314-like disc storage subsystem holds up to 29 megabytes of intermediate storage; and if more is needed, additional discs can be added. There's also an 80- or 132-column line printer offered for printing error listings during validation routines, as well as batch and tape listings, logs, and status reports. The model 18 can be made up of keyboard or crt stations, and these terminals can be located up to 1,000 feet from the supervisory console. The controller of the 18 is user-programmable (a first in such products?), which allows users to program their own custom data validation routines. The price of the system is $2800 per month, plus $70/month for each station. Deliveries are slated for the first quarter of next year. COMPUTER MACHINERY CORP., Los Angeles, Calif. For information:

CIRCLE 291 ON READER CARD

Batch Terminal

The model 88-23 batch terminal contains a 4K 16-bit minicomputer that a user programs to validate source data input. Information is stored on an endless-loop tape for transmission to the processing computer when the batch is



product spotlight

The Burroughs B 1700

Perhaps never before has a computer manufacturer combined so many innovative and desirable features in a single product line as has Burroughs in its B 1700 series. It's all there: multiprogramming, virtual memory, MOS/LSI memory, variable micrologic, completely reentrant code (programs that do not alter themselves so that several jobs can be using them simultaneously), memory addressability down to the bit level (allowing memory compaction), upward compatibility from this level to Burroughs' larger systems, source code compatibility with IBM S/3 and 360/20 RPG, and more. The fact that all of this is offered on System/3-class machines makes the message clear: Burroughs is going after the first-time computer user—and the competition—with a vengeance.

The way variable micrologic is used in the models 1712, 1714, and 1726 is the series' principal feature. Where in the past a computer designer was quickly locked into the basic architecture of the machine, changes are made in the design of the Burroughs machines hundreds of times each second.

The Burroughs software managers for COBOL, FORTRAN, RPG, and BASIC had an independent free hand to design the ideal machine for execution of each of those languages. Register sizes and number differed, the types of instructions differed, as did the frequency of occurrence. The variable micrologic is a representation of the ideal machine for all these diverse conditions, and that ideal machine is recreated each time the language is processed. So, while the B 5500 was optimized to run ALGOL efficiently and the B 3500 to run COBOL efficiently, their performance fell off when other languages were processed. But the B 1700 is optimized to whatever language it is processing.

Now to the individual machines. The baby of the series is the 1712 with a cycle time of 500 nsec, from 16-40K bytes (or equivalent) of memory, with monthly rentals ranging from $1500 to $2800. This machine is rated as just slightly faster than a System/3. Next comes the B 1714: a cycle time of 250 nsec, from 16-64K bytes of memory, and communications capability. Rentals range from $1600 to $4500.

The B 1726 has a cpu cycle time of 167 nsec and a memory read cycle time of 666 nsec for 24 bits. This machine has a bipolar control memory and is rated by Burroughs at 4.8 times the speed of a System/3. This model also has communications capability and rents from $3000 to $10,000 per month.

All models can have up to eight fully buffered channels. And there are 96-column card peripherals for those channels in addition to standard 80-column gear, discs, printers, tape drives, etc. The $1500/month price on the 1712 is for 16K of memory, a reader/punch, printer, the MCP operating system, one problem language, and utilities. It also includes maintenance.

A comprehensive list of complete software libraries in vertical applications can be delivered when the machines are (this quarter for the two smaller models, and the first quarter of '73 for the 1726).

It may be some time before we see another such significant technological announcement which promises so much performance and potential savings to the end user. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 234 ON READER CARD

The Hazeltine 2000
CRT Terminal System
Price/Performance Leader
in its class...

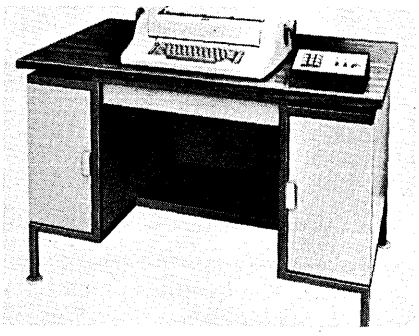
part of the

Alexander Smith Carpet-Puter™

a real-time national information network tying together manufacturing facilities, administrative headquarters, service centers, warehouses and customers all Alexander Smith carpet dealers around the country, providing instantaneous stock availabilities and locations, creating invoices, controlling shipping information and stock reservations. a network all the human working today." See them yourself!

Hazeltine Corporation

hardware



completed. The communication rates are 1200, 2000, 2400, and 4800 baud. The tape magazines are removable to allow off-line storage. The 88-23 is available in two versions: an IBM 2780-like terminal that rents for $395/month on a one-year lease, and a 4K version with a choice of line speeds that rents for $485/month. Rental prices include maintenance, and delivery is 30 days. DATA 100 CORP., Minneapolis, Minn. For information:
CIRCLE 230 ON READER CARD

ASR Pedestal Terminal

If lack of space is not a problem at your installation, perhaps the $40 per month rental savings will be the reason to consider the EDT 300 ASR terminal. A reconfigured GE Terminet 300, the unit has been redesigned as a pedestal mounted terminal. Impact printing produces up to six copies at 10, 15, or 30 cps on 118-column paper. Upper and lower case ASCII characters are normally used, but an operator option allows for degrading to Teletype-compatible upper case only. Paper tape gear is included in the $195/month price. WESTERN UNION DATA SERVICES co., Mahwah, N.J. For information:
CIRCLE 297 ON READER CARD

Communications Controller

Compatible with the IBM 360/370 series above the 360/20, the P-3000 can pretend to be either an IBM 270X or 3705. It gets its disguises from its 4K bytes of 200-nsec alterable control memory, which augments its 16-240K l-usec main store. The P-3000 can handle mixed synchronous and asynchronous lines up to 50,000 bps, performing buffering, code conversions, automatic answering, etc. on as many as 352 lines at one time.

Available in the fourth quarter of this year, the front-end processor will run between $37,000 and $140,000. A "typical" configuration with 16K and interfaces for 40 asynchronous lines would run $49,250 or $1530 per month. PRENTICE ELECTRONICS CORP., Palo Alto, Calif. For information:
CIRCLE 289 ON READER CARD

Crt Cluster
The Videomaster 7700 is offered as an electronic and logical plug-to-plug replacement for the IBM 2848/2260 video display system, but has a data rate more than twice as fast as its counterpart when operating on the multiplexor channel. Insertion and deletion of characters is done on a line basis, with screens displaying 240, 480, 960, and 1,920 characters. The terminals rent for under $75/month on a one-year lease. GTE INFORMATION SYSTEMS INC., Mt. Laurel, N.J.
CIRCLE 240 ON READER CARD

Card Readers
The models 8035 and 8045 photoelectrically sense punches, pencil marks, or both types of data on 80-column cards. The 8035 operates at 300 cpm and is priced at $2115 each in orders of 100; the 450-cpm 8045 is priced at $2265 in similar quantities. Push button controls select the run modes, which include reading holes and/or marks with or without timing marks. BRIDGE DATA PRODUCTS, INC., Philadelphia, Pa.
CIRCLE 241 ON READER CARD

Modem/dialer
A combination modem and automatic dialer has been developed which should interest designers of communication networks. It's compatible with Bell 103A or 202C modems and with Bell 801A or 801C automatic calling units. The modem/dialer sells for $700 and rents for $23/month on a three-year lease. VADIC CORP., Palo Alto, Calif.
CIRCLE 242 ON READER CARD

Static Card Reader
The model 960A is a card reader intended for control and data collection applications. It reads standard 80-column cards using a continuing brush technique. It operates in two modes: sequentially by column, stepped by an external pulse; and in an addressable mode that permits it to read any column randomly. The single unit price is $495, which sounds like one of the least expensive units of this type we've ever seen. THE HICKOK ELECTRICAL INSTRUMENT CO., Cleveland, Ohio.
CIRCLE 243 ON READER CARD

Microfiche Reader
The PORT-A-VU is a portable (9-pound) fiche reader that accommodates 24 and 30X film and displays it on an 8 x 11-inch screen. Frame selection is done manually by manipulating a slide. There is a choice of a blue or green filter to screen the 50-watt lamp. The price is less than $100, with deliveries slated for this quarter. GAKKEN CORP. OF AMERICA, INC., Irvine, Calif.
CIRCLE 244 ON READER CARD

370 Main Memories
These replacements for the IBM 370/155 and 165 core main memories are said to be both logical and electronic substitutes for them. As such, potential customers will probably be more interested in pricing numbers than anything else. On a two-year contract, a 256K module for the 370/155 is $2450/month, with two megabytes priced at $19,200. A 512K chunk for the 165 is $4800; three megabytes is $28,800/month. COMPUTER INVESTORS GROUP, INC., Stamford, Conn.
CIRCLE 245 ON READER CARD

Printer Silencer
It may be easier to justify getting some sort of silencer for printers like the Selectric now. This new firm has developed a quarter-inch plastic plate that simply fits over the opening on top of the printers, retaining full visibility of the paper. While admittedly not as effective as a full-blown acoustic enclosure, the company claims that noise is reduced 18 db in the 2-18 KHz frequency range, or roughly 88%. The prices range from $6-10 depending on the terminal or typewriter model. Delivery is said to be one to two weeks. ZOND INDUSTRIES, INC., San Mateo, Calif.
CIRCLE 246 ON READER CARD

Retail Processor
The minicomputer-based 725 retail control system is built for collecting sales data from cash register-like terminals and providing reports of sales activity. The 725 is said to support up to 600 of the 280 family of terminals, and to communicate with its on-site or remote concentrators at rates to 2400 bps. Priced at $20,200 with mag tape and printer, the system also performs credit verification. NCR, Dayton, Ohio.
CIRCLE 311 ON READER CARD

Crt Teller Terminal
The first on-line bank system was reportedly installed by this firm in 1961, when it was known as Teleregister Corp. Now it is introducing what it claims is the first teller terminal with a built-in crt. Priced at $9100, the terminal comes with a built-in controller, numeric keyboard, journal tape printer, and passbook printer to augment the 256-character display. BUNKER RAMO, Trumbull, Conn.
CIRCLE 317 ON READER CARD

Peripheral Interface
Manufacturers of ocr and card reader equipment are offered custom interface units that permit the equipment to be attached to IBM 360 and 370 selector or multiplexor channels. To the host system the device attached looks like an IBM 2501 card reader. Features include power on and off under computer control, an on-line/off-line switch, and the ability to alter the device address in the field. In quantities of 100, a typical interface would be approximately $2280. DATATREND CORP., Chatsworth, Calif.
CIRCLE 323 ON READER CARD

Terminal Controller
The model 204 is offered to oem's intending to build replacement or add-on products for tty's or similar devices. It can be used to drive a standard tv tube, accepting asynchronous data at up to 1200 baud. It has a 64-character ASCII set, switch-selectable page and roll modes, and can be ordered with serial and parallel tty RO33 or KSR33 equivalent interfaces. The single quantity price is $795. ANN ARBOR TERMINALS, INC., Ann Arbor, Mich.
CIRCLE 247 ON READER CARD □

Software & Services

Software Notes . . .

SIMSCRIPT, one of the most-used simulation languages, is celebrating its 10th anniversary. Originally announced by the Rand Corp. in 1962 (a year after IBM's GPSS) SIMSCRIPT was completely rewritten in 1968 (SIMSCRIPT II). One of the original developers, H. Markowitz, has since left Rand and joined Consolidated Analysis Centers Inc., Los Angeles, where he continues to improve the language—he's now up to version II.5. It's claimed that improvements in the software and documentation of II.5 largely account for CACI's having more than 50 university installations.

One simulation not done in SIMSCRIPT was the controversial doomsday report, "The Limits to Growth," based on the results of a computer model run at MIT predicting the total collapse of civilization in the not-too-distant future (see May, p. 152). The model was written in AED (Automated Engineering Design), a high-level language and programming system originally developed at MIT (with Air Force funding) but now commercially available from SofTech, Inc., Waltham, Mass. Although three years of sales effort with AED have been disappointing to the firm, there seems to be renewed interest in AED bcause of the world model and because the Boeing Co. has decided to use it to help design the B-1 bomber avionics package, a $62 million contract Boeing recently won.

The computer services industry is forecast to reach revenues of $7.5 billion by 1976, according to an analysis by Creative Strategies, Inc., Palto Alto, Calif. That figure represents a compound annual growth rate of nearly 29%, broken down as follows: business package software, $325 million; service bureaus, $4 billion; and time-sharing, $2 billion. Facilities management, currently the smallest of the four industry segments, is predicted to achieve a compound annual growth rate of 53%, generating $1.5 billion in revenues by 1976. Complete reports of the industry study are available from CSI for $360.

Honeywell Information Systems in January collected all of its conversion packages together in one department, the Conversion Technology Center. With 115 aids, CTC reports it's now receiving 140 inquiries a month from users of competitive equipment.

Decision Making

This time-shared service, called DEMAND (Data Evaluation of Management Decisions), attempts to give management more visibility in making decisions. It consists of program models available in the fields of market research, sales planning, investment analysis, financial planning, and budgeting.

Information is entered into the system and subjected to a series of analyses, including six probability distribution types to express ranges of values for uncertain factors; sensitivity analysis to test the relative importance of various factors in a situation and to demonstrate the impact of variations in estimates of the uncertain factors; serial correlation to describe the interdependency of the variables entered; a Monte Carlo simulation to produce the possible outcomes of a decision by running a number of trials that combine a number of relationships in the model; and a future assumptions module to simulate the effects of possible future developments on the present model structure.

At 6¢/cpu second, the charge for the service can vary greatly with the amount of data being processed. DEMAND is available nationally. RAPIDATA INC., Fairfield, N.J. For information:
CIRCLE 261 ON READER CARD

DEC 2780 Simulator

EM2780 is a program that allows an 8K Digital Equipment PDP-11 running under DEC DOS to act as a 2780 batch terminal. The routines execute as user programs and require no modifications to DOS. All the standard 2780 options are claimed. One feature of the program is that it will not lose line synchronization with the parent cpu when a terminal unit-record device fails. The package is priced at an even $1K. OREGON RESEARCH INSTITUTE, Eugene, Ore. For information:
CIRCLE 262 ON READER CARD

Debugging Aid

Installation managers at OS/360 sites may not want this package to be accessible to everyone, for as the developer says: "One slip in using it, and the whole system goes down." But if carefully used it might be just the debugging aid an installation manager has been looking for because it's so powerful. It's called SVCINTER, and it intercepts calls from slave programs to the system (SVC's). Instead of executing the slave program, SVCINTER is executed in the name of the slave program and the name of a BAL exit routine. OS never knows that an SVC was issued.

The exit routine has several options: It can return to the program and let normal processing continue; execute the SVC and then return to the slave program; or cancel the SVC and continue processing. While the exit routine has control, most any normal OS function can be performed. The routine can be used to determine why a slave program is in the supervisor, where, etc., while executing from the same portion. The small routine is priced at $200. S&B SOFTWARE PRODUCTS, Northridge, Calif. For information:
CIRCLE 263 ON READER CARD

Network Simulator

CAINS (Communications and Information Network Simulator) offers communications network designers the ability to model a system of up to 300 nodes and to optimize that system interactively. Inputs to CAINS describe line loads in terms of bytes of messages (plus variances) and in terms of alternate message routes. Outputs describe the time to process each message, line utilization, and queueing time. Written in FORTRAN IV, the program required about 40K words on a Burroughs 5500 to model a 20-node system. Its price of $5500 includes one-man week of consulting and instruction. ANALYTICS INC., Jenkintown, Pa. For information:
CIRCLE 264 ON READER CARD

DOS Console Simulation

Novice computer operators need not tie up a system while learning how to operate an IBM 360 or 370 running DOS. Three kinds of simulation drills are available which make a terminal accept commands and respond like the system console. Objectives of the Basic Operator Training Course are to help the operator identify major component programs of DOS; to teach operator commands and recovery procedures including IPL's; to teach the use of the system recorder file; and to help in understanding JCL, utility programs, and SORT. The basic course costs $225. The second set of drills is for customer problem determination ($235); the third for multiprogramming ($205). IBM CORP., White Plains, N.Y. For information:
CIRCLE 265 ON READER CARD

College Payroll, Planning

Payroll/Budgeting/Personnel (PBP), an information system for colleges and

The multi-terminal system for people who swore they'd never look at another.

Remember a few years back when everybody and his brother was promising multi-terminal systems?

There was only one problem. They ended up costing a mild fortune.

We watched all that happen and decided to do it right.

We didn't try to strip down a much bigger system. We built a minicomputer time-sharing system from the ground up. And we didn't scrimp on the software. We worked out a comprehensive operating system with file management, full peripheral support, terminal-oriented compiler — the works!

When it was ready, we didn't jump up and down and make a lot of noise. We quietly sold a few to distributors, manufacturers, and insurance companies. And made the system prove itself on order entry. Inventory control. Accounts payable. Claims processing.

Which it did.

So now we're ready to talk about it. Our RSTS-11. A 16 simultaneous user, on-line, interactive timesharing system you can lease for around $3000 per month. Termir data-base storage units and all. Or you ca buy it outright for around $100,000. Eith way it costs about a third of what you'd pay for other systems.

And this time, you can afford it.

Write Digital Equipment Corporation, Maynard, Mass. 01754. (617) 897-5111. European headquarters: 81, route de l'Ai 1211 Geneva 26. Tel.: 42 79 50.

CIRCLE 27 ON READER CARD

digital

universities, consists of three modules: a payroll package; a budgetary planning and control program; and a data base of WICHE and HEGIS-compatible information for planning future fiscal and personnel requirements. The programs are written ANSI COBOL and are set up to run on Univac 1108s and OS and DOS 360s. A report generator is included for reporting on the 280-element data base. Prices range from $10K (for payroll only) to $60K for the entire system, including source language, documentation, installation, and some training. Changes to the basic program are made under separate contract. INTEGRAL SYSTEMS, INC., Piscataway, N.J. For information:
CIRCLE 266 ON READER CARD

Mesh Plotting

This bicubic spline interpolation program—for taking coarse mesh data and generating a mesh of regularly spaced points defining a continuous surface—can generate output for off-line plotting or be used to drive an on-line graphics terminal. The mesh appears three dimensional, even on a flat surface. The program is written in FORTRAN and requires approximately 15K bytes. It is supplied in source statement form and is priced at $500, including documentation. DYNAMIC GRAPHICS, INC., Berkeley, Calif. For information:
CIRCLE 267 ON READER CARD

In-House COM Services

Firms lacking the expertise to set up an in-house computer output microfilm capability may contract for it. Services to be provided by this vendor include: establishing the hardware requirements, purchasing and leasing back the COM unit and readers, installation, training, and even marketing support if the installation is to be a service bureau. The service runs about $2000 to $2200 per month on a five-year lease, including indexing software and a machine the size of a Pertec 3700. U.S. DATACORP, Portland, Ore. For information:
CIRCLE 268 ON READER CARD

User-Graded Plotting

FASPLT's two modes of operation probably should be labeled "anyone can play" and "for those who know what they are doing." In one mode, the user gives as few as two control inputs, and the plot program will provide automatic scaling and automatic labeling with one variable per plot. In the other mode, the user can specify his scales, a legend, company logo, label up to five variables, and assign different symbols to be used at selected data point intervals on line, bar, or step function charts.

The stand-alone program requires 30K words (120K bytes) or less and operates on Univac 1108 and IBM 360 systems. FASPLT reportedly can produce plots in less than two seconds for CalComp, Zeta, and Complot equipment or other plotters or printer/plotters. If leased on a one-year contract for $115/month, 60% of the rental can be applied toward the $2600 purchase price. VERIFIED SOFTWARE PRODUCTS CO., Carson, Calif. For information:
CIRCLE 269 ON READER CARD

PDP-8 Business Programs

A comprehensive set of programs, including an operating system and an I/O monitor, is offered to Digital PDP-8 users interested in doing business dp. Among the applications packages included in the $20K price are sales order entry, billing, accounts receivable and payable, inventory and control, sales analysis, mailing list, and financial accounting. COMPUTER INTERACTIONS INC., Great Neck, N.Y. For information:
CIRCLE 270 ON READER CARD

Spooling Program Option

This company markets GRASP, one of the more successful DOS spooling packages around. And EPAT is the latest bell developed for it. It is a data set catalog module that provides automatic volume recognition for tapes based on a resident catalog of every physical tape volume in the installation. The catalog is accessed whenever a tape file is opened to determine the volume serial number of the most current generation of the required data set. The drives are then scanned to see if the volume is online; and if not, a mount message is issued to the operator. The catalog is self-updating as volumes move through the cycle of being data sets, retained data sets, and being scratched. EPAT rents for $180/month. SOFTWARE DESIGN, INC., El Segundo, Calif. For information:

CIRCLE 271 ON READER CARD

Distribution Mapping

MINI-MAPS is a 16K RPG program that composes spatially distributed data into a flat-tone map, graph, or other visual display, using a standard line printer. The map supplied is of the U.S., but the program can be modified to represent other regions. Each line of the map is 120 characters long, and the map can be of unlimited length. Five shades of differentiation are standard, although up to 10 levels, including blank areas, can be obtained. One tape and two card programs are available for $1170 or $90 per month. Installation assistance is extra. EDWARD STARK ASSOC., LTD., Needham, Mass. For information:

CIRCLE 272 ON READER CARD

software spotlight

Debugging Program

FAS/TEST can be used on 360 COBOL, BAL, and RPG programs (card, tape, and direct access files) to debug programs written in those languages. The program provides the programmer with a visual picture of how data is flowing through the program. Each time the user program prints a record, FAS/TEST inserts the contents of this record between the lines of the output, giving the programmer a chronological record of what the program actually did. By means of control statements, the user can print only critical portions of the file. Data exceptions are intercepted for programmer action before the system sees them so that the test program is not cancelled. FAS/TEST is written in BAL and requires 3K bytes of memory on any DOS 360 system. It can be purchased for $1750 and rented for $75/month. A 30-day free trial is offered. SYNERGETICS CORP., Burlington, Mass. For information:

CIRCLE 260 ON READER CARD

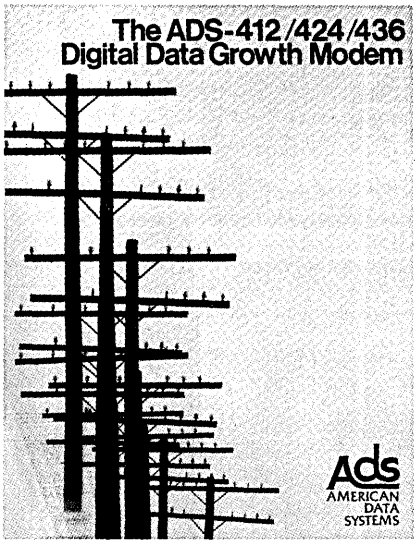
Matrix and Report Generator

Particularly suited for scientific applications, the MaGen Problem Descriptor System for the Univac 1108 and 1106 is more than its name implies. Its supplier claims that many problems that can be viewed as matrices are solved by merely being able to describe them, and that is part of what this program does. The other function is report generation, where the output needs are defined by abbreviated references to the same dictionary and data tables used in setting up the matrix. Aimed at engineering types, PDS can be made available in versions for Exec II or Exec 8 for about $20K plus training expenses. HAVERLY SYSTEMS INC., Denville, N.J. For information:

CIRCLE 273 ON READER CARD □

Literature

"Growth" Modem
Brochure describes a digital data "growth" modem, field-expandable from 1200 to either 2400 or 3600 bps through use of plug-in pc cards. The



unit operates on dial-up or private lines and is EIA, CCITT and Bell compatible. AMERICAN DATA SYSTEMS, Canoga Park, Calif. For copy:
CIRCLE 200 ON READER CARD

Add-on Memories
File folder contains data sheets covering add-on core memories for upgrading 360/30s to 256K, model 40s to 512K, and model 50s to one megabyte. COMPUTER HARDWARE CONSULTANTS & SERVICES, INC., Newtown, Pa. For copy:
CIRCLE 201 ON READER CARD

Universal Controller
A controller and disc storage system, adaptable to any cpu, is described in an eight-page brochure which includes a specification sheet for different disc drives available with it. PERIPHERALS GENERAL, INC., Cherry Hill, N.J. For copy:
CIRCLE 202 ON READER CARD

Telecommunications Catalog
Short-form catalog describes vendor's full line of telecommunications systems and equipment. It covers computer-controlled switching systems, radio/Teletype receivers, terminals, and modulated RF and frequency synthesizers. FREDERICK ELECTRONICS CORP., Frederick, Md. For copy:
CIRCLE 203 ON READER CARD

The Systems Man
"Profile of a Systems Man" summarizes the results of a recent survey of the salaries, job characteristics, and levels of responsibilities of systems analysts. The report is based upon responses from more than 5,000 systems analysts comparing current data with trends over the past 12 years. Copies are available at $5. ASSOCIATION FOR SYSTEMS MANAGEMENT, 24587 Bagley Rd., Cleveland, Ohio 44138.

Program Library System
Brochure describes a computer source program library system called PLS which it says saves time and storage space and provides tamper-free security in the maintenance and retrieval of computer programs. ISC/PRYOR, Chicago, Ill. For copy:
CIRCLE 205 ON READER CARD

Business Mini
Sixteen-page booklet describes the Datapoint 2200 as "the Business Mini Computer" and gives details on all its configurations, including tape, disc, and line printer. It also provides applications information on its use in data conversion and entry and in general on-line communications activity. COMPUTER TERMINAL CORP., San Antonio, Texas. For copy:
CIRCLE 206 ON READER CARD

Serial Impact Printers
Nine-page technical article outlines the principles of serial impact printers. It explains how the letters, numerals, and symbols of a "print-on-the-fly" machine are wrapped around the surface of a print wheel that is motor driven at high speed and electronically synchronized with a print hammer that drives the paper against selected characters as the print wheel spins into position. PRINTER TECHNOLOGY, INC., Woburn, Mass. For copy:
CIRCLE 207 ON READER CARD

Mini Controller
Four-page bulletin describes two asynchronous communications controllers which enable vendor's model 1600 minicomputer to communicate with local or remote asynchronous devices. MICRODATA CORP., Santa Ana, Calif. For copy:
CIRCLE 208 ON READER CARD

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A large-scale information storage and retrieval system which permits retrieval

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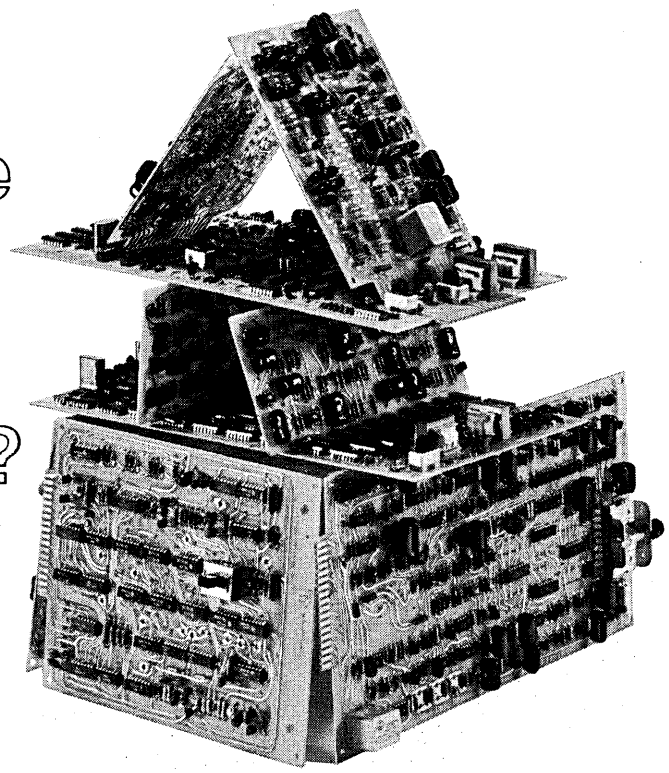
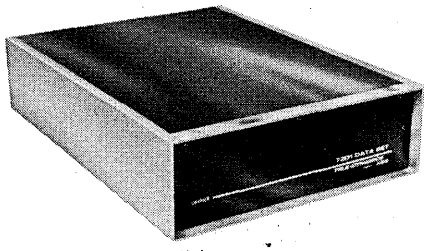
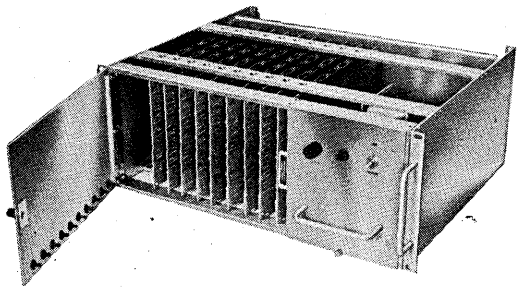


Call Tele-Dynamics

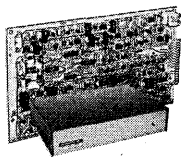
at (215) 643-3900. Ask for John Jurenko.





Also available as complete stand alone...or in rack-mounting for multiple installations.

Another **new modem** from Tele-Dynamics



7103 F and G

Full duplex 300 bps manual and automatic originate/answer. Interchangeable low-cost replacements for Bell 103A2, F2, E and G.

Available for delivery now. In PC card version for OEM or as a stand-alone complete with power supply, barrier strip termination, business machine connector and power cord. End-to-end compatible with all Bell 103 and 113 data sets. Voltage levels provided for all common interfaces. 7103F uses Type CDT DAA for public telephone network operation. 7103G uses Type CBS or CBT DAA.

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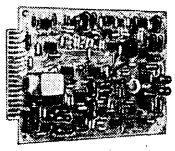
DIVISION OF **AMBAC**

Another **new modem** from Tele-Dynamics



7113A and B

Full duplex 300 bps originate-only and answer-only versions. Interchangeable low-cost replacements for Bell 113A and B.

Available for delivery now. In PC card version, or with mounting bracket, power supply, barrier strip termination and adapter cable especially for teletype machines. End-to-end compatible with all Bell 103 and 113 data sets. Voltage levels provided for all common interfaces. Uses Type CDT DAA for public telephone network operation.

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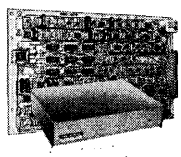

7202 D and E

Full duplex 1200 or 1800 bps transmit/receive and transmit-only with automatic answering. Interchangeable low-cost replacements for Bell 202D and E.

Available for delivery now. In PC card version for OEM; as a stand-alone complete with power supply, barrier strip termination, business machine connector and power cord; or in a multiple rack mounting adapter that houses up to ten 7202 PC cards. Functionally and interface compatible with Bell 202D and E data sets, but uses unique digital modulation and demodulation technique for improved performance and stability. Compatible with Type CDT manual DAA or CBS and CBT automatic DAA for public telephone network operation. Optional 5 baud reverse channel and automatic answering DAA interface.

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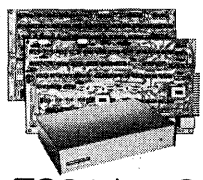

7201 A and B

Full duplex 2000 or 2400 bps automatic or manual answer. Interchangeable low-cost replacements for Bell 201A and B.

Available for delivery now. In PC card version for OEM; as a stand-alone complete with power supply, barrier strip termination, business machine connector and power cord; or in a multiple rack mounting adapter that houses up to five complete data sets. Functionally and interface compatible with Bell 201A and B data sets. Uses Type CBS or CBT DAA for automatic public telephone network operation, or CDT for manual only.

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literature

of any microfilmed document from millions within an average of 14 seconds and a maximum of 18 seconds is covered in an eight-page brochure which describes its encoder, mounter, remote viewing, rapid remote access, and various options. VARIAN ADCO, Palo Alto, Calif. For copy:
CIRCLE 209 ON READER CARD

Data Communications
Vendor's capabilities in computer-controlled data communications systems are described in an eight-page brochure which summarizes hardware, software, and support available. XEROX CORP., El Segundo, Calif. For copy:
CIRCLE 210 ON READER CARD

Beginning of the End
"Could This be the Beginning of the End?" is the title of a brochure describing Tapeguard, a safe designed to meet the protection needs of film, microfilm, magnetic tape, disc packs, and other records media. MOSLER, Hamilton, Ohio. For copy:
CIRCLE 211 ON READER CARD

Data Modems
Data modem fact sheet describes a line of low-speed, Bell-compatible modems available in a variety of configurations and featuring tty, EIA, or TLT interfacing; loop-back testing and visual diagnostics; and dedicated or dial-line operations. PULSE COMMUNICATIONS, INC., Falls Church, Va. For copy:
CIRCLE 212 ON READER CARD

Disc Memory System
Two-page data sheet describes vendor's L107MA disc memory system which is a hermetically sealed version of its rugged, small, fast random access, head-per-track series L107. SINGER LIBRASCOPE DIV., Glendale, Calif. For copy:
CIRCLE 215 ON READER CARD

Instrumentation Systems
A general information manual on instrumentation systems was written for the man who is responsible for integrating a computer system into the laboratory environment. It introduces new concepts and techniques for laboratory automation, data acquisition, and automatic testing. Topics include computer functions, functions classification, computer system, laboratory interface, system software, and application software. EMR COMPUTER, Minneapolis, Minn. For copy:
CIRCLE 214 ON READER CARD □

People

His doctoral thesis, "Sketchpad," resulted in the first modern computer graphics system—and he still works at the forefront of computer graphics technology. Dr. IVAN E. SUTHERLAND, vice president for research and development at Evans & Sutherland Computer Corp., Salt Lake City, recently became the first recipient of the Vladimir K. Zworykin award of the National Academy of Engineering. The $5,000 award, personally presented by Dr. Zworykin, is designed to provide "timely recognition of outstanding achievement by an individual in the early stages of his career."

van E. Sutherland

Sutherland, who was cited for his "outstanding achievements in the field of electronic engineering in the service of mankind," is not one for making brash statements or broad generalizations. In answer to questions, he refrains from commenting on the breadth of current activities in graphics or the overall state of the art. But he says, "The thing that's happening around here is the production of shaded pictures. We're getting to the point where the pictures have a great deal of realism. They're shaded, the objects are opaque, and they look like objects."

Continuing his research in graphics on a part-time basis as an associate professor of electrical engineering at the Univ. of Utah, Sutherland adds, "We're now to the point in computer output where it's hard to tell that the output is, in fact, from a computer. Which means you can begin to concentrate on the contents of the picture, rather than the mechanism by which it was produced." He goes on to say, "The realism of the pictures opens a wide variety of applications that weren't available before."

His partner in business, Dr. DAVID EVANS, apparently deserves credit for much of the progress now being made. It was Evans, at the Univ. of Utah, who lured Sutherland from Harvard and Thomas Stockham from MIT. Evans contributed his expertise in incremental computing, Sutherland his knowledge of three-dimensional mathematics and the clipping divider, and Stockham his work in contrast enhancement and his understanding of picture processing, human vision, and photography. "And the results we've had," Sutherland explains, "have been the results of the coming together of those three independently quite strong research activities."

"I want it all." Sol Zasloff, new vice president for marketing at Computer Automation, Newport Beach, Calif., minicomputer manufacturer, was talking about the minicomputer market. Anyone listening to him for awhile would either believe he will get it or would hope he will, for he's quite believable when he says, "I get physically sick when I lose." Zasloff, who spent some seven years in marketing with Xerox Data Systems and doesn't find marketing minis much different from selling medium to large scale computers, doesn't expect to get "it all" over night. He says Computer Automation, which now has 1,000 machines in the

Sol Zasloff

people

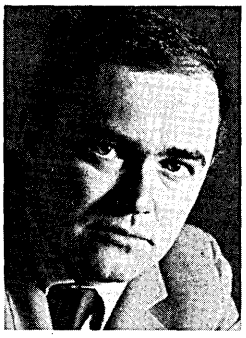
field, is in about tenth place among minimakers in number of machines installed. He sees this changing to fifth place in a year and a half and third place in three years.

There's a slight trend toward the centralization of computer facilities, but it will take awhile to come to fruition. "Not that there isn't a great state of the art in telecommunications," says FENWICKE W. HOLMES, "but there's a lousy state of economics in telecommunications." Holmes, who is dp manager for Del Monte Corp., San Francisco, was recently elected president of the San Francisco chapter of the Assn. for Systems Management.

Asked to distinguish among the ASM, the DPMA (Data Processing Management Assn.), and the ACM (Assn. for Computing Machinery), he says: "I think most of the members of those three societies belong to some common discipline that hasn't been named yet. It isn't exclusively computer; it isn't exclusively office methods. It's management embracing the latest tools, of which the computer is the principal."

Holmes, a retired Marine Corps colonel, has been a member of the 160-member chapter since 1964, the same year he joined Del Monte as a systems analyst. Of Del Monte's efforts to link some of the computers of its several operating divisions and subsidiaries, a few of which are really remote (canneries apparently are established where, over phone lines, seldom is heard a digital word), he says: "As far as telecommunications is concerned, we're still on the barbed wire circuit."

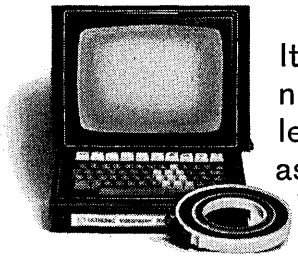
EDSON D. deCASTRO, president of the Data General Corp., still winces slightly when he thinks of the first minicomputer his firm shipped three years ago. "The customer was delighted because we were ahead of schedule," deCastro recalls. But the delight was short-lived when the Nova machine was lost by the airline for several weeks. The customer got the next Nova so he wasn't really put out by the incident. Later, when Data General shipped its first minicomputer to Europe, deCastro recalls that the Data General salesman had his car stolen—with the computer locked up in the trunk. The Nova later was found in a ditch, cleaned up, and delivered in working order.



Edson D. deCastro

Things have settled down since deCastro and a handful of associates operated out of a renovated storefront beauty parlor. They're now housed in a sprawling 220,000-sq.-ft. plant in Southboro, Mass. In number of units shipped—not in dollar volume—Data General has moved into the No. 2 position in the minicomputer business behind Digital Equipment Corp. Many financial analysts predict Data General will log $30,000,000 in sales this year. deCastro hasn't fared badly either: the prospectus shows his initial $12,500 investment is worth well over $10 million. deCastro, a graduate of the Lowell Technological Institute, Lowell, Mass., also attended Harvard Business School, but says he was thrown out "for lousy marks." He always had an interest in mechanical and electronic gadgets and earned his way through college by fixing tv sets and air conditioners. With a smile, he says his Nova computers are so reliable that there isn't much revenue in fixing them. □

Now you can go on-line, even if you have a short memory.



Meet MINICOMM.™ It's a software communications monitor that lets you go on-line with as little as 24K memory. Without adding core.

A product of Programming Methods, the software people from GTE Information Systems, MINICOMM is for DOS users of System 360/370.

MINICOMM is a lot like our famous INTERCOMM™, except it's for smaller systems.

It handles up to 99 CRT applications, written in any language, concurrently with batch processing.

And it's so easy to use that it can be in action on your system in just two days.

MINICOMM is flexible, efficient and very economical. And it's backed by GTE Information Systems, a major supplier of total data communications systems.

If you'd like to go on-line, but think you're too small to afford it, talk to us about MINICOMM.

We just might be able to convince you. Call Paul Berens, at 212-489-7200. Or mail the coupon.

Programming Methods
1301 Avenue of the Americas
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City_____ State_____ Zip_____
Phone No._____

GTE INFORMATION SYSTEMS

Books

Computational Solid State Physics

Frank Herman, Norris W. Dalton, and Thomas R. Koehler, ed.
Plenum Publishing Corp., 227 W. 17th St., New York, N.Y., 1972
450 pp. $26

Today over one-third of all scientific articles published in physics deal with solid state topics. The combination of solid state physics and computation may be termed computational solid state physics. In October of last year an International Symposium on Computational Solid State Physics was held in Germany, and most of the papers presented there are included in this volume. The objectives of the symposium were to explore future experimental and theoretical opportunities in solid state physics, with particular emphasis on problems that lend themselves to computational investigation; and to encourage the establishment of computational solid state physics as a subject of interest in its own right. The six major sections in this volume include: experimental studies of the electronic structure of solids, theoretical studies of the electronic structure of solids, exchange and correlation effects in solids, solid state astrophysics, lattice dynamics, and selected topics in the defect solid state.

Proceedings of the 1972 Spring Joint Computer Conference

AFIPS Press, 210 Summit Ave., Montvale, N.J. 07645
1,217 pp. $30 ($15, AFIPS members)

Contains 127 formal papers presented at 33 technical sessions at the SJCC held May 16-18, 1972, in Atlantic City. Also available on microfiche; will be offered on microfilm later this year.

The Multics System: An Examination of Its Structure

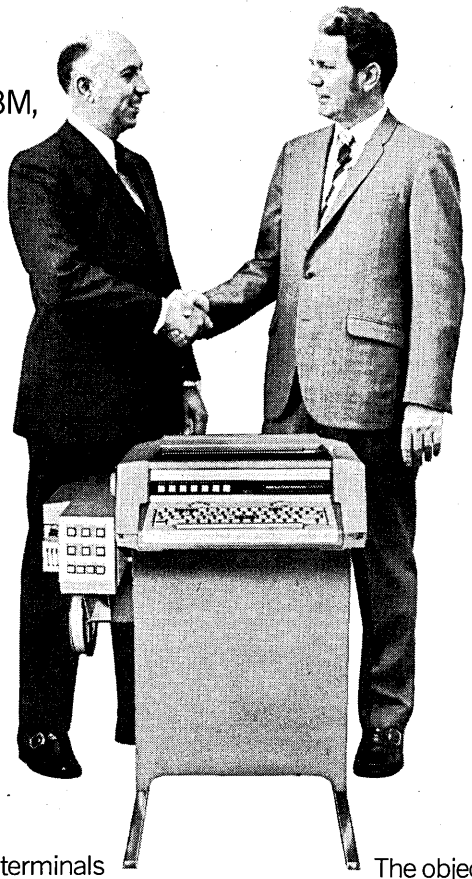
by Elliott I. Organick
The MIT Press, 28 Carleton St., Cambridge, Mass., 1972
392 pp. $13.95

This book provides an overview of the Multics system developed at MIT—a time-shared, general-purpose-utility-like system with third-generation software. The advantage of this system over its predecessors lies in its expanded capacity to manipulate and file information on several levels and to police and control access to data in its various files. This volume is intended for the moderately well-informed computer user familiar with the subject. It is approved by the Computer Systems Research Group of Project MAC, which invited the author to develop over a period of years an explanation of the workings, concepts, and mechanisms of the Multics system.

Tom Watson does it again, with another way to reduce time-sharing costs.

"Tom, who doesn't work for IBM, now brings you an ASR version of our EDT-300 data terminal."

Z.V. Zakarian, president
Western Union
Data Services Company



Our new 30 c.p.s. data terminals in the KSR model are already saving money for our customers.

Now we offer an ASR configuration for greater flexibility.

Both models can cut in half the cost of computer connect time, compared to 10 c.p.s. terminals.

They lease for as little as $125 a month. (You can figure out how much you'll save on your monthly time-sharing bill.)

These high-speed terminals can also reduce your telephone line costs, not to mention freeing up needed lines.

Minor advantage: they are very quiet machines.

The EDT-300 was developed by General Electric working with Data Services Company.

The objective was reliability. (After all, maintenance is our responsibility.)

The objective has been realized. This is the most reliable 30 c.p.s. electronic printer available. But since we have yet to achieve perfection, it's backed by Termicare,™ our centralized diagnostic, maintenance and support service for all our terminals.

There are EDT-300 models for acoustic coupling, Data-Phone* or data access arrangements.

And of course we still offer our range of Model 33 and 35 data terminals.

For information please call Tom Watson, toll free at 800-631-7050 (New Jersey 201-529-1170). Or write Western Union Data Services Company, 16 McKee Drive, Mahwah, New Jersey 07430.

*Registered trademark of AT&T.

western union data services company

Look Ahead

(Continued from page 8)

THE GRAY GIANT'S PARISIAN AFFAIR

The management and administrative part of IBM World Trade, based in New York, is expected to be moved lock, stock, and barrel to the European center in Paris. Reports from Paris suggest that the European part of IBM will be given a separate corporate status; its stock would be issued on the Paris Bourse and possibly on other European stock exchanges.

The purpose is to meet criticism and forestall possible trade restrictions from the European Economic Commission, which has already attacked IBM over its operations in Europe. The main complaint is that IBM's "decision center" vital to the industrial development of the Common Market countries lies outside Europe (see p. 73). First outward manifestation of such changes came with a World Trade management reorganization (June, p. 98).

WHAT'S BEHIND THE RUBLE RATTLING?

The USSR is thinking of wholesale purchase of American-made computers, if the rumors and reports are to be believed. The latest is that Burroughs is dickering to sell 400-500 of its new B 1700s to Russia, but no order has been signed yet. (If it is, the U.S. feds and NATO will have a headache analyzing it for the typical case-by-case approval needed.)

IBM finally received approval for its first 360 sale to Russia, the 360/50 for the Ministry of Chemistry; but it's still trying to figure out why a Russian official told the French press and government and CII delegates there this spring that it may buy 1,000 360s from IBM in a deal that would include a reconditioning plant. IBM's never been contacted, spokesmen swear. Some conjecture that the Russians were trying to whet the French appetite and willingness to make sweeter deals. IBM's announced it has bid on the Aeroflot contract, by the way, and the word is it's a 370--the first such bid.

RUMORS AND RAW RANDOM DATA

Memorex may be the next peripherals manufacturer to lease IBM 360s and 370s with attractive discounts to those who also take Memorex disc drives. Others have launched similar plans (see p. 92). A spokesman, confirming this report at press time, cautioned that the company is in a "very limited test market phase" of such an endeavor...In filing a petition against the gag rule for participants in the Justice Dept. antitrust suit against IBM, Adapso (p. 92) charges that "IBM's role is that of the prosecutor, not the defendant"...Honeywell is expected soon to offer its Multics large time-sharing system commercially. It's now implemented on two 6000 series machines in the company. Honeywell has been using it for software development...Programming problems experienced by the Del Pero Mondon Meat Co. when it installed a Qantel V computer in February '71 involved a third-party programming company, not Qantel, as might have been implied in a Datamation survey of small business computer users (June, p. 47). Qantel, which has installed some 125 systems during the past two years, said its staff later solved the programming problems...CARS, Inc., a Birmingham, Ala., service bureau for 900 car dealers, is replacing 500 tty's with Sycor model 340 smart terminals and has an option for 500 more. Production shipments start in October. Sycor beat out Terminal Communications, Inc., which was touting an on-line system...At a large financial house, the water-cooled 370/165 "sprung a leak, caught pneumonia, and died." IBM had to replace half the cpu.

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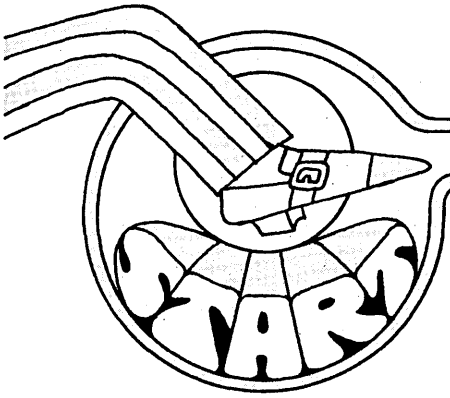

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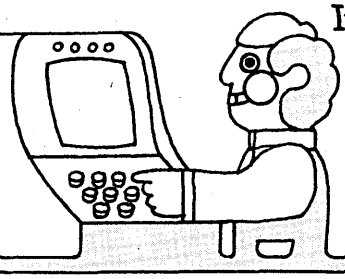

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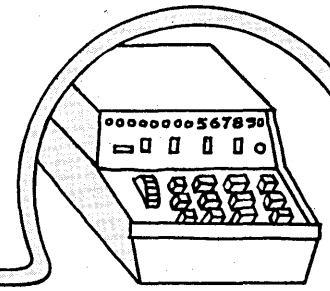

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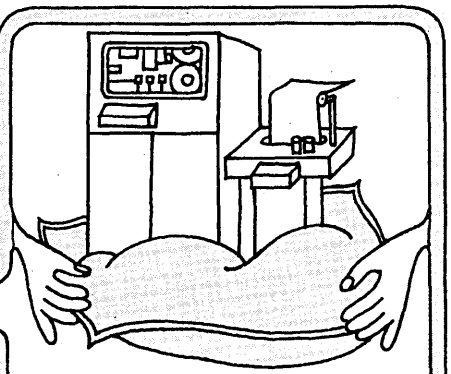

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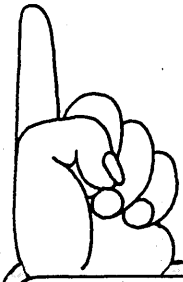

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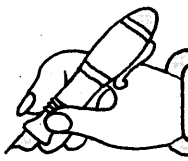

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The Forum

Answer to an Open Letter

Dick Sprague's eloquent and thoughtful letter ("The 2,700—An Open Letter," The Forum, July, p. 134) will properly be applauded by most readers. I, for one, heartily agree that Judge Neville's order was quite outrageous—the cost and inconvenience it imposes on the respondents, and the evident threat to security of properly private corporate data, are objectionable. Dick's assertions about IBM's influence and dominance are overstated, though, as some readily available facts show. These issues are important and poorly understood by most, so it's incumbent on those who like Dick are most experienced in the business (and on DATAMATION, its primary voice) to air them factually and objectively. Three points:

1. It is possible to prosper and grow by competing directly with IBM. Honeywell and Burroughs, according to their published reports, have highly profitable and rapidly growing computer businesses. Univac appears securely profitable. Computer Machinery has had spectacular growth while competing directly against the sacrosanct keypunch. Electronic Data Systems and Automatic Data Processing, competing against SBC and the Custom Contracts activity, have been equally spectacular. There are others. Admittedly you have to be good to compete against IBM and there's at least one failure for every success, but isn't that what capitalism is about? These facts are widely known; I can't comprehend the recent rash of statements that "you can't compete with IBM."

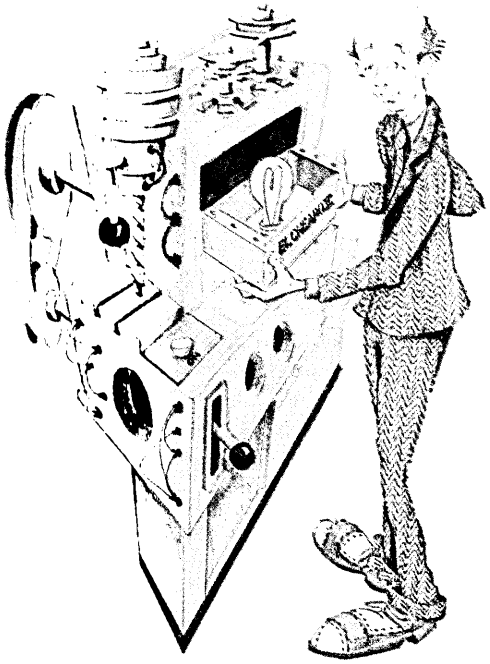
2. IBM's influence is limited. It is indeed strong, strong enough to induce acceptance of a valid standard such as the byte or nine track tape. But the record shows numerous failures by IBM to induce acceptance of standards that were inferior or rejected by the market. To name a few: COMTRAN, PL/I (not a complete failure, of course), total unbundling of support, short term rental contracts, total conversion from DOS to OS. When IBM makes a mistake the market and competition are clearly powerful enough to make them eat it. As long as this is true I'm not too worried.

3. IBM's dominance is slowly declining. This can't be proved on the basis of published facts because IBM withholds the key data about their shipments, but all the independent data sources agree that IBM has slowly been losing share of cumulative value of general-purpose systems installed, by about 1% per year from a peak in 1964. In terms of system concepts there's also a pretty good argument that the lead has been passing to Burroughs (MCP), Honeywell (GECOS-III and MULTICS, courtesy GE) and Control Data (STAR).

I don't mean to conclude that IBM has no influence nor any degree of dominance, and it may be that some action against IBM is in the public interest. But for the sake of sanity let's debate the issue unemotionally and in full consideration of the available facts.

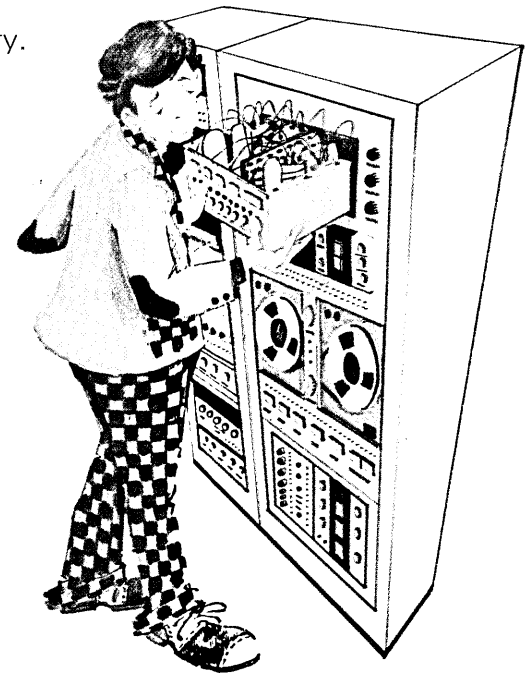
—Frederic G. Withington

What the industry taught us about cheap OEM minicomputers.



Stripped for action.

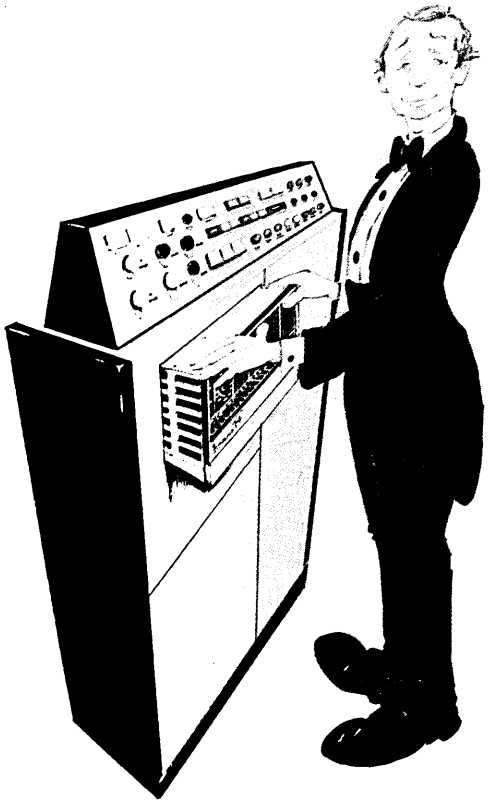
Here's a familiar approach. El Cheapo II. In reality, it's the good old Mod X stripped of all the stuff that made the old Mod X good. Instructions. Memory. I/O facilities. Everything. But it's cheap. It's really cheap. Only the hum remains.



Dressed to kill.

Here's the same machine in disguise. Now it's hiding behind all the things you have to hang on it to make it work. Like a power supply and a memory and some sort of I/O kluge so your system can talk to it.

Also hidden, of course, is the cost. And it isn't so cheap any more.



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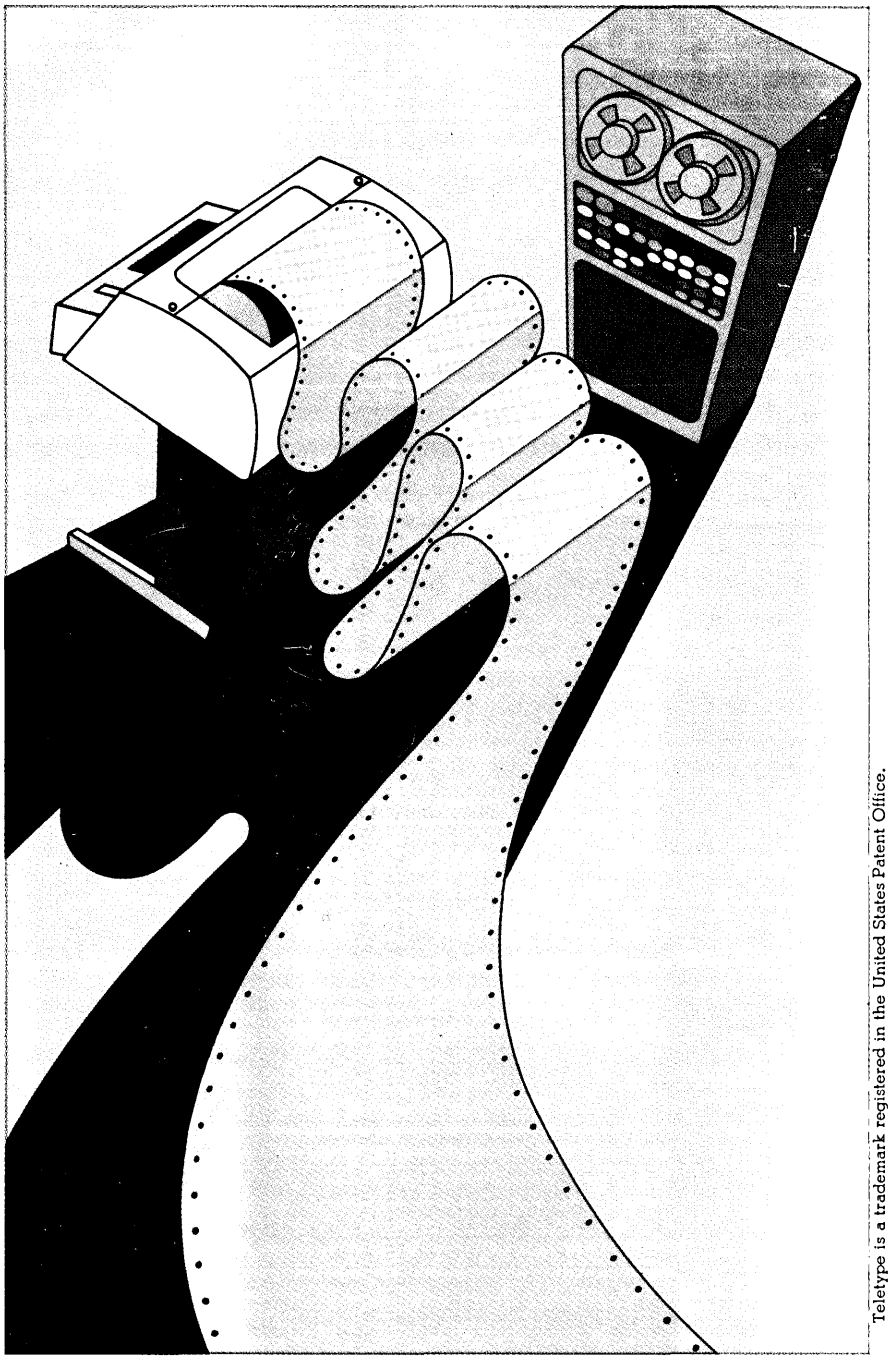

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