DATAMATION® 76
May

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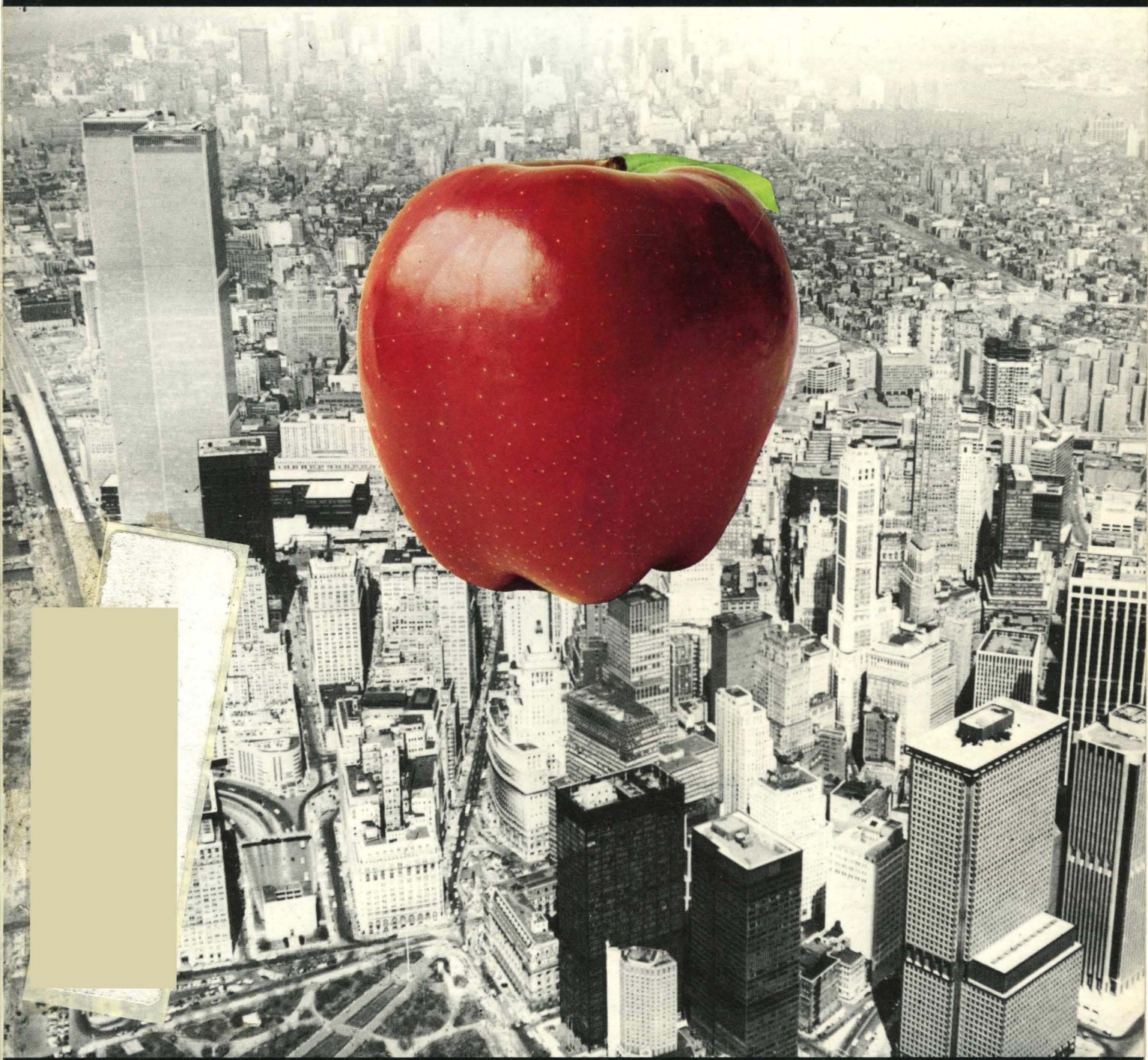
In The Big Apple
June 7-10



Also: decentralizing (p. 79), second half of the computer age, and communications processor survey (p. 151) . . .

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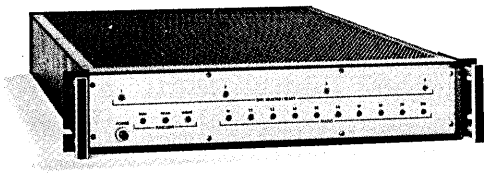

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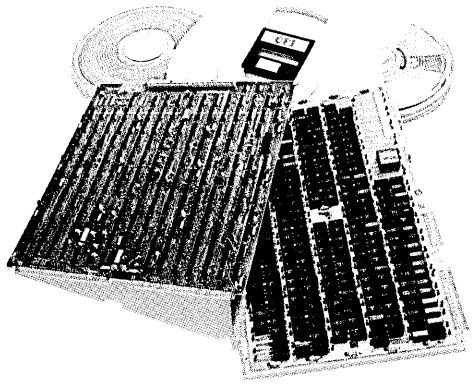

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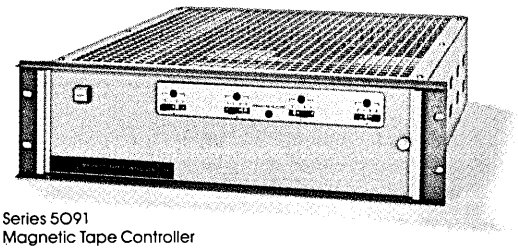

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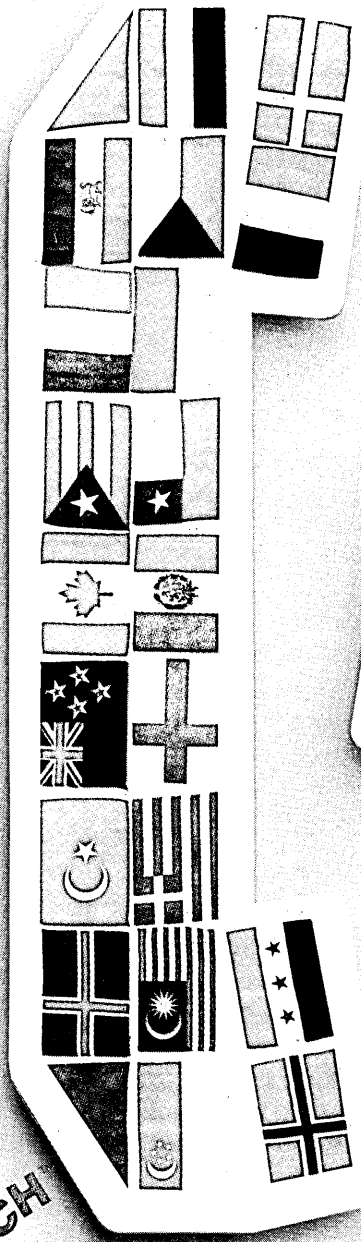

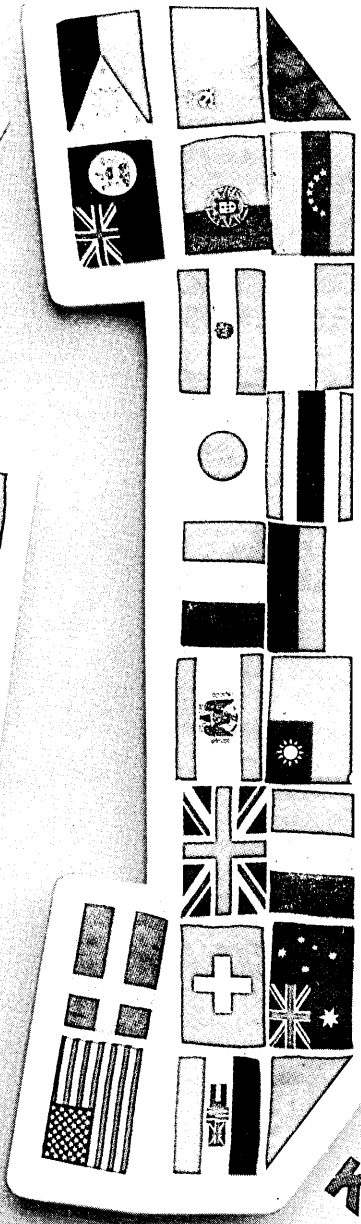

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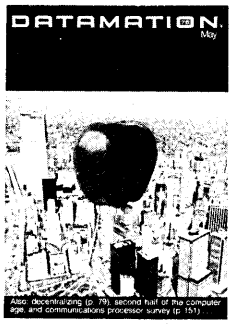
DATAMATION® 76

VOLUME 22 NUMBER 5 This issue 128,000 copies MAY 1976

FEATURES

National Computer Conference
A preview of the fourth annual NCC in New York June 7-10. It plays before an anticipated record turnout of 35,000 to 45,000 persons. Its exhibit of 300 companies in 945 booths is almost as big as in the late '60s. There's an historical note this Bicentennial summer: it's the 25th anniversary of joint computer conferences.



NEWS IN PERSPECTIVE

DEPARTMENTS

ABOUT THE COVER
The Big Apple, shiny and bright, symbolizes New York City and its welcome to this year's National Computer Conference. Our cover is by Barbara Benson.

DATAMATION.

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letters

One paradox resolved

The July 1975 issue of DATAMATION carried an article by W. David Gardner, "Paradoxes Emerge as the Trial Starts" (p. 70). In it, Mr. Gardner stated, "Nicholas deB. Katzenbach . . . was U.S. attorney general when the Justice Dept. instituted the antitrust investigation against IBM."

Mr. Gardner's statement could be taken to imply that Mr. Katzenbach was in some way involved with the suit when he served in the Justice Dept. We could not respond at the time of publication because IBM and the Justice Dept. were prohibited by court order from commenting on the case or its issues. That order has since been lifted, and I would appreciate your correcting DATAMATION's files about this matter.

Mr. Katzenbach was attorney general in 1965 and 1966. He then served as undersecretary of state from 1966 to 1969. The antitrust suit against IBM was filed on Jan. 17, 1969, the last business day of the Johnson Administration, by the then attorney general, Ramsey Clark, and by assistant attorney general Edwin M. Zimmerman, who had been appointed to that office after Mr. Katzenbach joined the State Dept. As undersecretary of state, Mr. Katzenbach had no involvement with Dept. of Justice cases.

Furthermore, as soon as Mr. Katzenbach joined IBM, he asked the Dept. of Justice to doublecheck any possible connection he might have had with the IBM suit as attorney general, one which he conceivably could have overlooked. The answer, in a letter of June 22, 1969, from Mr. Zimmerman, was that there was no record or recollection of any involvement by Mr. Katzenbach in any way with the suit. This information was read into the record in a hearing on June 11, 1970, before Judge Philip Neville of the U.S. District Court for the District of Minnesota, Third Division.

J. R. YOUNG
Director of Communications
International Business
Machines Corporation
Armonk, New York

Bicentennial editorial

Your editorial ("Promises to Keep," March, p. 47) is another example of everything is wrong with America, but the rest of the world does things right. Your example of the terraced rice paddies in the Orient that stay fertile for a thousand years, while in this country, we created a dust bowl in one generation is ridiculous. If you have been reading the newspapers lately, you would know our dust bowl has been feeding most of the world including the people of the fertile rice paddies.

This idealistic thinking of yours is responsible for past disappointing results since our promises and goals do not take into account the reality of people.

J. V. LEANZA
Eastchester, New York

Congratulations! An excellent editorial in your March 1976 issue.

Fed enough "progress" and given continued misdirection, we shall "self destruct" before the tricentennial!!

ROY HEARSUM
Senecaville, Ohio

Electronic mail box

I would like to suggest that the Matsushita tv-printer (Hardware, March, p. 194) is for the role of the electronic mail box. The ARPA network and other similar systems allow one to send information from one terminal to another. CBS News, March 25, says the price of mail is projected to be 23 cents per letter. Perhaps it is time for a hard-copy of selected information to be routed to your local terminal.

E. ROBERT ASHWORTH
Assistant Professor
Southern Illinois University
Carbondale, Illinois

Cash flow analysis

It should be noted that the discounted cash flow method of analysis, which was used by Ted Szatrowski in his excellent article on the acquisition of equipment ("Rent, Lease, or Buy?" Feb., p. 59), is also applicable and should be employed when user-owned equipment is being released.

Quite often the anxious user will sell at any price when leasing of his old equipment would be much more cost effective. The twin factors of today's tight money, which makes it easier to rent at a good price rather than sell at a good price, and the retaining of investment tax credits, which would have to be refunded to the government on sale of the equipment, will usually combine to produce a much greater rental present value than the price that could be obtained by selling.

Of course, rental will present more administrative problems than selling, but these can usually be minimized by retaining the services of a good broker.

THOMAS P. TIERNEY
Framingham, Massachusetts

Ancient hex solution

Mr. Steinberg (March, p. 8) wants a hexadecimal calculator. May I suggest a Chinese abacus. On each of its columns, there are two rings on the top half and five rings on the bottom half, so that 0 to 15 are easily represented. It is under $5, portable, and needs no battery.

F. F. LIU
California State College
San Bernardino, California

Privacy and anonymity

The distinction between privacy and anonymity (Forum, Feb., p. 168) supplies a sorely needed perspective on what has been a confusing subject. The author is to be commended.

CLEMMER G. WAIT
St. Paul, Minnesota

Encryption controversy

I find myself in sharp disagreement with Professor Hellman's position as described in the Security article by Edward K. Yasaki, "Encryption Algorithm: Key is the Thing" (March, p. 164).

Inherent in the discussion of the key size is the assumption that the only way to cryptanalyze the system is to try the many variations of the key. The assumption is not a cryptographically sound one but let us, for the moment, assume it to be correct. There are 2^{56} (approximately 72×10^{15}) permutations. I have implemented the algorithm using RPG II on an IBM System/3, Model 10. Execution time is approximately 25 seconds for 64 bits. Admittedly, this is slow. Even if we were to assume that the same can be accomplished, possibly via hardware, in one millisecond, it would take approximately 2.2×10^6 years, a very long time, to try all of the possibilities. This does not take into account the time necessary to analyze the output nor are we even sure that our output unit can keep up with this pace.

The opinion was implied that the National Security Agency prefers the present key size because it can break the existing system, but is at a loss with larger key sizes. Quite frankly, I suspect the NSA can crack the system regardless of the key size. At least, I hope so. Our national security depends in large measure on their efficacy and they have been known to break far more difficult cryptographic systems.

This is not to say that the National Bureau of Standards, more specifically, Dr. Ruth M. Davis, is free of fault. The initial proposal in the March 17 Federal Register makes it obvious that the algorithm was first submitted and the "standard" written to meet the algorithm. I cannot blame IBM for gearing the algorithm toward their 8-bit bytes and 32-bit words and not taking into account non-IBM equipment, but NBS should have considered this and spelled out these variations in the proposal. "Standard" execution

letters

times should have been given as well as definition of what constitutes a good system so that alternate, and possibly better, proposals could be considered. We still do not have a true standard, just an algorithm which appears, for the moment, to meet our immediate goals.

One minor point: The Kahn article referred to is in the December 1975 issue of *Playboy*, and not the January 1976 as stated.

ROBERT DECKER
Computerized Industrial Security Company
Woodstown, New Jersey

Prof. Hellman replies: It is not inherent in our statements that trying all the keys is the only way to break a cryptosystem. Rather, except in some unwieldy systems such as the one time pad, exhaustive search is always a possible attack, and to be secure, a system must therefore have a large enough key to prevent such a brute force approach. Rather surprisingly, the proposed standard does not have such a key.

As to the speed estimates stated by Mr. Decker, the algorithm is very slow in software and NBS' MSI TTL hardware version takes only 13 usec to do one 64 bit encryption. There is little point in decreasing this time since I/O takes 40 usec. Our cost and speed estimates are based on a special purpose LSI search chip, different from the device used for normal encryption. It would try a sequence of keys until one was found which encrypted a known plaintext block into the corresponding ciphertext block, or until the search was completed. The extremely low I/O volume allows the search chip to sacrifice I/O speed for on-chip computation speed, and with CMOS/SOS technology, a search time of less than 1 usec per key is possible. A machine with a million such chips can exhaustively search the 2^{56} keys in one day. We are in the process of preparing a detailed position paper which justifies these figures.

There is no guarantee that NSA cannot break a 128 bit key version of the standard, but there is a guarantee that it and its foreign equivalents can break the 56 bit key version currently proposed, and that the decreasing cost of computation will allow almost any reasonable size organization to break it in 5 or 10 years time.

We are in agreement with Mr. Decker's desire to see a definition by NBS of the security level afforded by the proposed standard. In addition, public documentation of the certification process is needed.

Instant classic

Without doubt, Ray Sanders' and Vinton Cerf's article, "Compatability or Chaos in Communications?" (March, p. 50), will become one of the classics in this field because it is so lucid and well balanced. Thank you for making such a fine contribution to a technical area that has revealed its chaos through frequently incomprehensible writing.

PAUL A. STRASSMANN
Director
Administration and Information Systems
Xerox Corporation
Stamford, Connecticut

Budget anecdote

In response to the February Editor's Readout (p. 51), I offer this anecdote about budgeting, somewhat disguised to avoid offending those still living.

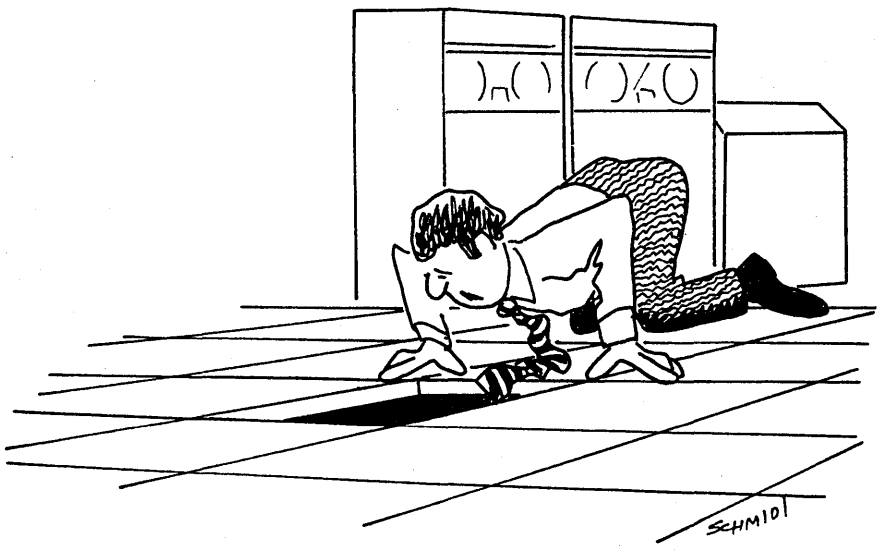
It was a typical year for the budgeters in the dp dept.: we were growing too fast and wanted too much money to perform our costly functions. Why not, an aggressive member of the finance committee suggested, reduce the company's dp costs by getting rid of some of the department's computer equipment? If they didn't have the gear, they couldn't do the work, could they? (Of course, he didn't bother to tell us how to decide *whose* data processing wouldn't be done, but that was just a trivial, political detail that could be worked out later.)

I counterpunched by saying that not all of the company's data processing was done by the dp dept., for example, the massaging of all the budget requests by the finance committee. Indeed, I continued, the bulk—in *both* volume and dollar cost—of the company's data processing was done outside the dp dept. I had studied the activities of employees in two representative departments to ascertain the "data processing content" of each task. I used the "average data processing content" so determined to estimate the total amount of data processing done by the 13,000 employees of the company; that number together with an estimate of the average wage *plus* the budget of the dp dept. gave me an estimate—crude, it is true—of the *total* cost of data processing in my company.

Will anyone be too surprised to learn that the total cost of data processing in that company was more than 14 times the sum allocated for operating the dp dept.? Well, my finance committee was not only surprised, it was outraged. The latter behavior may also have been a consequence of the conclusion I reached from the results of my survey: perhaps, I suggested, if we *increased* our investment in computing equipment (that investment was only 2½% of the total cost of dp as I conceived it), we might reduce the total cost to the company. Suppose, I went on, instead of reducing our rental of hardware by 10% (which would reduce the company's dp expenses by ¼%) we increased them by 10%, as a result of which we might reduce the *total* cost of data processing by 10%! That investment would yield a return almost 30 times greater than had been proposed in the finance committee, I pleaded in conclusion!

(The sums of money involved went something like this: the dp dept. budget was just over $5.25 million, of which hardware rental was about 40%, just over $2 million. The total cost of data processing I estimated at $73 million; in other words, the company was spending $68 million annually that it declined to call "data-processing expense"! The finance committee proposed to decrease the cost of data processing by $20,000 per month, from $73 million to $72,760,000 annually, by reducing hardware rental by $240,000 that year. My proposal

(Continued on page 227)



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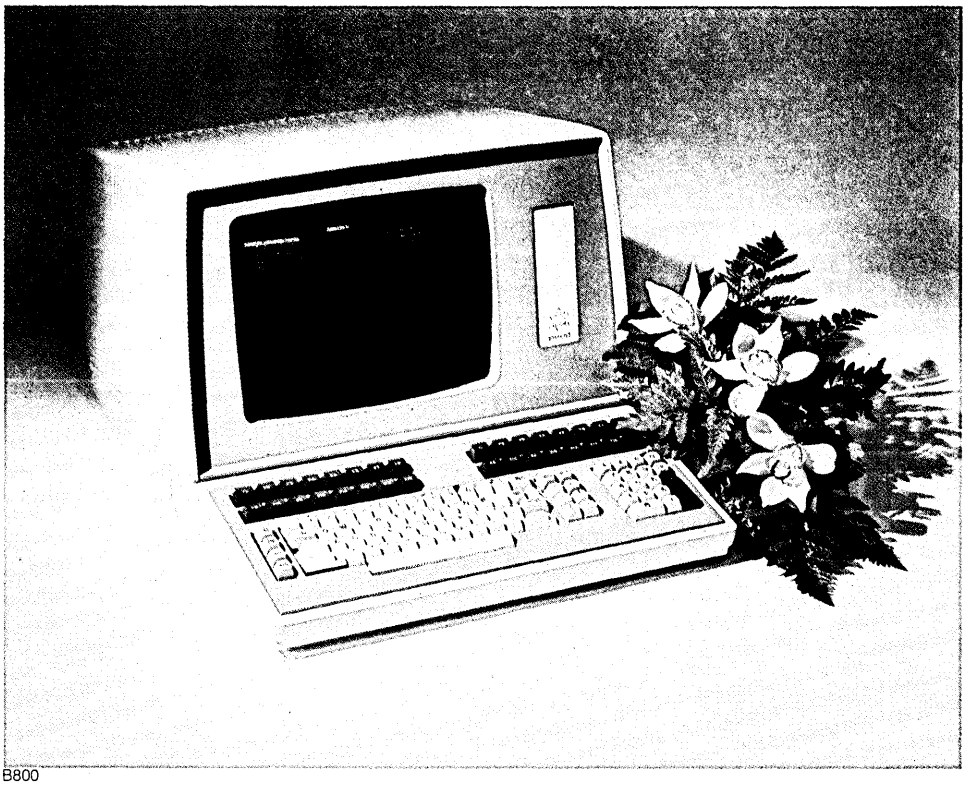

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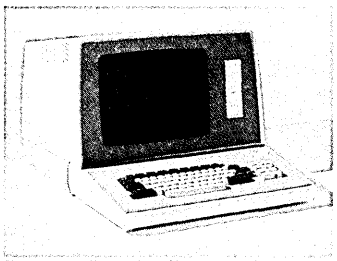

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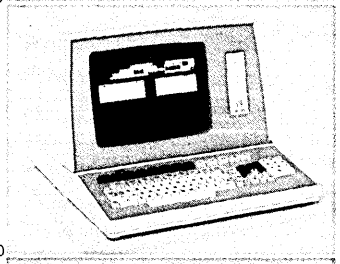

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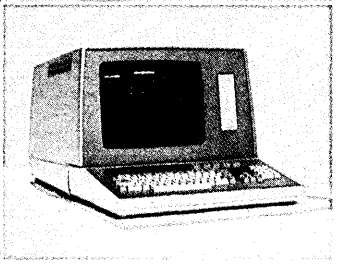

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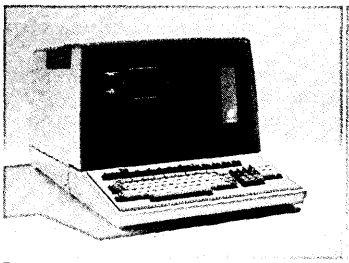

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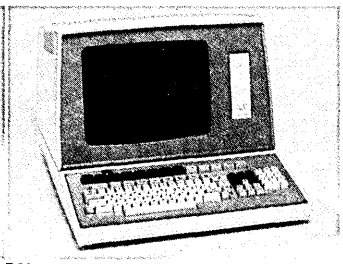

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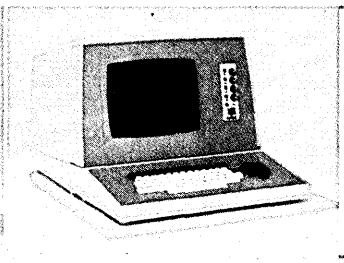

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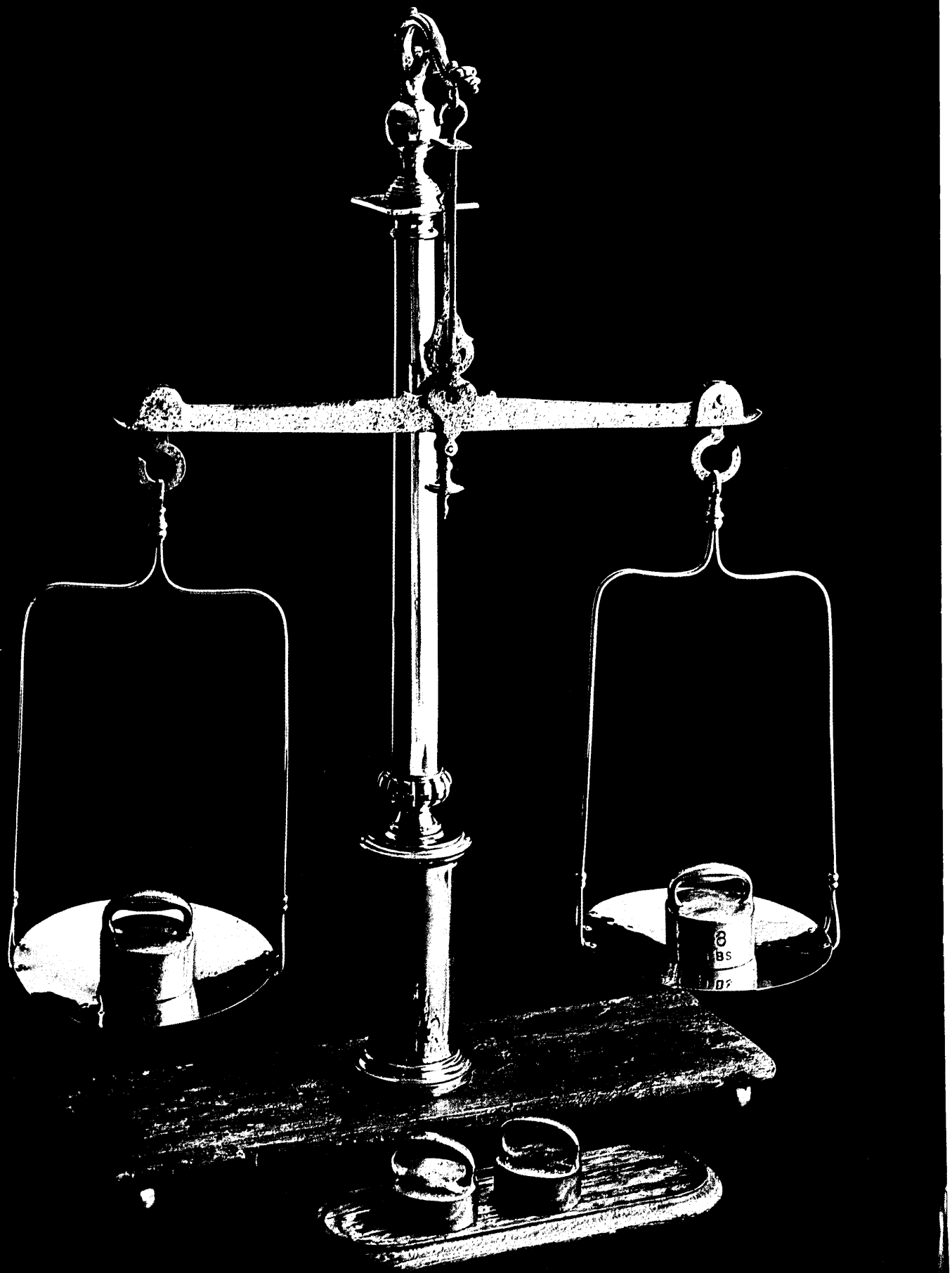

The SEL Mini keeps its balance, to help you keep yours.

Any systems designer knows that if you don't have a balanced system going in, the end result can be intolerable.

So at Systems, the SEL 32 Mini was designed to be a totally balanced system, in every respect.

Let's see how the SEL 32 Hardware balances with the SEL 32 Software.

On the hardware side of the scale, we'd like to say a few brief words about obsolescence, throughput, and I/O.

The SEL 32 Mini's powerful CPU architecture is proof against obsolescence. Want to upgrade? Just change a board or two.

Throughput? The SEL Bus is capable of transferring data and commands at a continuous throughput of 26 megabytes per second. Based on a 150 nanosecond clock, this has established the industry standard for bus speed.

Lastly, I/O. The SEL 32 is the only 32-bit mini that employs micro-programmable, independent processor-based I/O, so it doesn't have to steal cycles.

That's all quite nice, but so far, it's just iron. Let's take a look at the other side of the scale: software.

You understand the impact of unreliable software. The SEL 32 software has seen over five years of enhancement and action, so you can be sure it's bug-free, seasoned, and headache-proof.

But there's more to software than a super track record.

The nucleus of our software is provided by a powerful, disc-based Real Time Monitor ... a true multi-programming operating system capable of handling up to 255 concurrently executing tasks.

One of those tasks, the new SEL Terminal Support Subsystem, allows up to 16 CRT operators to develop programs, debug, or activate tasks... concurrently. Result? Increased flexibility.

Another SEL software bonus is our highly optimizing FORTRAN IV Compiler, which reduces the amount of memory and execution time required for a program. In addition to its full ANSI-standard capabilities, several extensions are available which enhance its real-time applications even further.

There's more, of course, such as RJE terminal support, graphics software, a BASIC compiler, and additional operating systems.

Consider, then, this combination: Flexible, reliable software, based on our powerful RTM; and dynamic hardware, with Independent I/O, record-shattering bus speed, and totally upgradeable CPU, which absolutely defies obsolescence.

This is how the SEL 32 keeps its balance... to help you keep yours. (And for as little as $18,000, it's been known to help balance some corporate budgets, too.)

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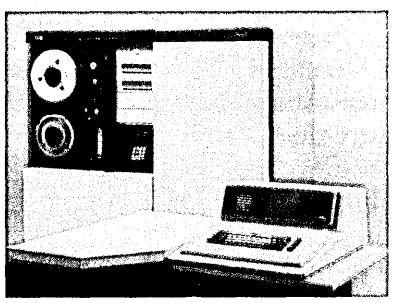
Now you can put key-to-disk flexibility in remote locations, for decentralized data entry *at reasonable cost.*

System 1200 KDS offers the ultimate in price/performance for the multiple-site user. Its shared processor efficiencies allow you to decentralize data entry without dislocating your budget.

The 1200 KDS includes the acclaimed MDS 2491 keystation with tutorial CRT, adjustable keyboard, keystroke job set-up and 125-character page layout. Optional printing and concurrent communications add even more value.

System 1200 handles from 4 to 16 keystations. Up to 256 record formats can be used, with eight chained subformats. All supervisory functions are handled through a designated keystation, and various statistics on batch status, operators or shift activity may be extracted for operator evaluation and work load dispersal.



Our 1200 KDS does more than improve entry speed and accuracy. *User Programmability* lets you format for *optimum CPU efficiency,* too. You get a lot more work through your data center. And your activity statistics will prove it.

Ask your local MDS representative to show you how the low-cost MDS System 1200 makes remote entry practical. Call (201) 540-9080 or write Mohawk Data Sciences Corporation, 1599 Littleton Road, Parsippany, NJ 07054. We'll get back to you overnight.

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people

New Twists at The Big D

"How would you like to be able to add to your resume that you were the world's champion programmer of 1977?" asks Dr. Portia Isaacson, who'll be conference chairman of next year's

DR. PORTIA ISAACSON
A big budget for public relations

National Computer Conference in Dallas. A programming contest is among the innovations the Univ. of Texas at Dallas professor hopes to bring to the annual conference June 13-16. That's when it moves to the southwestern U.S. for the first time in the five years that NCC's will have been held as successors to the traditional twice-a-year Fall and Spring Joint Computer Conferences.

Another new twist will be a Personal Computing Fair—an exhibition of the things computer hobbyists are doing with home-grown microprocessor-based computers. Also on the list of changes is a plan to solicit more involvement from the Data Processing Management Assn. (DPMA), newest member of AFIPS, which sponsors the NCC. And the number of sessions—which may rise to 127 this year in New York (see page 56)—will be trimmed to around 100.

"We're deciding now what kind of program topics we want and then we're going out to find them in a 'specialized' call for papers."

Her 12-person steering committee, which was established three months ahead of the usual NCC schedule, already had held two meetings by the end of March, 15 months before the NCC opens in the Dallas convention center—a huge midtown complex with 70 meeting rooms and a 200,000 sq. ft. exhibit hall. And the budget was put together even earlier. Says NCC committee chairman Jeffrey D. Stein, "Dr. Isaacson has great ideas and most important, she's putting them to work. She's a real computer nut."

Dr. Isaacson's impressive credentials put her in a position to accept graciously the "computer nut" label, which she does. She has an M.S. degree in computer science from North Texas State Univ., a B.S. in physics and mathematics from East Central Univ., and her M.A.S. and Ph.D., both in computer science, are from Southern Methodist Univ. You name it in computer hardware and software and she's done it—with Bell Helicopter, Computer Usage Co., Recognition Equipment and Xerox Corp. She's now assistant professor of mathematical sciences at Univ. of Texas at Dallas, conducting computer science courses for persons from many of the Dallas science-related industries. She's the ACM chapter chairman in Dallas and her hobby—which she shares with her husband David Wilson—is computing.

The 600 sq. ft. basement in their home houses three computers—two microprocessor-based Altair and Sphere machines and "my husband's own home brew design." Their present fun is in interfacing the cpu's with a keyboard television set and a teletype machine; eventually all three cpu's will be lashed into a sort of bargain-in-the-basement network.

"We're twiddling with hardware, but there are many personal computer users who are developing outstanding applications," says Dr. Isaacson. She hopes these will be the kind of applications that will be seen when the 1977 NCC Personal Computer Fair unfolds. Although plans aren't completely defined, the NCC programming contest probably will become the finale for a series of three types of regionally-conducted programming contests: college level, high school level and "open."

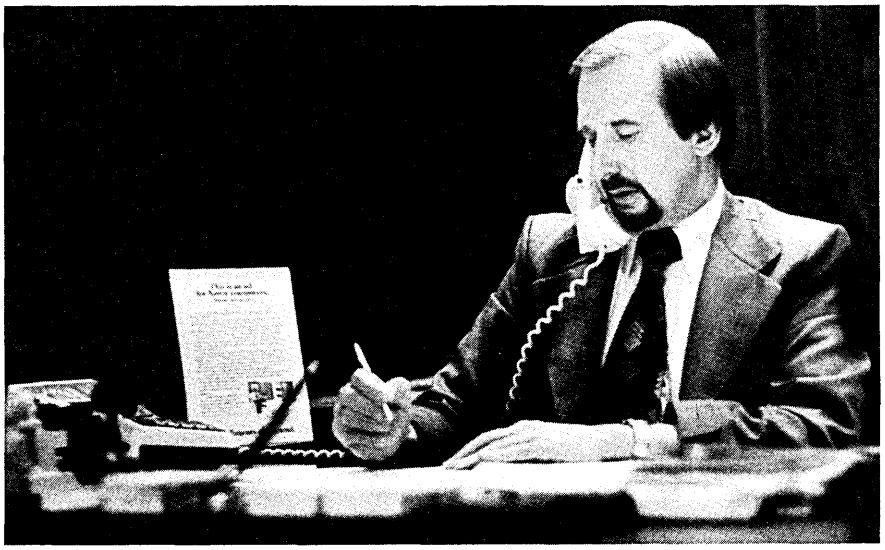
The main 1977 NCC program will address technology and computer applications; management applications; and individuals in computing, the last two classes hopefully involving the management people represented in AFIPS by DPMA. The program role is in the hands of SMU computer sciences professor Bob Korfhage, technical program chairman.

Meantime, Dr. Isaacson these days concerns herself with attendance. She's poring over previous NCC attendance records, an analysis of the computer population in Texas where probably 60% of the attendance will originate, and all sorts of ideas to attract a crowd to the first such conference to be held in the southwestern U.S. "It's not a case of simply telling them the NCC will be held this year, as you could do in New York or Anaheim. We've got to tell them what an NCC is." Not surprisingly, the public relations budget is higher than ever before. But it's affordable. The rent for the Big D's convention center is about one seventh of the $100,000 NCC is paying this June for New York's Coliseum and hotel facilities.

"Things Were That Bad"

When Samuel V. Edens was called in as a management consultant back in 1971 to help then-ailing Telefile Computer Products Inc., his advice was to close down the company.

"Things were that bad," says Edens today with a smile. He can afford to smile about it. The company didn't



SAMUEL V. EDENS From a West Virginia farm.

take his advice. Instead it hired him to take over as president and turn the company around. He did to the point where Telefile expects to do some $7.3 million in business this year. It has grown from 10 employees in the dark days (and they're still there) to some 75 today.

And the company has changed too. In '71 its basic products were IBM compatible front ends. Edens doesn't believe "in taking on number one." Instead he positioned the company firmly in the Xerox marketplace with Xerox compatible disc systems, main memory and peripherals, and total computer systems.

When Xerox exited the general purprose computer business, Telefile intensified marketing efforts with Xerox users. "We wanted to buy the whole operation but they wouldn't talk to us seriously," said Edens. He then set about attempting to corner Xerox customer base on his own. They picked up a few but most customers "are waiting to see what Honeywell's going to do," he said in April. He felt the waiting would be over this month when Exchange, the Xerox computer users group was to meet in Phoenix (April, p. 102). Edens and Telefile planned to be present at the meeting in full force.

Telefile even puts out a newsletter which it recently renamed Tele-Flyer as the result of a naming contest in which two entrants, Stan Brown, of Wyoming and Bill Crow, Univ. of Vermont, submitted the winning name.

And the Irvine, Calif., company continues to promise "a longer and fuller life" to Xerox computers. Its most recent development in this area was a memory map for the Sigma 5 which permits users to run CP-V and CP-R operating software for the first time.

But Telefile isn't restricting itself to the Xerox marketplace. Edens said the firm is looking to position itself in the marketplaces "of number two and number three" as well.

Telefile started up in Newton, Mass. in 1968. In 1970 it purchased Interactive Data Systems of Irvine which became the tail wagging the dog and now the dog is no more. The rights to the name Telefile were purchased from Bunker-Ramo which once produced a computer by that name. Edens said a few are still in existence and operating.

Edens is proud of his company and his employees. The ten who were with him in the dark days sacrificed paychecks and "dug into their piggy banks" to help raise the money to keep the firm afloat.

He likes to tell too of a move from cramped quarters to their present 12,000 square foot facility (soon to be doubled). "We couldn't afford to paint and clean the place up so we had an old-fashioned paint party one weekend."

To Edens the paint party was reminiscent of his boyhood spent on a West Virginia farm. He even has a tintype on his office wall of his grandfather feeding chickens in the farmyard "just to remind me of my humble origins."

Enthusiasm Tempered...

Jim Case brings a boyish enthusiasm to just about everything he does. It's an enthusiasm tempered with an aura of knowledge that is definitely mansized.

When he talks on subjects like software taxation and computers and privacy—as he's done a lot in recent years in trade association meetings and before state and federal legislators on behalf of both Wema and the Association

JIM CASE
Didn't want pharmacy

of Data Processing Service Organizations (ADAPSO)—he comes off almost like a lawyer.

He's not. He got into the data processing business as a programmer because he wanted to escape the family pharmacy business. Now he's formed his second computer company, Case-Wachter Associates, whose activities range from conversions, upgrades, software products through seminars in which they will represent anyone's package and do training and installation.

One of the company's first major projects, one still on-going, is a conversion for the city of Burbank, Calif., from an IBM 1440 to a 370. They will convert from any machine to IBM, says Case.

A recent coup was the naming of the fledgling firm as U.S. representative for Holofile Industries Ltd., a Canadian firm which has acquired the holographic research activities and technology of TRW Inc.

Case, 44, formed Case-Wachter after seven years as president of Dylakor Computer systems. His associate in the new company, Gail Wachter, also was at Dylakor where her specialty was seminars. She will be the moving force behind Case-Wachter's seminar activity.

Case helped form Dylakor in 1969. He had been working for Southern California Water Co. as data processing manager. There were outside services he felt that company could offer but regulatory problems prevented this.

Earlier, Case had worked as a programmer at Menasco Mfg. Co. for Bill Newcomer, present president of Dylakor, who was in the process of setting up Dylakor just as Case was becoming frustrated at the water company. Newcomer had developed an inexpensive utility package at Menasco which Case believed in so he joined in the effort to get Dylakor going.

They set out to become "the McDonald's" of the software business with first Dyl 250 (based on the Menasco utility package) and later Dyl 260. They become the first mail order software business. The company philosophy: "software should be cheap."

Dyl 250 and 260 are designed for use with IBM computers. The only non-IBM installation is at Disney studios which has RCA nee Univac machines. Disney itself did the interfacing. Now Case-Wachter is offering to interface the Dyl packages to the rest of the IBM universe.

Case is enthusiastic. And when he's not enthusing about business he does the same with his major hobbies, golf and photography.

In New Posts

FRANKLIN P. WEIGOLD was appointed general manager of the TRW Financial Systems Division . . . ANNA TIPTON was elected corporate vice president of Advanced Computer Techniques Corp. . . . CARROLL A. PEDIGO has been appointed vice president of Scientific Software Corp. He is president of SSC's Business Services Division. ❋

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LOOK AHEAD

GET YOUR FREE MEMORY HERE

Since February, IBM has been offering 158 and 168 users the chance to try out up to two megabytes of additional memory free for one week. The idea is to let users see how well the added storage operates on their own configurations. A crew comes in over the weekend and installs it (500K-1 megabyte per cpu) and takes it out the following weekend--without fail. (Users can't keep that same memory even if they decide to buy.)

It's a handy freebie for the users. In keeping with IBM's general strategy, it might also be meant to help stave off the pack of independent memory makers who have been attacking with cheaper memories. One user quipped, "Anyone who buys memory from IBM ought to be scrutinized for insanity."

AN IMS-LIKE SOFTWARE FROM DEC?

Digital Equipment Corp. should be making a big move into the commercial data processing arena soon when it unveils a new data base management system for the PDP-11 family of minicomputers. The new system---internally called DBMS-11--is based on the highly successful IDMS system marketed by the Cullinane Corp. The software meets CODASYL standards and is compatible with IBM's IMS, so mini maker DEC will be bearding the lion of Armonk in his den.

DEC is said to be preparing the data base system to sell primarily with its PDP-11/70 in configurations costing over $250,000. While the 11/70 hardware and IDMS are proven products in the market, there could be a stumbling block for DEC: the firm's engineering-oriented marketing force may have trouble selling the product at dp installations. We hear, for instance, that DEC's highly-touted word processing DataSystem-310W has thus far laid a sales egg in the commercial environment.

CRAY GETS $9 MILLION WITH NO SALE

Seymour Cray received his $9 million from the first public offering of Cray stock, despite a failure to deliver a single machine. A 500,000 64-bit word machine, sent to Los Alamos Scientific Laboratory at Los Alamos, N. M., for a six-month inspection, won't give the company any funding unless the contract is updated. Work on a second machine is expected to be completed by the end of 1976, but there still is no word on that machine's destination as Cray Research, Inc. types keep quiet until June 17 when the 90-day period of SEC-ordered non-disclosure ends.

During that time, Los Alamos has the option of keeping or returning the machine, but the best guess is that it will remain there and that its memory will be doubled to 1,000,000 words. It offers both vector (processing of an operation on a set of numbers with a single instruction) and scalar (a separate instruction for each number in such a set) processing for which there's a market of about 80 installations, chiefly government data processing services. Other supercomputer builders: Control Data with its 7600 and STAR and Texas Instruments' ACS computer.

CARLSON TO LEAVE JUSTICE DEPT. CASE AGAINST IBM

There is quiet speculation in Washington that Raymond Carlson, the lead attorney in the government's antitrust case against IBM, will be finishing his assignment before long. Carlson is scheduled to retire from the Justice Dept. in November 1977, and he is said to have enough vacation and leave time accumulated to retire now. If Carlson leaves the New York scene, some feel the government's effort--which has been lackluster at best so far--would deteriorate and there is already some wishful thinking on the part of some that the Justice Dept.'s Joseph Widmar will return to the case. Widmar, an ex-IBMer, worked on the case on and off for several years, returning recently to a Justice Dept. post in Washington. Alan McAdams, a government economic consultant, plays an increasingly important role in running the case.

As the case unravels, at any rate, the feeling grows that the government's poorly paid bureaucrats are no match for IBM's crackerjack legal armada. When one of IBM's top attorneys on the case, F. A. O. Schwarz, left the case, moving from a lucrative private practice to a government post as counsel on Sen. Frank Church's committee that is investigating the CIA, the good natured joking around the New York courthouse had it that Schwarz had moved on to "browner pastures."

On the subject of the government's case against IBM, letters to and from ex-president Richard Nixon regarding the case are listed as "wholly privileged" documents in the Justice Dept. files. Copies of the letters have been turned over to IBM. The letters are understood to have raised no eyebrows by those who have seen them.

LOOK AHEAD

JAPAN: SLOW PROGRESS IN THE U.S.

Efforts by Japanese mainframe manufacturers to get their computers marketed in the U.S. are making slow progress. But that may be less an indication of any problems with their gear and more a reflection of the care they're taking in forming any marketing alliances. A spokesman for one outfit that took a close look at an offering says a claimed IBM compatibility was lacking, and the price was too high.

Service companies and leasing firms, we hear, are being sounded out for their interest in handling sales. But Jesse Aweida, chairman of Storage Technology Corp., a plug-compatible peripherals maker, had a talk with one of the Japanese companies. He adds that they never entered into any negotiations.

National Semiconductor, which makes add-on memories being marketed by Itel Corp., has a mainframe development effort underway. We hear that's a year away from becoming a commitment, but if they go ahead with it at that time it presumably would also be marketed by Itel. Meanwhile the company that brought you Amdahl Corp., the Japanese Fujitsu Ltd., is reported to have one of its mainframes, an M-160, installed in Sunnyvale, Calif. It's a smaller model than the M-190 that some unkindly label as a Chinese copy of the Amdahl 470.

CDC'S IBM REPLACEMENT: NO DEAL YET

Control Data's first large scale IBM replacement might be a 370/145 product called the Alpha series (in-house code name). Priced 30 percent lower than IBM models, it would be compatible at the bit level, meaning that object programs for IBM machines would run on the CDC machine. The machine has been built by Cambridge Memories, Inc. CDC says that it has been looking at the machine, but that "no deal" has been consummated as yet.

FOR ONLY ONE DOLLAR...

American Express Corp. is going to make it nice and easy for international travelers to get travelers checks.....if they're willing to spend one dollar. AE is working with IBM and Docutel to develop travelers check dispensing terminals which it will install in the international sections of airports around the country this summer. Any amount of travelers checks you want for only $1.00 and AE will bill.

AS THE LILLIPUTIANS SAY...

Jonathan Swift still didn't have anything to do with it but this time his name does. Gulliver Technology Corp., which will begin shipping its first 6250 bpi tape drives next month, is already hard into its next project -- a mass storage device. And while Gulliver (the company) says Jonathan (the author) didn't have anything to do with the company name (it was named after a restaurant) the mass storage device owes its name to Jonathan.....it's called SWIFT.

FAST FORWARDING

There's a lot of grumbling about mail service these days but not among people in Knoxville, Nashville, Chattanooga, Tenn., and portions of Atlanta, Ga., who have moved recently. In a pilot project for the U.S. Postal Service, National Data Corp., Atlanta, has automated mail forwarding in these areas. Change of address information is maintained in National Data's central data base in Atlanta. Using Burroughs TC terminals, post office personnel key in the first four digits and the last three (in an old address) and the terminal prints out a label with the new address. George Thorpe, president of National Data, said the system is handling up to 400 address changes in an hour. He said National Data has two other systems for the post office in the works, one for P. O. Box accounting and the other for meter accounting.

HONEYWELL SETTLES OUT OF COURT--FOR $100K

Honeywell and Integrated Computer Services have settled their differences out of court. The New York service bureau was suing on the grounds that the 3200s it bought from Honeywell allegedly did not perform according to Honeywell benchmarks, and couldn't without the conversion the vendor said wasn't needed. ICS claimed the system didn't even perform as well as its smaller 1200, which it traded in.

ICS ended up sending the 3200 back to Honeywell and buying from used dealers. Honeywell sued for monies owed them on both the old and new systems, amounting to more than $3 million. The settlement was for a payment of under $100,000 by ICS

(Continued on page 210)

WHAT DO ALL THESE PEOPLE HAVE IN COMMON?

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The Hewlett-Packard 2000 System.

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There is also a Source Data Entry package that helps reduce input errors. Data is entered, edited and validated locally on HP 2640 CRT Terminals.

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Additionally, all users can process data concurrently, create and manipulate local files (up to 120 megabytes of on-line storage), and share all peripherals for program development.

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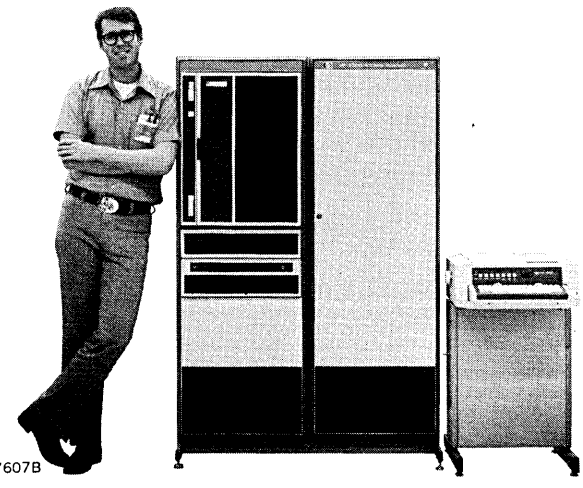

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calendar

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Executive Seminar on Privacy Legislation, DPMA, **June 1,** Chicago. This one day meeting sponsored by the Data Processing Management Assn. will give dp managers in the private sector a view of problems that federal government agencies are having in complying with the Privacy Act of 1974. Officials of major federal agencies will be panelists, and discussions will include proposed or pending privacy legislation in individual states. Fee: $65, including luncheon and the proceedings. Contact: DPMA Privacy Seminar, 505 Busse Hwy., Park Ridge, Ill. 60068 (312) 825-8124.

National Computer Conference, **June 7-10,** New York City. This annual giant gathering of the computer clan will feature more than 300 exhibits of products and services, a demonstration of interactive computing and network communications, and a student computer fair, among other special events. (For full conference preview, see page 56.) The conference is sponsored by the American Federation of Information Processing Societies, Inc. (AFIPS), and four of its participating organizations—the Assn. for Computing Machinery, the Data Processing Management Assn., the IEEE Computer Society, and the Society for Computer Simulation. Advance full-conference registration of $60 includes the entire four day program, exhibits, and the conference proceedings. In addition, a $10 credit will be applied toward first-time membership in any one of AFIPS constituent societies. Other fees are $25, one day, program and exhibits; $10, four days, students; and $25, four days, exhibits only. Full-conference on-site registration is $75.00. Contact: AFIPS, 210 Summit Ave., Montvale, N.J. 07645 (201) 391-9810.

National Operations and Automation Conference, American Bankers Assn., **June 13-16,** Washington, D.C. Major presentations on electronic funds transfer systems, data processing and bank operations will underscore the theme of "Operations: An Earning Asset." More than 200 bank equipment and services exhibit booths will feature the latest in industry developments. In addition, the results of a telecommunications survey will be announced. Fees: $175, member; $225, nonmember. Contact: ABA, 1120 Connecticut Ave., N.W., Washington, D.C. 20036 (202) 467-4332.

First Joint MMM-Intermag Conference, **June 15-18,** Pittsburgh, Pa. The annual conference on Magnetism and Magnetic Materials, and the International Magnetics Conference, will hold a joint meeting. The program will include papers on experimental and theoretical research in magnetism, the properties and synthesis of new magnetic materials, and advances in magnetic technology. An exhibit of equipment, components, materials, and technical information has been arranged. Fees: $60; students, $5. Contact: R. M. Josephs, Sperry-Univac, P.O. Box 500, Blue Bell, Pa. 19422 (215) 542-4011.

Minicomputers: The Applications Explosion, **June 16-18,** Chicago. Case studies of successful minicomputer applications will be combined with "lessons learned" by users in a series of presentations and workshops. Fees: $295; teams, $195. Contact: Dept. MINI76, AIIE Seminars, P.O. Box 25116, Los Angeles, Calif. 90025 (213) 826-7572.

International Symposium on Information Theory, **June 21-24,** Ronneby, Sweden. Papers will be presented on coding theory, communications systems, computer communications, pattern recognition, stochastic processes, and detection and estimation, plus related topics. Special charter flights are being arranged. Symposium fees: $65, member; $70, nonmember. Contact: IEEE, 345 E. 47th St., New York, N.Y. 10017 (212) 644-7500.

Computer Society Curricula Workshop, **June 21-23,** Bloomington-Normal, Ill. This meeting will attract a nationwide audience of college teachers of computer science and computer engineering to discuss new ideas and materials. Fees: $25, IEEE or ACM member; $35, nonmember. Contact: Dr. David Rine, West Virginia Univ., Morgantown, West Va. 26506 (304) 293-3196.

International Symposium on Fault-Tolerant Computing, **June 21-23,** Pittsburgh. Speakers from the U.S. and around the world will highlight this sixth annual forum. There will be sessions on design and modeling, current practices and future needs, sequential circuits, testing, and on-line detection. Fees: $70, member; $85, nonmember; add $15 after June 4; $15, student member; $20, student nonmember; add $5 after June 4. Contact: Steve Clark, Computer Science Dept., Carnegie-Mellon Univ., Pittsburgh, Pa. 15213.

Government Management Information Sciences Annual Conference, **June 21-25,** Denver. Directors of data processing from large and small municipalities in the U.S. and Canada will attend this year's G-MIS conference on Cost Effectiveness—Productivity. Fees: $40, member; $50, nonmember. Contact: Joseph M. Lewis, Administrator, Data Svcs. Div., City & County of Denver, 627 S. Broadway, Denver, Colo. 80209 (303) 297-2251.

Syntopican IV, Intl. Word Processing Assn. Conference, **June 22-24,** New York City. Among topics for 15 seminars on the theme, Information Transmission Systems, will be computers, micrographics, phasing into word processing, and work measurements and standards. There will be equipment exhibits, training films, and special literature. Fees: $125, member; $150, nonmember; one-day registration, $75 and $85, respectively. Contact: Lorraine Lear, IWP, Maryland Rd., Willow Grove, Pa. 19090 (215) 657-3220.

CALL FOR PAPERS

Computer Networks: Trends and Applications, IEEE, **Nov. 17,** Gaithersburg, Md. Three copies of 1000-word abstracts of tutorial papers should be submitted by June 15 to Dr. Patrick McGregor, Network Analysis Corp., 9105 Westerholm Way, Vienna, Va. 22180. Papers should describe practical results with computer networks and networking systems, or present new research results, in such areas as multicomputer, value-added, or terminal-oriented networks; network design or access techniques; economics, management, or measurement of networks; applications, and future directions for networking. Authors will be notified of provisional acceptance by July 30. ❁

Conference information submitted to Calendar should include registration fees, phone number and name of contact. Items for consideration should be received by DATAMATION three months prior to the event.

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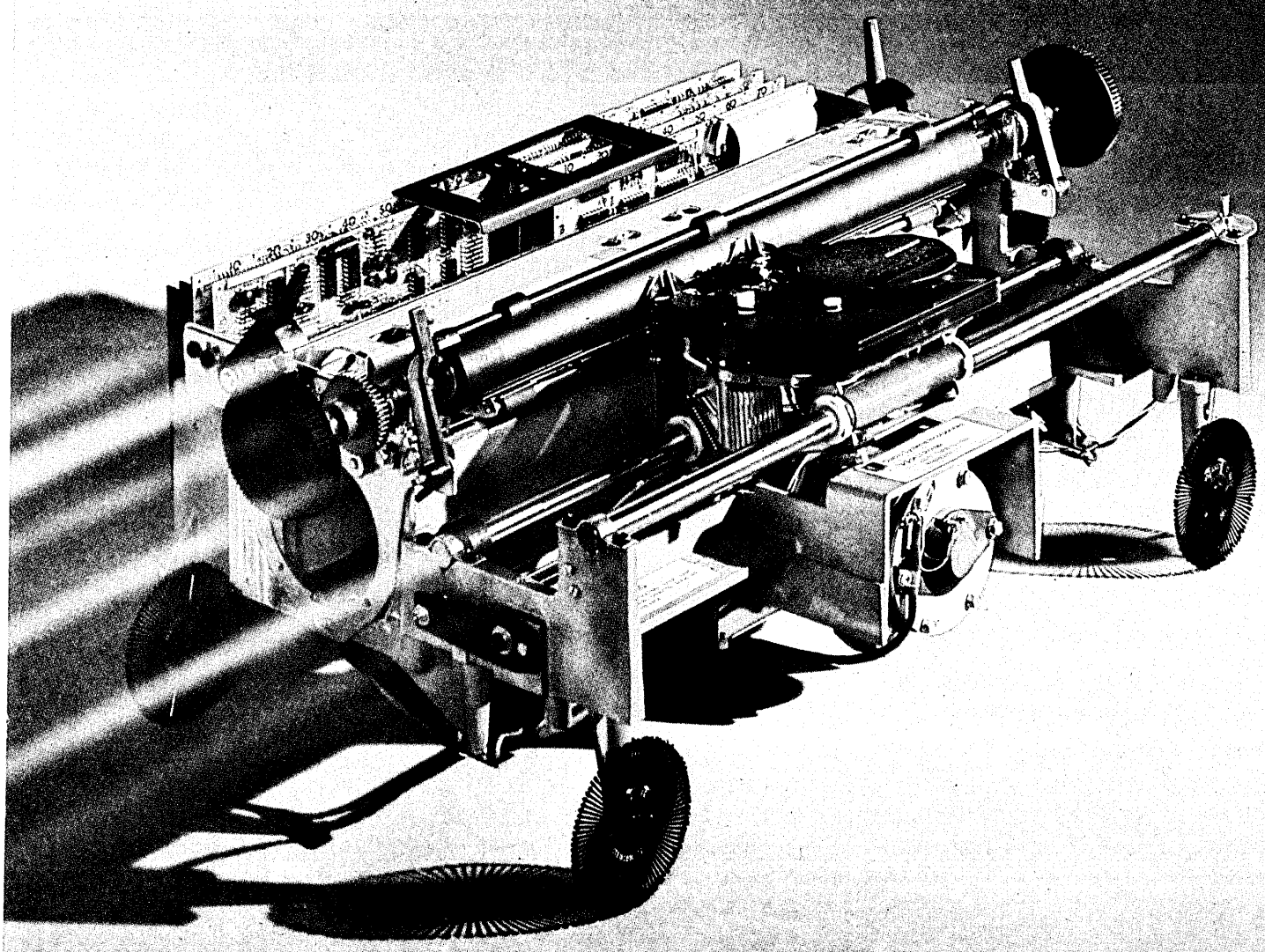

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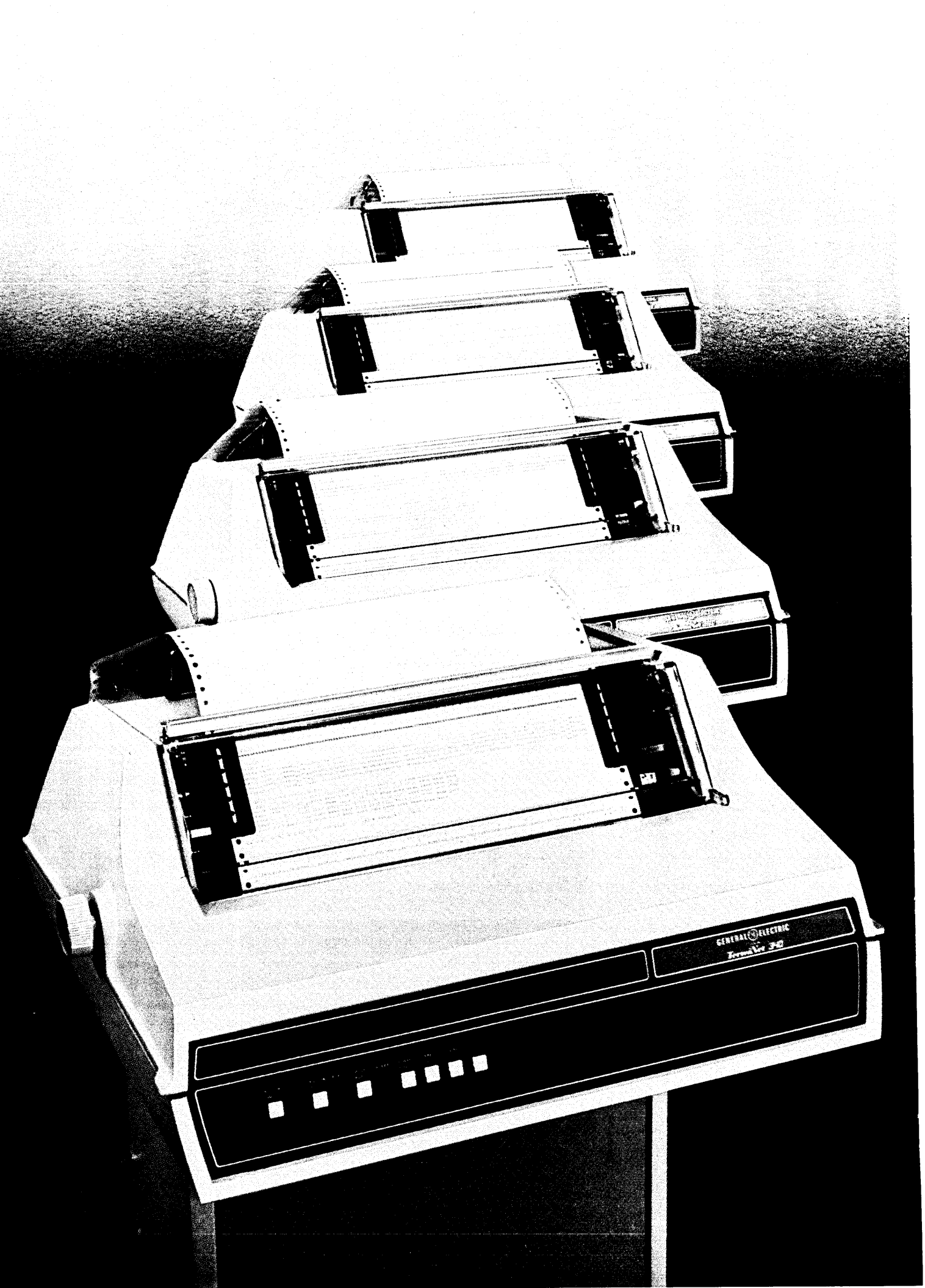
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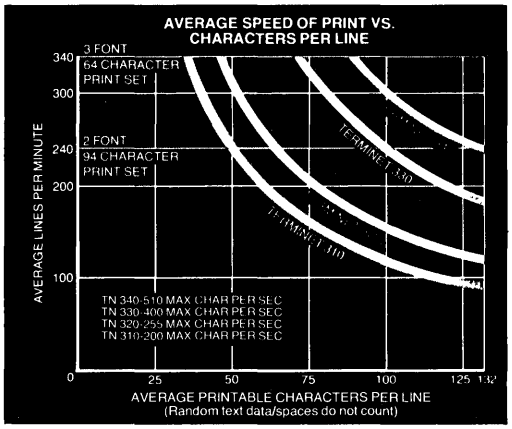

The print rate for TermiNet line printers varies with the number of printable characters per line and the size of the ASCII subset used. Analysis of the typical rate curve shows that TermiNet 340 throughput for the 64 character ASCII subset is an average of 340 lines per minute when there are 90 or fewer characters printed on a line. This includes one line feed per line. Minimum throughput is 231.8 lines per minute when printing characters in all 132 columns, faster if there are spaces in the print line.

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books

EDP Facility Accounting: Implementation (Vol. 1)
205 pp. $300
EDP Facility Accounting: Technical Foundations (Vol. 2)
191 pp. $100
by Kenneth W. Kolence
Bank Administration Institute, P.O. Box 500, 303 S. Northwest Highway, Park Ridge, Ill. 60068 (1975) (50% discount to BAI members)

The basic objective of these volumes is to provide a thorough description of the factors to be considered when establishing a dp accounting system for distributing incurred costs to multiple users (or applications). This objective is carefully and well achieved. All the relevant factors are defined, and a mathematical relational means is provided to integrate these factors into a whole such that costs can be fairly and visibly apportioned by user or application.

Six specific comments can be made:

1. The methodology presumes an existing, operating data processing system with modern monitors and repeatable work load.

2. The fundamental intent behind this accounting methodology is to provide means to tune an existing system, and thus properly charge its users for its use rather than to provide explicit purchasing guidance for comparing new systems. The methodology is also of little help to designers of new systems.

3. The somewhat complicated nomenclature and mathematical expressions need only the more frequent attachment of their units (or dimensions) to facilitate rapid understanding.

4. Importantly, and properly, charges are explicitly and mathematically related to the actual work done—an excellent contribution.

5. The mathematical structure provided is best suited to systems with static, rather than dynamic resource allocation algorithms because all of the conversion factors (to convert Natural Forecasting Units of familiar work to the author's common measure of superimposable or additive software work) presume run time repeatability.

6. Principal users of this work would probably be software designers of the cost accounting and user invoicing procedures and programs for a large dp installation.

As in all things, since the measurement determines the system, I must observe that users will attempt to minimize their charges once a clear charging algorithm is provided. In this case, my guess is that the cheapest scheme is to write all programs to execute directly out of data base (disc) using minimal main memory, calling for the shortest possible records that can be used, using cpu as little as possible, throwing as much load onto the I/O handlers as possible to accomplish those results.

To counter such tendencies, it would be desirable in a future version of this accounting system to give users credit for writing programs that use system resources efficiently.

It is extremely difficult to find familiar Natural Forecast Units of work that are orthogonal (linear in the author's sense). Most such parameters that are easily measured and are always talked about when measuring computer systems, do not produce independent effects on memory transfers. "Software work" as used by the author is measured by the number of bytes changed in any storage media. The several parameters which are familiar measures on computers do not usually produce independent effects on byte change rates in system storage media.

As a personal feeling, I am uncomfortable with the idea of equating "software work" with the amount of busy work that can go on inside a poorly designed program. This construct provided by the author does allow a means to aggregate all the work done by many programs in a fashion which will then apportion out charges according to this measure of work done. It also penalizes the person who does his programming work poorly, uses much memory, and runs I/O inefficiently. It further makes a person pay for the resources required to run programs in a hurry. But I suspect it also allows the clever ones to run their programs cheaply by running up system overhead using carefully selected strategems. "Useful work" should be measured, and wasteful or inefficient use of system overhead functions should be penalized.

In conclusion, it is a pleasure to read, contemplate, and discuss this careful, thorough, and useful work by one of the pioneers in performance measurement.

—**Robert R. Johnson**

Dr. Johnson is vice president in charge of engineering at Burroughs Corp. He was earlier director of engineering for commercial dp systems and equipment and electronic business machines. Before joining Burroughs in 1964, Dr. Johnson was manager of engineering for General Electric's computer dept. in Phoenix, and earlier, a research physicist for Hughes Aircraft Co.

Collected Papers of Jay W. Forrester
Wright-Allen Press
238 Main Street
Cambridge, MA 02142 (1975)
284 pp. $30

Jay W. Forrester is Germeshausen Professor at MIT and a leader in the field of system dynamics. Some DATAMATION readers will remember him also for his early work in computer development, particularly for his basic contributions to core memory technology.

This book is a chronological collection of 17 of Prof. Forrester's papers on the subject of system dynamics spanning the period from 1958 to 1972. This review is oriented to DATAMATION readers who are not directly engaged in the field of system dynamics. Those who work in this field would view the *Collected Papers* somewhat differently, for example, in relation to Prof. Forrester's four other major works: *Industrial Dynamics* (1961), *Principles of Systems* (1968), *Urban Dynamics* (1969), and *World Dynamics* (1971).

After a foreword by Professor Emeritus Gordon S. Brown, formerly Dean of Engineering at MIT, *Collected Papers* divides essentially into two parts. The first nine papers, covering a decade from 1958 to 1968, primarily address the application of industrial dynamics to corporate issues. The remaining papers address the application of system dynamics to urban and world social topics.

Industrial dynamics involves the application of the principles of feedback systems to a wide range of industrial topics. Applications discussed in some detail are advertising (paper 2) and market growth (paper 7). *Collected Papers* is not mathematical in presentation, although paper 7 has an appended computer printout of equations used for system simulation. Those papers which address specific applications typically have a number of graphical illustrations of results. Paper 5 discusses the problem of reducing research costs, primarily by increasing research efficiency. An observation by Forrester: "... research is involved in a postive feedback spiral where increasingly inefficient research becomes the training ground for each new generation of research workers." Paper 6, "A New Corporate Design," is a compact discussion of Forrester's

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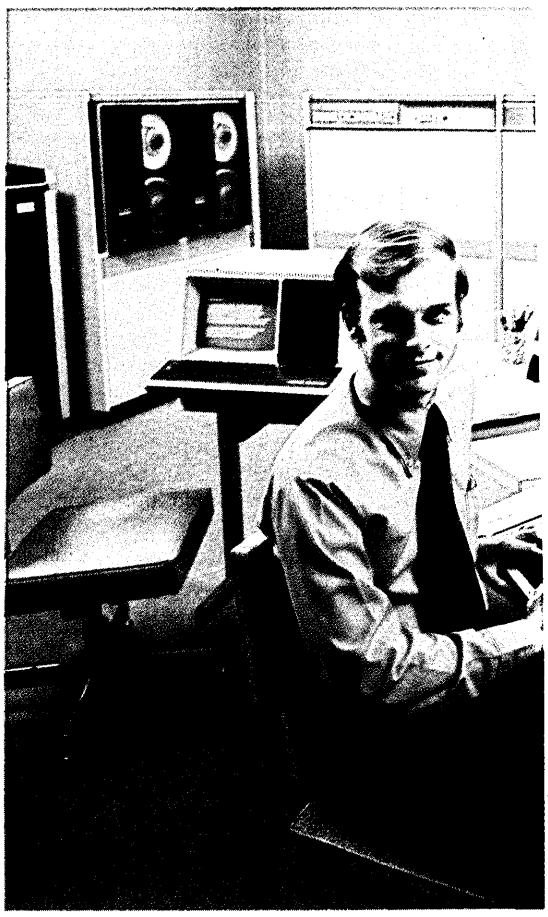

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concepts for a corporation. Much of the discussion relates to interpersonal relationships, and freedom and mobility for the individual.

In the second part of *Collected Works,* we see the fruits of application of industrial dynamics, under the new name of system dynamics, to problems outside the realm of corporations. "I am speaking," says Forrester, "of what was earlier called 'industrial dynamics.' The name was a misnomer because the methods apply to complex systems regardless of the field in which they are located."

Paper 11 presents the results of system analysis as applied to urban planning. Factors like labor, housing, mature business, new enterprises, and taxation are taken into account. Growth and stagnation curves for a 250-year period appear to be extremely relevant to major U.S. metropolitan centers.

Most readers will be interested in paper 14, "Counterintuitive Behavior of Social Systems," an extension of urban dynamics to a world model. This paper was presented to a subcommittee of the House of Representatives concerned with urban growth. Interaction of key parameters—natural resources, world population, quality of life, pollution, and capital investment—are presented in seven scenarios of assumptions. The results indicate near-term gyrations in most parameters, particularly pollution, quality of life, and population. Indeed, the last scenario which shows a set of conditions for world equilibrium assumes sharp reductions in natural resource usage (−75%), birth rate (−50%), pollution generation (−50%), capital investment rate (−40%), and even a reduction in food production (−20%). Forrester regretfully concludes that we are living in a golden age when the quality of life is better than it has been, or will be.

Paper 16 is addressed to quite a different audience, the church. Forrester asserts that "churches should be custodians of the longest term values in a society." He describes the church's predicament in terms of population growth, and raises fundamental questions about "egocentricity," "fallacy of human equality," and "potential evil in humanitarianism."

All in all, *Collected Works* is a mind-expanding book. It races through a variety of corporate problems to urban and world social problems and institutions. Prof. Forrester makes no claim that people exposed to the results of application of system dynamics will understand the basic methodology—that still requires a grounding in feedback system theory. The DATAMATION reader who has a broad interest in the topics that are covered would be well advised to read this book. Even at its premium price, it would be a significant addition to one's personal library.

—Lowell Amdahl

Mr. Amdahl was a founder and is chairman of Compata, Inc., Los Angeles, and is Datamation's technical advisor.

BOOK BRIEFS . . .

Principles of Digital Computer Design, Vol. 1
by Abd-elfattah M. Abd-alla and Arnold C. Meltzer
Prentice-Hall, Inc., 1976
606 pp. $18.50

This is a highly technical, in-depth presentation of the principles underlying the design of digital computers, and contains information on how to use these principles in the design of a small digital computer using microprogramming. Required background for the reader is a knowledge of programming using a high level language, and a knowledge of switching theory design. A second volume is planned that will describe the advanced development concepts of computer design.

Annual Review of Information Science and Technology (Vol. 10)
Carlos A. Cuadra, ed.
American Society for Information Science, 1155 Sixteenth St., N.W., Suite 210, Washington, D.C. 20036 (1975)
488 pp. $27.50 ($22, ASIS members; $24.75, ASIS affiliates, prepaid)

Billed as a "state of the profession" report, this latest edition features carefully chosen material written by selected experts that reflects significant developments and trends in the field of information science. Contents are divided into four sections: planning information systems and services, basic techniques and tools, applications, and special topics.

The Compleat Computer
by Dennie L. Van Tassel
Science Research Associates, Inc., 259 E. Erie St., Chicago, Ill. 60611 (1976)
216 pp. $5.95 (paperback)

Many books of this type—compendiums of short articles, humor, poetry, computer art, games, and puzzles—are merely reproductions, largely poor in quality, from other sources. This volume uses a different approach. Although most of the material is gathered from other sources, all of it has been prepared especially for this printing, which makes the book visually pleasing and much more readable. The material itself? Well chosen, interesting and amusing.

Computer Systems Organization and Programming
by Harry Katzan, Jr.
Science Research Associates, Inc., 259 E. Erie St., Chicago, Ill. 60611 (1976)
459 pp. $12.95

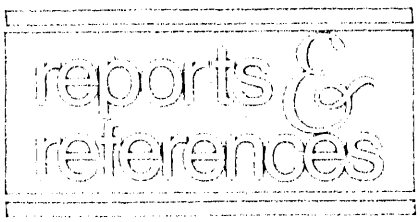
The first four chapters of this text provide detailed discussions of computer systems, computer organization, data and storage structures, and computer operations and machine language. The balance of the book covers several topics that can assist the professional in a changing job market; these include treatments of data management, data base technology, virtual storage, and an up to date review of structured programming.

Games With the Pocket Calculator
by Sivasailam Thiagarajan and Harold D. Stolovitch
Dymax, P.O. Box 310, Menlo Park, Calif. 94025 (1976)
47 pp. $2 (paperback) plus 50¢ for handling

There are two dozen games in this book that can be played with calculators of almost any type and price (minimum is one with a six digit display). The games are billed as interactive activities, requiring mental manipulations as well as calculator computations. They look like fun.

Operations Research for Immediate Application: A Quick and Dirty Manual
by Robert D. Woolsey and Huntington S. Swanson
Harper & Row, 1975
204 pp. $5.95 (paperback)

The lighthearted title indicates the approach used in this problem solving "cookbook" for people who have to deal with finding real-world solutions to operations research problems. Sample Q&Ds: minimizing total processing times, economic order quantity for constant demand, no shortages allowed; deciding whether or not to stock an item; for optimum cash replenishment with lumpy demand. Each Q&D has references for those interested in backup theory and derivation of the method.



Management Audits

Management Auditing of Computer Operations: A Tutorial is a 480-page paperback of reprints from journals, newspapers, on the need of managers to keep track of the impact of the computer on the entire operations of their organization. In addition to the 31 articles reprinted, there are discussions by the editors. Sample articles are Tom Alexander's "Waiting for the Great Computer Rip-off" (*Fortune*), Brandt Allen's "Embezzler's Guide to the Computer" (*Harvard Business Rev.*), and Fred Brooks' "The Mythical Man-Month" (*Datamation*). Price: $16 ($12 to members). IEEE COMPUTER SOCIETY, 5855 Naples Plaza, Ste. 301, Long Beach, Calif. 90803.

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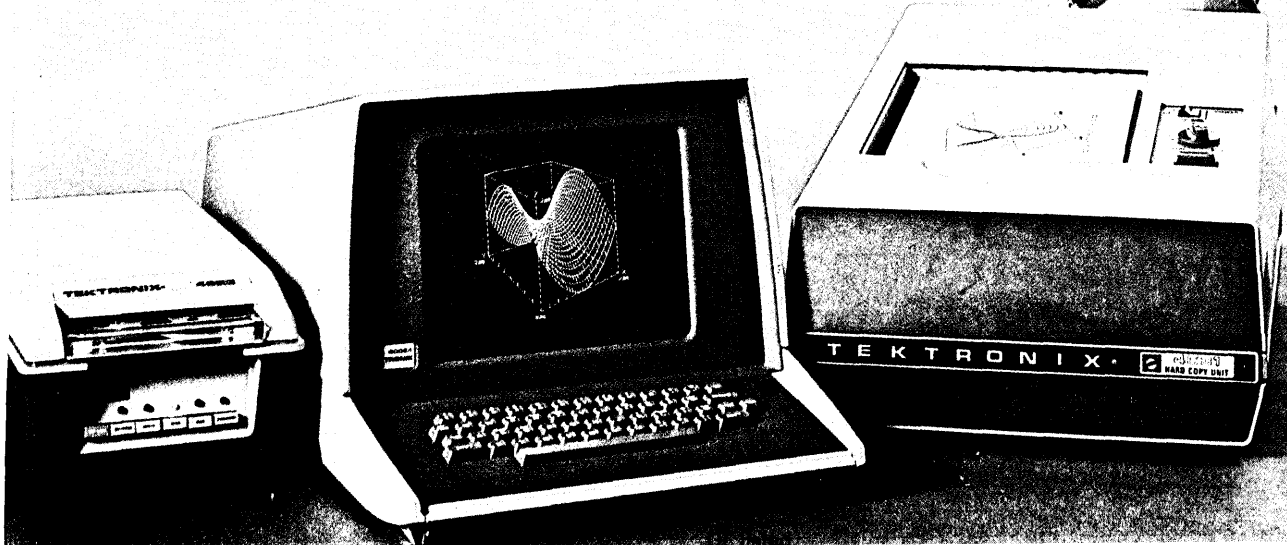


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Multidimensional arrays allow you to organize data logically, thus saving program space and execution time. A 20 x 20 matrix can be inverted in 10 seconds.

Buffered I/O increases throughput by providing a programmable software buffer between the program and an external device.

Memory load and record allows you to suspend processing whenever you want and store the complete contents of memory on tape —including data and pointers —for continuation later on.

High level language (HPL) offers you power and efficiency for handling equations, data manipulation, and input/output operations. Yet it is easy to learn and use.

Other features and capabilities enhance 9825 performance and versatility: for example, upper and lower case alphanumerics on both the display and printer; interfacing to any of eight HP calculator peripherals through three I/O slots, and up to 42 different instruments via HP Interface Buses.

Simultaneous processing of several diverse jobs. Say you're using a 9825 to control an instrument test stand, and acquiring data from it at speeds in excess of 1000 bytes a second; then printing the results on the new HP 9866B Thermal Line Printer. At the same time, the same 9825 can also be processing and plotting a statistical problem. And through the 9825's live keyboard, you can check the progress of either program and even change parameters if you desire. It seems the 9825 is doing all these operations simultaneously, thanks to its speed, buffered I/O, and interrupt capability.

Unexpected performance from a computing calculator

All this performance comes in a 26-pound, 5"x 15"x 19" package. Yet, with all its power and computer-like features, the 9825 still retains the friendliness and simplicity of a calculator. You don't have to be a programmer to get performance out of a 9825; nor do you need to be a systems expert to do interfacing applications. When you know all the facts, we think you'll agree the 9825 is a great buy. Write for your free copy of the 16-page 9825 brochure, or call your local HP sales office for more information.

HP computing calculators put the power where the problems are.

HEWLETT hp PACKARD

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Teleprinters and Typewriters

Computer Transceiver Systems and Digital Equipment Corp. teleprinter terminals were rated highest by 571 users with a total of 11,158 installed terminals. So finds *All About Teleprinter Terminals*, a 42-page report reprinted from the March supplement to *Datapro 70*. The report presents detailed characteristics of 149 teleprinter terminals from 57 vendors in a comparison chart form, plus specific user ratings on more than 50 individual makes and models.

The 18-page *All About Office Electric Typewriters* reports that six manufacturers are challenging IBM's 80% share of the $500 million per year market. Competition from Adler, Facit, Olivetti, Olympia, Royal, and Sperry Univac will further stimulate improved performance and development of new features. The study compares 33 models from 11 manufacturers.

Price: $10 each. DATAPRO RESEARCH CORP., 1805 Underwood Blvd., Delran, N. J. 08075.

Communications Services

Keeping track of local and state common carrier services is now facilitated by the loose-leaf *Intrastate Guide to Communications Services (Vol. 1)*. This monthly service provides updates of the latest tariffs for each state. A check sheet is also included each month which summarizes rate applications activity. An overview and description of how to use the service are provided. Annual subscription: $375 (plus postage). CENTER FOR COMMUNICATIONS MANAGEMENT, INC., P. O. Box 324, Ramsey, N. J. 07446.

Microcomputer Dictionary

A useful, comprehensive *Microcomputer Dictionary and Guide* by Charles J. Sippl and David A. Kidd is part of this vendor's "Universe" microcomputer service. This 600+ page paperback contains extensive explanations of microelectronic terms, plus a number of useful appendices on programmable calculator terms; summaries of APL, BASIC, and FORTRAN; mathematics and statistics definitions; symbols, units, and constants of electronics; and more. Price: $14.95. CRAMER ELECTRONICS, INC., 85 Wells Ave., Newton, Mass. 02159.

University Directory

A 100-page booklet, *Administrative Directory of College and University Computer Sciences*, lists names and addresses of 300 chairmen of computer science departments and 900 directors of computer centers at universities and colleges in the U.S. Also included is information on degree programs offered, on-site computing equipment, and related information processing societies and government agencies. Price: $7.50 ($5 to ACM members). ASSOCIATION FOR COMPUTING MACHINERY, 1133 Ave. of the Americas, New York, N. Y. 10036.

EFTS Deskbook

The 500-page *1976 EFTS Deskbook* presents some helpful facts and materials about electronic funds transfer systems. The book is divided into sections with pertinent information on national trade groups, national regulatory groups, service groups, state directories and biographical facts on 300 EFTS specialists from various organizations. (Some important names, however, are missing, such as Dale Reistad, president of Payment Systems, Inc., and Russell Fenwick, a senior vice president of Bank of America who was also the guiding force behind SCOPE which obtained the first automated clearing house.) Included are an acronym dictionary, a master index, and an inquiry service available from the vendor. Price: $95. THE FINANCIAL LIBRARY, Carnegie Building, Hillcrest Rd., Madison, N. J. 07940.

Small Business Programs

Evaluations of three computer programs designed for small wholesalers

(Continued on page 45)

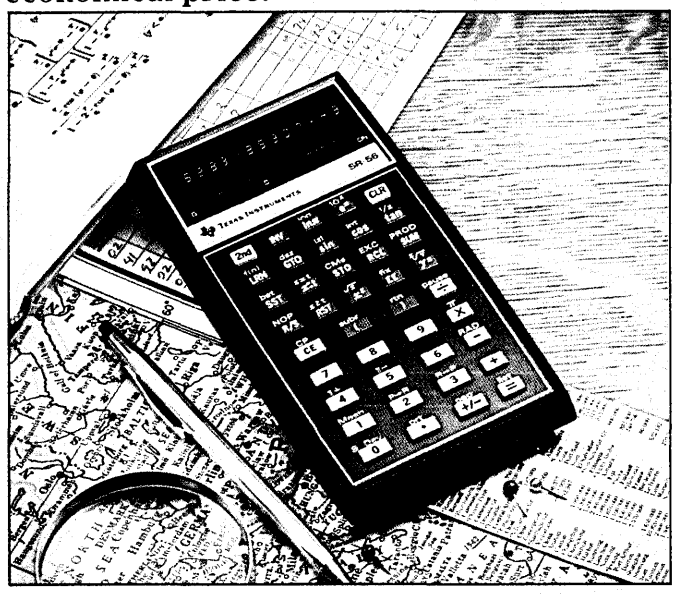
Technology.

At Texas Instruments, it is the foundation of a double goal:
Produce better products.
Produce them economically.

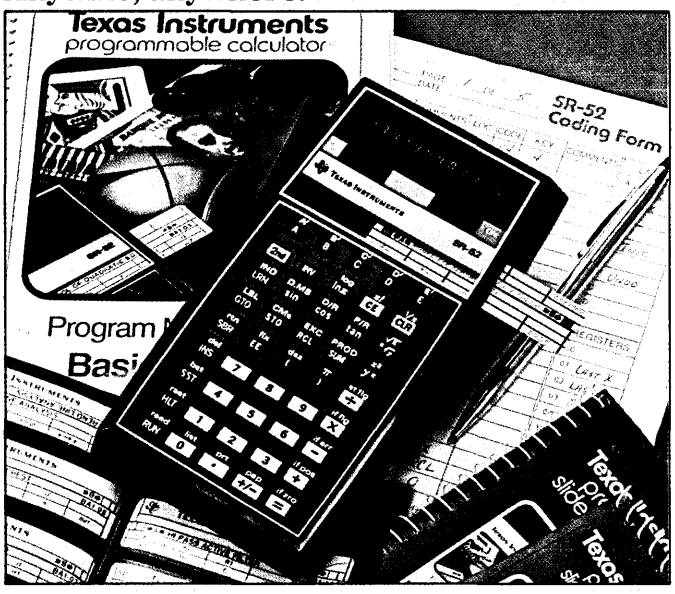
Now, we've added three new programmable calculators... at prices you can afford.

Choose the right programmable ...and problems that once took hours can be solved in seconds.

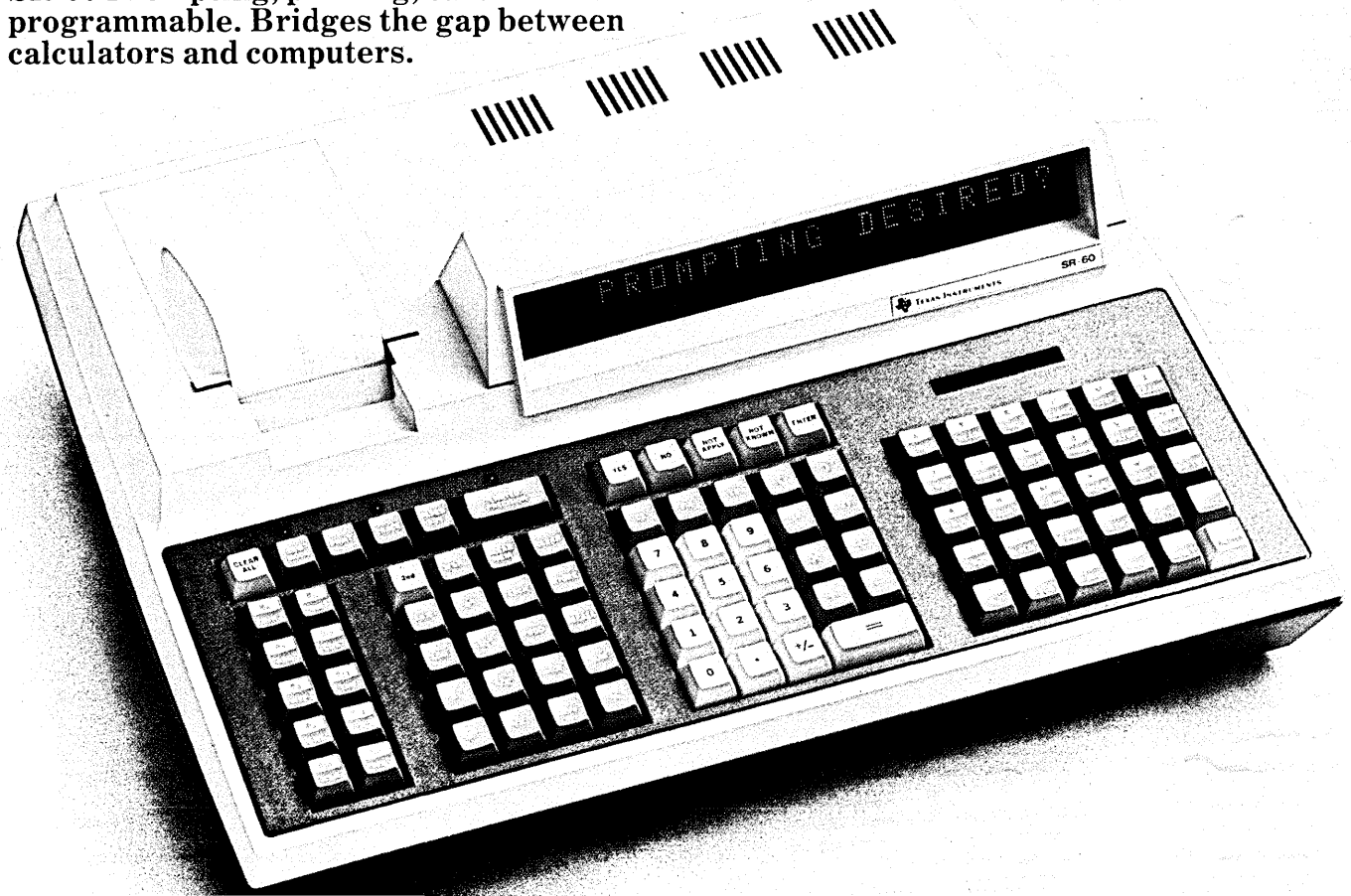
SR-56 Key programmable. Full programming capability at an economical price.



SR-52 Pocket-card programmable. Records your programs for instant use. Anytime, anywhere.



SR-60 Prompting, printing, card programmable. Bridges the gap between calculators and computers.

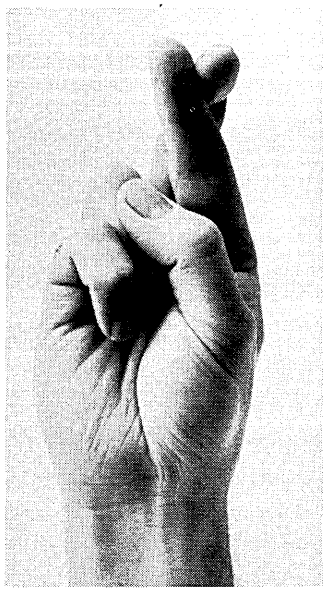


Congratulations: you didn't have a computer fire again last year.

You're one of the lucky ones.

Unfortunately too many companies last year did suffer major business interruptions due to fires in or near their computer rooms.

What's even more unfortunate is the fact that a lot of the damage, clean-up and downtime could have been avoided.



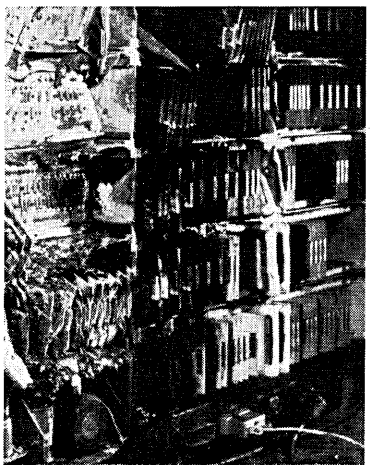
Days of Downtime vs. a Few Seconds of Halon

These companies could have been protected by a high speed Fenwal Halon Fire Suppression System.

The system that snuffs out fires dry. Just seconds after they start.

And lets you get right back to work. No wet mess to clean up.

With some systems you've got to evacuate a room before the extinguishing agent can go to work.



But because Halon 1301 is harmless to people, it can start snuffing out the flames immediately. Which gives you the fastest jump on the fire.

With ordinary systems there's usually at least 48 hours of clean-up before your computer can go back on line.

With a Fenwal system there's virtually no clean-up, no shorted-out wires. No electrical shock hazards. No damage to tapes or records.

Fenwal's unique, modular system permits rapid agent discharge and easy extension of existing systems.

Why Push Your Luck?

The consequences of a computer fire are a lot more devastating than you might think. Despite all the precautions you take.

At Fenwal we've got documented proof that our Halon Fire Suppression Systems are *the* solution to the damage and downtime of computer room fires.

It's proof you can see for yourself. In a film called "The Fireaters".

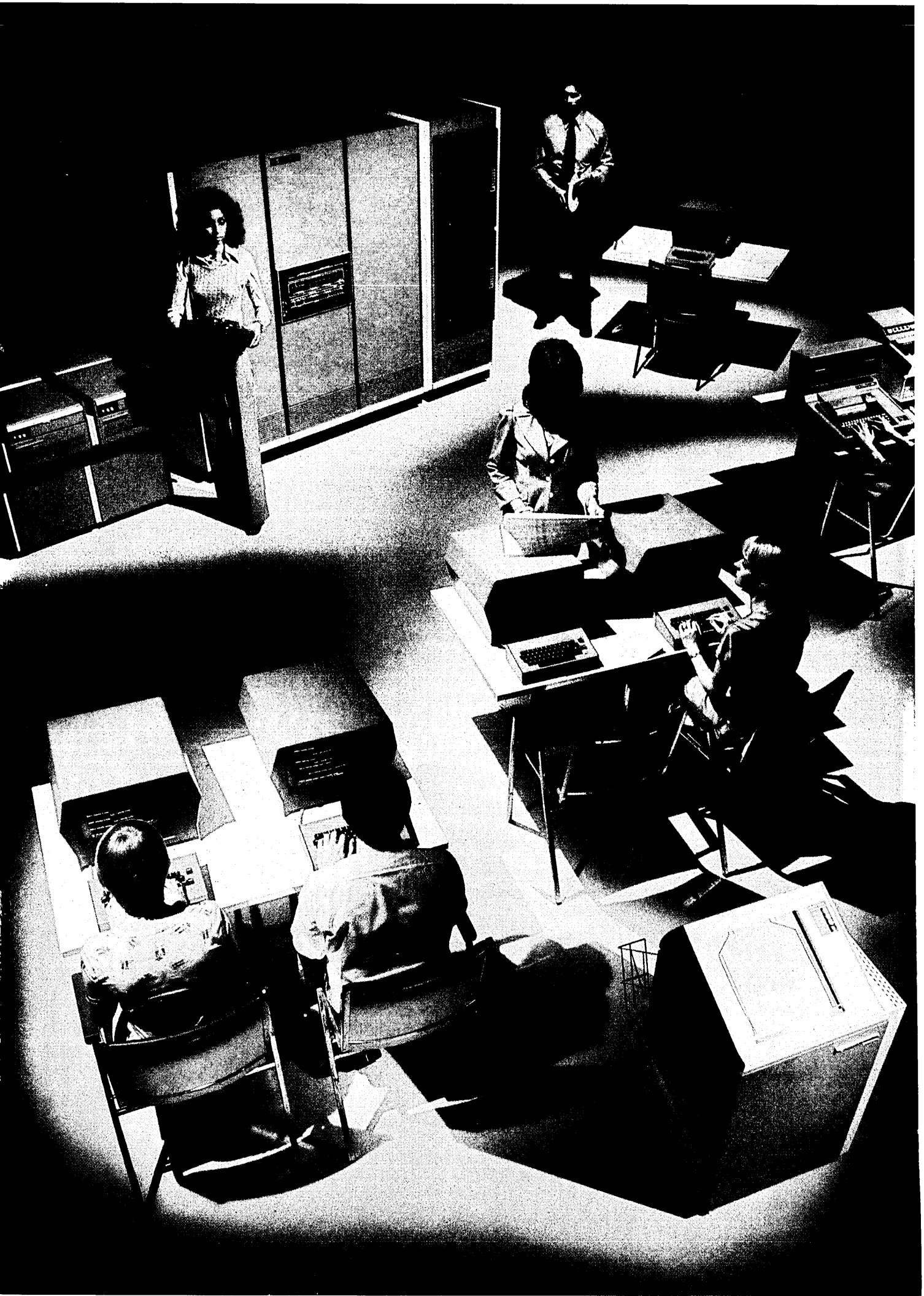
We think it will convince you that you need more than luck to keep your computer in business.

To arrange a viewing, call us at (617) 881-2000. Or write to Fenwal Incorporated, Ashland, MA 01721. A Division of Walter Kidde & Co., Inc. Our local, service-oriented distributors are listed in the yellow pages under "Fire Protection".

FENWAL

Nobody in the world has more experience in fire and explosion suppression systems.

FM Approved – UL Listed



A lot of computers offer multi-level batch processing, or RJE, or realtime, or interactive timesharing.

But only Harris offers all of it, concurrently.

Only Harris delivers multi-use concurrency. Our high performance S100 and S200 packaged systems, combined with our responsive VULCAN operating system delivers simultaneous compute services to each user. As well as simultaneous individual user access to the system.

The S220, shown here, is packaged around the most powerful CPU in the industry. Dozens of benchmarks, including Whetstone, prove the S100/S200 series superior performance. The S220 is one of 6 packaged systems available today, starting at $85,000. All operate with COBOL, FORTRAN, BASIC, RPG II, FORGO, SNOBOL, and extended BASIC. And all 6 in the series deliver multiple RJE, multi-level batch processing, multiple interactive timesharing, and real-time processing...all at the same time. If your need is distributed processing, time-sharing, data base management, or any kind of multi-use concurrency, benchmark the S100/S200 packaged systems.

Only Harris gives it all to you, concurrently. Write Harris Computer Systems, 1200 Gateway Drive, Fort Lauderdale, Florida 33309. Europe: Techmation N.V., Gebouw 105/105 Schiphol-Oost, Netherlands.

HARRIS

COMMUNICATIONS AND INFORMATION HANDLING

CIRCLE 42 ON READER CARD

Bell & Howell's new 3800 Series COM

(It's chiefly for the non-clairvoyant.)

If you could foresee your exact COM needs for the next three . . . four . . . five . . . or even more years, there might be another single configured system that would serve as well as our field-upgradable 3800 series.

If you could read clearly in the stars whether you might eventually require a front end mini preprocessor, for example, the latest Bell & Howell COM array would lose one of its big advantages. And if you could only predict what peripherals you need — lineprinter, CRT, disc, tapedrive, or the entire combination — our 3800 would be just another COM series to you.

But, if you're like the other ungifted 99% of us, you'll appreciate this new hedge against the uncertainties of an "iffy" economy and hard-to-predict corporate changes and growth rates.

You can enjoy this freedom without sacrifice, too. Our 3800 Series is competitive in price, speed, and operator convenience. Attractively styled. Accompanied by strong, flexible software. And backed by Bell & Howell's worldwide sales, service, and support organization.

Your Bell & Howell COM representative can give you some other sensible reasons for choosing the 3800 Series. To get in touch with him, call Pat Flynn, collect, at (714) 752-1940 or write him at 1451 Quail St., Newport Beach, CA 92660. (He may even make you an attractive offer on your slightly-used crystal ball.)

MICROIMAGERY GROUP

BELL & HOWELL

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(Continued from page 34)

and distributors appear in *Packaged Software Reports.* The packages are Burroughs B700 Wholesale Business Management System, NCR's SPIRIT, and Basic Four's Comprehensive Business System. Each package is available commercially on a small business computer, and is modifiable and supportable by the manufacturer. Price: $15. MANAGEMENT INFORMATION CORP., 140 Barclay Center, Cherry Hill, N. J. 08034.

Tape and Disc Packs

There is a high degree of user satisfaction with vendors of media maintenance equipment, according to the report, *All About Magnetic Tape and Disk Pack Maintenance,* reprinted from the March supplement to *Datapro 70.* The 10-page report describes the product lines of the seven leading vendors: Computer-Link, Data Devices International, General Kinetics, Graham Magnetics, Kybe, Randomex, and Recortec. Price: $10. DATAPRO RESEARCH CORP., 1805 Underwood Blvd., Delran, N. J. 08075.

EFT Analysis

A 40-page analysis of various approaches taken by state legislatures concerning EFT appears in *Remote Electronic Facilities—An Analysis of Enabling Acts.* The book provides nontechnical descriptions of state statutes, an outline of policy considerations in EFT lawmaking, a reference matrix comparing provisions of state statutes, and definitions of federal regulations and rulings. Price: $10 ($8 for ABA members). AMERICAN BANKERS ASSN., Communications Group, 1120 Conn. Ave., N. W., Washington, D. C. 20036.

vendor literature

Apparel minis

A 12-page illustrated brochure, *Micos, A Minicomputer System in the Apparel Industry,* describes the "Micos" system which is specially constructed for order entry, inventory control, invoicing, accounts receivable, etc., as applicable to the apparel industry which requires extremely up-to-date information. A cut and sold report, salesperson commission statements, open commitments report, and advertising cost analysis are sample reports available. Crt illustrations and hard-copy output are shown, and specifications of the system given. MINI-COMPUTER SYSTEMS, INC., Elmsford, N. Y.

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Tape Management

"Why it is Cost Effective to Establish and Implement a Tape Management Program" is a 4-page primer and do-it-yourself cost analysis worksheet. Information on tape errors, program and equipment justification, identifying actual costs of tape failure, and establishing a tape maintenance program, is provided. COMPUTER-LINK CORP., Burlington, Mass.

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Custom ICs

An 8-page booklet describes custom IC chip manufacturing and the economics of using custom IC's in place of many standard IC's for the same function. A custom, large scale integrated (LSI) circuit, for example, can often replace 10 to 100 standard IC's, with subsequent reduced assembly costs, elimination of one or more printed circuit boards, lower field maintenance and repair costs, higher reliability, smaller volume, reduced weight, lower power consumption, etc. SILICON SYSTEMS INC., Santa Ana, Calif.

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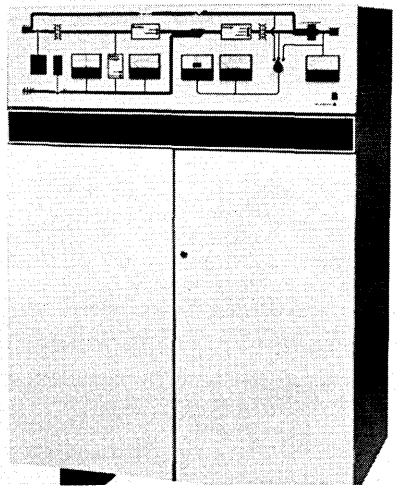
UPS

An illustrated brochure describes the Topaz Uninterruptible Power Systems, 81000 series, designed to protect critical loads against AC power line disturbances and loss of commercial AC



power. Loads are claimed to be protected from instantaneous and subcycle power losses as well as from longer term power outages. Especially applicable to computer-based equipment, the standard models have single-phase outputs and are available in 3, 5, 10, and 15 kVA ratings. TOPAZ ELECTRONICS, San Diego, Calif.

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Tape Formatter

An illustrated brochure describes the

(Continued on page 49)


WBNC

BASF invented magnetic tape 40 years before Memorex broke their first glass.

Back in 1932, when Hoover was still president and radio was the big noise in home entertainment, BASF invented magnetic tape and the technology that made today's high-density data processing media possible. The state of the art has evolved considerably since then, and we're no longer alone in the magnetic media field. That's why, while we know we were first, we'd rather you know that we're the best. And we've put more effort into being the best than anyone else in the business. That's why we design and manufacture our own testing apparatus, and why we use up 75,000 miles of computer tape every year in our development department. Because at BASF, "good enough" just isn't good enough. We've been around for a long time . . . long enough to know that it's what we've done for you lately that counts. Ask our customers . . . most people who choose BASF make it their only choice. BASF Systems, Bedford, Massachusetts 01730.

BASF The Original.

Computer Tapes Disk Packs Flexydisks Word Processing Supplies

Your mother needs help.

At one time, people were willing to wait around for your big computer to get around to them.

No more.

Now they're demanding more work, faster than your mother can possibly do it.

Which has put you in a rather difficult position. You've either had to put them off, or put your mother through an upgrade so expensive it's unreal.

Neither of which you have to do any more. Because now you can get your mother a little help. A computer that can do the jobs she's too busy to do.

An ECLIPSE C/300.

The C/300 is smaller than the big computers you may be used to using. But it has the things big computers have. A comprehensive commercial instruction set that even has an EDIT function, for example. And large memory configurations.

The C/300 also has an incredibly sophisticated data management system with multilevel keyed access called INFOS. It supports the languages anyone could ever want: COBOL, RPG II, Real-time FORTRAN. And INFOS runs under RDOS, our real-time multitasking operating system.

And the C/300 has intercomputer communications ability that lets you interface to your mother. Directly via channel connect, or via communication lines so it can emulate 2780's or HASP. Or be itself. And, wherever you put an ECLIPSE C/300 you can hang terminals off it with synchronous or asynchronous lines.

The COBOL that comes with the C/300 is the highest level implementation of ANSI 74 COBOL standards. It's a complete language system that comes with features like an interactive debugger. And an integrated SORT/MERGE.

And you can get all your peripherals at Data General. Because Data General has all kinds of discs, tape drives and printers. In all sizes. Discs for example, come in anything from a floppy to 3330-type 90 megabyte drives.

Write for more information.

That way, you'll be able to spend more time with your mother. Because you'll be spending less time making up excuses.

ECLIPSE C/300: BECAUSE YOUR MOTHER NEEDS A LITTLE HELP.

DataGeneral

Data General, Route 9, Southboro, Mass. 01772 (617) 485-9100. Data General (Canada) Ltd., Ontario.
Data General Europe, 15 Rue Le Sueur, Paris 75116, France. Data General Australia, Melbourne (03) 82-1361/Sydney (02) 908-1366.

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source data

(Continued from page 45)

Datum series 5191 magnetic tape formatters, a control and formatting system for minicomputers. Special features include a "designed-in software compatability," "proven" hardware design, plus other specifications which are detailed in the brochure. DATUM INC., Anaheim, Calif.
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Aids Catalog
The 1976 40-page ISA catalog describes more than 200 instrumentation publications and educational aids. Proceedings of conferences and symposia, reference books, periodicals, study guides, videotape programs, audio cassettes, standards and recommended practices, and instrument specification and test forms are detailed. Automatic control, computers, modeling and simulation, and telemetry are among the many areas covered. INSTRUMENT SOCIETY OF AMERICA, Pittsburgh, Pa.
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Leaders Digest
A pamphlet to help those who want to lead better business meetings, *Leaders Digest,* is available. This 12-page booklet provides tips on meetings as a management tool, planning and conducting such meetings, discussions of visual aids, etc. Visual Products Div., 3M CENTER, St. Paul, Minn.
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Computer Power Supply
A 4-page bulletin describes the General Electric Computer Power Supply, GET-6583, a line of packaged motor-generator sets. These sets, rated 30 through 200 kw, are designed to protect computer systems and to isolate critical load equipment from power line voltage fluctuation. The equipment can be used in parallel for higher reliability and for riding through transient power losses for short durations. Included are application data, information on system operation and design, ratings and dimensions. GENERAL ELECTRIC CO., Schenectady, N. Y.
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Diskette Drive
The Orbis Model 76 diskette drive which is offered in standard or double density up to 6.4 million bits, is described in a 4-page illustrated brochure. A uni-ball head positioner with zero backlash is an important feature. The benefits of an integrated design approach are also described. ORBIS SYSTEMS INC., Tustin, Calif.
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Selectric I/O Peripheral
A technical bulletin describes features and technical specifications of a Selectric I/O peripheral designed for use with the IBM 5100 programmable calculator. Included are applications, key features, and specifications like type characters, type styles, code formats, print rate, dimensions, etc. TYCOM CORP., Fairfield, N. J.
FOR COPY CIRCLE 210 ON READER CARD

Corporate Profile
A brochure describes the products and services for the teleprocessing industry available from this vendor. OSI provides consulting and educational services, software systems and products, and a publication—*Telesystems Journal.* ON-LINE SOFTWARE INTERNATIONAL, Hackensack, N. J.
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courses

Microcomputer Software
In 10 self-teaching lessons, the course, *Microcomputer Programming with Modu-Learn,* provides information on computer architecture, operation, and software systems. Each lesson contains sections on software concepts and software implementation, and emphasis is on the hardware/software rela-

(Continued on page 174)

Microdata makes everything on this page.

Together they make up the most powerful OEM computer systems on the market. Completely integrated systems.

Computers. Disc drives. Tape transports. PRISM™ display terminals. Ready-to-use software. Everything but the kitchen sink.

Microdata makes it all. So you get single-source responsibility, support and service.

Our systems utilize micro-programming and stack processing to give you superfast response time and improved overall system efficiency.

With our high-level systems programming language you can cut coding, debugging and software development costs by more than half. If you're looking for an OEM system that does everthing but wash your dishes, contact us today. Microdata Corporation, 17481 Red Hill Avenue, Irvine, CA 92714, P.O. Box 19501, Irvine, CA 92713, Telephone: (714) 540-6730, TWX: 910-595-1764.

Microdata

Circle for Immediate Need 36 and for Information Only 37 on Reader Card.

See us at our NCC Booth #3407

Meet the new NCR generation... the Criterion.

The new NCR Criterion is the first of a series which sets a standard for productivity in the information processing industry. It's a complete computer system.

A virtual machine, the Criterion changes characteristics to fit its job. It can become a COBOL 74 virtual system. A dynamic multiprogramming system. Or an NCR Century. Simply by changing the firmware. This means broader usability for you.

Through this new system, NCR continues to offer you the highest degree of compatibility, not only from model to model, but from generation to generation.

And the Criterion is extraordinarily fast: Up to 56 nanoseconds processor cycle time. It provides the power of a large-scale system in a remarkably small package to reduce your environmental requirements.

It offers virtual storage. Modular growth without processor replacement. Online program development. Expandable memory—128K to one megabyte—and extensive peripheral mixes to meet your needs. More reasons why we say the Criterion sets a standard for productivity.

To discover what the new NCR Criterion models 8550 and 8570 can do for you, call your local NCR office. Or write to EDP Systems, NCR Corporation, Box 606, Dayton, Ohio 45401.

NCR
Complete Computer Systems

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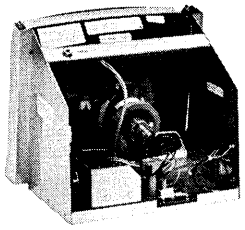
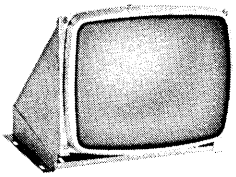
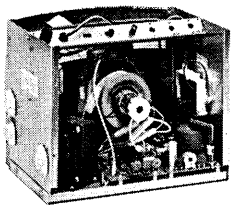
Reliability: Our data displays are outstanding solid-state designs with critically matched magnetics to optimize the performance levels and dependability demanded by your customers. We use the most advanced engineering and production techniques to assure consistency of performance. No data display is built with more deliberate attention to quality and reliability.



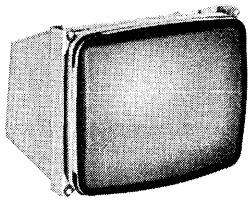
Delivery: We have been in the display electronics business long enough to know about rush orders. If you need it yesterday — we'll try to get it to you yesterday.



Experience: We've built thousands of displays for many of the major manufacturers in the country. Perhaps we already have a unit that would meet your requirements. With slight modifications. It would be less costly than starting from scratch. If you need a new, special package — we'll produce it for you, in the configuration you want, at minimal expense.



Cooperation: If you're developing a new data terminal, we will be glad to cooperate with your terminal design engineers in reviewing your exact specifications and developing the most economical display possible. And quickly! Whatever you need, we have the experience and talent to design it. And improve it.

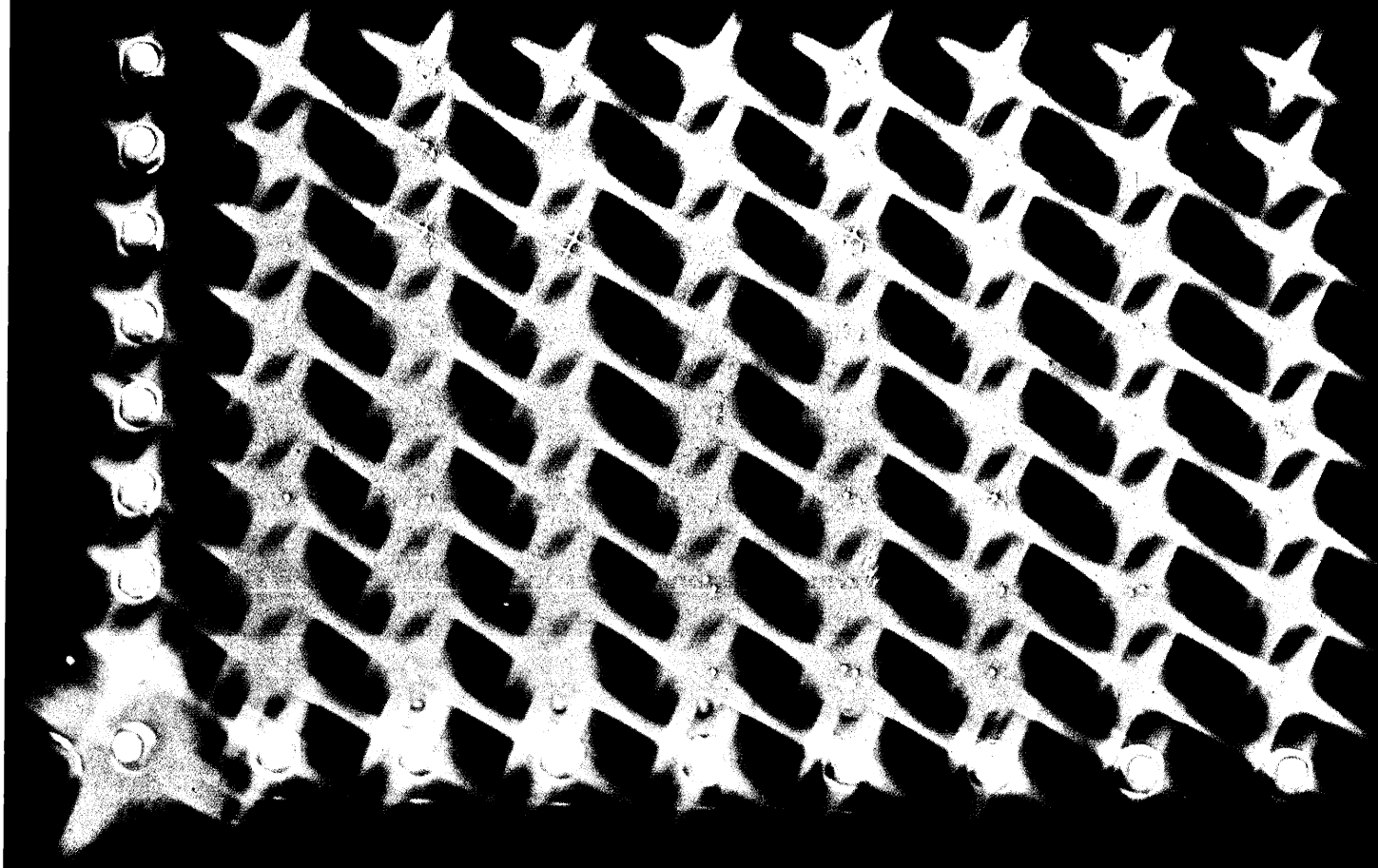


But don't take our word. See for yourself by contacting us today.

You'll come up with your own reasons for using Setchell Carlson CRT display modules.

If you make top-quality data terminals, here are four reasons to use Setchell Carlson CRT display modules in your system.

SC ELECTRONICS, INC.
A SUBSIDIARY OF AUDIOTRONICS CORPORATION
530 5th AVE. N.W. NEW BRIGHTON, MN. 55112 (612) 633-3131



T-bar® makes computer switch systems for IBM installations

T-BAR 3915/3916 Computer Switch Systems offer ■ matrix sizes up to 4x16s ■ compatible IBM channel switching ■ continuous configuration status ■ 3916 remote control ■ flexibility of peripheral pooling. Write or phone today for complete facts.

T-bar INCORPORATED

COMPUTER SWITCH DIVISION 141 Danbury Road, Wilton, CT 06897 • Telephone: 203/762-8351 • TWX: 710/479-3215

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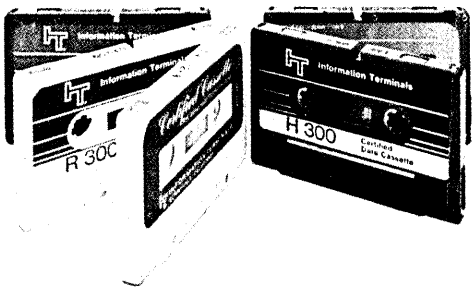
Try pricing out the cost of lost data.

Then you'll know why over half the certified digital cassettes in use throughout the world today are made by Information Terminals.

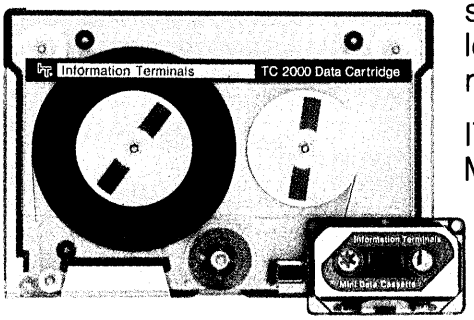
A dropped bit could mean only a misspelled name. It could also mean a check a hundred or a thousand times too big, a carload shipment sent to the wrong destination, or a fleeting moment in time lost forever!



100% Certified. You can be sure with ITC.

To help protect you, your company and your projects against such losses, ITC tests its computer grade information storage media 100% *after assembly.*

This means *every* ITC computer grade digital cassette, floppy disk, FLIPPY™ disk, ¼-inch Data Cartridge and Mini-Cassette is checked for perfect mechanical and recording operation before it leaves our hands. 100% Certified. You're sure with ITC.



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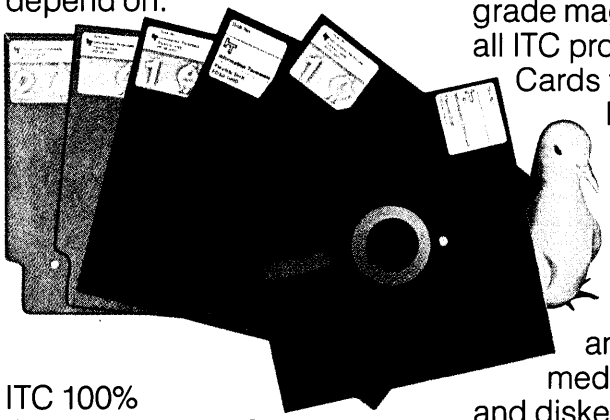

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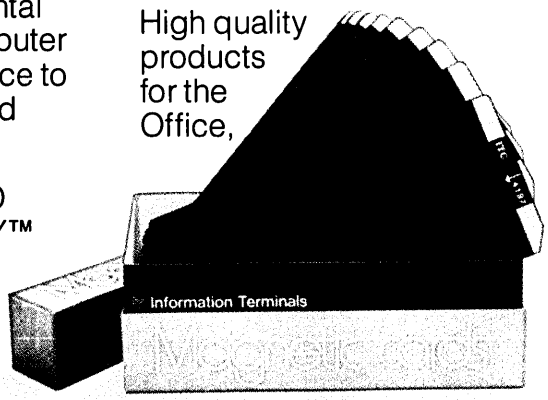

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CIRCLE 73 ON READER CARD

Editor's Readout

John L. Kirkley, Editor

Distributed Definitions

How many angels can dance on the head of a pin? Who invented peanut butter? What's the definition of distributed processing?

Three of the great unanswered questions of our time.

Given enough diligent research the first two are probably answerable. We're not so sure about the third.

As a buzz word whose time has come, the term "distributed processing" has some rocky semantic difficulties to overcome. Muddying the waters are a host of definitions and related terms, sometimes used interchangeably, sometimes expressing a subtle difference, and sometimes simply adding to the confusion.

*

"The question is" (says Alice in *Through the Looking Glass*) "whether you *can* make words mean so many different things. . . ."

"When *I* use a word," Humpty Dumpty said in rather a scornful tone, "it means just what *I* choose it to mean—neither more nor less."

*

Editors are a tenacious breed. Undaunted by conflicting opinions and red herrings like dispersed computing, distributive data processing, distributed computing, networked computing, and the like, we attempted to find some sort of morphological thread at the recent Data Communications Interface show in Miami.

Most of the people we interviewed agreed that any kind of straightforward configuration involving a communications network—a host cpu and user terminals that simply collect and transmit—does not qualify as a distributed system. Even if the terminals have a few smarts and do a little editing and formatting, the "base conditions" still aren't met. But from that point on, the muddy waters started rising.

Suppose, for example the terminals function as remote batch units during the night, but in the daytime operate as local functional processors. Does that system qualify? Or perhaps there is a cluster of very intelligent terminals—really computers in disguise—operating on a local data base but being polled regularly by the host cpu for summary data and data base update. And how about ridding ourselves of the central site's cpu altogether? We'll fragment the system into a ring network with nodes of minis and terminals, each doing individual jobs, as well as sharing information, and also acting as backup in case one or more nodes go down.

The banks may know; they are, after all, leading the way in reconfiguring based on data communications.

On the West Coast, for example, Bank of America is segmenting and distributing their application data base and specialized processing among clusters of mini-based modules. On the other hand (and on the opposite coast) Citibank is moving its computing power out of the centralized site and into the hands of its four major divisions. Because each division will have its own separate and distinct dp capability, this is clearly a case of decentralization, not distributed processing. Or is it?

What's causing the confusion? Well, the problem is simply this: we've been trying to define distributed processing in terms of specific configurations when in fact the term is a broad, inclusive concept. And concepts are notoriously slippery. Attempting to nail down a precise definition of what a distributed processing configuration is or is not is an exercise in futility.

Better to approach distributed processing as an umbrella term embracing a wide range of solutions available to the user . . . solutions that involve moving intelligence and processing closer to where the action is. The exact nature of the configuration is unimportant *except that it significantly improves the contribution that data processing is making to the running of the business.*

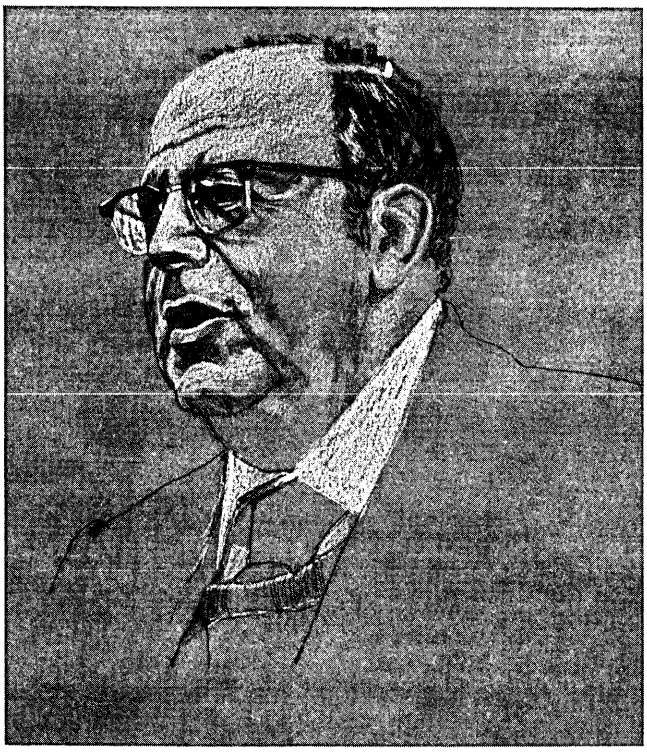
But beware. Distributed processing, no matter what form it takes, is not a panacea. Unfortunately some manufacturers of minis, microcomputers, and intelligent terminals, in a burst of messianic fervor, are making sweeping claims for whatever version of distributed processing fits in with their product base.

Some of the problems—and the promises as well—are addressed in this issue by Bob Patrick in his article, "Decentralizing Hardware and Dispersing Responsibility" on page 79; in Phil Dorn's sidebar, "The Trouble with Minis," p. 82; and in Ed Yasaki's conference report, "The Mini: A Growing Alternative," p. 139.

If you are contemplating that traumatic move—whether it be to centralization, decentralization, dispersing or distributing—we recommend these articles to you.

❋

CARL HAMMER
conference chairman



STANLEY WINKLER
program chairman

Conference for a Large Clientele

by Tom McCusker, Senior Associate Editor

Program blossoms into a record 125 sessions. Exhibit draws 300 vendors to New York Coliseum. A touch of history. And a promise of excellence.

It has been three years since that strange new phenomenon—the annual National Computer Conference—first opened in New York in June 1973 as a once-a-year successor to the twice-a-year Spring and Fall Joint Computer Conferences. Ever since, the people who put it on—the American Federation of Information Processing Societies (AFIPS) and their army of volunteers from the elite of computing science—have been agonizing over the problem of its size and content.

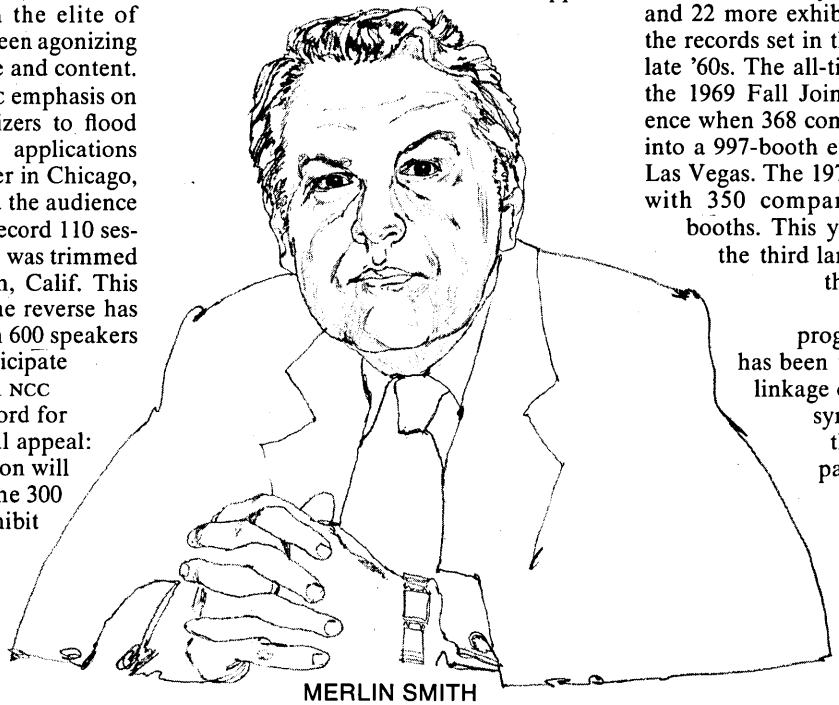
Criticism of previous JCC emphasis on technology led the organizers to flood the 1973 conference with applications oriented topics. A year later in Chicago, almost anything went—and the audience was overwhelmed with a record 110 sessions. The program in 1975 was trimmed to 89 sessions in Anaheim, Calif. This June 7–10 in New York the reverse has been selected as more than 600 speakers have been lined up to participate in about 125 sessions in an NCC that not only will set a record for talking, but for commercial appeal: its money-making exposition will draw an NCC record of some 300 vendors occupying 945 exhibit booths on three floors of the huge New York Coliseum.

The turnout to the exhibit and conference—which nobody at AFIPS officially will predict—could range anywhere from 35,000 to 45,000.

The size of this year's NCC is an indicator of economic health. After 18 lean months, business has improved and the vendors vigorously are going after it. The AFIPS exhibit staff had mapped out the exhibit for a maximum of 900 booths, but in mid-April went back to the drawing board to accommodate a waiting list of 20 companies. It has had only four cancellations compared with the usual 20 to 25 in previous years of economic uncertainty.

And the exhibit—with 145 booths more than last year's Anaheim show and 22 more exhibitors—comes close to the records set in the boom years of the late '60s. The all-time record was set at the 1969 Fall Joint Computer Conference when 368 companies were crushed into a 997-booth exhibit in two halls in Las Vegas. The 1970 Spring JCC opened with 350 companies occupying 960 booths. This year's turnout will be the third largest in the history of these computer shows.

The conference program, although huge, has been well structured into a linkage of more than 30 mini symposiums—a scheme that has been devised partly to accommodate persons unable to spend four full days in New York. For example, persons attending on



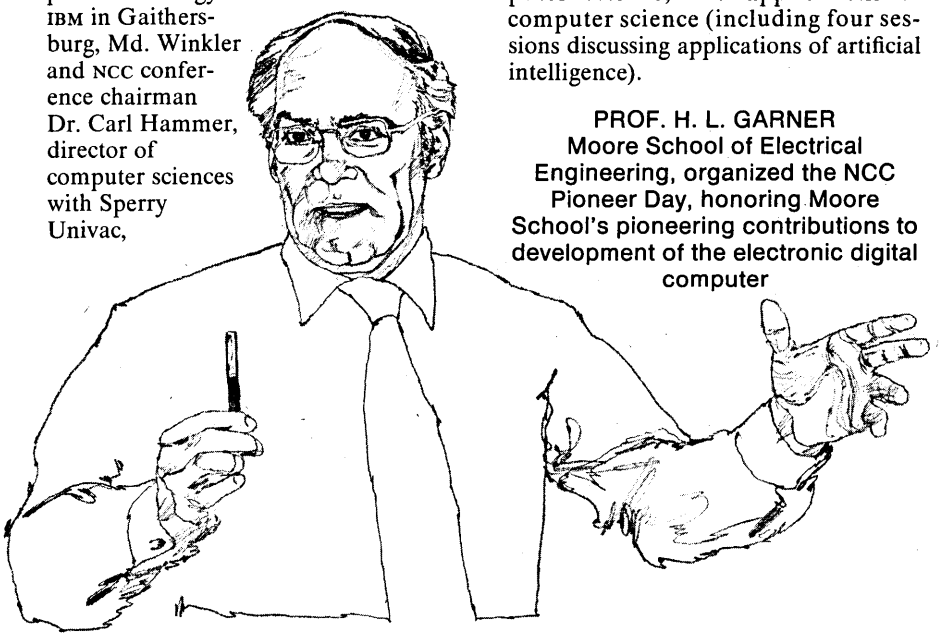
MERLIN SMITH
chairman of the NCC board

Tuesday would have a selection of seven complete symposiums on the following subjects: Data Security, Public Access to Computers, Criminal Justice Systems, Word Processing and Office Automation, Computer Architecture, Software Design & Engineering, and a three-session "Pioneer Day" gathering to discuss the story of the ENIAC computer. (See Conference at a Glance, page 58.)

"We structured the program to meet the informational needs of a very large clientele," explains program chairman Dr. Stanley Winkler, manager of applied technology with IBM in Gaithersburg, Md. Winkler and NCC conference chairman Dr. Carl Hammer, director of computer sciences with Sperry Univac, Washington, D. C., have been working for close to two years on the program which Winkler says "will set standards of excellence." For example, all of the more than 400 papers submitted to the NCC have been refereed by five persons. Hammer and Winkler recruited 1,247 referees and insisted that every paper, including invited papers, be refereed. To keep the conference, which is being held in the New York Hilton and Americana hotels, moving smoothly, every one of the sessions will start and end at the same time, with a 15-minute break between. Session chairmen have been instructed to advise authors to discuss rather than read their papers and to leave time open for question and answer periods. Another departure from previous conferences: questions from the audience will be submitted in writing. There will be no microphones in the audience and thus, "no speeches from the audience," Winkler says.

The conference program whose main theme is "Performance, Productivity and Profit," has been classed into three major themes, each with four subsets and subsets of these subsets. The first theme, Computers and People, has four subsets (or "tracks," as Winkler calls them): societal concerns, computer profession, issues in computing and applications serving people. Some 50 sessions will be held within that category, addressing subjects such as data security, public policy issues, public access to computers, software productivity, health care, computers and the physically handicapped and criminal justice systems.

A second theme, Systems, will cover computer systems, systems management, networks (11 sessions on that topic) and business and industry systems. The third theme, Science and Technology, will address computer and data base architecture, software, computer science, and applications of computer science (including four sessions discussing applications of artificial intelligence).



PROF. H. L. GARNER
Moore School of Electrical Engineering, organized the NCC Pioneer Day, honoring Moore School's pioneering contributions to development of the electronic digital computer

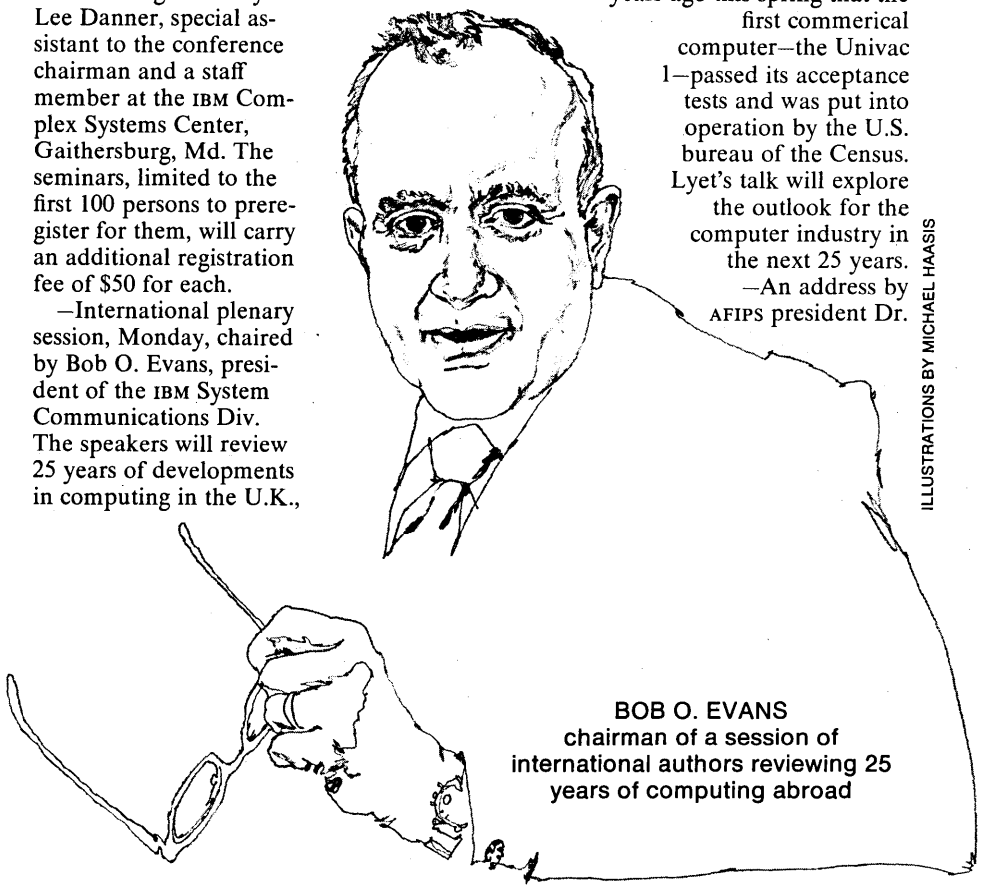
Other events:

—Eight professional development seminars organized by Lee Danner, special assistant to the conference chairman and a staff member at the IBM Complex Systems Center, Gaithersburg, Md. The seminars, limited to the first 100 persons to preregister for them, will carry an additional registration fee of $50 for each.

—International plenary session, Monday, chaired by Bob O. Evans, president of the IBM System Communications Div. The speakers will review 25 years of developments in computing in the U.K., Japan, the Soviet Union, Austria and Central Europe. Joining Evans on the one-hour panel in the Hilton hotel's grand ballroom will be Shiro Omato, president of Nippon Univac Kaisha, Ltd.; Dr. Anatoly A. Dorodnicin, an academician who is director of computer systems at the USSR Academy of Science; Prof. A. S. Douglas, Univ. of London; and Dr. Heinz Zemanek, director of the IBM laboratory in Vienna.

—A keynote address at 10:15 on opening morning, Monday, June 7 by L. Paul Lyet, chairman and chief executive officer of Sperry Rand Corp. It was 25 years ago this spring that the first commerical computer—the Univac 1—passed its acceptance tests and was put into operation by the U.S. bureau of the Census. Lyet's talk will explore the outlook for the computer industry in the next 25 years.

—An address by AFIPS president Dr.



BOB O. EVANS
chairman of a session of international authors reviewing 25 years of computing abroad

ILLUSTRATIONS BY MICHAEL HAASIS

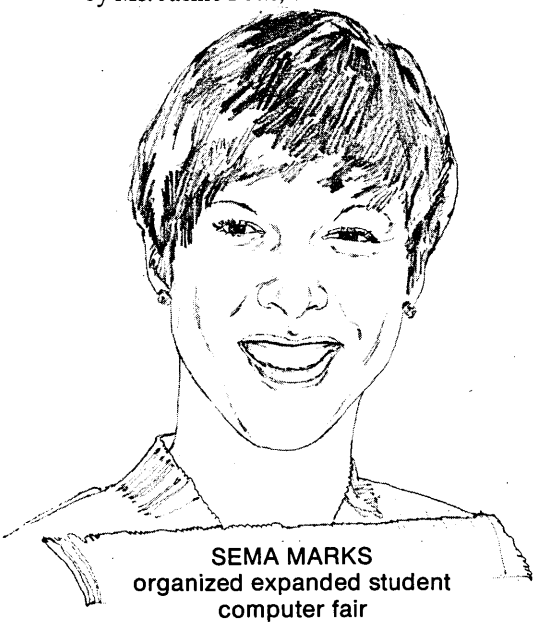
Conference Particulars

Dates: June 7–10
Place: New York Coliseum, Hilton and Americana hotels, New York.
Technical Program: Monday, 2:30 p.m.–5:45 p.m. Tuesday, Wednesday and Thursday, 8:30 a.m.–5:45 p.m.
Exhibits: Monday, 11 a.m.–7 p.m. Tuesday, Wednesday and Thursday, 10 a.m.–6 p.m.
Fees: Conference, exhibits and proceedings for entire conference, $75. Exhibits only for one day, $10. Exhibits and conference for one day, $25. Students, $10 for entire conference and exhibits.
Sponsor: American Federation of Information Processing Societies, 210 Summit Ave., Montvale, N. J. 07645. Telephone: (202) 391-9810. ✲

Anthony Ralston, Tuesday at 12:30, on the growing interrelationship and interdependence of science and government.

And there are many other events: a student computer fair, organized by Dr. Sema Marks, director of academic computing at City Univ. of New York. Everything goes this time—including drawings of computers by elementary school children, essays and short stories by older children, programs to print the bicentennial symbol and a simulation of the game Monopoly . . . A computer graphics art exhibit which will include nine computer art serigraphs by artists from Europe, the U.S., Canada and the Far East as part of a collection held by Systems Dimension, Ltd., a Canadian concern. The exhibit has been organized by Ms. Jackie Potts, of the Social Security Admin., Baltimore . . . A science film theatre . . . A technical demonstration of networking and interactive computer communications in which the facilities of Telenet Communications' national network will be used.

ANTHONY RALSTON
president of AFIPS which sponsors NCC



SEMA MARKS
organized expanded student computer fair

The Conference at a Glance

Monday, June 7
Morning:
Keynote Address
Afternoon:
International Plenary Session
Societal Concerns
Computer Profession
Issues in Computing
Applications Serving People
Computer Systems
Systems Management
Networking
Business and Industry Systems
Computer & Data Base Architecture
Software
Computer Science
Artificial Intelligence

Tuesday, June 8
Morning & Afternoon:
Data Security
Pioneer Day
Computing in Europe
Public Access to Computers
Criminal Justice Systems
Computer System Design
Computer System Management and Planning
Networking
Word Processing and Office Automation
Computer Architecture
Software Design & Engineering
Computer Science
Artificial Intelligence
Afternoon Only:
The Computer Profession

Wednesday, June 9
Morning & Afternoon:
Public Policy Issues
Computers and the Physically Handicapped
Industry & University Relationships
Medicine & Health Care
Microprocessors
Computer System Performance & Evaluation
Networking
Computer-Assisted Manufacturing
Data Base Architecture
Programming Languages
Computer Science
Computer Graphics
Afternoon Only:
Public Policy and Computers

Thursday, June 10
Morning & Afternoon:
Public Policy Issues
Computer Profession
Software Productivity
Minicomputers
Computer System Performance and Evaluation
Networking
Computer-Controlled Publication
Developing Data Base Systems
Software
Mathematical Programming
Computer Studies in the Humanities

In addition to the exhibits, the huge technical program and the side events, the fact that this year's NCC has special historical significance should draw more than the usual conference goer to New York this Bicentennial summer. It's the 25th anniversary of the first national Joint Computer Conference—a conference held Dec. 10-12, 1951, in the Benjamin Franklin hotel in Philadelphia. The co-sponsors were computer divisions within the American Institute of Electrical Engineers and the Institute of Radio Engineers. (The two societies were merged a decade later into the Institute of Electrical and Electronic Engineers—the IEEE.) At that conference 877 persons turned out to hear discussions on such storage devices as mercury relay lines, magnetic drums and cathode ray tubes and to hear presentations on systems such as the Census Univac System, the Burroughs Laboratory Computer, IBM's card-programmed calculator, the ORDVAC, and the Whirlwind I computer.

JACKIE POTTS
organizer of computer graphics art exhibit

Among the many changes in technology and society over that quarter century, a pleasant one is in evidence at next month's NCC: the participation of women on the program. Nearly a quarter of the session chairmen this year are women, the result of a publicized effort to attract women to the program, ". . . not because they are women, but because they have something important to contribute to the data processing field," said Winkler at the time.

He later recalled a positive response from a colleague who said she was pleased "for the first time ever being subjected to reverse discrimination." ✲

Issues at the conference

The more than 100 program sessions at NCC *will address the most diversified list of computer-related topics in the 25-year history of joint computer conferences. Here's a brief selection of topics that may interest persons concerned with some of the societal, management and technology questions:*

A panel of professional forecasters headed by the Government Accounting Office's Walter L. Anderson will transport their NCC audience to the year 2000 where "we'll look around and see how it feels." Anderson, who is associate director of financial and general management studies administration within the GAO, points to a number of situations 24 years away which he thinks will affect "Information Processing in the Year 2000," title of the session on Monday.

He'll set the environment in the opening presentation and look at such possible changes as population, gross national product, transportation and government. He'll also explore what he expects will be the dawn of an age of "energy equilibrium" where outgo must be balanced with income in the provision of energy. "My thoughts will be one-third extrapolation, a third educated guesses, and a third intuition," says Anderson who, for example, wonders how we would deal with the implications of a one-degree cooling of the earth's average temperature in the year 2000.

Other participants include: Univac resident futurist Earl C. Joseph who will explore, among other things, the need circa 2000 for closer ties between suppliers and customers and between management and labor as the resources of each become more limited; Frederick G. Withington, of Arthur D. Little, Inc., who will take a "broad jump" beyond his noted shorter-term forecasts for the information processing field; Margaret K. Butler, Argonne Research Center, who will look at the computer and the community as they might relate in 2000; and Murray Turoff, New Jersey Institute of Technology, who will apply his noted skills in computer conferencing to the informational needs of the future.

How it will feel in the year 2000. Will anything relate to the way present problems are handled?

Anderson thinks the session will interest individuals planning their futures as well as professional corporate and product planners. He said he hopes to "stretch people beyond their normal cycles of planning" in order for them to see if anything that is found during this imaginary journey to the year 2000 "can be brought to bear on handling our present problems."

As digital data networks proliferate around the world, the technical requirements for accessing their services and benefits are becoming vital to users, as well as to suppliers of data communication and data processing systems.

An intense battle has been raging for years over network access requirements. It revolves mostly around efforts within CCITT (Consultative Committee on International Telephone and Telegraphy) to develop a standardized communications protocol for packet networks. Behind the often esoteric technical argument, is an intricate battle in which private network operators are on one side, carriers on the other, and IBM and various other suppliers occupy ill-defined intermediate positions.

The private network operators, whose most vocal spokesman has been Louis Pouzin of France, insist that the user, if he wants to, should be free to establish his own end-to-end communications protocol, since this is the best way to optimize network service. Messages containing such user-specified protocols generally are referred to as "datagrams."

The carriers, concerned about optimizing network resources for *all* users, and worried about the loss of revenue implicit in datagram service, argue for a "virtual call" protocol. This scheme will require that the interfaces between their networks and customers' data communications systems be modified in ways specified by the carriers.

Last March, a CCITT study group recommended adoption of a proposed protocol based on the use of "virtual calls" and further intensified the debate.

The next round in this battle will be fought at the NCC in a Monday afternoon session, "Protocols for Computer Networks." One paper will be presented by Pouzin, the other by a group representing packet common carriers in the U.S., France, Canada and the U.K. The latter group was largely responsible for getting the proposed protocol standard approved by CCITT's study group last March.

Standard protocols: the battle of network operators and carriers moves to the NCC in June.

Pouzin chairs another session, Tuesday afternoon, "Interactions Between Private and Public Data Networks in Europe." It will explore the limitations which European telecommunications carriers (PTT's) have proposed for limiting access to their facilities by private networks. Since many U.S.-based companies use these facilities and supply systems in the European market, the basic issue had widespread significance. Papers will be presented by two users—Tom Baker of Unilever, Ltd. and Dieter Kroneberg of SITA, a communications consortium of international airlines—and by a carrier spokesman, Phillippe Picard of the French PTT.

The kaleidoscope of electronic funds transfer systems (EFTS) development is undergoing regular examinations by the consumer and trade press, by legislative and regulatory bodies, by consumer organizations, and by the public at large.

Two sessions at the NCC will attempt to bring some of the pieces into clear focus. One will zero in on the myriad of policy questions. Anthony J. Patinella, with IBM in Gaithersburg, Md., will moderate a panel discussion he says will "attack the policy implications of EFTS as they impact the consumer."

Everybody's a consumer, he notes, "and EFTS is traumatic in that it seems to mean losing that dynamic float associated with credit cards and checks." Data processing people, he says, in addition to their being affected as consumers, are affected by EFTS policy in that they need to know what computers and software can and cannot do under a myriad of existing and developing governmental regulations.

One panel member, William Smith, general counsel of the American Bankers Assn., will offer a rundown on some of the statutes. He also will touch on what a recent decision handed down by a Washington, D. C. circuit court, that remote terminals constitute branches, will mean to national banks.

Jack Benton, executive director of the National Commission on Electronic Fund Transfers, will offer a progress report on the embryonic commission's activities.

"We have a cross section of opinions represented on the panel," said Patinella, "and it's a controversial subject, so I expect a lot of lively discussion."

The less controversial side of EFTS, implementation, will

be handled by a panel of technologists moderated by an affirmed non-technologist, William R. Weber, Esq., counsel to the Subcommittee on Financial Institutions of the Senate Committee on Banking, House and Urban Affairs. "I'll be there to keep the stuff understandable to the average Joe," he quipped in mid-April.

Topics to be covered include networking problems, design of an EFTS switch, and security considerations in EFTS networks.

The authors of a paper on security considerations, D. Kaufman and K. Auerbach of System Development Corp., Santa Monica, Calif., offer a complete and clearly presented set of guidelines for developing a "secure, national system for electronic funds transfer." Basically, they'll present their security guidelines while they trace the steps in an EFT transaction from the point-of-sale device or automated teller terminal (remote service unit) to the computer facility of a financial institution (host processing center) where the transaction is authorized and the transfer of funds to or from a person's account is implemented.

Among other security precautions, the authors address the unauthorized alteration of transactions and explain the workings of such cryptographic techniques as network cryptographic devices (NCDs) and serial cryptographic devices (SCDs). They recommend that the National Bureau of Standards data

EFTS concerns: for some it's the float, for others it's security of EFTS networks.

encryption algorithm, recently a subject of controversy over its key size (March, p. 164) be used in these devices because it "has many desirable features" and "is rapidly becoming accepted as a standard for use in EFTS networks."

(The authors' position favoring the NBS data encryption algorithm should stir some controversy at this session and at one being held the previous day on security in computer networks. Kaufman who will give the presentation in the EFT session, also collaborated with Frank R. Heinrich of SDC in a paper at that session in which the algorithm also is treated favorably—see below. The authors are prepared to rebut the challenges by explaining how the key can be made vastly stronger.)

Kaufman and Auerbach explain in their paper that SCDs, similar to standard cryptographic devices which now are available, protect single telecommunications lines, and multiple lines when multiplexed. "NCDs, on the other hand, are quite unlike anything now produced. NCDs maintain a fully interconnected network. By using a unique key, each NCD can protect the communications path to any other NCD in the network . . . It is assumed that an automatic key update mechanism in the NCDs and SCDs will change the keys after a given amount of use."

The authors don't foresee the development of a nationwide EFT network for some time, although it's inevitable. But they think that when one emerges, it will consist of a linking of local systems already in existence. Thus, they recommend, national standards will have to be developed so that these local systems will be designed to operate as part of a national system. "Effective and secure after-the-fact linking of heterogeneous local systems may be virtually impossible," they say.

Despite some controversy over its security features, the NBS data encryption algorithm is vital in the design of secure computer networks that use currently available technology. That point is being made during a Tuesday afternoon session at the NCC on security in computer networks.

Two authors from System Development Corp., Santa Monica—Frank R. Heinrich and David J. Kaufman—will provide a list of reasons for the algorithm in a paper that describes an NBS-supported study of network security at the system design level. The network structure proposal, to which their studies led, incorporates data protection devices called network cryptographic devices and a special purpose processor, called the Network Security Center, to control access to the network. In recommending that the cryptographic devices make use of the algorithm, they point to "several characteristics" that make it "well suited" for use in network cryptographic devices:

"1. The secrecy of the transformation is dependent only on the secrecy of the key, not on the secrecy of the algorithm.

"2. The length of the key is 64 bits, eight of which are

An endorsement of the NBS data encryption algorithm.

reserved for parity. Thus there are 2^{56} potential keys. The key is not so short as to make exhaustive search techniques feasible, yet not so long as to make distribution to a remote device (which they recommend be attached to other resources in the network) difficult.

"3. The algorithm is block-oriented; that is, data is grouped into blocks of 64 bits which may be enciphered and deciphered independently of any other block. As long as the same key is used, position of time synchronization of encryption with decryption is not required.

"Due to routing and transmission differences, message transit time through a network is somewhat variable. Messages may arrive at a destination in a different order than they were sent. Using the NBS algorithm, cryptographic devices can be built which do not require position or time synchronization and are independent of the communication subsystem.

"4. When enciphering or deciphering, the change of a single bit in either the key of the input test has an unpredictable effect on the output text. This characteristic has two implications. First, the correct key must be known to make use of (i.e. decipher) enciphered information. Second, alterations to enciphered text cannot produce predictable changes to the corresponding clear text.

"5. Analysis of clear/enciphered test pairs does not aid in code-breaking to determine the key used. Penetrators are forced to use impractical exhaustive search techniques for code-breaking.

"6. The NBS algorithm is expected to be available as an LSI package. This will provide a low cost, high speed implementation suitable for use in network cryptographic devices."

With the advent of relational data bases, a situation could arise where "an entire company sits on seven discs." Yet, says consultant Gopal Kapur, top management's attitude toward the computer and the people who surround it is one of "complacency, indifference and lack of real concern."

Kapur, who is chairman of an NCC session Thursday, "Executive Management Must Become Involved," bases his find-

Management involvement: music appreciation courses don't solve the problem.

ings on interviews with some 35 managers. The interviews were conducted chiefly in person by Kapur and by George Glaser, San Mateo, Calif., consultant and former president of AFIPS. He said another 20 managers will be interviewed before he and Glaser present their comments at the NCC session and hopefully offer "practical solutions to the problems."

Kapur said he found the dollar cost/benefit ratio of computer resources to be "very low" in those organizations where it could be measured. "In most cases, they can't measure it."

One installation, by staying with old equipment, reduced

its hardware budget to zero; but it was spending $200,000 a year on personnel. Another didn't have production schedules. Where top management concern was found, a lack of followup also was observed. "They meet once, and the next meeting never comes about." Although the data processing manager is given a leadership role to play, it isn't a constant role. "He's driven by who is shouting the most," Kapur says he observed in his interviews. "User management stands accused of unwillingness to participate and cooperate," Kapur says, possibly because they don't have a close understanding of the dp operation.

As an example, users trained in "management by objective" techniques demand specific information instead of long listings. And because they don't understand the reprogramming implications, they cannot accept the fact that "it now costs more to get less."

Teaching management about hardware and buzzwords—or "music appreciation courses," as Kapur calls it—isn't going to solve the problem. Their involvement in the operation of data processing services will have to be considerably deeper.

An "underwriters laboratory" for software? Such a facility which could take vendors' programs apart to see if they are up to standard and fix what needs fixing, could emerge when automated software testing tools reach a higher level of sophistication and versatility.

There already are such tools available and more are on the way, says Edward F. Miller, Jr., of Science Applications, Inc., Oakland, who is chairman of an NCC session Thursday on "Automated Software Testing and Evaluation." Miller says four researchers will describe state of the art tools and techniques and give the audience a "peek into modern software engineering laboratories and a view of the future."

Humans will always have faulty memories.

Basically, the thrust of research at these labs is to create programs that read programs, especially large ones, and exercise every unit of the programs. One such program, called DAVE (a combination of some of the letters of a "Validation Error Detection and Documentation System for FORTRAN Programs"), is at work at the Univ. of Colorado and will be described in a paper by Leon J. Osterweil and Lloyd D. Fosdick of the university. They call it a working prototype that was designed at first to analyze only programs written in ANSI FORTRAN and later "liberalized" to accept most of the FORTRAN dialects available on Control Data equipment, specifically a CDC 6400.

Despite the limited application, the authors explain in their paper how they foresee the eventual incorporation of systems such as DAVE into a future generation of compilers. And, while admitting that a lot of new software-writing disciplines have caught on in recent years to produce high quality, error resistant programs, they feel there'll always be a need to include with these disciplines some form of testing activity. "Humans will always have faulty memories, be prone to committing keyboard errors, and will inject various other errors into their programs." Automated testing, they say, also should "offer some hope of helping determine the validity and worth of some of the enormous body of programs already in existence."

Other speakers will address symbolic testing and program analysis (James C. King of IBM); a practical system for automatic test case generation (Mark A. Holthouse of Science Applications, Inc. and E. S. Cosloy, Sperry Research); and experiments with a symbolic evaluation system (William E. Howden, UC-La Jolla, Calif.).

Seldom do session participants have a full dress rehearsal before their formal presentations, but most of the panelists discussing "AI Applications in Medicine and Science" at a Monday NCC session will be attending a four-day conference the week before the NCC. This AIM meeting (Artificial Intelligence in Medicine) at Rutgers Univ. will be an intensive workshop at which researchers will present their respective projects.

In this NCC session, then, these same researchers will discuss, on a less technical level, advances they are making in applying the principles in AI to problems in medicine and science. There's also the possibility that terminals linked to the Arpanet will be available for live demonstrations.

One of the panelists is developing a consultation system for ophthalmology. He has gathered a large body of knowledge about the processes of circulation of fluids in the eye. From a patient who is being diagnosed for glaucoma, then, details of the individual's condition can be obtained by the specialist and the computer can assist in an analysis and interpretation of the data, determine the stage to which the disease has progressed, and even recommend courses of treatment and therapy, providing also an explanation on the reasons for these conclusions. Thus it is more than merely a computerized classification of data. Rather, it aids the physician by making available to him the wide body of medical knowledge from which he must draw.

The process of accumulating this knowledge and setting it in some semblance of order, it turns out, is also assisting medical schools, says Saul Amarel of Rutgers, co-chairman of the session. "That's the way people in medical school can study and understand disease processes in detail," he adds. "It's also very important for some medical theoreticians in the sense that that's probably one of the best ways to organize medical knowledge."

But in addition, as new knowledge becomes available, it can be tested against the old or the old against the new, and additions and deletions made accordingly.

In the NCC session, there will be 10 panelists including two chairmen, telling about advances in the analysis and interpretation of various types of scientific data; in the planning of molecular genetics experiments; in model building for social psychology and speech perception; in the planning of chemical synthesis pathways; and in the use of medical knowledge in the processes of diagnosis and therapy. Future prospects for the use of computers as intelligent assistants to scientists and physicians also will be discussed.

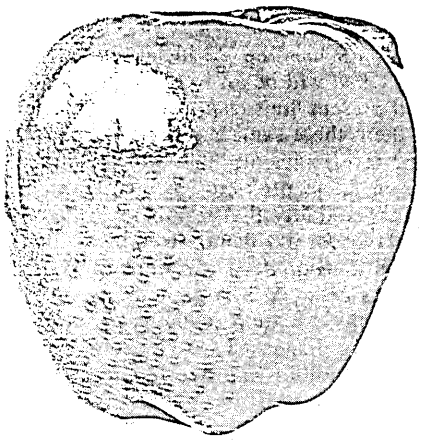
Persons doing business processing such as inventory control and accounting in which they make selective use of a data base may find MUMPS to be "another way to live," says Norman F. Hirst, chairman of an NCC session Friday, "An Introduction to MUMPS."

MUMPS shouldn't need an introduction, having been designed in 1968 as a high level interactive language at Massachusetts General Hospital in Boston for the medical community. (It's the acronym for Massachusetts General Utility Multiprogramming System.) And its more than 200 users have reported using it in medical, business, system and general applications.

MUMPS for business

Ostrin, a Greenwich, Conn., consultant, says it's a language, not unlike BASIC, which provides powerful string handling functions for text oriented data processing and with unusual data base facilities for ease in designing highly dynamic data bases. It has an ease of use—probably more so for the nonprogrammer than the programmer who has preconceived notions of what should be done in writing programs. MUMPS, Ostrin says, makes a fallacy out of the notion that all programs must be efficient. Its users develop programs that evolve. "Efficient" or fixed programs crumble if changed.

Since it was designed nine years ago, the language proliferated into some 14 different dialects, but now after a two year effort by users is close to becoming an ANSI standard—another factor that might find it gaining more use in business applications. ✲



'76 NCC Product Preview

Touring Herewith

Computers & Systems

E&L INSTRUMENTS INC.
Derby, Conn. **Booth 1413**

Microcomputer System
The Mini-Micro Designer (MMD-1) is an Intel 8080-based microcomputer system complete with tutorial and programming software for additional systems development tasks or tutorial usage. Included with the MMD-1 is 1K of random access memory and the power supply. The MMD-1 is priced at $350 in kit form, $500 assembled.
FOR DATA CIRCLE 291 ON READER CARD

INTERNATIONAL COMPUTER PRODUCTS, INC.
Dallas, Texas **Booth 1511**

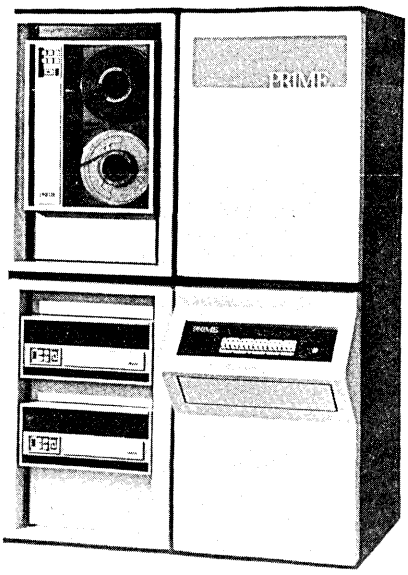
Computer System
This long-time peripheral manufacturer finally got into the computer business and will bring a system 8700 to the show. A minimum configuration consists of a 32K cpu, single crt, dot-matrix printer, and 9.6 megabyte disc, priced at $29,500. The system can be expanded up to 256K in increments of 8K bytes, and memory can be partitioned into 32K byte segments. Priorities are established as a function of the job stream and are dynamically controlled by the operator. The programming languages are assembler, BASIC, and/or a special symbolic language, SPL.
FOR DATA CIRCLE 292 ON READER CARD

MICRODATA CORP.
Irvine, Calif. **Booth 2345, 3407**

Computer Systems/Peripherals
EXPRESS is the name of a new family of systems designed for the oem and large volume end-user markets. Initially EXPRESS will come in two versions consisting of the stack-oriented microprogrammed architecture, disc storage, tape storage and one or more terminals. The first version, designed for low-cost entry, will feature a cartridge tape storage system and sell for approximately $20K. The larger version, offering cartridge or IBM-compatible tape, will be priced under $30K. Both models will be fully upward and downward software compatible. Software support will be provided for multi-terminal and multi-language processing. In addition to EXPRESS, a new fixed-media disc drive will be announced.
FOR DATA CIRCLE 293 ON READER CARD

PRIME COMPUTER, INC.
Framingham, Mass. **Booth 2719**

Computer System
There's a new top-of-the-line in the manufacturer's TEMPUS computer family, an upward and downward compatible model dubbed the 400. The TEMPUS lineup of entry level packaged systems



are tailored to principal market sectors, and the 400 at NCC will be in a CREATE IV configuration designed for the computation and time-sharing markets. The configuration will consist of 256K bytes of MOS memory, 2K of bipolar cache memory, floating-point hardware, a 30 cps operator terminal, 80 megabyte disc drive, 9-track, 800 bpi tape drive, 300 lpm printer, 16-line communications controller and operating system. Priced at $130K, the 16-bit Prime 400 will be shown exchanging files with a smaller 300 system.
FOR DATA CIRCLE 294 ON READER CARD

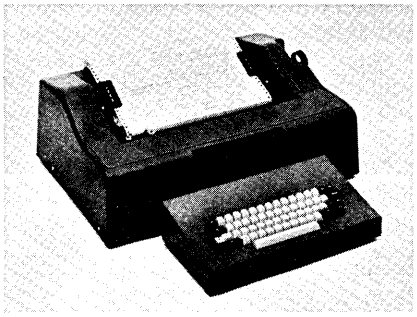
NEWMAN COMPUTER EXCHANGE
Ann Arbor, Mich. **Booth 1317, 19**

Microcomputer
At $289, the KIM-1 will be pitched as a complete computer system for the price of a programmable calculator. The KIM-1 consists of a computer module supplied by MOS Technology, a system power supply, and complete software and documentation necessary to operate. The fully assembled microcomputer includes an 8-bit microprocessor, 13 addressing modes, multiple interrupt processing, and 16-bit addressing of up to 64K. Also included are two 1K ROMS, 64 bytes of RAM, 15 I/O pins and an interval timer. The monitor and operating systems are stored permanently in the 2K rom bytes provided. A built-in audio tape interface, and tty interface round out the KIM-1.
FOR DATA CIRCLE 290 ON READER CARD

Peripheral Equipment

APPLIED COMPUTING TECHNOLOGY, INC.
Irvine, Calif. **Booth 3414, 16**

Printer/plotter
The 900 series of interactive medium speed matrix printers has been graced by a plotter version capable of 60 dots per inch horizontal resolution and 72



dots per inch vertical resolution. Data rates of 110, 300, and 1200 baud are switch selectable. The printer/plotter's bidirectional printing capability increases throughput above what the baud rate limitations suggest, it's claimed. Prices are $1,945 in oem orders of 25 units.
FOR DATA CIRCLE 295 ON READER CARD

exhibits should be especially rewarding at this edition of the NCC. a sampling of the many new products that will be apples in the users' eyes...

CALIFORNIA COMPUTER PRODUCTS, INC.
Anaheim, Calif. **Booth 2243**

Peripherals

Of all the products on display here, including a floppy disc system and CalComp's recently introduced vertical plotter (see July 1975, p. 99), perhaps the most important will be the highest performance member of the Trident

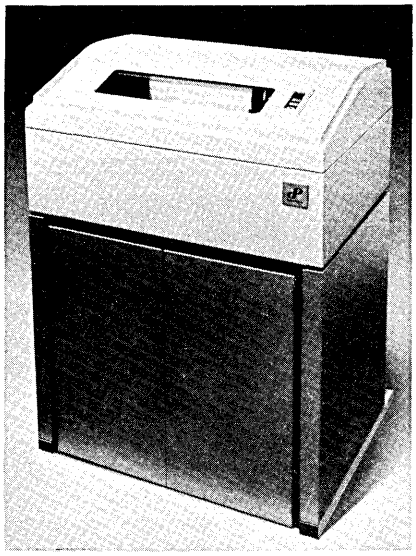
oem disc series introduced to date. The Trident 300 uses an IBM type 3336-II pack to store 300 megabytes of information at 6060 bpi densities. The track-to-track access time is 10 msec, and the transfer rate exceeding 1.2 megabytes per second. Slated for delivery in September, T-300 prices are $11,750 for single orders.

FOR DATA CIRCLE 296 ON READER CARD

DATAPRODUCTS CORP.
Woodland Hills, Calif. **Booth 1329**

Printers/components

Of the numerous products Dataproducts will display at NCC, perhaps the highlight will be the model 2290, a 136-column, 900 lpm printer rated at 900 lpm



performance. The patented field-proven Mark IV hammer-actuator (which is now being sold separately to oem's) is the heart of the 2290. Other features include a servo-controlled ribbon and paper system to eliminate complicated mechanisms while achieving single-line advance and slew rates in excess of 30 ips. There are only five types of pc boards in the 2290, an important maintenance consideration, and the mean time to repair is said to be less than 30 minutes. The oem price is under $12,500 for single units. Also on display will be four other line printers, five memories, a printer components display, and printer ribbons.

FOR DATA CIRCLE 297 ON READER CARD

DATUM INC.
Anaheim, Calif. **Booth 2741**

Peripheral Controller

Individually driven ports for up to four tape transports in any combination of 7- or 9-track, NRZI or phase-encoded recording method, any density from 200

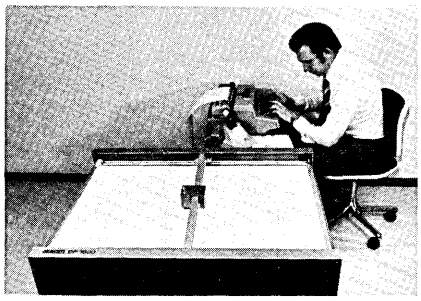
to 1600 bpi, and any speed from 12.5 to 200 ips can be controlled by this unusual controller, called the Quad-Density 5191. The unit is compatible with most major minicomputer manufacturers' offerings and features separate, parallel outputs for each drive instead of using the conventional daisy-chain method. Single unit prices start at $5,400.

FOR DATA CIRCLE 298 ON READER CARD

GLASER DATA CO.
Palo Alto, Calif. **Booth 2122**

Plotters

In addition to a range of plug-in compatible plotters for Hewlett-Packard's 9830 calculator, this firm will display a flat-bed plotter that offers 800 increment/second plotting of E size drawings



(44 x 34 inches). A builtin microprocessor provides internal line and character generation to reduce data transmission, memory and programming requirements. The plotters accept ASCII signals and are available with a wide range of interfaces, including RS232. Price of the DP-1700 is $17K.

FOR DATA CIRCLE 299 ON READER CARD

GNT AUTOMATIC, INC.
Waltham, Mass. **Booth 3114**

Peripherals

Paper and mylar tape equipment manufactured in Denmark and just coming to the U.S. market will be featured. The model 3424 punch is a tabletop unit that punches at asynchronous speeds up to 70 cps. (A 40-cps model is also available.) The 3424 can punch 5-, 6-, 7-, or 8-track tape without adjustment and features a positive punch pin drive. Tentative pricing is $1,750 each.

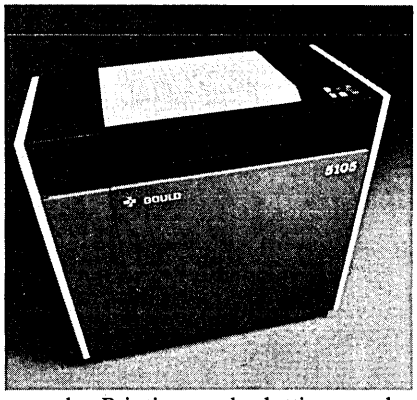
FOR DATA CIRCLE 300 ON READER CARD

GOULD INC., INSTRUMENT SYSTEMS DIV.

Cleveland, Ohio **Booth 2813, 15, 17**

Plotters/peripherals

In addition to a severe environment data logger/reader, Gould will be introducing the 5105, a 22-inch wide electrostatic printer/plotter capable of plotting D-size (22 x 34-inch) drawings in eleven



seconds. Printing and plotting resolution is 100 dots per inch in both directions. It plots graphics at three ips and prints 264 alphanumeric characters per line at a speed of 1200 lpm with a repertoire of 128 ASCII upper/lower case characters. A staggered head is used with offset stylii that arrange charges in two rows to increase contrast. On-line interfaces are available for many major minicomputers. The 5105 carries a price of $15,500 that is dependent on options and interfaces.

FOR DATA CIRCLE 301 ON READER CARD

INTERDYNE CO.

Van Nuys, Calif. **Booth 2635**

Peripherals

One of the more unusual products displayed at NCC will be the UNIREEL model IC 1300, offered as a possible alternative to low-performance cassette

and cartridge drives. The drive is a self-threading device single-motor device that takes a UNIREEL storage package that measures 2⅛ inches in diameter, weighs less than an ounce and contains approximately 140K bytes of information. The tape speed is 12 ips, with an optional search speed of 60 ips. Control logic protects against inadvertent UNIREEL removal, tape run-off, etc. The new device is priced at $400 in evaluation quantities.

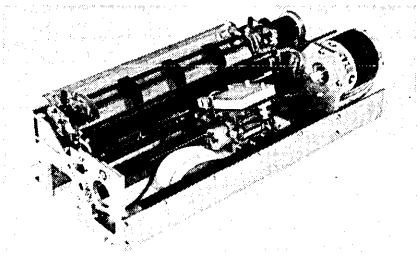
FOR DATA CIRCLE 302 ON READER CARD

MITSUI & CO. (USA), INC.

New York, N.Y. **Booth 3509, 11**

Serial Impact Printer

This large trading corporation will be bringing the Shinko "HELIANTHUS" M-60 impact printer to the fair. The 60 cps unit features heavy duty design, 128



character font for printing up to 158 columns on standard size paper. The M-60 also features capabilities for using as a bank passbook inserter and for multicopy generation or even two color printing. Production quantities will be available during the summer for the M-60 which is priced at $1,410 in orders of a thousand.

FOR DATA CIRCLE 303 ON READER CARD

POTTER INSTRUMENT CO., INC.

Plainview, N.Y. **Booth 1333**

Peripherals

In addition to a high-performance oem line printer, a plug-compatible disc and printer controller for the IBM System/3, and an off-line print station, Potter will introduce the LP6351, a 500 lpm printer (with full 132-column lines) to oem's. The 6351 uses Potter's helical platen concept wherein printing is accomplished with only two different moving parts, hammers and the platen. There are 22 hammers plus the spiraling platen with all hammers set in a single accessible bank for minimum maintenance. Microprocessor logic provides character generation and print control. The LP6351 is priced at $4,600 each in orders of 100 and initial deliveries have begun.

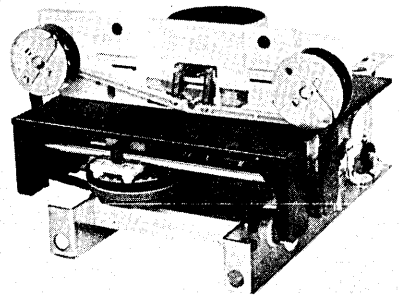
FOR DATA CIRCLE 304 ON READER CARD

PRACTICAL AUTOMATION INC.

Shelton, Conn. **Booth 1631, 33**

Oem printer

The DMTP-6 series of oem alphanumeric serial input data printers is available in three sizes, 35 columns, 60 columns, and 80 columns. They use ordinary paper up to 8½-inches wide and ribbon or impact sensitive paper rolls. Input is serial with proprietary dot matrix heads used as the printing medium. Character pitch is normally 12 per inch but is variable and character enhancement can be achieved through optional electronic controls. the input rate is 110 characters per second. Character height is formed in a 7 x 5 matrix to produce a full ASCII set of 64 characters. Line rate is length dependent as, when the end of line signal is received, the head returns home. Pricing for the 35-column units is typically



$182.50 in 100 quantity orders. Various control board options can be offered: power supplies, bit parallel, character serial input, parallel input, and RS232C communication at up to 1200 baud.

FOR DATA CIRCLE 305 ON READER CARD

STANDARD MEMORIES, INC.

Newport Beach, Calif. **Booth 2032, 34, 36, 38**

Mini Storage

The PINCOMM 'I', a pin-to-pin compatible memory with up to 32K words of capacity for Interdata Models will be featured. The memory attaches to the Interdata models 50, 55, 70, 74, 7/16, 7/32, and 8/32. The access and full cycle times of 275 nsec and 750 nsec, respectively, are cpu-dependent. Prices are $1,900 in single orders.

FOR DATA CIRCLE 306 ON READER CARD

SYKES DATATRONICS INC.

Rochester, N.Y. **Booth 1711, 13, 15**

Peripherals

An oem floppy disc system kit will be displayed consisting of a microprocessor-based controller for either IBM compatible or dual density formats, and up to four disc drives. The smart controller provides functions generally done in software, including hardware address search, automatic sector and track sequencing, a first-in, first-out buffer for asynchronous operation, and automatic character redundancy generation and detection. Only 13 lines are required for the complete interface to transmit data, disc commands, and disc status. Price for a single drive kit is $1,398.

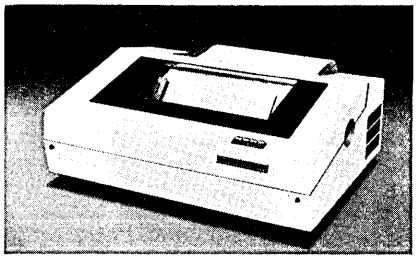
FOR DATA CIRCLE 307 ON READER CARD

TOKYO JUKI INDUSTRIAL CO.

Tokyo, Japan **Booth 3240**

Peripherals/Subsystems

In addition to a buffered card punch, a photo engraver, and a data recorder, this firm's North American office will display a fast serial printer, the model 5703. Equipped with dual printing heads, the unit prints at 330 characters



per second, or 80 132-character lines per minute. A 7 x 9 dot-matrix is used to represent 64 ASCII characters. An original plus up to five copies can be generated. The vertical forms control is a two-channel unit that uses paper tape. Prices get down to $2,200 per unit in quantities above 100.

FOR DATA CIRCLE 308 ON READER CARD

ZETA RESEARCH
Lafayette, Calif. **Booth 3501**

Plotter
One of the things IBM seems to have temporarily overlooked is plotting capability for its 5100 desktop computer, but this resourceful supplier has seen to that! The model 1250 operates from 2-20 times faster than competitive units, it's claimed. The 300/1200 baud, 3,000 step-per-second plotting system is available in both 12- and 36-inch plotters. The plotter is priced at $9,950.

FOR DATA CIRCLE 309 ON READER CARD

Terminals and Communications

APPLICATIONS GROUP INC.
Maumee, Ohio **Booth 2127**

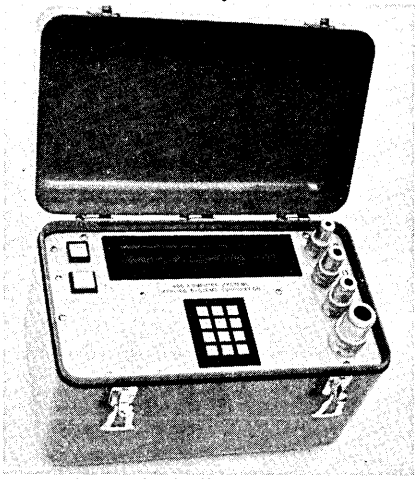
Data Terminals
The AG 90 and 91 are alphanumeric data terminals with 64 character ASCII sets displaying eight lines of 42 characters, or a total of 336. The AG 90 has

a typewriter style keyboard and the AG 91 has a tty-style keyboard. A third model, the AG 95 is similar to the 91 but features graphics capability. In graphics applications, the display matrix size is 80 x 256 points with a resolution of 33 points per inch. The standard interface is RS232. A model AG 95 is priced at $2,200.

FOR DATA CIRCLE 310 ON READER CARD

APPLIED SYSTEMS CORP.
St. Clair Shores, Mich. **Booth 2100**

Communications Terminal
The ASC comprises a numeric pad and a plasma display of 32 characters to serve as a portable communications terminal. Additional keyboards are offered



as options (including an upper case ASCII unit), and various plasma screen sizes go up to eight lines of 32 characters. The ASC operates in full- and half-duplex mode, with switch selectable parity. Prices begin at $2K.

FOR DATA CIRCLE 311 ON READER CARD

DATA TERMINALS & COMMUNICATIONS
San Jose, Calif. **Booth 3529**

Data Terminal
The DTC-302 HyWriter KSR hardcopy terminal uses the Diablo Hytype II printer and an advanced microprocessor controller upward compatible with the firm's earlier DTC-300/S. Offered in ei-

ther desktop (standard) or mobile pedestal stand version (optional), the 302 is capable of print speeds of 45 cps. A new buffer optimization and monitor technique allows the 302 to operate at optional data rates as high as 1200 baud. Other features include additional levels of print hammer intensity for better quality printing, and ribbon out/paper out interlocks. The base price of a single unit is $3,490.

FOR DATA CIRCLE 312 ON READER CARD

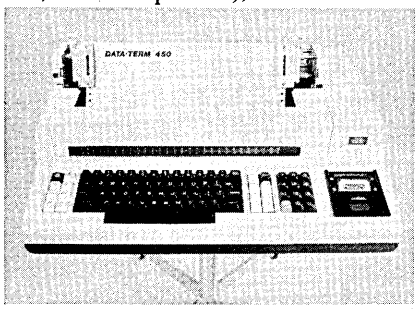
DELTA DATA SYSTEMS CORP.
Cornwells Heights, Pa. **Booth 2631, 33**

Intelligent Terminal
It's hard to beat the $3,100 price tag on this combination intelligent terminal and floppy disc system, each of which is under microprocessor control. The display terminal can have up to 16 kilobytes of read/write memory and is programmable from the keyboard. Standard features include a keyboard with a set of programmable function keys, display for upper/lower case, etc. The disc subsystem can contain up to six drives and uses a microprogram to interpret a sophisticated set of record and file storage and retrieval commands that can be sent from the terminal or any other RS232-compatible device.

FOR DATA CIRCLE 313 ON READER CARD

INTERTEC DATA SYSTEMS CORP.
Charlotte, N.C. **Booth 2807, 09, 11**

Data Communications Terminal
The DATA-TERM is a serial impact data terminal offered the oem market. It features 132-column print widths, portability (it weighs less than 45 pounds), standard 45 cps performance (optional 60, 120, and 180 cps rates), an IBM Selectric



configured keyboard with tactile feedback, a 30-key alphanumeric "gear shifted" keypad, horizontal tabs, vertical tabs, variable forms control, and a user programmable character set. Other optional features include an APL/ASCII character set, IBM 2740-41 compatibility and a microprocessor-controlled cassette storage device called Intercette. The basic terminal is priced at $1,300; Intercettes go for $700. The terminal's 8080 microprocessor can be expanded to a full 64K bytes of memory to accommodate high-level software routines loaded from the Intercette.

FOR DATA CIRCLE 314 ON READER CARD

MEGADATA COMPUTER AND COMMUNICATIONS CORP.
Bohemia, N.Y. **Booth 1005, 07**

Programmable Terminal
The 700 system is the second generation of this manufacturer's Powerscope, on the market since 1972. The 700 is one of the more powerful programmable intelligent terminals around, featuring a 12-bit mini expandable from 4-64K, 126-key keyboard with up to 71 application programmed function keys, a 15-inch diagonal display, assembly language programming, status lights, a full complement of peripherals, and software compatibility with most any cpu. Even special languages such as Farsi or Hebrew, or even hieroglyphics can be

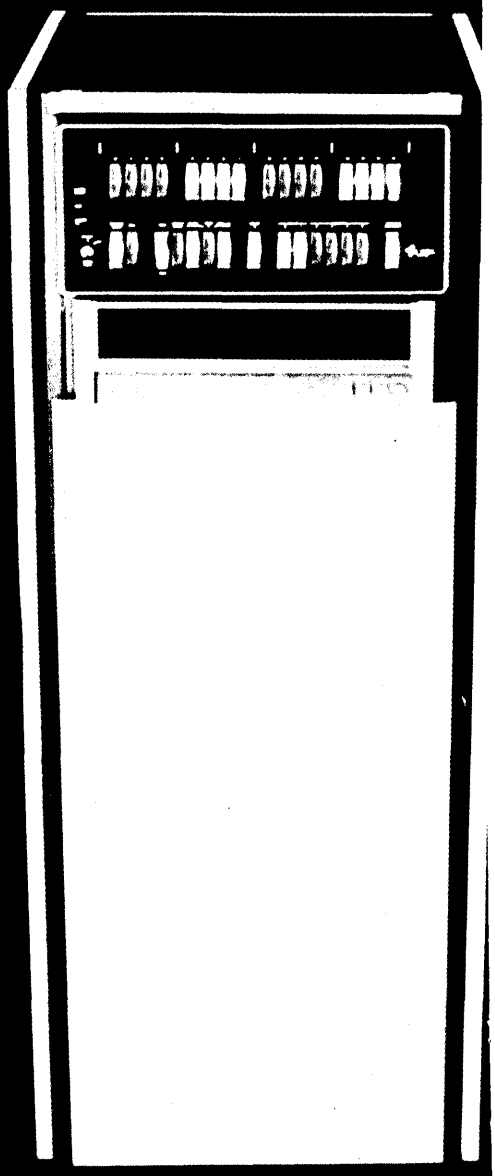
Introducing the UN-remote

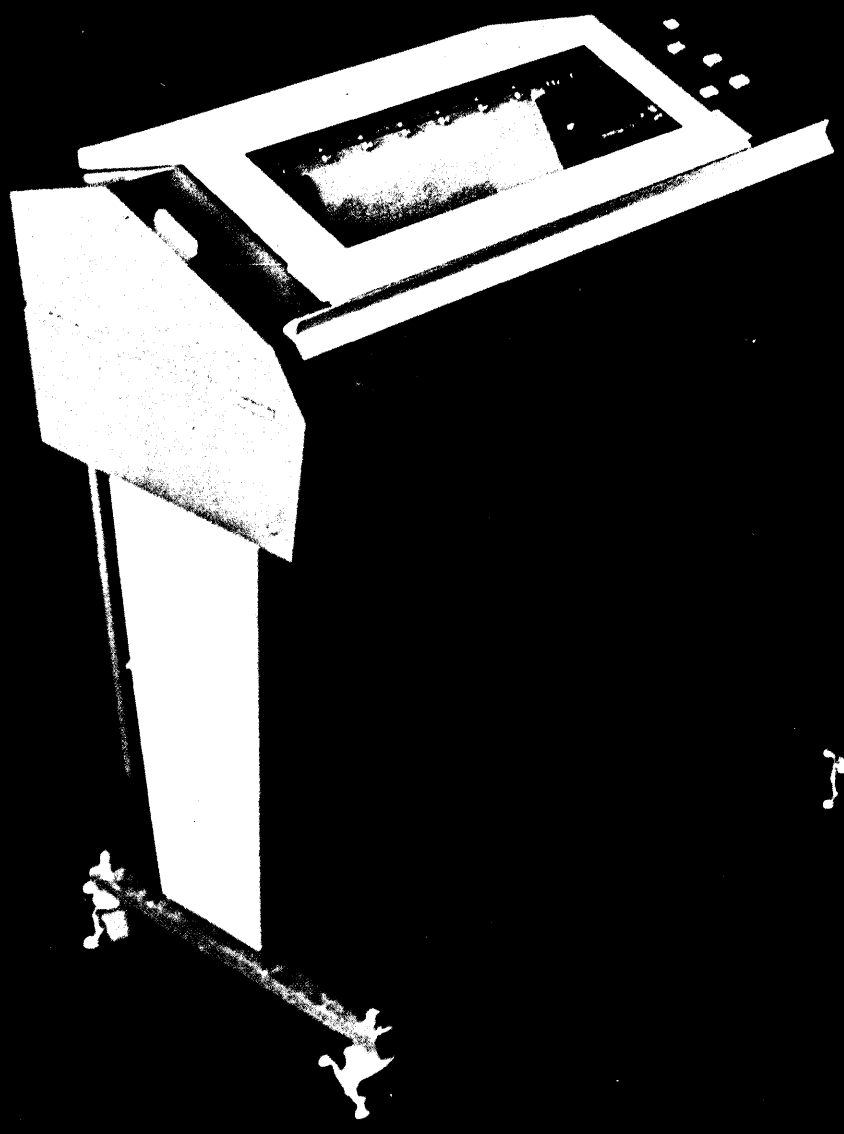
It's an intelligent Remote Batch Terminal. It's a satellite computer. And a very un-remote stand-alone processor. All in one.

It's the MODCOMP Remote Terminal System. And it allows people in your outlying offices or plants to handle a lot of their local computing needs on the spot. Without running up long distance line charges on jobs that can be handled more efficiently at the local level. Without using expensive CPU time on the big central computer when a smaller computer can do the same job a lot more economically with no transmission delay or communications problems. Yet when they need to, they can still use the Remote Terminal System as an RJE terminal or satellite computer communicating directly with your IBM, Control Data or Univac host processor.

MODCOMP Remote Terminal Systems come in three different versions. So you can pick the one you need, depending on how much local computing power you need.

All three systems include a console CRT, 300CPM card reader, 300LPM line printer, plus emulators for IBM 2780/3780 and CDC 200UT terminals. Univac 1004 and HASP Workstation emulators are also available. Peripheral options include mag tape units and faster printers or card readers.





Remote Terminal System.

MODCOMP RTS-1 The basic system, but one that still packs a lot of power. When it's not being used as an intelligent RJE terminal communicating with the central computer, a large number of local tasks can be handled by its MODCOMP II computer with 64K bytes of core memory and built-in dual floppy disc unit.

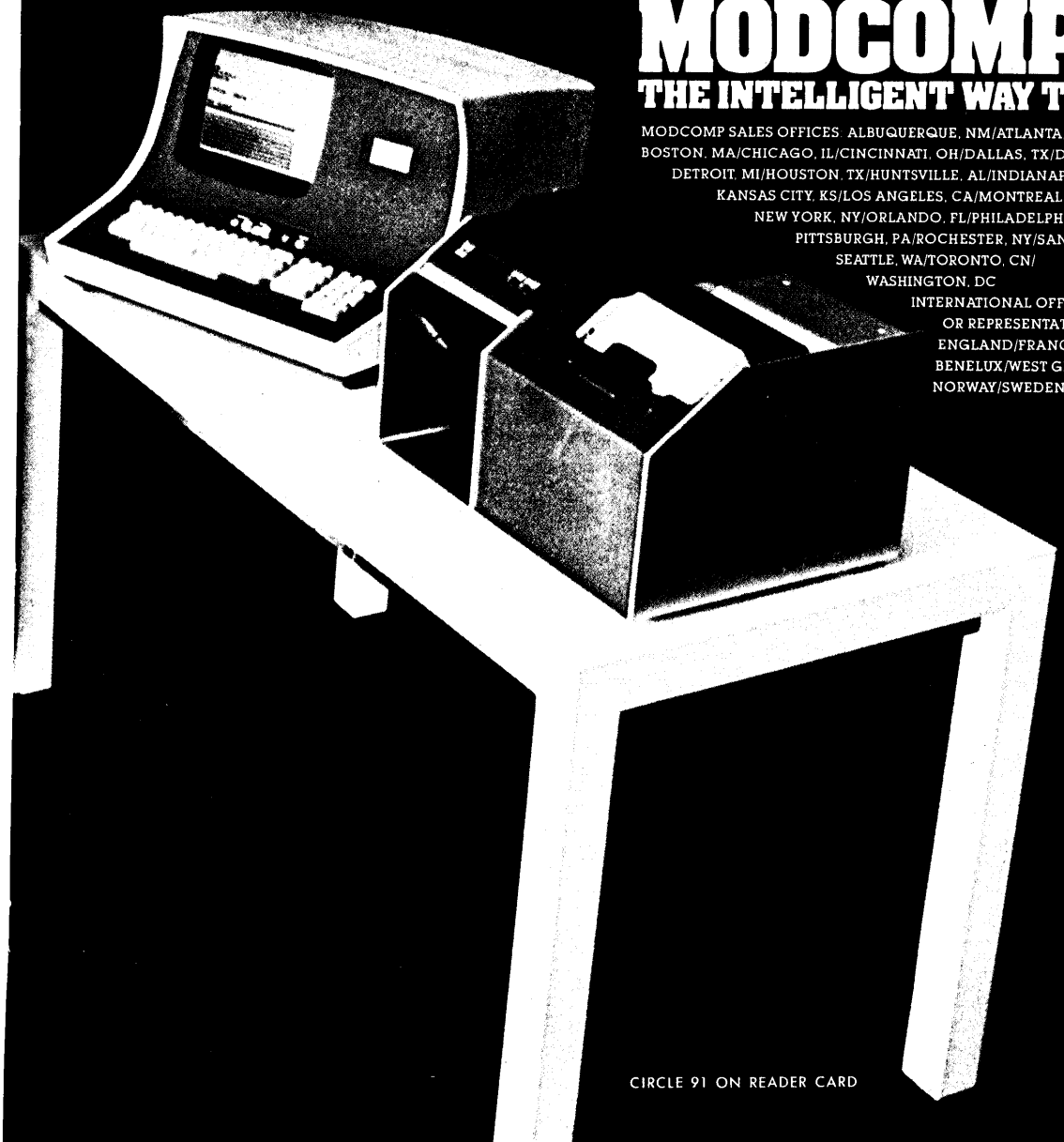
MODCOMP RTS-2 (illustrated) is the next step up. It can simultaneously handle both remote batch and local processing. And its moving head disc gives you a lot more storage capacity and computing speed.

MODCOMP RTS-3 The powerhouse. 128K bytes of core memory. Floating point hardware. And a dual disc unit with 5-million bytes of storage. Running both remote and local processing concurrently, it can handle just about anything you throw its way.

MODCOMP Remote Terminal Systems. They're all part of what we call MODCOMP TSP. Meaning Total Systems Performance.

Which in turn means that a MODCOMP Remote Terminal System will cost you a lot less money than trying to get anywhere near the same performance anywhere else.

For more information, call your nearest MODCOMP sales office. Or write for detailed brochure to Modular Computer Systems, 1650 West McNab Road, Ft. Lauderdale, FL 33309. Phone (305) 974-1380.
European Headquarters: Export House, Woking, Surrey, England. Phone (04862) 71471.



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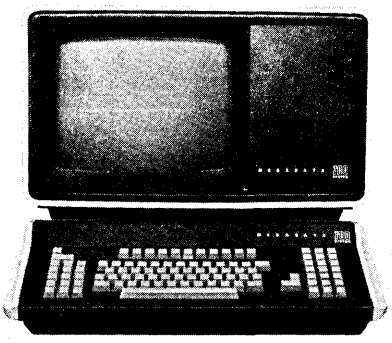
INTERNATIONAL OFFICES OR REPRESENTATIVES IN ENGLAND/FRANCE/ BENELUX/WEST GERMANY/ NORWAY/SWEDEN/JAPAN.

CIRCLE 91 ON READER CARD



generated on this particular terminal. Typical applications include banking, order processing and distribution control, reservation systems, text editing, payment processing, data input/verification/updating, etc. The average price of the System 700 is $3,500 in orders of 50, depending on application.

FOR DATA CIRCLE 315 ON READER CARD

TECHTRAN INDUSTRIES, INC.

Rochester, N.Y. **Booth 2825, 27, 29**

Floppy Disc Terminal

This RS232 compatible unit connects to data terminals, crt's, and minicomputers to provide random access storage. Features include IBM formatting, selectable speeds of 110, 300, 1200, 2400, 4800, or 9600 baud; track/sector addressing; high speed character string searching; bidirectional skipping; manual/remote control; insert/delete character, word, line, and file; a line recording mode for adding to previously recorded data; dual RS232C interfaces; and track/sector indicators. Base prices begin at approximately $2,500.

FOR DATA CIRCLE 316 ON READER CARD

THE VADIC CORP.

Mt. View, Calif. **Booth 2846**

Communications

MANDATE (Multiline Automatic Network Diagnostic and Transmission Equipment) is offered to large multidrop leased line users the ability to control all points in the communications network from a central site no matter how complex the network configuration without using costly supervisory channels. Due for availability early next year, MANDATE allows the entire system to be upgraded from a system utilizing only manual controls to a fully automated system without altering mainframe hardware or software. Systems using around 100 type 201 modems would be priced something under $1K. A multiline automatic calling system, RS232 to RS366 converters, auto dialers, and low- and medium-speed modems will also be on display.

FOR DATA CIRCLE 317 ON READER CARD

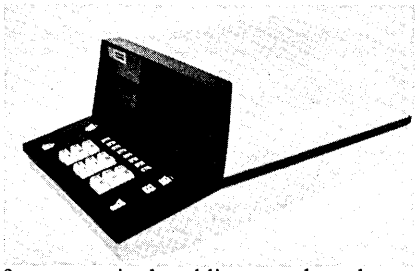
Special-purpose Systems

ANDERSON JACOBSON, INC.

Sunnyvale, Calif. **Booth 1212, 14**

Text Editing Recorder

The AJ 730 provides the capability to store and edit data off-line, and to communicate on-line to a remote computer, remote terminal, or a network of data devices including other AJ 730s. The 730 automatically handles a number of different terminal and line speeds and protocols. It interfaces with both ASCII and Selectric terminals and computers. Philips-type cassettes are used for the storage medium, holding up to 1,550 lines of data per cassette. Search and line edit modes can then be used for file and text searches and the correction or updating of previously recorded data. Priced at $2,850, first units of the AJ 730 have gone to the field.



FOR DATA CIRCLE 330 ON READER CARD

SCIENCE ACCESSORIES CORP.

Southport, Conn. **Booth 1803, 05**

Digitizer

This firm's line of user-oriented digitizers has now been complemented by an oem offering that features a new approach to convert point locations and graphic line representations into digital information for processing. The NT series employs two point microphone/sensors rather than linear microphones. They can be mounted at opposite ends of a bar assembly or as individual sensors, depending on the model selected and on the user's needs. Distances from the pen or cursor are then measured as times for a supersonic pulse to reach the sensors. The result is "triangular" coordinates which are converted by formulae into Cartesian coordinates. The price is approximately $1,500.

FOR DATA CIRCLE 319 ON READER CARD

KEY TRONIC CORP.

Spokane, Wash. **Booth 1706, 08**

OCR Wand

The KR3 handheld optical character recognition device permits data entry operations to be automated at speeds of 50 cps. The device can be used with a crt terminal for mixed entry—keyboard plus OCR interactive inputting. Both typed or printed human-readable data can be processed, numerals 0 through

9 and OCR A; a second model, the KT9 expands the recognition capacity. The wand can be moved across typed lines at speeds up to 10 ips, equivalent to 100 cps for conventional 10-point type. Prices begin at $3,250.

FOR DATA CIRCLE 318 ON READER CARD

TAB PRODUCTS CO.

Palo Alto, Calif. **Booth 2707, 09, 11**

Data Entry Systems

This manufacturer has added a microprocessor to its line of buffered keypunches to produce a unit that in addition to standard capabilities features up to 28 program levels (eight standard), automatic program sequencing, up to 220 memory constants (58 standard), left zero or blank fill, check digit and standard computation, RS232 interface, and faster operation in punch, punch/print, verify and interpret modes. Prices start at $6,850 for the standard unit, or $144/month on a one-year contract, plus $42/month for maintenance.

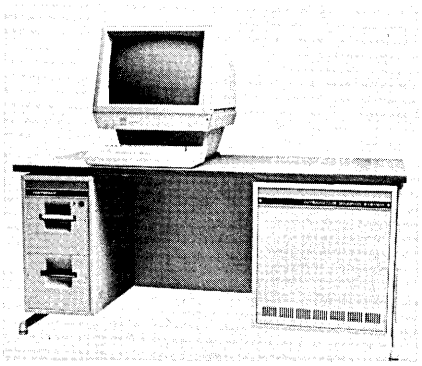
FOR DATA CIRCLE 320 ON READER CARD

TEKTRONIX, INC.

Beaverton, Ore. **Booth 2101**

Graphics System

Tektronix' product line has graduated from terminals that need constant support from host cpu's to a true graphics system that can function as a much more powerful terminal, or in a reasonably capable standalone mode. Two computers are incorporated in the 4081: a general-purpose processor and a special display processor. Together they control the 19-inch display, tape cartridge, ASCII keyboard, 12 function keys, a joystick, and RS232 communications interface. The complete configuration is priced at $27K, surely one of the lower priced units with such capabilities. It



Four problems in Data . . . and how Wright Line's System helps you

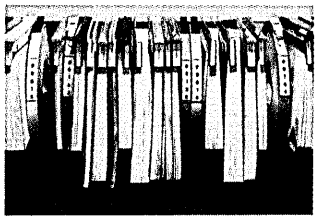
Processing Documentation New Documentation Handling solve them . . .

1 The many different sizes and shapes of documentation . . . manuals, computer reports and listings, flow charting and layout forms, punched cards and even magnetic files . . . don't fit properly into conventional office equipment.

2 Various documentation that is used together should be filed together. Even special purpose equipment doesn't allow you to intermix different sizes and shapes.

3 Reference documentation should be at your fingertips. Existing equipment does not recognize both a filing mode and a reference mode.

4 Documentation moves physically from place to place; in systems, programming, operations and user departments. Existing equipment does not provide total compatibility at all locations.



Wright Line's New Documentation Handling System provides the answer to these problems and gives you the tool you need to organize and control your D.P. Documentation System.

With its new center hook hanging concept, Wright Line's documentation handling system provides hanging cartridges for software, hardware and user manuals; hanging cartridges for print-out reports and listings; hanging binders for user output reports and hanging folders and document holders for every size and shape of documentation including cards, microfiche, flow charts, layout forms and project correspondence. And, each of these devices fits interchangeably into all equipment in the line. You can choose from a wide variety of equipment designed for both filing mode and reference mode use. The line is so complete you can configure work station and library environments to your exact needs from the ground up or add new organization and control by combining elements of this new system with your existing furniture.

Get complete details on this exciting new way to organize and control your Data Processing Documentation System. Circle the readers' service number or write today Wright Line Inc., 160 Gold Star Boulevard, Worcester, Mass. 01606

Wright LINE

Offices and representatives in principal cities throughout North America

"suddenly occurred" to Tektronix engineers that the cursor inside their venerable BiStable tube could act to some extent as a refreshable display, capable of continuously redrawing more than a thousand inches of the terminal's 20,000 inches of total image capacity. Thus, the user doesn't have to continually request the computer's assistance to update every line. Software capabilities include three-dimensional representations, hidden lines, zooming, etc.

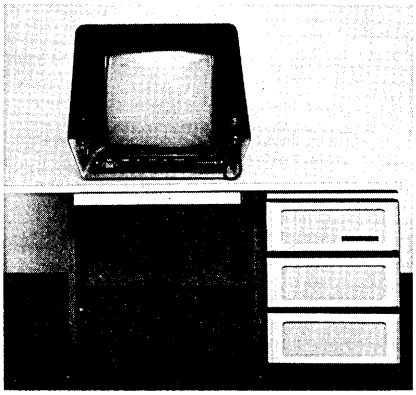
FOR DATA CIRCLE 321 ON READER CARD

VECTOR GENERAL, INC.

Woodland Hills, Calif. **Booth 1701**

Graphics System

The 3400 system utilizes a proprietary vector generator unit operating with buffer registers to minimize data access delay times, and a microprocessor pro-



vides most of the features, which include three-dimensional digital transformations, a dynamic magnification range of 16,000:1, programmable graphic instructions and character set, and device support including light pen and tablet. Typical configuration prices are $51,500.

FOR DATA CIRCLE 322 ON READER CARD

Auxiliary Equipment

BDT BURO- UND DATEN-TECHNIK GMBH

Rottwell, W. Germany **Booth 3305, 07**

Forms handler

The FF 120 is designed for adaptation to a wide range of serial printers that includes matrix, print wheel, and golf ball types. It provides the capability to handle cut single forms and/or cut multiple part form sets in addition to continuous forms. The completely self-contained and powered peripheral performs single line feed, slew and eject operations. It's priced at approximately $320 in orders of 100 and will be available next month.

FOR DATA CIRCLE 323 ON READER CARD

DATA I/O

Issaquah, Wash. **Booth 2835, 37**

Prom Programmer

The Model VIII portable Programmable Read-only Memory (PROM) programmer can program any PROM by addition of a personality card, claim its builders.

The unit features keyboard entry, master entry, and controlled "field" selection with full diagnostic display. The memory complement is 1K x 8 bits. An attache case is optional. The price is $1,500 in quantities of 10. Also on display will be a ROM emulation system used to emulate or simulate any ROM or PROM ranging in size from 32 x 8 to 1K x 8-bits.

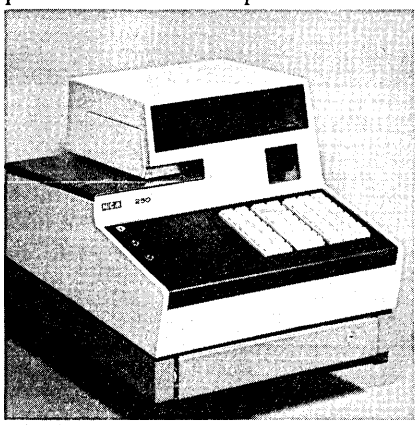
FOR DATA CIRCLE 324 ON READER CARD

PREMIX, INC.

North Kingsville, Ohio **Booth 1024, 26**

Oem Product Construction

This firm doesn't really have a product to display, as such, but offers a material called Premi-Glas sheet molding compound. It's used on the point-of-sale ter-



minal NCR manufactures, as well as major products for such firms as IBM, Raytheon, Dataproducts, Xerox, and others, we're told. The material is UL recognized and can be used in computer room applications. Moldings are said to compete very favorably with metals used in many of these applications.

FOR DATA CIRCLE 325 ON READER CARD

Software & Services

CULLINANE CORP.

Wellesley, Mass. **Booth 1411**

Software

The EEO-AFFIRMATIVE ACTION REPORTER product is specifically designed to assist personnel department managers and Equal Employment Opportunity officers prepare reports and implement an effective affirmative action program. The package is designed to analyze workforce composition, employee participation in job decisions, minority employment and demographic data, and applicant flow/demographic data. The system is also designed to project empirical assumptions over any selected time period in order to develop attainable goals and timetables. Over 70 reports are generated, including statistical and graphical outputs. Priced at $20K, the package runs on IBM 360/370, and Univac Spectra 70 systems under any OS.

FOR DATA CIRCLE 326 ON READER CARD

DATAPRO RESEARCH CORP.

Delran, N.J. **Booth 2724, 26, 28**

Services

An updated, loose-leaf information called *Datapro Reports on Retail Systems* will be introduced at the Coliseum. More than 400 pages of detailed product reports on integrated point-of-sale (POS) systems, electronic cash registers, EFTS, credit and payment systems, vendors, applications, specialized equipment, software and other retail product categories will be featured. Bimonthly report supplements are also included, as is *Retailnews,* a monthly newsletter that discusses and interprets industry events. A telephone inquiry service through which subscribers can get immediate problem solving information beyond the scope of the published reports is an additional feature. The annual subscription price is $290; NCC attendees get a break: $250 for a charter subscription.

FOR DATA CIRCLE 327 ON READER CARD

INTERNATIONAL MATHEMATICAL & STATISTICAL LIBRARIES, INC.

Houston, Texas **Booth 1112**

Software Libraries

The fifth edition of this vendor's very successful library of mathematics and statistics routines is in the process of being released, and in addition to IBM, CDC, Honeywell, Xerox, and Univac gear, the product is now offered to DEC System 10 and Burroughs series 6700/7700 users. The library consists of 385 FORTRAN subroutines and function sub-programs arranged by chapter and subgroups according to their function. A reference manual is provided which is a quick reference to chapter abilities, noting subtleties, special instructions, and featured abilities. The IMSL library rents for $1,220/year and cannot be purchased.

FOR DATA CIRCLE 328 ON READER CARD

Whenever there's pressure, you need a safety valve.

A safety valve can cool tempers, ease pressures and save thousands. In the pressure-cooker world of data processing, DP Executives of major corporations* use SBC data processing capabilities as a kind of **permanent** safety valve.

The pressures SBC can relieve seem to be coming from every direction at once:

Pressure of new applications. Backlogs are growing, and management expectations regarding new applications are rising.

Pressure of change. The changing business climate is forcing costly and time-consuming modifications of essential applications—and creating new requirements.

Pressure of rising budgets. Hardware/people costs are soaring, data processing volume is increasing, and the scope of EDP services is widening.

The challenge to the professional DP executive is to respond to these pressures as a businessman, by considering the alternatives available to get the job done.

The SBC alternative is now being used for hundreds of applications in the mainstream of the business, particularly those which require end-user responsibility. Typical applications generate decision-making information in such areas as corporate planning, cash management, product analysis, and forecasting.

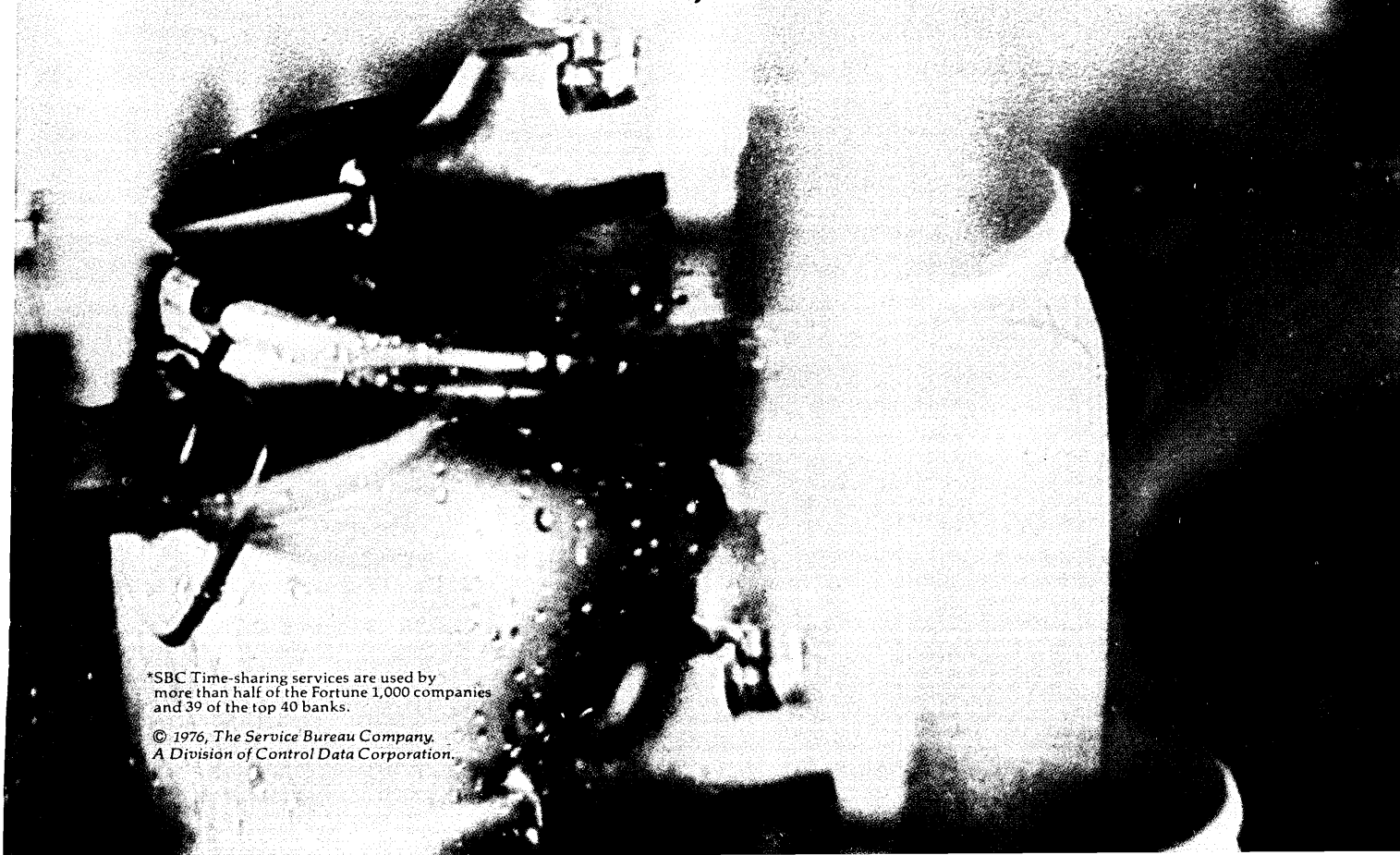
How can SBC help you respond to the rising pressures of new applications, budget restraints and the changing business climate? As a DP executive, you may find the answers technically intriguing. But as a businessman, we know you'll find them eminently practical.

John P. Thompson, V.P. & General Manager Management Services Div. McCormick & Company, Inc.

"When working with SBC on a particular application, I am making a clear-cut business decision to use their service as a part of our overall system capability. SBC's services provide an effective and practical way of approaching management needs."

THE SERVICE BUREAU COMPANY
500 West Putnam Ave., Greenwich, Conn. 06830
a data services division of CONTROL DATA CORPORATION

SBC. The alternative, for business reasons.



*SBC Time-sharing services are used by more than half of the Fortune 1,000 companies and 39 of the top 40 banks.

PRODUCT PREVIEW

MRI SYSTEMS CORP.
Austin, Texas **Booth 1115**

Data Base Management
Version 2.70 of System 2000 is being distributed to current and new IBM customers of this data base management system. General processing in both batch and on-line environments is showing throughput improvements by factors of 2:1 and 4:1 and more compared to previous versions. New features include compatibility with IBM's MVS operating system; a new buffer manager; an extended where-clause that will allow non-key elements in the where-clause for immediate access, report writer and extended PL/1 precompilers; enhancements to self-contained language processing in multi-thread, teleprocessing environments; additional statistical aids; and an extended procedural language interface COBOL and PL/1 precompiler. Available for a variety of large scale systems (including the Amdahl 470), System 2000's data base management systems range in price from $30 to 110K, with the average being approximately $70K.
FOR DATA CIRCLE 329 ON READER CARD

ADDED ATTRACTIONS . . .

Peripherals

BRAEMAR COMPUTER DEVICES INC., Burnsville, Minn. booth 2745, will be showing the model CS-400 digital cassette tape transport system for use with standard Philips-type cassettes . . . CENTRONICS DATA COMPUTER CORP., Hudson, N.H., booth 3300, 01, will be showing a complete line of 60 cps to 300 lpm printers and teleprinters . . . COMPUTER OPERATIONS, INC., Lanham, Md., booth 2007, 09, will be showing its complete line of LINC Tape peripherals storage systems for minis . . . DATAPOINT CORP., San Antonio, Texas, booth 3250, will be showing the latest peripheral to be added to its business processor line, a 10.5-inch magnetic tape unit . . . DATARAM CORP., Cranbury, N.J., booth 1117, 19, will show its DR-128 single-board 256K byte core memory system for oem's . . . DATA SPECIALTIES, INC., Northbrook, Ill., booth 2117, will be showing the MODUPERF "75," a paper tape punch . . . GENERAL AUTOMATION, INC., Anaheim, Calif., booth 2501, will be showing a 32K memory system called the Micromemory, a 400 nsec hybrid semiconductor unit for minis . . . INTERFACE MECHANISMS, INC., Mountlake Terrace, Wash., booth 1022, will be showing the model 9106 bar code reader . . . OKIDATA CORP., Moorestown, N.J., booth 2301, will be showing the CP210 document/passbook printer . . . PERSCI INC., Marina del Rey, Calif., booth 1642, will be showing the model 270 dual diskette drive, first units of which were delivered last December . . . QANTEX DIV. NORTH ATLANTIC INDUSTRIES, Plainview, N.Y., booth 2831, 33, will display a variety of cartridge and tape drive systems for minis . . . SCIENTIFIC MEASUREMENT SYSTEMS, Cherry Hill, N.J., booth 3117, will introduce an automatic tape label printer . . . SHUGART ASSOC., Sunnyvale, Calif., booth 1601, 03, will display the 800 series of floppy disc drives . . . VERSATEC, Santa Clara, Calif., booth 2718, 20, 22, will give the first public demonstration of its new 24-inch wide electrostatic plotter . . . WANGCO INC., Los Angeles, Calif., booth 1521, will show magnetic tape and moving head disc systems interfaced to DEC PDP-11 computers . . .

Terminals and Communications Equipment

APPLIED DIGITAL DATA SYSTEMS INC., Hauppauge, N.Y., booth 1219, will display its System 70 pre-programmed intelligent terminal . . . ATLANTIC RESEARCH CORP., Alexandria, Va., booth 1542, 43, will display a fully programmable data communications monitor and interactive tester called INTERSHAKE II . . . DIGI-LOG SYSTEMS, INC., Horsham, Pa., booth 2014, 16, will show features added to its data line monitor, The Tattletale . . . INFORMER INC., Los Angeles, Calif., booth 2000, 02, will display the PA 301 portable crt terminal . . . INFOTON, Burlington, Mass., booth 3005, 07, will display its VISTAR GTX and VISTAR/SATELLITE alphanumeric display terminals . . . RCA SERVICE CO., Camden, N.J., booth 1006, will be showing the GE TermiNet model 30 printer it rents for $140/month . . . RESEARCH, INC., Minneapolis, Minn., booth 2022, 24, will show the model 3700 and 3900 APL crt terminals . . . WESTERN UNION INFORMATION SYSTEMS, Mahwah, N.J., booth 1114, 16, will show a microprocessor-based time division multiplexor, the series 4200 . . .

Special-Purpose Systems

NCC will mark one of the first showings of the model 77 remote entry system from DATA 100 CORP., Minnetonka, Minn., booth 2327 . . . For oem's there will be a selection of line printers, cartridge disc drives, card, and paper tape products . . . VOCAL INTERFACE DIV., FEDERAL SCREW WORKS, Framingham, Mass., booth 3327, 29, will be showing its Votrax model LV50 electronic voice response systems . . . FLOATING POINT SYSTEMS, INC., Portland, Ore., booth 2629, will be showing the AP-120B array processor, a parallel pipeline unit capable of 12 million operations per second that attaches to a host cpu . . . SPACESAVER CORP., Ft. Atkinson, Wisc., booth 2001, will display mobile carriage systems for computer records filing and storage, both manual and automatic . . . SPATIAL DATA SYSTEMS, INC., Goleta, Calif., booth 1111, will again probably attract huge lines to its Computer Eye Image station . . . SUMMAGRAPHICS CORP., Fairfield, Conn., booth 1826, will show a microprocessor-based digitizer system . . . SYCOR INC., Ann Arbor, Mich., booth 2731, will exhibit its line of distributed data entry and processing equipment . . .

Auxiliary Equipment

ELGAR CORP., San Diego, Calif., booth 2224, will be showing an uninterruptible power supply system for minicomputers . . . similarly, EXIDE POWER SYSTEMS DIV., ESB INC., Raleigh, N.C., booth 1100, will display a variety of digitally controlled static uninterruptible power systems . . . INFORMATION TERMINALS CORP., Sunnyvale, Calif., booth 3519, 21, will display a high reliability digital cassette and a cassette tester used by the firm's own engineers . . . INTERNATIONAL POWER MACHINES CORP., Mesquite, Texas, booth 2119, 21, will display a 166 KVA uninterruptible power system . . . KNICKERBOCKER CASE CORP., Chicago, Ill., booth 3517, will have information on custom-designed computer serviceman's cases . . . KYBE CORP., Waltham, Mass., booth 2118, 20, will have what it claims to be the world's fastest tape cleaner at 225 ips . . . LICON, Chicago, Ill., booth 1127, 29, will display a variety of lighted pushbutton switches and other keyswitches . . . MAGNUSONIC DEVICES, INC., Hicksville, N.Y., booth 1420, will display magnetic tape and disc heads to oem's . . . MOTOROLA DISPLAY PRODUCTS, Carol Stream, Ill., booth 1228, 30, 32, will display a new microprocessor analyzer, the MPA-1 . . . SHOP-VAC Corp., Williamsport, Pa., booth 2124, will display computer room vacuum cleaners . . . THE TEXWIPE CO., Hillsdale, N.J., booth 1224, will display a disc pack inspector complete with optical scanner . . .

Software & Services

CREATIVE COMPUTING, Morristown, N.J., booth 2004, will be showing a book entitled "The Best of Creative Computing," a collection of articles and games that can be played on computers and calculators . . . DELTAK, INC., Schiller Park, Ill., booth 3400, will have information on over 300 courses in data processing. ✲

"The only problem 4051 software won't solve is what to do with my free time."

Our flexible program structure leaves you ample time for creativity. Tektronix has streamlined data entry, storage and editing. Our desktop computing and interactive software have eliminated many routine and repetitious steps. Results come quicker with solution-oriented software that exploits the full versatility of our 4051 BASIC Graphic Computing System.

Software like our high-powered statistics package... wide-ranging programs that let you work at your own pace, accumulate weeks of data, edit, revise and analyze for the greatest possible integrity of final solutions.

Modular mathematics... featuring fast, stable, state-of-the-art algorithms that may be extracted and used as separate programs. The linear programming package can solve a program with 40 variables in less than 10 minutes.

Interactive electrical engineering . . . let's you work with active and passive circuits, for example. Edit errors without re-entering, perform whole programs with a single key, or loop through analyses any number of times.

In the interactive 4051 library, you're drawn into every solution. Ask your Tektronix Sales Engineer for the whole 4051 software story. Or write:

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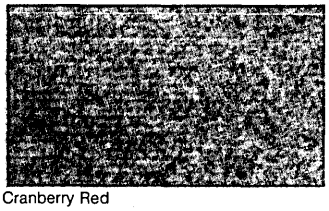
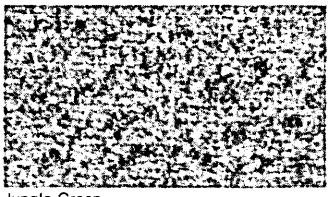
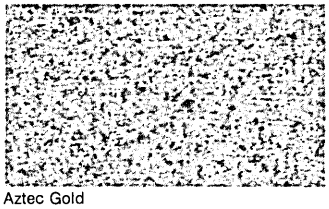
TEKTRONIX®

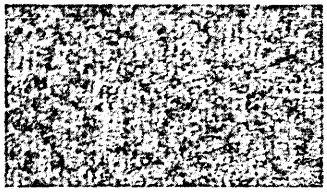
CIRCLE 54 ON READER CARD

NO MORE SHOCKS. PERIOD!


Cranberry Red


Jungle Green


Aztec Gold


Brownstone

Crown's Stat-Zap mats and matting.

Now, someone has finally come up with a true anti-static mat and matting product. Proven in test after test to reduce the level of static charges below the 3000-volt level...the shock cut-off point for most people. The first carpet-top, vinyl-back, anti-static mats and matting ever offered. And they're made only by Crown. Stat-Zap mats and matting. No more shocks. No more sparks. No more equipment malfunctions caused by electro-static build-up. Fulfilling a real need in many applications. Wide choice, too: 8 mat sizes, 3 rolled matting widths, 4 decorator colors... all with a full 5-year limited wear warranty. Send for more information. And learn how you can stop static shocks.

Please send me more information about your Stat-Zap mats and matting.

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#76-4U

Decentralizing Hardware and Dispersing Responsibility

by Robert L. Patrick, Editorial Advisor

Falling hardware prices and rising complexity in large-scale dp operations argue for decentralizing computing resources, but don't write off the big machines yet.

The trend towards centralization has stopped. Each salesman you encounter has some simplistic explanation for the phenomenon and always manages to imply that his product is totally responsible for the change. However, many persons working in large central shops are not even aware there has been a change; they would hardly be ready with an explanation for the forces that brought about this phenomenon.

Since the early 1950's we've been told that bigger is better and bigger is cheaper. Some of us even built icons and graven images to Grosch's law [i.e., performance rises roughly as the square of the computer cost] because it paved the way to further centralization, more responsibility, and higher salaries. And now it has all stopped. We've been on an incomplete freeway to nowhere.

Fig. 1 starts to tell the story. The left two columns are an approximation of Grosch's law. They show that as computer power increases, the related cost increases at a lesser rate. Thus if you centralize and put in a bigger machine, you get more bang for the buck. Unfortunately while that may have been true in the '50s and early '60s, for the last ten years we have lacked a good measure of computer power.

At one time a good approximation to computer power was fixed point add time. But more recently the architecture of the machine, the speed and variety of the channels, the way the secondary storage is addressed, and the efficiency of the operating system have made such simplistic definitions of computer power useless. Instead we've come up with a variety of definitions of computer power (also useless) based on benchmark performance, or throughput, or weighted performance on job kernels, or some other criterion which is useful in a local environment but not very meaningful when comparing installation to installation.

As a result, we have more or less assumed that power was proportional to price, and if the monthly rental was higher, in some sense there was more power installed. But Grosch's Law was propounded many years ago, when the cpu cluster was the dominant element in a computer configuration, accounting for most of the cost of the computer. A change has been made in computer configurations, and it was made so gradually that many people even today don't realize that more than half the hardware cost in a big centralized shop is in I/O gear, and that the cpu cluster (including the memory) amounts to only about 40% of the cost. (See Fig. 2.) Grosch's Law has been repealed, at least for these big shops, and the relation between total computer configuration cost and performance is more like that illustrated in Fig. 1.

The economics (of power increasing faster than price) argued for centralization. And centralization demanded running more jobs per day through each cpu.

As the machines became more reliable and the cost per bit of disc storage came down, our imaginations ran away with our better judgment. In the late '60s and early '70s, we measured the unused cpu cycles and ordered additional memory to run enough small partitions to saturate the cpu's. Naturally as partitions were added, I/O had to be added to serve those partitions. Today it is not unusual to find a big

COMPUTER POWER vs. COMPLEXITY

FINANCIAL VIEW		PRACTICAL CONSIDERATIONS	
Computer Power	Related Cost	Support Costs	System Complexity*
1	100	1	1.0
2	175	2	2.5
4	300	3	8.0
8	450	4	20.0

*For general purpose workloads with teleprocessing

Fig. 1. Once Grosch's Law, which declares that computer performance rises with the square of computer cost, was more nearly correct. It may still be useful today when applied to the cpu cluster alone. The real relationship between computer performance and total configuration cost is now more like the scales shown in columns one and two, which show an economy in size but not as much economy as Grosch's Law would suggest. Support costs, which are primarily personnel costs, also rise more slowly than the costs of the computer configuration, and therefore continue the argument that bigger is cheaper.

On the opposing side, the complexity of the entire system of hardware, software, and personnel, rises much more rapidly than computer power or cost. When that complexity rises to a point where it taxes our abilities to manage, it argues strongly **against** centralization in spite of any economies of scale.

cpu "routinely" running ten or more jobs at one time.

"Routinely" is in quotation marks because operations in many big shops are far from routine. Fig. 1 shows that support costs have climbed roughly in proportion to our systems costs. We now have teams of system programmers where formerly a few individuals were sufficient. We have setup people and stagers, schedulers and production controllers, managers and system measurement experts and in-house consultants and editors to publish newsletters—a computer shop acting as an in-house service bureau and billing $20 million a year can have 600 employees without counting application programmers!

This does not mean to imply that those employees are stumbling over one another and are looking for work to do. They are all totally occupied. Many of them work overtime, and yet the operation is still far from routine. A big production shop can be quite tranquil if the applications are stable and the change to hardware, software, and "skinware" is being managed with great care. However, if you're constantly trying to apply the latest software fixes, do a little innovation and development on top of the manufacturer-supplied software, support a battalion of application programmers, and still run the scheduled production . . . the shop is definitely complex.

Complexity rises fastest

The fourth column of Fig. 1 illustrates that system complexity is rising faster than computer power. To be more exact, system complexity has risen faster than our ability to cope with it. System complexity is another one of those vague terms, ill-defined but generally used throughout the trade. I can't cite a single equation that will allow system complexity to be quantified. But I can find legions of managers who will admit that a system with two or more connected cpu's with four or more megabytes, 100 communication lines (connected to anything), and 40 or more spindles of disc is complex. They can prove it by displaying in excess of a million lines of software which go to make up the operating system, the data management package, the communications front end, and the raft of compilers, utility programs, restart packages, and accounting systems required just to run the factory. With that much software, complexity is there even if only one application system is being run.

Two or three years ago progress in the big shops stopped when system complexity equaled the ability of the staff to cope with it. I was working in a shop that had availability problems. We did everything we could to improve our record for on-time delivery of scheduled jobs and non-stop operation for the on-line system. We went through hell working long hours, investigating every flaw, and scouring every problem to get to the heart of it.

All of a sudden things materially improved. Over a beer, two of us admitted we were ash white and shaken. We were more concerned that the system had improved for a reason we did not understand than we had been concerned with the instability we had previously experienced. Several weeks later we were back into difficulty, and once again we hadn't seen any change in workload, procedures, software, or equipment. It was embarrassing because we couldn't explain the fluctuations in service, but we had to admit that *we* were saturated and unable to cope with the complexity of the systems we had created.

Needless to say, customers of complex systems are an unhappy lot. They have learned to expect scheduled work late, crashes in the middle of the day, supposedly transparent changes that affect them, and frequent reorganization in the computer shop. In addition to the turnover that is visible to the customer, they might have noticed additional pressure on the vendor, attempts at improved maintenance, and an entirely new way of planning and scheduling major changes. All of these are classic prescriptions for an organization in trouble.

If you bought your hardware or if you've made profound statements to senior management about how much more you can get out of existing equipment by reconfiguring it to use up those available cycles, an observer would see a management credibility gap opening up that could swallow the *Queen Mary*. In some shops the embattled management has backed down from the precipice and started taking their systems apart to reduce complexity.

In order to save the investments in hardware and software, a frequent action sees the installation of a compatible medium sized computer that is *not* connected into the existing network, but is dedicated to running a subset of the applications. We've found that a master integrated data base which is the granddaddy of all data bases, is interesting to contemplate academically, but almost impossible to operate. Since the engineering system didn't have all that much to do with the manufacturing system anyway, and since there is a well defined interface when products are released to manufacture, it is quite logical to cut along the dotted line and take these two systems apart again. In other cases we've found we didn't need all those applications on-line after all, so we capture

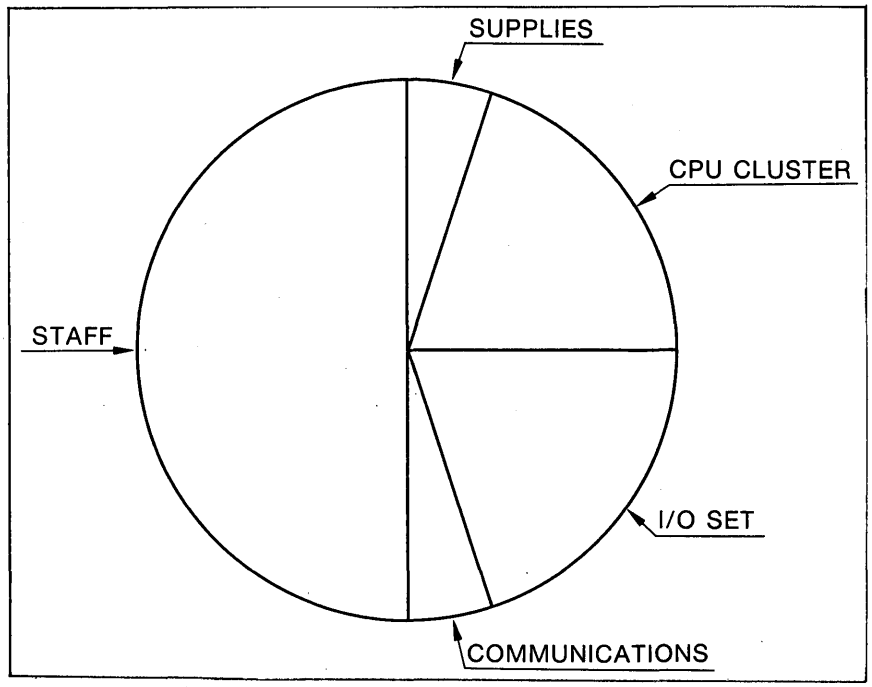


Fig. 2. In decentralizing computer resources, one goal is to reduce costs by using less expensive hardware. This can work well when the application being split off is fixed in scope and has no direct ties to other systems. In the budgets for large shops, however, the cpu cluster represents only about 40% of the cost of the hardware (20% of the total budget), and it is only that relatively small amount which is usually attacked in decentralization. Other anticipated savings can often slip away in increased staff and overhead costs.

the data on-line, and return to updating and reporting in the batch mode (where a failure won't have a disastrous effect on the integrity of the file, and the reports can be more or less guaranteed out on a schedule).

Minis for "bounded" jobs

Just about the time the management of the central shop became seriously beleaguered, the minicomputers came on strong. The minis have been around for 10 years, and have been successfully used in environments where the scope of applications was limited. Early minis were used as control computers in industrial laboratories, colleges, hospitals, and factories. They were frequently dedicated to a single application. Often that application was defined and flowcharted before the equipment was purchased! The early ones didn't have to cope with a wide variety of I/O, constant growth, new applications, or even, in some cases, changes to existing applications. The initial mini business used a stored program to simplify what otherwise would have been an enormous amount of fixed logic.

Many minis were purchased for college and laboratory use, but each of these was installed into a world of its own. As long as learning progresses, availability is not too critical. As long as student circuits and experimental I/O devices don't blow the internal electronics, the pedagogue is supplied with a very flexible piece of logic that he can customize through stored programs.

Just about one recession ago, the business changed. Government funds started drying up, and this affected the work done in colleges and laboratories. Further, the mini makers became more proficient in their art, the cost of circuitry came down, and the variety of mini peripherals exploded. Suddenly it was possible to get a mini that wasn't restricted to a teletypewriter with punched paper tape in and out. When this occurred, the only thing the minis lacked was software.

Today decentralized computing is upon us. It is possible to obtain minicomputer software off the shelf for real-time control, multi-tasking operation, on-line time-sharing, and data base management. As long as the size of the configuration is small and the speed of the cpu system is high, rather ornate software can be had which still supplies good response.

The year these two trends crossed was 1975. The big shops were still in trouble and the mini makers were coming on strong. For the organization that has a broad range of systems talents, the mini is truly an alternative. You need to know something about dealing with multiple vendors, about running a project that involves custom hardware and software, and be pretty sure of your systems analysis. If you have enough confidence in your systems analysis to sign a turnkey contract, and if you have enough management talent with the right skills, a mini is a good solution (even if you do the development yourself). It will take a while to select a system carefully from the various vendor offerings, get the people trained, and prepare the applications to use it, but if the scope of applications is bounded (that's what turnkey implies), your chances of success are good. Furthermore, along with that success, comes independence from the central computer problems that you do not help create. And last—a mixed blessing—you are isolated, insulated, and suddenly back in control of your own destiny.

However, the academics and Madison Avenue invented a few confusing new terms, so we hear "distributed computing, distributive data processing, decentralization, and network computing" all pronounced without definition, and all meaning something about gradations in size, sophistication, and management responsibility. (You can get immediately to the heart of the latter by asking two questions: Who do the programmers work for? And who sets the standards? The size of the cpu and who pays the bill are of no consequence.)

Mini headaches too

If you have previously done business with an in-house monopoly, and if you can find some way to work around the corporate strictures, you may be off and running your own minicomputer. (This is somewhat easier to sell if you work for a decentralized corporation and your boss has profit responsibility.) However, there may be some surprises in store for you. First, the manager of the corporate monopoly may aid and abet your decision. If you've given him a disproportionate number of problems for the revenue he gets from you, he'll be glad to reduce his complexity a little without reducing his revenue a lot. If you've made constant demands on his application programming force, and if you have severe peaks and valleys in your workload that are hard for him to contain, he is likely to transfer to you the average headcount you've been using and let you worry about smoothing the flow of work.

You may find you've got a reliable, stable system, but the minute you put on the second application for the second department, you'll find yourself running a mini-monopoly yourself. You'll need to install some accounting and issue some monthly bills. The other users will want a voice in management, and while you may have the management skills required, as the shop grows you may get saturated with problems—or what's worse, you may find that you can no longer pursue your primary interests because you have suddenly become a computer center manager.

It goes without saying that your own mini may save you money over your current billings, but you must have the capital to spend and anticipate enough usage to break even. If your workload is easily contained within the capacity you've installed, you will get good response and turnaround with no priority problems. If an application is totally self contained, you need not even have a communications line to the central. (You can even be totally isolated and not install a compatible I/O medium.) You will have security and privacy such as you've never had before, and the responsibility and authority is all yours. You can even manage your own backlog, direct the programming work force, and worry about their career progression, their unusual turnover, and whether they are documenting well. In the cost justification you must be sure to plan well, provide for installation, and arrange for test time.

If you are moving from a central system you must face file load for commercial work, arithmetic incompatibilities for engineering applications, and plan to pay the cost of conversion of parallel operation. The easiest transition involves bringing up only new work on the mini, but that sometimes means a lightly loaded system for a few months and pushes the breakeven point down the calendar somewhat.

Break up the data centers?

Some national speakers have advocated the total dissolution of the central computer complexes and their replacement by a network of minis. These people are incredibly naive. Not only does this distribute the complexity in some unmanageable way, but almost every industry has a few very big jobs that won't fit on anybody's mini. For some time now the configuration of the central facility has been at least partially determined by the biggest job that must run. This determines the minimum number of tapes, scratch disc, and amount of core you must have. The attempt to do one of those maxi jobs on a minicomputer with limited memory and I/O harkens back to the early 701 days when we had 4K words and spent two-thirds of our time manipulating the overlays to get a big job through the machine.

If you grant for a moment that all

jobs are not homogeneous in size and the biggest job to be run in-house determines the size of the in-house installation, the next question is economic: how do you load that installation so the unit cost is reasonable? A totally free market won't work because you need some little jobs to run along with the big jobs or you can't afford to run the big jobs.

As in many situations, the name of the game is compromise. The enlightened manager today doesn't fight the mini trend but tries to live with it. The seasoned campaigner knows that little jobs tend to combine and combinations of little jobs tend to get big, therefore he tries to establish some standards so jobs that outgrow the minis won't have to be completely reprogrammed to run on the central facility. He also notes that projects come and go, and that selecting many minis from a few vendors makes the equipment inventory easier to manage.

Finally he knows that many users are negotiating contracts for the first time, and a little help and professional advice will tend to make sure the company receives what it is paying for and on the schedules needed to support project activities.

A person contemplating a mini for general purpose work should be cautioned to enumerate the goods and services that are bundled into the price

The Trouble With Minis

by Philip H. Dorn, Contributing Editor

The trouble with minicomputers is that they refuse to stay mini, they grow just the way any computer grows. What begins as a very small, special purpose system somehow is transformed across time into a medium sized, general purpose system. After the prime motivating application is completed, somebody gets a bright idea to add more applications and the charge toward upgrading begins. A few cases in point:

Case 1

A major university once bought a minicomputer to do some very special research in structural analysis. A 16K system with no peripherals except a graphics console, it was operated by the professor for 2 to 3 hours a day. Five years pass. The professor's students are imaginative. The machine now has 32K of memory, a card reader, printer, tapes, and even a small disc. The applications now include literature search, project management, and even student scheduling. The departmental secretary can't run the system anymore; it is too complicated. Whenever it crashes, a professional from the computer center has to amble across campus, diagnose the difficulties, and get things started again.

Case 2

A financial institution carefully specified a mini to be used for data collection. The system was small, 0.5MB of disc and 32K of memory. Two years later, the system had grown to 128K of memory, 5MB of disc, a larger model processor and a 300 lpm printer. Why? Because someone thought that as long as the data was collected, it ought to be edited. And, since the data was now clean, why not do a little processing to save time on the big system? The net result is that the system now operates almost around the clock and serves as a mini data center with operators and support personnel.

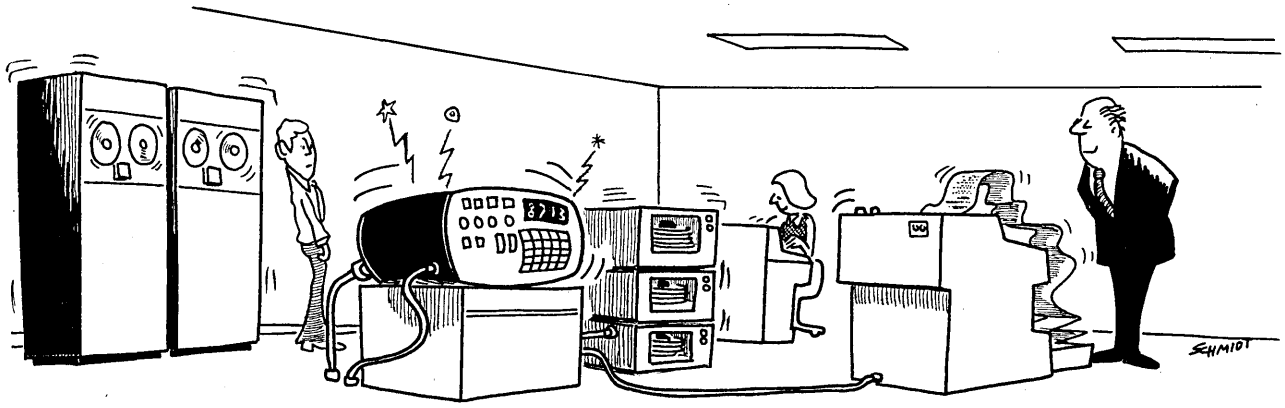
Case 3

Another financial institution had their 4K, tty-oriented mini grow in seven years to 32K with card reader, disc, and other peripherals. Formerly used for statistical analysis, it now is a real-time system. Acquired for one application, it now supports many.

Now there is nothing wrong with any of this; it proves that minicomputers are flexible, are comparatively easy to program, support a wide variety of applications, and apparently have a long and useful life. It is a great testimonial to the hardware designers and software developers.

But we are compelled to wonder about the management in these organizations. Have they lost control of the computing operation? What is the bottom line effect of the central facility having to support a multitude of smaller installations and bail them out when they are in trouble? Are these new applications that just appear being documented and supported the way that they would have been if centrally implemented? What is the effect on local management when they have to run a computing center in addition to performing the jobs for which they were originally hired?

There are no fixed answers to any of these questions; doubtless the financial details must be developed for each unique case. But the message should be clear. If you are going to install a mini, you had better know what problem you are trying to solve and how to bound the installation. If you ignore the mini after it is installed, it will grow and a whole new set of managerial problems will appear. ❁



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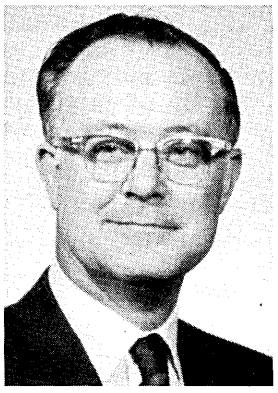
charged by the central facility. If he doesn't need all those services (as he doesn't if the application is bounded), then the hardware price primarily determines the total cost, and the minis look quite attractive. However, if he is going to do general purpose work on a special purpose machine, he is getting ready to see costs of software, training, management, and accounting that must be absorbed somewhere. Beware that you don't buy a system with an inexpensive initial price and forget to look at the total cost. Further, if you are buying it with company funds, the life and depreciated value are going to be hard to compute because the market is changing so rapidly.

Don't let these words of caution totally deter you. In one recent case the *annual* cost of bundled services from a central installation exceeded the *total* purchase price for the mini hardware, including all the display terminals and disc drives. We could see an application life of three to four years. Since the programming and software cost just about equaled the hardware costs, we would break even in 24 months. Needless to say, we ordered the mini system.

A mini is a good solution, sometimes. Decentralization—or distributed processing, or distributive computing, or whatever—is a good solution too, sometimes. But they are only good solutions for some problems. As in most things we do, the important work is in deciding whether the solutions we like fit the problems we have. ❋



Mr. Patrick has been an independent data processing consultant since 1959. His assignments usually involve system design, computer center management, or audits of computer center operations.

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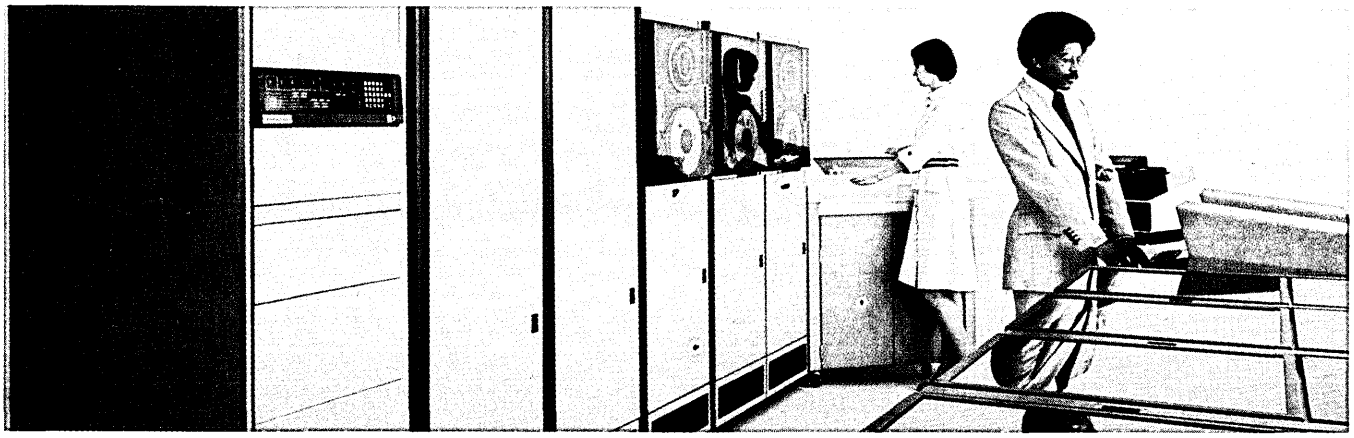

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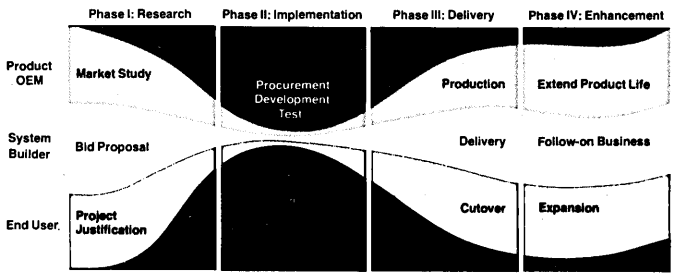

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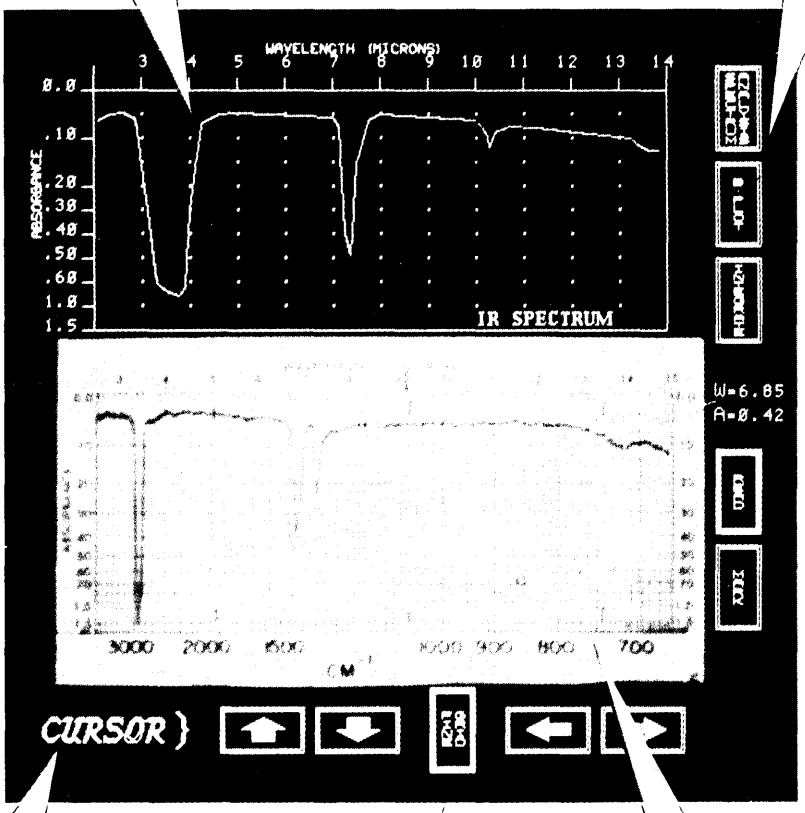

UNLIMITED CHARACTER POINT and FORMATTING — programmable character memory facilitates user-designed symbols for additional characters or pictorial combinations.

REAR PROJECTION — we have designed a computer addressable, random access rear projection unit which displays microfiche thru the transparent plasma panel. This enables you to compare fixed data base information (microfiche) against variables of your choosing.

Because of the unique characteristics of the plasma panel, you get a flicker-free display with excellent contrast. As a result, there is less eye fatigue, allowing longer periods of concentration.

SOFTWARE — we offer software packages to interface your computer to our terminal. Our microcomputer-controlled terminal is compatible with most main frames and minicomputers and has many programmable alternatives that may be specified by the user.

Software available includes GPAC (Graphics PACkage), an ANSI FORTRAN-oriented interface for most popular minis, and a high-level graphics system including CalComp previewing written for IBM 360/370 OS systems.

The Magnavox display terminal offers features normally available only in much more expensive refreshed graphics systems. At $8,500 for the basic terminal, we're on the low end of this spectrum. Yet, for this price, you get combinations nobody else offers.

Complete details are available when you address a letter to us stating how you might use our terminal. We will arrange a demonstration for you at no obligation.

Let us show you our Plasma Display terminals and discuss your applications at the *1976 NCC.* Look for us at booth 1822-1824.

Magnavox

DISPLAY SYSTEMS

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CIRCLE 89 ON READER CARD

The Second Half of The Computer Age

by Werner L. Frank

The electronic computer had its start in 1946 with ENIAC. That means 1960 was the midpoint of the computer age as we know it today. Let's look back on just the *second* half of this era and take note of the promises of the computer, observing the industry that has evolved in the fulfillment of those promises.

In 1960, DATAMATION reported the following items:

• SDC purchases a Philco S2000 Computer as the hub of the new systems Simulation Research Laboratory.

• In an address, Brig. Gen. David Sarnoff, chairman of RCA, discloses, "In our already substantial strides into the data processing field, we are tilting with an economic pardox; the more successful we are initially, the larger our accounting losses are—initially. The rental—or deferred income—nature of the business makes this inevitable. What must be spent, we are spending to establish RCA as a major participant in this still-formative industry. In 1959, we incurred what I call 'money in the bank' losses on data processing, and the losses will continue in 1960. But the day is not far distant when this resolute effort should be rewarded . . ."

• General Mills enters the general purpose digital computer field with three transistorized machines with microsecond core and all parallel logic, even though pundits insist that they will still be "cereal" computers.

• A new firm, Computer Applications, Inc., will bring computing services to the New York metropolitan area. A $30,000 contract launches the company's operations. At the same time, a new firm called Applied Data Research, Inc., forms in Princeton, New Jersey.

Sometimes it is easier to see what lies ahead by looking behind.

• The $10 million and up IBM STRETCH-type computers are now available to business and government agencies, IBM reports. These powerful systems (rated 75 times faster than the large scale IBM 704 systems) can actually complete 100 billion computations in a single day—at a very low per-unit cost.

• At the same time, IBM announces TRACTOR, a computer magnetic tape system termed the world's fastest. It is 24 times faster than systems now in use, and its tape reels will store 60 billion characters—the equivalent of a library of 150,000 volumes. The unit can manipulate as many as 640 reels and literally permits the machine to read and write 1½ million characters per second.

• Minneapolis Honeywell officially announces its FACT compiler which, it states, can be applied "to all typical functions of business data processing, including card input reading and editing, creation of data files, data sorting, arithmetic computations, updating of data files, and generation of printed or punched reports based on input data, file data, or program results." (It will be recalled that the FACT compiler project launched the success which now belongs to Computer Sciences Corp.)

• 1960 was also the year DATAMATION observed that Daniel McCracken, Robert Patrick, Bob Barton, Gene Amdahl, and Herb Grosch were full-time consultants and "It will be interesting to watch the fortunes (or lack of the same) of these bold and rugged individuals."

In its 1960 issue, the "Communications of the ACM" had the following to say about an emerging subject:

"A Common Business Oriented Language, called COBOL, *for use in writing instructions on business-type*

Name	Manufacturer	Distinction
Bizmac	RCA	Variable word length, no tape handling.
Datamatic 1000	Honeywell	Three-inch wide tape.
Raydec	Raytheon	Built-in arithmetic conversion.
RW400	TRW	Modular hardware, centralized electronic switching.
LARC	Univac	Binary-coded decimal, floating point, I/O processors.
STRETCH	IBM	Look ahead and interleaved memory.
Solomon (ILLIAC IV)	Westinghouse	Highly parallel machine with array of arithmetic units.
B 5000	Burroughs	Built-in ALGOL.
G-20	Bendix	Commercial multicomputer system with the organization chart concept.

Table 1

problems for any digital electronic computer, may soon be available. COBOL, *which is written in English and independent of any make or model of computer, was presented in the final report of the Short Range Committee to the Executive Committee of the Conference on Data Systems Languages . . ."*

Two letters to the editor of "Communications of the ACM" are particularly noteworthy. The first led to the important development of special interest groups within the ACM.

"Dear Editor:

This letter, coming as it does from the EASTERN *shores of the blue Pacific and the* WESTERN *shores of the good old U.S., is an effort to suggest a coherent nationwide nonexclusive course of action in business data processing by* ACM *members—present and future—in that field.*

The problem, in the view of many of us, is that ACM *offers little for business data processing members, present and potential.*

Business data processing needs a professional focal point and it is up to the members of this profession to establish a society which does this . . ."

J. A. Postley
The Rand Corporation
Santa Monica, California

John got his way by ultimately forming the first of what subsequently became special interest groups within ACM—this one devoted to business data processing. Indeed, John organized and held a special, one day symposium on June 23, 1960, with the theme "Automation in Business Decision Processes."

The second letter reflected the thinking of the day, which has radically changed in these 15 years.

"Dear Editor:

It has come to my attention that a 704 statistical program has been produced at Arizona State University which apparently does a pretty good job on factor analysis and a few other things. Unfortunately, the letter I saw indicated a charge of $3 for the manual, $4 for one box of binary cards, and $20 for four and a half boxes of SAP *cards (plus postage).*

I believe that this has very unfortunate implications for the computing profession. When one has to cover printing and card costs, that is one matter. In this case, however, it is clear that what is being charged for is the development of the program, and while I am particularly unhappy that it comes from a university, I believe it is damaging to the whole profession. There isn't a 704 installation that hasn't directly benefited from the free exchange of programs made possible by the distribution facilities of SHARE. *If we start to sell our programs, this will set very undesirable precedents."*

Bernard A. Galler
The University of Michigan
Ann Arbor, Michigan

The $½ billion software products industry of today gives testimony to substantial change in thinking with respect to software value and industry attitudes.

1960 was the period when many organizations were moving from IBM 704 to 7090 computers, some through the half step of the 709, while others considered the Univac 1105, and some were beginning to consider Control Data 1604 computers. It was also the time frame of emerging unique systems, attempting individually to move the marketplace in a special and sometimes parochial direction. It was an active period with computer announcements such as in Table 1—p. 91.

1960 was also the ending point of a rash of excitement concerning Automatic Programming.

The term Automatic Programming was, however, an enigma. The concept suggested too much. Visions of a computer performing the programmer's work captured the imagination. A cartoon of the time reflected these innovative thoughts, taking the possibility of voice entry into a computing system and showing a user carefully enunciating into a black box the words, "DO MY PROBLEM!" *That's really automatic programming!*

But that concept was not so far-fetched. A no less sophisticated organization, MITRE, allied with the Air Force Electronic Systems Div. (ESD) at Hanscom Field, brought forth a revolutionary and mind-boggling proposal to the Department of Defense, a solution to the enormous problem of implementing and maintaining the manifold data processing applications.

It will be recalled that 1960 was the time frame of the famous Air Force "L" Systems. There were: 417L, 465L, 480L, etc. Each L System was a huge man/machine weapon or information system designed around computers. L Systems created companies, L Systems created software, and L Systems led to hardware.

L Systems invited two major problems. First, they were so enormous in concept and expectation that they could not be implemented before the requirements changed; and, second, they devoured manpower in such proportions that the country could not satiate their appetites—hence, Mitre and ESD solved the problem with "Implicitly Programmed Systems."

The Pentagon was besieged for tens of millions of dollars to support research that would achieve an information system environment which would significantly ease the system analyst and programmer training problem and provide tools by which an untrained data processing airman, in the guise of a user, could, by sitting at a console, assemble a useful application system—presumably by utilizing modules of available programs and having at his disposal the most advanced, powerful processing and data manipulating language.

This program was part of the Air Force Project Forecast and captured tremendous enthusiasm, since it promised to solve so many problems. However, some sober thinking led DOD to convene a panel of outside experts to evaluate the proposition and subse-

quently comment on its feasibility. The project was deemed technically premature and did not receive endorsement.

So much for the hope that there is a ready-made solution to the fundamentally difficult problem of implementing an information system.

Fifteen years later, a similar proposition would probably not get very far, despite the many positive and far-reaching advances made in technology in the interim.

The birth of POLs

One such advance development in that same time frame was the infusion of what has since been called the POL, i.e., Problem Oriented Language, or, as others would term it, the Higher Order Language. It appeared that POL was slated to refer to any implementation language which had structure and sophistication above that of the conventional Assembly Programming Languages. POLs included the plethora of languages of that day such as the following:

FORTRAN	COMMERCIAL TRANSLATOR
ALGOL	FACT
XTRAN	SURGE
MAD	CL/1
NELIAC	IPL
CORREGATE	LISP
AP2	MIMIC
CLIP	JOVIAL
COBOL	SIMCOM
APT	TABLEMAKER
COMIT	MORTRAN
SNOBOL	SIMSCRIPT
ALTAC	COLINGO

Mixed in this bag are really two types of POL. One is a general purpose implementation system such as FORTRAN or COBOL, whereas some are clearly oriented to a specialized function or application as are, for example, SIMCOM and APT.

In any event, the prime objective of this movement to languages and associated dialects was to provide higher-powered tools to programmers, so that they, in turn, could increase their own productivity—measured by how many programmers, over what period of time, and with what consumption of machine capacity, were required to achieve operational capability.

But that was easier said than done. If productivity through POLs was that easy and readily achievable, then why didn't everyone rush to seek the latest language or utility with which to obtain this objective?

I am reminded of the period prior to 1960 when we were deeply involved in developing the first trajectory programs for missile firings and the early space missions. FORTRAN became available. My experience with that system tells the story.

Fortunately, I was introduced to FORTRAN through what I now still consider the most lucid and well presented programmer documentation, the FORTRAN Primer. The primer was a subset of FORTRAN, uncluttered and with limited capacity. The new user was essentially given a starter set from which he could build as his understanding deepened and his needs broadened. For example, this FORTRAN had a single read and write command with no modifiers—that is to say, input and output had just one permissible and well defined format.

Many who were applications oriented gravitated to the system at once. Systems-oriented professionals, however, looked down upon FORTRAN and, in fact, considered it less than a sport to solve data processing problems once or twice removed from the "bits." Symbolic coding was already a step enough away from the pure machine!

But even several years earlier, at the beginning of the '50s, a similar experience was encountered in the ILLIAC Laboratory of the University of Illinois, the university that hosted that incredible group of computer pioneers, Wheeler and Gill, of Cambridge. The story was told of how the early ILLIAC programmers were coding their hexadecimal and octal commands and addresses and painfully fitting their programs within fixed address locations in the 1024 word memory of the ILLIAC.

However, these two Englishmen came over and began to quietly generate massive lines of code written in symbolic form, employing what subsequently was called a one-pass assembler. While the diehards stuck to their machine coding, the obvious slowly penetrated to the more innovative and soon the message was clear—programming productivity could be enhanced by the use of a symbolic assembler and the subroutine, which was also the invention of these Englishmen, formalized with the assistance of Wilkes, in their early and fundamental book, "A Comprehensive Set of Mathematical Subroutines," published in 1951.

The quest for machine independence

The diversity of machines and of implementation languages in the late '50s and early '60s, together with the need to retain flexibility in implementing systems, led to the search for either the one machine-independent and universally accepted implementation language, or for methods and techniques to make all languages readily available to all machines.

The first of these alternatives resulted in many efforts to foster variations of FORTRAN and COBOL, such as ALGOL, NELIAC, IPL, and PL/1. For example, the objectives set forth for NELIAC are a perfect example of these endeavors:[1]

1) That a programming language be selected which was computer and problem independent, but capable of expressing the logical procedures for solving any computer problem, whether business, scientific, engineering, military, etc.

2) That the language be independent of a particular spoken or written language, but capable of expressing any spoken language using English alphabet.

3) That the language be simple enough to be easily mastered by any user who might find it necessary to state a problem.

4) That the language be easily understood by persons familiar with the field of the problem, but who are not

[1]"NELIAC: A Universal Machine Independent Programming Method," M. H. Halstead and R. R. McArthur, U.S. Navy Electronics Laboratory, San Diego 52, California, 19 July 1960, TM-419

Our time-sharing terminals operate at 120 cps in interactive or batch mode. Either way you save.

And you save in two ways: You reduce communications line costs and cut computer connect time.

With these 1200 baud terminals you make full use of telephone line capacity. So even with moderate terminal usage, your savings can really mount up.

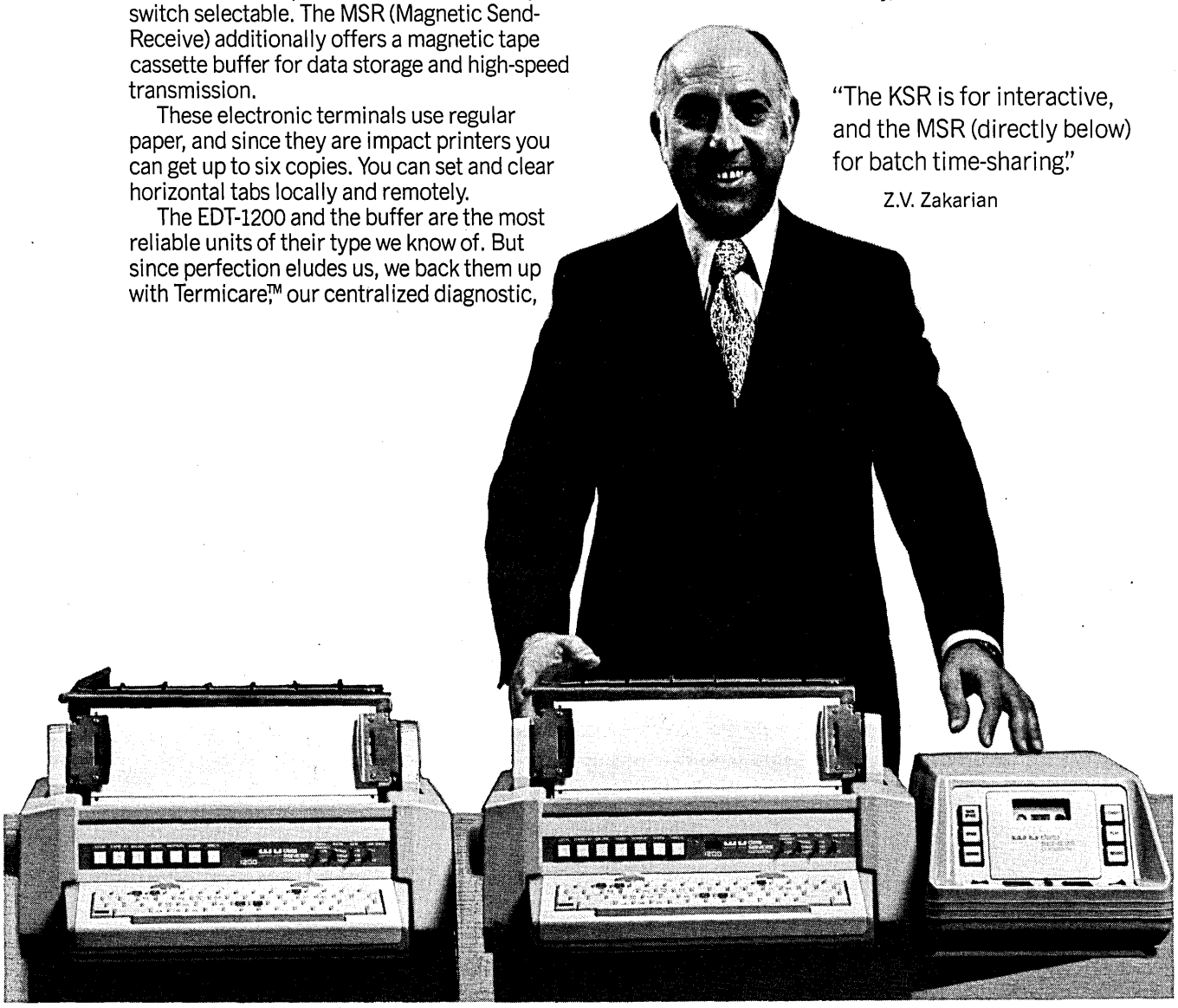
We offer two models of our EDT-1200 series: The KSR, which operates at 10, 30 or 120 cps, switch selectable. The MSR (Magnetic Send-Receive) additionally offers a magnetic tape cassette buffer for data storage and high-speed transmission.

These electronic terminals use regular paper, and since they are impact printers you can get up to six copies. You can set and clear horizontal tabs locally and remotely.

The EDT-1200 and the buffer are the most reliable units of their type we know of. But since perfection eludes us, we back them up with Termicare,™ our centralized diagnostic, maintenance and support service for all terminals.

We offer more than 50 options and special customer arrangements on our EDT-1200 models.

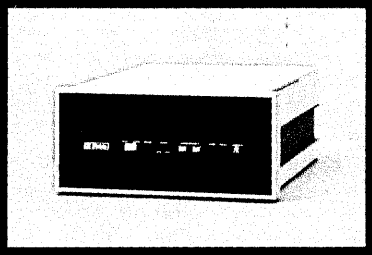
For more information about our EDT-1200 models, please contact me, Z.V. Zakarian, Western Union Data Services Company, 70 McKee Drive, Mahwah, New Jersey 07430. 800-631-7050 (in New Jersey, 201-529-1170).



"The KSR is for interactive, and the MSR (directly below) for batch time-sharing."

Z.V. Zakarian

western union data services company



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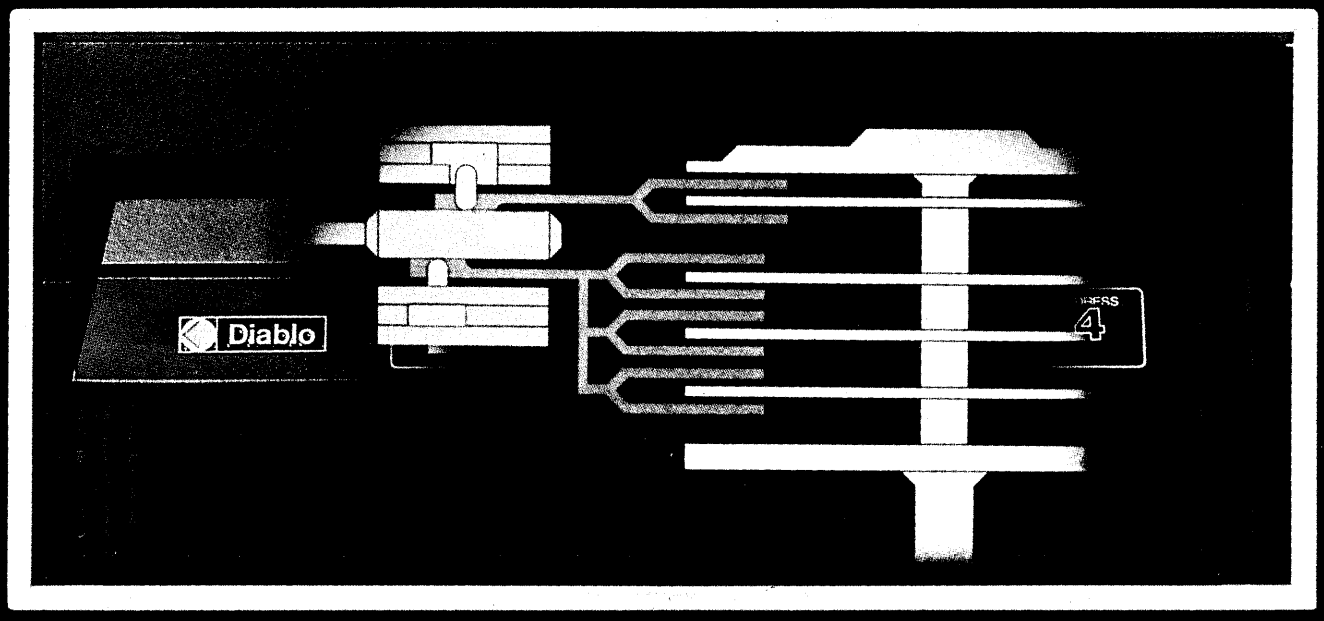

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CIRCLE 52 ON READER CARD

necessarily well grounded in automatic data processing techniques.

5) That a compiler be developed to translate the language to the most efficient machine language programs possible.

6) That the compiler be capable of compiling itself, or one similar to itself, when expressed in its own language.

7) That the compiler be capable of generating compilers to implement the language of other computers.

Despite all of the language endeavors, it appears that today, 1976, the leading contenders are still FORTRAN and COBOL, with the one possible innovative contribution, APL, making very slow but steady progress. Needless to say, there are many specialized approaches, such as our Informatics MARK IV Systems, which contribute to the achievement of powerful implementation capabilities by their scope of application and machine independence. Such systems fall short, however, of universal acceptance.

In search of UNCOL

This leads to the second question concerning the search for the Universal Computer-Oriented Language (UNCOL). In the period of 1960, organizations devoted themselves to the seemingly unrewarding task of structuring and finding consensus for a language which would adequately express the capability of any one of a selected number of physical machines; each such target machine would have a target compiler written in UNCOL. The POL would then be implemented in UNCOL once and, via the many UNCOL target compilers, would be available for all UNCOL-served machines. Given all of these facilities, it would be possible to map P-POLs into Q machines with the ease of writing P language implementations and Q translators (P+Q), rather than P × Q compilers.

The seriousness of these endeavors was exemplified by the SHARE UNCOL Committee which undertook this project over a period of four years and involved the talents of top innovators of that day, viz, Frank Wagner, Tom Steel, Owen Mock, Jack Strong, Joe Wegstein, Phil Bagley, Webb Comfort, etc. And if that were not sufficient proof, here is what DATAMATION said in its issue of January/February 1960:

"Those who think of UNCOL *as a pie-in-the-sky concept should be advised that an effort of considerable magnitude, in quality, if not quantity, is underway to make the Universal Computer Oriented Language a reality. Representatives of manufacturers and users from all parts of the country have met and are meeting to attempt to put* UNCOL *on paper."*

Yet, with all these good intentions and the support of the industry, it came to naught.

What happened? A fundamental new period in data processing began in the early '60s with the users very rapidly shifting their interests from certain hardware design and software system concerns to the real problems for which they obtained the computers in the first place, the solution of user applications.

This change in emphasis came about for a number of good economic reasons:

1) Hardware devices suddenly improved in performance as the second generation of the computer age arrived.

2) A sufficient software base was reached, including languages, compilers, and operating systems, so that useful and efficient work was now achievable.

3) Independent software houses were springing up and making things happen on the system software scene.

Perhaps the most direct blow to UNCOL came as a result of the rapid breakthroughs in the economics of compiler building. Before 1960, typical compilers required expenditures of $250K to $500K and as long as a three-year cycle to complete the project. These economics and the proliferation of various types of computers argued well for a more efficient POL development.

Then, in early 1960, a number of independent suppliers of software devised techniques leading, for example, to the production of FORTRAN compilers for $30,000, with availability in six months.

Not all of UNCOL was lost, however. The Air Force, through System Development Corp., supported the development of the JOVIAL System, with its associated intermediate language, providing the UNCOL objectives for at least one POL mapped onto the IBM 7090, IBM 360, ANFSQ7A, Philco 2000, and CDC 1604.

What else isn't new?

As cited above, interest in applications began in the early '60s. This was the time when debates formed on a number of popular themes, including first, the more esoteric consideration of:

Artificial Intelligence
Self-Organizing Systems
Heuristics

and then the feasibility consideration of:

Computer-Assisted Instruction
Pattern Recognition
Language Translation
Simulation and Modeling

together with certain technological investigation into:

Memory Hierarchies
Associated Memories
Parallel Processing
Parallel Computers
Multiprocessing
Multicomputers
Multiprogramming
Time-Sharing

to, finally, the whole area of:

Management Information Systems
File Management Systems
Data Base Management Systems

While most of the above-mentioned subjects have never found their way to

pragmatic hardware or software solutions (e.g. computer-assisted instruction and language translation), the period will be remembered for giving birth to what we now call the time-sharing industry and the whole data base/data communications technology.

This, then, was the technological promise of the computer at the outset of the last 15 years. What progress has been made and what is the fulfillment as seen today? What does the future foretell?

Progress in metal and silicon . . .

First, a glance at the hardware environment as seen today:

- The medium and large scale computers worldwide number 150,000, or a factor of 25 over 1960. The installed value of the equipment, at $60 billion, is an increase by a factor of 30.

- The maximum memory capacity of systems, then and now, has gone from a ¼ million megabyte to 4 megabytes, an increase by a factor of 16.

- Viewed strictly from the point of view of computing power, today's inflated dollar will purchase 20 times the computing power brought by a more valuable dollar in 1960.

- A $2 million data processing system of 1960, which may well have been an IBM 704, would buy, today, an IBM 370/145, with improvements in technology as follows:

Core memory up by a factor of .16
Core access time improved by a factor of 48
Fixed and floating add times faster by a factor of 10
Line printing up by a factor of ..13
Tape transfer rates faster by a factor of 80
Card reading up by a factor of .. 6
Card punch up by only a factor of 3

The typical computer user in 1960 was not really concerned with communications, since the technology of modems, I/O controllers, and communications software had not yet really emerged. The cost of communications was, therefore, rather expensive, given the absence of multiplexing, the presence of primitive buffering systems, and the higher costs of transmission.

1960 was the year when North American Aviation was experimenting with communications and had just established a microwave transmission system from Los Angeles to Rocketdyne in Canoga Park, a distance of 40 miles.

Since that time, communications hardware and software improved, and AT&T charges have dropped as follows:

WATS Service, Los Angeles to New York City

1961	$2,275/month
1975	1,675/month

Peak hour, station to station, Los Angeles to New York City

1960	$2.25 per 3 minutes + 60¢ addl. minutes
1975	1.36 per 3 minutes + 40¢ addl. minutes

Transmission across the country was some 50% more expensive in 1960 than in 1975.

In this setting of technological progress, the dp industry has been rather good to the professionals, who have had satisfactory growth opportunities, both financially and in responsibility:

- A beginning programmer can now expect to start out at $11,000 per year, whereas in 1960 he started at $7,500, an (apparent) increase of almost 50%.

- A senior programmer today commands an annual salary which is over 1½ times his expected wages of 1960.

These figures, of course, do not reveal the impact of inflation, which, based on the U.S. Department of Labor Consumer Price Index, and excluding effects for taxes, indicates a need today for an approximately 80% increase over 1960 salaries to maintain 1960 parity. Assuming, however, that today's compensation reflects today's competitive marketplace, one is led to the observation that 1960 salaries of programmers may well have experienced a 20% premium due then to the shortage of personnel demanded by the burgeoning new computer industry.

In other related areas, costs have increased as follows:

- The worker today pays maximum FICA of $825 versus the $120 of 1960, an increase of almost 700%.

- ACM national membership dues increased almost 600%, from $6 to $35 per year.

- A subscription to Electronic News has gone from $3 in 1960 to $12 in 1975, an increase of 400%.

Fortunately, a subscription to DATAMATION is still complimentary and, indeed, the magazine has moved from a bimonthly publication generating over 400 pages per year in 1960 to a monthly journal producing over 1,400 pages in 1975, a 300% increase of information annually.

. . . but not necessarily in applications

But what has the software practitioner wrought?

Unfortunately, the last 15-year period has not left many significant marks on software development. Certainly, we cannot say today that there have been any significant improvements made in software productivity, or as it is now known, software engineering.

Consider first the question of languages. We have already noted the widespread use and influence of FORTRAN and COBOL to the exclusion of nearly any other system.

The proponents of Implicitly Programmed Systems would not be overly impressed by our current panaceas of:

Modular Programming
Chief Programmer Concept
Top Down Programming
Structured Programming
Egoless Programming

nor through software systems such as:

Time-Sharing

THE MATCHMAKER

Telefile introduces the only disk system flexible enough to match any minicomputer with any of the hot, new 3330-type drives. Big disk storage at a mini price.

Telefile now has available the most flexible large capacity disk system for minicomputers on the market today. The Matchmaker. It comes two ways:

As a disk system for users (DS-16-C) where we match your minicomputer with *any* of the latest 3330-type technology drives you want. Telefile supplies the complete package.

As an OEM disk controller. You can order just controllers alone (DC-16-C) and mix and match minicomputers and drives to satisfy your customer's whims and storage requirements.

Either way, disk system or controllers alone, you are assured of flexibility, performance features, and price no one else can match.

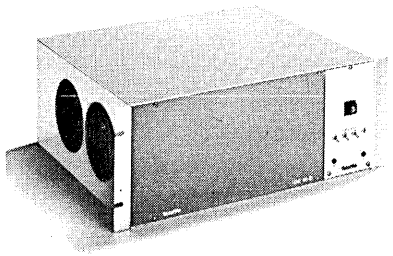
Each system stores up to 1.2 billion bytes.

You can match just the right drives to meet your storage capacity needs all the way from *13.3 million to 1.2 billion bytes per controller.* Each DC-16-C Matchmaker controller handles up to four drives. Minicomputers never had it so good.

Choose any of the latest drives.

You've seen them announced one-by-one and they're coming on strong. CalComp's Trident. Control Data's Storage Module. Diablo's 400 Series. The Ampex 9000's and Memorex 677's. Each builds upon IBM 3330 technology, which means higher storage densities and new circuitry for superior reliability.

To switch drives, simply change one controller circuit board. We've timed it at 63 seconds flat!



Compatible interfaces to eleven minicomputers.

We're designing a complete line of compatible interface boards to match up to many minis: Data General, DEC, Interdata, Keronix, D.C.C., Microdata, Honeywell, Lockheed, H-P, Varian, and Cincinnati Milacron. Simply fit our tailor-made computer interface module inside your computer chassis and you're in business. If you have another type mini, we'd be glad to design one for you.

Or you can design your own interface.

Your designers may want a piece of the action. Our general interface board makes it easy. Your board will tie in directly, bringing big disk storage to *any* 16-bit minicomputer.

A controller so small you can even hide it.

The Matchmaker is our smallest controller yet. It is totally self-contained right down to its power supply and cooling system. It's small enough to tuck away in a drive housing or in a rack above, below, or even *behind* the computer. Out of sight.

We'll even make you a faceplate.

If you want to show the Matchmaker off, we'll make a bezel to match your computer panel. Private label it and call it yours. There's no end to the flexibility.

Easy "front door" maintenance.

Five circuit boards slip right in from the front of the DC-16-C Matchmaker. A disk interface board, a general interface board, a command/timing board, a memory/address board, and an optional maintenance board for offline disk pack formatting and test exercising.

Unmatched features

- Contains 512-byte buffer for data rate matching
- Variable data search and read
- Block transfer of data up to mini-addressing capacity
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- Write protection to the sector level
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- Overlapping seek capability
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We wrote the book on disk controllers, and you can get it free.

For years, we've helped minicomputer users grow their disk capacities. Now our Matchmaker system is a quantum leap forward. A new in-depth, hot-off-the-presses Matchmaker technical manual gives you all the facts. Write for it. Prove to yourself that this is one disk controller no one else can match.

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Turning minis into maxis with moxie

Please send me your Matchmaker book.
I'm interested ___now ___later (more than six months from now).

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CIRCLE 49 ON READER CARD

Datapoint's 4000 Series DATASHARE Systems

For dispersed processing capability tailored to your company's productivity needs...and your company's pocketbook.

Datapoint Corporation's widely-used DATASHARE business timesharing system is now being offered in four integrated systems configurations, which offer significant cost savings when compared to system component purchases or leases. The four systems are designated the 4220 and 4240, based upon Datapoint 2200 processors, and the 4520 and 4540, based on Datapoint 5500 processors. Each configuration consists of a processor, disk memory, communications interface and systems operating software on pre-generated disk cartridges.

These business timesharing systems permit users at low-cost remote work stations to access the central processor to perform a wide variety of data entry, data processing and report generation assignments while optionally handling data transmissions to other computer sites. Precise systems configurations are as indicated in the charts below.

With any of these systems, an operator at a terminal can utilize the processing capacity of the central processor independent of any other terminal user for her specific data entry and data processing needs. Likewise, each user may access the storage capacity of the central system disk units independent of other users. Printing units are optionally available for user terminals and may be connected via telephone service or local connection with the central processor.

Tested & Shipped as a System

Users of 4000 Series Systems will realize significant savings over buying individual components. In addition, the user receives a system that's tested as a total system rather than as a collection of separate units. For example, the Disk Operating System is generated right on the system prior to shipment as a final test, and the operating level software and documentation is shipped with the hardware. The entire system arrives ready for installation and the user can begin developing his own application programs immediately. Additionally, the 4000 Systems which utilize cartridge disks have the disk memory buffer expanded from 1K to 4K characters allowing even faster program execution. (Current DATASHARE users will be able to add this increased disk buffer to their cartridge disks if they wish.)

Add the Peripherals You Need

The customary wide variety of Datapoint peripheral equipment is available for use on these systems, including printers, tapes, user terminals and terminal printers. All DATASHARE systems use the DATABUS high-level language for application programs which will run on any DATASHARE system without modification. DATASHARE virtual memory techniques offer users expanded program space.

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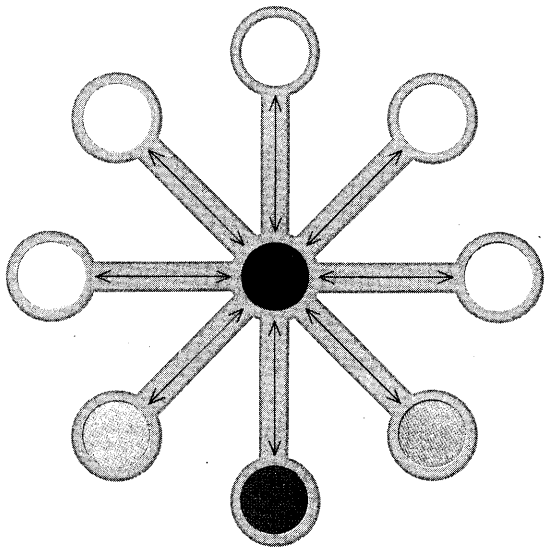
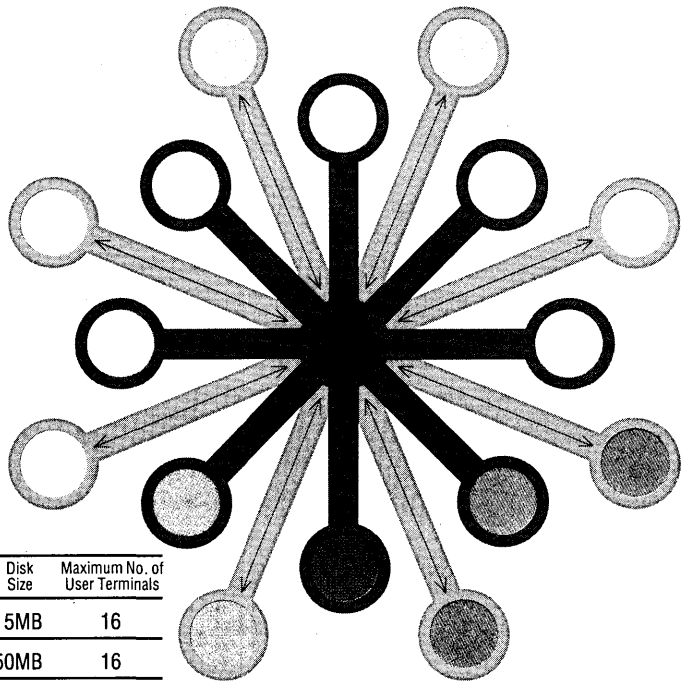


System Number	Central Processor	Central Memory Size	Virtual Memory Size	Disk Size	Maximum No. of User Terminals
4220	Datapoint 2200	16K	128K	5MB	8
4240	Datapoint 2200	16K	128K	40MB	8



System Number	Central Processor	Central Memory Size	Virtual Memory Size	Disk Size	Maximum No. of User Terminals
4520	Datapoint 5500	48K	512K	5MB	16
4540	Datapoint 5500	48K	512K	50MB	16

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Data Base Management Systems
Inquiry Systems

Despite these advances, there are no signs of significant jumps in the programmer's implementation productivity.

Let us consider the following economic exercise. In the early 1960 period, programmer output in business applications was at the rate of $3 to $5 (say, $4) per finished machine instruction. Systems programmers, on the other hand, produced their output in the range $10 to $15 (say, $12) per line of code, the upper end associated with real-time, on-line applications. Given no further improvements, inflation leads to a comparable $6 and $18 today.

Today, a new business application requiring 20,000 lines of code would, therefore, cost us some $120,000 and, more than likely occupy four people for a year.

Since 1960, however, improvements have been made with respect to automating design techniques through program design languages, development of compilers such as COBOL with associated enhancements, special purpose languages and specification systems such as our MARK IV System, check out and debugging systems, and automated documentation systems.

Also, there have been developed programmed organizational techniques (chief programmer), implementation tools (time-sharing), and project management procedures (project control tools). One could presumably concatenate the productivity improvement that each of these techniques, where relevant, provides over the more conventional processes.

Since each of these processes or techniques promises performance improvements of a significant amount, we conclude that, if we could use only half of them in solving any one problem, we should get an improvement in productivity of at least a factor of ten and, thereby, reduce our application implementation cost to 60¢ per line of code. Hence, we should be able to generate a program consisting of some 20,000 instructions for $12,000, accomplished by two people in two months.

Such productivity, however, is rather remote from present experience. It is the unfortunate situation that programming is still far from a science and software engineering has a long way to go. In fact, there does not seem to be anything coming down the pike at this time which gives any hope in the near future for significant improvement in the system designer's and programmer's performance.

Naturally, the availability of packaged software is an alternative at the moment for cost reduction—but this is not to be confused with increasing the individual programmer's productivity.

Ever onward

The fulfillment of the computer's promise in these last 15 years, while substantial in the area of hardware, has fallen short with respect to software achievements. It is expected that hardware improvement will continue well into the next decade, while the future of software is less assured. Nevertheless, we are confident that breakthroughs in software engineering will eventually occur—inspired by no less than the industry leader's confidence expressed in 1960 in the hymn "Ever Onward," from the IBM Song Book, Form No. 30-8798-0-8-12-53-P:

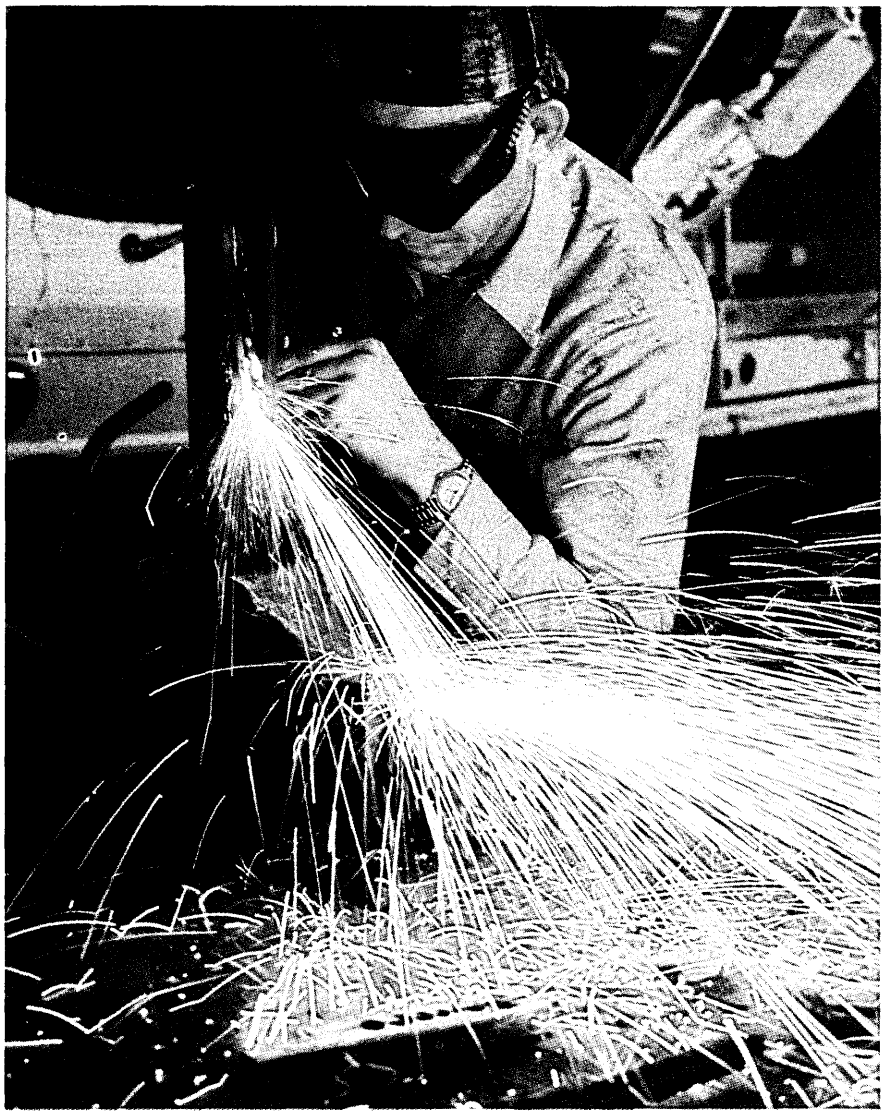
EVER ONWARD—EVER ONWARD!
That's the spirit that has brought us fame!
We're big, but bigger we will be,
We can't fail for all can see
That to serve humanity has been our aim!
Our products now are known in every zone,
Our reputation sparkles like a gem!
We've fought our way through—and new
Fields we're sure to conquer too
For the EVER ONWARD IBM. ❋

Mr. Frank's dp experience goes back to programming early computers in the Army's data reduction lab. He worked on the ILLIAC at the Univ. of Illinois, and directed development of some of the first trajectory and orbit determination computer programs at Thompson Ramo Wooldridge and Space Technology Labs. In 1962 he cofounded Informatics Inc. where he is currently executive vice president, director, and member of Informatics President's Office. From 1971-73 he was president of Equimatics, a joint venture of Informatics and The Equitable Life Assurance Society. He has authored or coauthored 19 technical papers.

This article is taken from a talk given to the San Fernando Valley Chapter of the ACM, of which Mr. Frank was founding chairman.

DP Dialogue

Notes and observations from IBM that may prove of interest to data processing professionals.



Yesterday a blacksmith, today a welder. Dempsey Faulkinberry learned a new skill with the help of Oklahoma's vocational rehabilitation program.

A Helping Hand for Public Assistance in Oklahoma

When a citizen of Oklahoma applies for public assistance with the proper documents, he or she may be in for a pleasant surprise. Even if the application involves multiple services, such as aid to dependent children, medical care or vocational training, a single interview with a caseworker may cover everything, with the appropriate specialist being called for more technical services. The applicant's eligibility for various services can be determined almost immediately and if assistance payments are involved, a check can be issued within 24 hours.

This fast, efficient service is based on the statewide information system of the Oklahoma Department of Institutions, Social and Rehabilitative Services (DISRS). The system operates under the Customer Information Control System (CICS), and links an IBM System/370 Model 158 computer in Oklahoma City to over 250 IBM 3270 visual display terminals. There is at least one terminal in each of Oklahoma's 77 counties. Through a common data base used by all of the public assistance programs, complete and up-to-date information on any case is swiftly accessible through any terminal, reducing the possibility for delay or conflicting data.

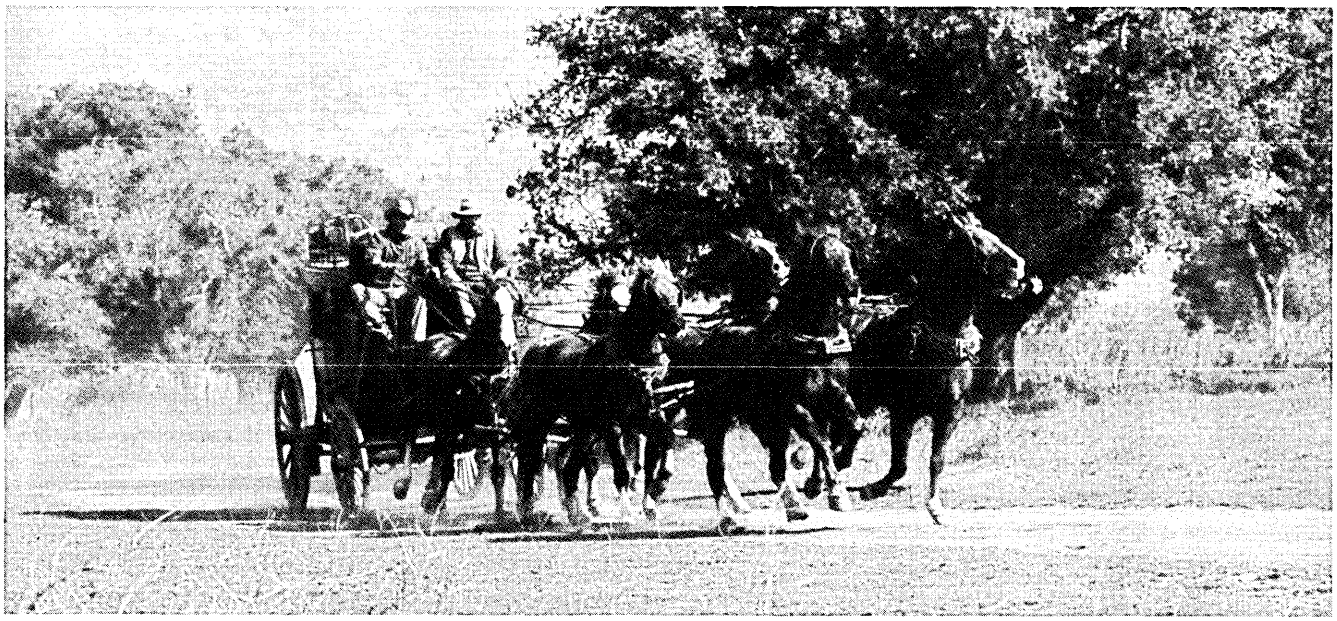
As Charles F. McDermott, comptroller of DISRS, points out, the system establishes both eligibility and non-eligibility with equal speed.

"Take aid to dependent children," he says. "Nationally, over 9% of all cases are found to be ineligible. Here in Oklahoma, the ineligible rate is down to 2%—one of the lowest in the nation—due almost entirely to our ability to cross-check through the information system. That reduction alone is saving the taxpayers of Oklahoma about $600,000 a month."

The system also makes it easier to coordinate public assistance grants with employment opportunities and work training programs. This has contributed to another record for Oklahoma—a higher percentage of people on public assistance are getting vocational rehabilitation than in any other state.

Before the information system was installed, a professional caseworker for the Department typically handled about 60 cases. Now, due to the dramatic savings in time and clerical work, a caseworker can oversee as many as 200 cases.

"The caseworker and the client both benefit from the system in improved morale and a greater sense of purpose," says McDermott. "And the individual who foots the bill—the taxpayer—has the satisfaction of knowing that the State's tax dollars are being spent more productively."



3890 Hits the Trail with Wells Fargo

Between 4 p.m. and 9 p.m. every evening, trucks from 11 regional offices of the Wells Fargo Bank drop off over two million checks and other documents to be sorted and handled at the bank's San Francisco headquarters. All the work must be completed by 11 p.m. the same night.

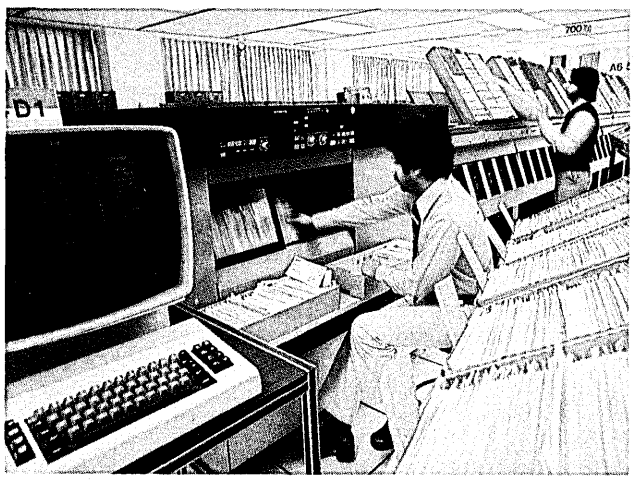
"Getting the checks from our own 300 branches in Northern California organized, logged and reconciled is a tremendous problem in logistics. Losing time can mean losing a lot of money in the banking business. The faster we can post our own demand deposit accounts and get credit on checks drawn on other banks, the faster we can reduce our float and use the additional money to earn profits," says Watson McKee Jr., senior vice president.

Wells Fargo is the 11th largest commercial bank in the nation.

"Since Wells Fargo began using IBM 3890 Document Processors last December, reconciling time, even on peak days, has been cut by two hours," adds McKee. "Now we can capture and sort over 100,000 magnetic ink encoded documents (MICR) per machine per hour—just about double the speed of our older IBM 2956 processors."

With improvements in multichannel character recognition and an extremely sensitive read head, the 3890 has cut the number of previously "unreadable" documents by 50%. It has helped Wells Fargo to lower its reject rate to 1.3%—less than half the national average for banking.

"Re-sorting rejected checks is traditionally the most expensive aspect of the entire document handling operation because it has to be done manually," explains McKee. "The 3890's will save us a considerable amount of money in that area alone."



At Wells Fargo Bank, operators work with one of eight IBM 3890 Document Processors. Each machine can read and sort over 2,000 MICR encoded documents a minute.

Equally important, the 3890 provides a full audit trail for every transaction. After reading the MICR code, the 3890 prints a unique item number on the back of each document. It imprints the bank's endorsement legend on the checks, transmits the MICR code and the item number to one of the bank's two System/370 Model 168 computers. It also makes a microfilm of each document for future reference.

After capturing, numbering and endorsing the documents, the 3890 sorts them according to the bank, branch and type of account to which they belong. In addition to checks, documents such as deposit slips, loan payments, master charge receipts and Christmas Club payments are also processed.

Advanced Features

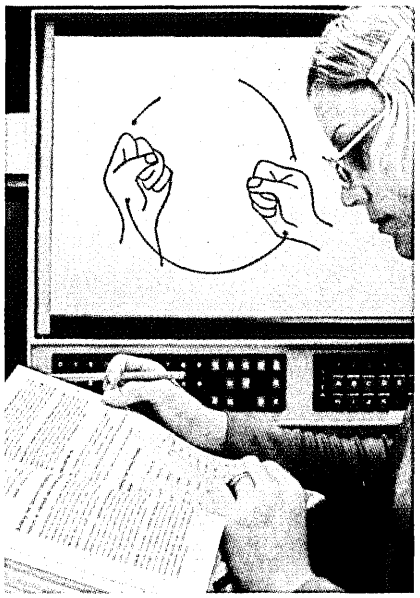
Among the advanced features of the 3890 are a built-in jogger which automatically aligns the documents and a new document separator which virtually eliminates the "piggy-back" problem—two checks sticking together.

With a total capacity of 36 pockets, available in modules of six pockets, the 3890 can grow to meet the needs of almost any operation. Wells Fargo now has eight 3890's, each equipped with 30 pockets, to handle all the work from its branches in Northern California.

Final conversion to the 3890 was accomplished in a little over two weeks —about a month ahead of schedule. According to Mike Macpherson, group manager in charge of installation, "We did nine months of extensive testing and then gradually added offline applications. Moving to online sorting was virtually transparent to our users."

"We've already realized considerable benefits from the 3890," says McKee. "And as new applications come on, such as cycle sorting, we expect the processor to help us save even more money in the future."

Teaching the Language of the Deaf with Interactive Computing



Using interactive computing, a student at Golden West College learns the symbol for "drive" in Ameslan, a sign language for the deaf.

A student at Golden West College in Huntington Beach, California, is using a computer terminal to study a picture. The image she is looking at represents the word "drive" in Ameslan, the American Sign Language of the deaf, used throughout North America.

Over 200 students, most of whom have normal hearing but are interested in communicating with the deaf, are enrolled in Golden West's sign language courses which use computer-assisted instruction programs. The programs include 49 separate lessons which introduce 660 signs corresponding to frequently used words or phrases.

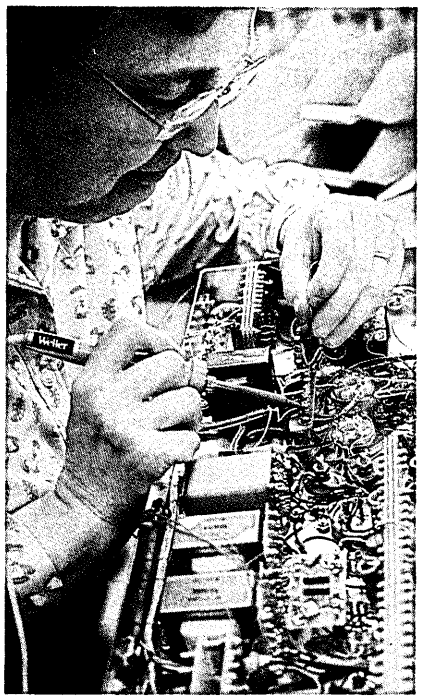
"We see interactive computing as a very powerful and integral component of coordinated instructional systems which also include the traditional classroom and other non-traditional learning activities," says Richard L. Mercer, supervisor of computer services at the college. "Using computer-based practice, simulation and other programs, students can add to their knowledge and improve their skills at their own pace and at their own time—almost as if each has a private tutor."

By typing in the English word or phrase at the terminal, the student activates a microfiche file linked to an IBM System/370 Model 155-II at the Coast Community College District's computing facility. A drawing showing how to make the appropriate Ameslan sign for that word flashes on the screen within seconds. The system can also be used in reverse so that the student can test himself.

"We have found student reaction to computer-assisted instruction overwhelmingly positive," says Paul M. Culton, chairman of the impaired hearing program. "It makes learning fun. And it also serves to correct misconceptions on the spot, instead of next week in class."

The college has over 1,000 learning programs in 55 different disciplines ranging from Ameslan to more traditional subjects like history, science and mathematics. All of the programs were developed using A Programming Language (APL). According to Bob Schaulis, director, information services for the Coast Community College District, "We believe that personal computing—giving many people simple access to the full power of the computer—will become increasingly important in many areas of instruction."

Computer Helps Weston "Get It Out the Door" Faster



Shop Floor Control is one of several IBM programs used to report on the status of work in progress at Weston Components.

When you've got 100 highly complex subassemblies in production on any given day, an hour of lost time can mean meeting or missing a shipping deadline. At Weston Components, an affiliate of Schlumberger, Ltd. at Archbald, Pennsylvania, an IBM computer is helping make every hour count by reducing the paper workload and increasing the controls over work in progress.

"We need very accurate knowledge not only of our inventories and purchasing requirements, but also of the exact status of each job," says Mario Dell'Aglio, director of operations. "A great deal of our business is 'job shop' kind of contracts—specialized components made to order. That means we have to figure out new production scheduling, parts requirements and budgets to fit each new assignment."

To help keep track of orders in various stages of completion, Weston uses several IBM programs which run on the company's System/370 Model 115 virtual storage computer. A data base management program creates and maintains basic information files describing product structures and the manufacturing procedures associated with each product.

"We've used the program very successfully to organize our bills of materials—the lists of parts used in each assembly," says Jack Minelli, Weston's systems engineer. "By automatically generating purchase requisitions for each job, it has reduced our clerical work by 30%. Equally important, it allows us to find out how many of the same parts may be needed on several different jobs, thus saving us money through volume buying."

The program insures that up-to-date information relating to costs, parts availability and inventory can be made available to all the departments that may need it. Since data is only entered once for inclusion in a master file, the chances for errors are minimized.

During the past year, Weston computerized another critical aspect of its business—following the progress of a work order at every stage during production. The job is now being done with the help of the IBM Shop Floor Control Program.

"Now we can keep much better track of the manufacturing process and

(continued on next page)

Advertisement

North Central Airline Lands $7 Million Saving

As one of North Central Airline's DC-9s lands at midnight in Minneapolis, aircraft mechanics are ready in the hangar with a list of parts to be tested, checked and possibly replaced. Within three or four hours, the necessary inspections and repairs are completed and the plane is in the air again taking passengers to Chicago, Milwaukee, Detroit or any one of the 90 cities served by the regional carrier.

The rapid "mini" overhaul is possible because North Central developed a series of unique computer programs to avoid more costly total overhauls, which can keep a plane grounded for days, instead of hours. Called SCEPTRE —System Computerized for Economical Performance, Tracking, Recording and Evaluation—the programs were developed using structured programming, a technique that required 30% less time than the previous method. They access a data base controlled by IBM's Information Management Systems (IMS) which includes a complete maintenance history of each of the carrier's fleet of 50 DC-9s and Convair 580s.

Aircraft mechanics service a DC-9 at North Central's maintenance center in Minneapolis. An online IBM computer system helps make the operation faster and more accurate.

"We're a regional airline, and our profits really depend on keeping all our planes fully utilized," says John Pennington, SCEPTRE project administrator. "With SCEPTRE, we can schedule maintenance time so effectively, it's like having an extra DC-9 in our fleet. That's a $7 million savings right there."

Information such as aircraft performance history and parts inventory and replacement forecasts is stored on an IBM computer at North Central's corporate headquarters in Minneapolis. Using the SCEPTRE programs, a mechanic, pilot, or executive can check on the maintenance status of any plane from any one of 45 IBM 3277 and 3275 Display Stations located in North Central's hangars, machine shops and parts storage areas. The SCEPTRE files can also be accessed through IBM reservation terminals located in airports throughout North Central's system.

"SCEPTRE helps us spot potential problems long before they occur," says Clive Schuelin, systems manager. "The initial justification of SCEPTRE was based on the expectation that by the time the system is completely operational, it will reduce the existing maintenance budget by 10%. With development well underway, we have already received significant dollar benefits."

Weston Components...

(Continued from page three)

establish priorities for work assignments," says Dell'Aglio. "In addition to getting job status reports daily, instead of weekly, the program helps us identify the total time spent at each work station.

"The system provides for the preprogramming of jobs so that the most efficient work sequence, due dates and priorities are followed."

Both program products aim at the same goal—organizing the manufacturing process so that situations like bottlenecks, material shortages and scheduling conflicts can be spotted and corrected immediately.

"By taking the paperwork burden off our foremen, we can free them for the really important work—planning to optimize the use of our machines and men and avoid costly disruptions of the work flow," says Dell'Aglio. "And the more precisely we know where we stand on work in the shop, the more responsive we can be to our customers' demands."

DP Dialogue appears regularly in these pages. As its name suggests, we hope DP Dialogue will be a two-way medium for DP professionals. We'd like to hear from you. Just write: Editor, DP Dialogue, IBM Data Processing Division, White Plains, N.Y. 10604.

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It all adds up to more productivity in your data entry operations, more CPU time for your big jobs, more timely and accurate management reports, and more efficient use of expensive communications lines.

That's the whole theory behind Sycor's family of intelligent terminals for distributed data entry and processing networks. Whether it's a stand-alone or clustered configuration, Sycor has a system which will match the throughput requirements of your remote sites.

Find out how Sycor intelligent terminals can make a big impact on your bottom line by contacting one of our 30 sales offices. They're in the Yellow Pages. Or send in the coupon. Better yet, contact Ken Wilson, our product marketing manager, at (313) 995-1371.

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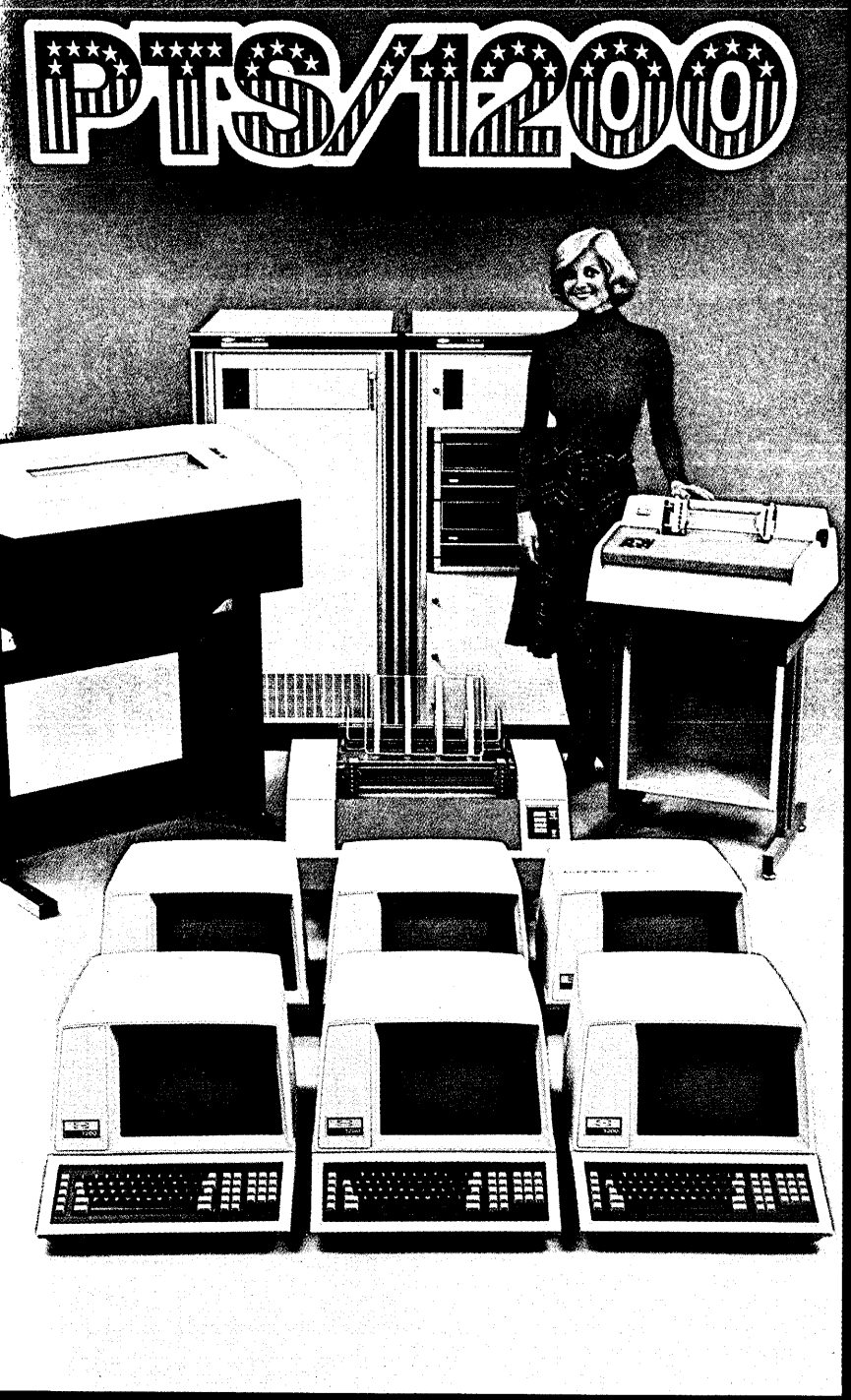

Raytheon's new PTS/1200 distributed processing system gives companies with extensive branch operations new independence from centralized information handling.

The versatile, cost-effective PTS/1200 system allows remote sites to perform their own:

- source data entry and pre-processing, including editing and validating;
- file and record maintenance — creating, accessing and updating locally stored data;
- unattended two-way communications, either in point-to-point or multi-point networks;
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- fast, flexible report printing, in many formats;
- 3270 terminal emulation on-line with 360/370 computers.

Ready-to-use software gets your data up fast — and you can program your own applications easily. The system can utilize up to 24 terminals simultaneously. It reduces computer line costs and forms costs, expedites data retrieval and reports, improves productivity and requires minimal operator training.

A demonstration says it all. To arrange that, write to Raytheon Data Systems, Marketing Department, 1415 Boston-Providence Turnpike, Norwood, MA 02062 — or telephone 800-225-9874 (toll-free). When you build better information processing systems . . . **the Word gets around.**

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CIRCLE 62 ON READER CARD

Halfway To a Relational Data Base

by Michael F. Korns

A compromise provides a less expensive way to test relational data bases in the application environment, and an easier conversion too.

Most companies are in a position to profit tremendously if they could decrease the programming time required to develop an on-line application, or if they could decrease the processing time required to answer impromptu queries against their data files. Relational data base systems offer the user several advantages toward these ends:

- Terminal support of interactive programming and inquiry functions.
- Application development times several orders of magnitude lower than with COBOL or PL/1.
- Quick response to unanticipated ad hoc questions—through the use of multiple index structures.
- Reduced processing time via internal conversion of user queries into optimal search strategies.

Unfortunately there are several problems inherent in relational data base systems which make them impractical for many industrial applications. Relational data organizations usually store more data in multiple indexing structures than would a more traditional organization. While multiple index structures tend to increase search speed, there is usually a penalty in update speed. Thus a relational data base is typically good for data bases which are referenced often and updated infrequently.

If a relational data base system updates its multiple indexes and pointers dynamically, an abend or other hard failure is usually catastrophic. In addition most relational data organizations are not applicable to very large data bases (data bases over a billion bytes). Finally, the impressive functions of a relational data base system cannot be applied to existing data unless that data is converted to relational data base organization. In point of fact, most companies cannot afford such a conversion.

At Western States Bankcard Association (WSBA) in San Francisco, we recognize many opportunities for data base applications. However, these opportunities are often frustrated by the considerable disruption that installing the data base system would have on current production files and programs.

Furthermore, although the relational data base model seems to offer us the most impressive array of functions, we do not consider relational data organizations mature enough, at this point, for practical application in the banking industry—certainly not for us. (WSBA is the world's largest regional charge card association, representing more than 260 banks in California, Oregon, Washington, Idaho, Utah, Nevada, and Wyoming. These banks represent combined total assets of $72.3 billion. Charge card activity, for the association's 6.5 million Master Charge card holders, amounted to over $2.5 billion in the last fiscal year.)

The problem, as we see it, is to develop some means by which the impressive range of relational data base functions can be run against current data without disrupting the data or the production programs running against the data. We would like to be able to implement a more conventional data organization scheme which would sacrifice some of the multiple indexing features of relational data organizations, but which would escape the catastrophic recovery and update problems currently impacting those data organizations. And, we would like to leave ourselves in a position to interface relational data organizations if, at a later date, the problems we mentioned are solved.

The CDS system

The CDS Data Base System (CDS for Control Data Sets) described in this article is fully interactive data base system which was developed at WSBA and installed in February 1976. This data base system is capable of simulating a wide range of relational data base functions while running against many different types of data files. It offers WSBA these advantages:

- Terminal support of fully interactive inquiry and programming functions.
- Support of formatted displays and fill-in-the-blanks updating functions on crt terminals.
- Application development times several orders of magnitude lower than with COBOL or PL/1.
- Support of current data files, concurrent with the old COBOL and Assembler programs running against them, for a wide range of data base functions.
- Current support of a more conventional data base organization sacrificing some multiple indexing in return for better recovery and updating capabilities.
- The ability to become a relational data base system by interfacing with relational data organizations in those cases where it becomes practical.

Record streams

The CDS Data Base System is capable of simulating relational data base functions on a wide range of data files. Basically, the system processes a query using the data dictionary, to form a "Select" program. That program runs against the actual file on tape or disc

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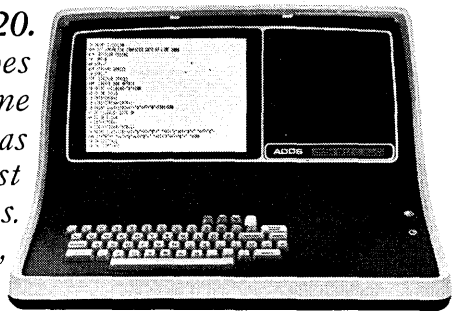

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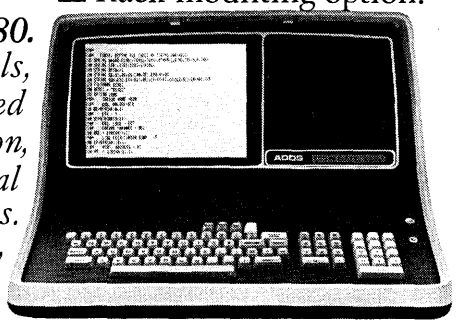

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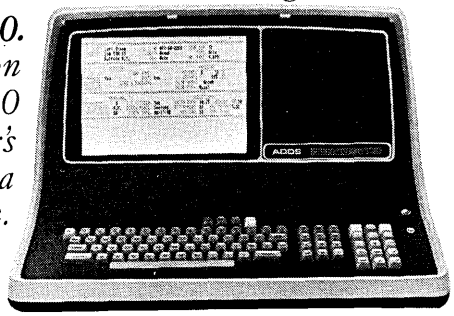

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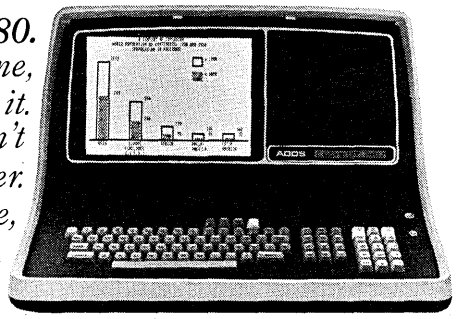

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using a standard access method to create a file subset. That subfile is then formatted and displayed as the response to the query. The method is based on the handling of "record streams."

Relational systems have their own special language in which data is stored as *relations* in which occur *tuples* which are subdivided into *elements*. In the CDS Data Base System, data is spoken of as being stored in *files* which contain *records* that are subdivided into *data fields*. The latter terminology enjoys wider familiarity among dp personnel. (A more detailed account of this data structure is presented in Fig. 1.)

We believed that relational theories could be merged into a system which could apply to a wide variety of record streams. But before this could be accomplished, a program had to be developed which could read a simple data dictionary description and pull a target data field from an arbitrary record stream. Thus underlying all of CDS's operations is a scheme for breaking up arbitrary record streams into individual data fields. (See Fig. 2.)

Once separated from its record stream, a data field is loaded into a work area where it is dealt with in a manner similar to other relational data bases. CDS is coded in Assembler for the IBM 370 series and supports data fields with the following data types: (a) fixed point; (b) floating point; (c) packed decimal; (d) character; (e) zoned (picture); and (f) hexadecimal.

The CDS System obtains a record stream from within a file by: (a) looking up the file name in the data dictionary; and (b) passing the desired record key value along with an I/O command to the file access facility listed in the data dictionary for the file. CDS is kept simple with only four I/O commands: (1) read a record by key; (2) write a record by key; (3) delete a record by key; and (4) read next record (for sequential scans of files).

Record streams which are obtained by the system are stored in internal storage areas, and the system operates on data fields within these record streams by: (a) looking up the field name in the data dictionary under the file name; (b) using the information about the data field to pull the data field from its record stream and load it into a work area; (c) passing these work areas to operating programs; and (d) using the data dictionary information to place the results back into the record streams. The CDS system currently supports field-to-field operations and comparisons of: *move; add; subtract; multiply; divide; and; or; exclusive or; less than; not less than; equal; not equal; greater than;* and *not greater than.*

During the trial runs with the prototype version of the system, it was shown that the system could support formatted displays on IBM 3270 terminals without any additional software. This is possible because the IBM 3270 I/O stream falls among the class of record streams which can be described directly by the CDS data dictionary. (See Fig. 2.) This feature is also used to support fill-in-the-blanks updating

CDS FILE STRUCTURE

SYMBOLIC FILE REPRESENTATION

EMPLOYEE (man#, department, salary, boss, name)

FILE REPRESENTATION AS AN ARRAY

THE EMPLOYEE FILE

(key)

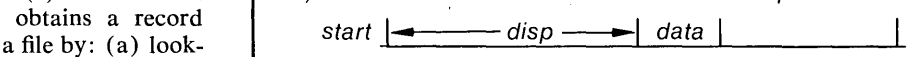
MAN#	DEPARTMENT	SALARY	BOSS	NAME
0985	adminis	40,000	None	Jefferson
1395	accounting	14,000	Jones	Smith
2418	systems	13,500	Wolf	McDowell
2451	security	19,000	Hart	Long
3428	accounting	18,000	Maxwell	Jones
5647	auth center	11,000	Jackson	Wells

Fig. 1. The Employee File is a collection of records, each divided into the fields shown. The man# field uniquely identifies the record. Each row corresponds to a record while each column represents a data field. The actual physical representation of each data field within the record streams of the Employee File is stored in the Data Dictionary according to the scheme in Fig. 2.

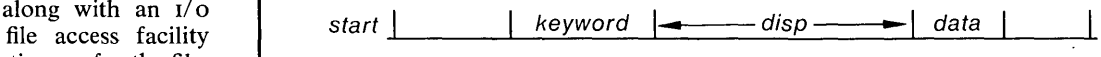
SCHEME FOR EDITING ARBITRARY RECORD STREAMS

LOCATING THE DATA FIELD

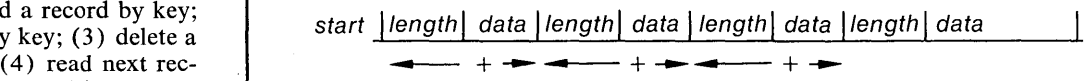
A) *POSITIONAL → start of record + displacement*



B) *KEYWORD → locate keyword, then add displacement*



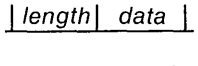
C) *SLIDING → add lengths of preceding fields*



DETERMINING THE LENGTH OF THE DATA FIELD

A) *FIXED → field is always of predetermined length*

B) *VARIABLE → data is preceded by length field*



C) *FLOAT → data is ended by special character set*

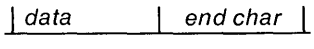


Fig. 2. Most disc and tape records have positional data fields with fixed length and some variable length fields; some disc records have sliding variable length fields. The IBM 3270 I/O stream can be described as keyword with floating length fields (the 3270 SBA and ADDRESS bytes serve both as unique keyword values and special character set). Experience indicates that this scheme will handle about 95% of the existing production record formats.

operations from IBM 3270 terminals, again without additional software.

The CDS data base

Currently the CDS System incorporates two data base access methods which are promoted as system standards:

- The data dictionary is stored internally using a tuple access method, written at WSBA, which is much like the XRAM access method used in IBM's relational data base system, SEQUEL.
- All user data is stored on disc using an altered form of IBM's VSAM access method.

Each of these access methods permits:

- Dynamic allocation of logical files.
- Dynamic physical space allocation and deallocation.
- Dynamic logical file ordering by record key.

The data dictionary is small compared to the size of the user data itself; therefore, the data dictionary information is stored using the tuple access method. Tuple access methods, such as XRAM, operate under the virtual machine concept, and are limited to 16 million bytes of storage. At WSBA, the user data is far too large for any tuple access method. One user logical file alone is over 700 million bytes. By using a modified VSAM access method, we are confident of handling a data base which we conservatively estimate at two billion byes by 1977.

Creating new user logical files is accomplished interactively from IBM 3270 terminals using a fill-in-the-blanks procedure which adds new descriptions to the data dictionary. CDS data dictionary descriptions include: (a) the name of the access facility which will access record streams to the CDS System; (b) a description of the physical layout of the record stream for this logical file; and (c) a description of the special format by which the records of this logical file are to be displayed on the terminal.

While adding new logical files to the system can be accomplished interactively by the user alone, adding non-data-base files to the system cannot be accomplished without programmer intervention. However, the programmer's task is made considerably easier since he can leave most record stream editing to the CDS System. He need only write an access facility which will receive CDS System I/O commands and pass the proper record streams, in their natural format, to the CDS System. There are only four CDS I/O commands (see Fig. 3 for a detailed account).

Once written, a new access facility is given a name, and becomes a part of the CDS System Resource List. When the new access facility is added to the system, the programmer's task is complete. The description of the physical record stream layout and the description of the special format by which records are to be displayed on the terminal can be accomplished interactively by the user alone. This procedure for adding non-data-base files to the CDS System makes it possible for

CDS I/O COMMANDS

KREAD

Read a record by key. Pass me the record stream which is associated with the key value I have passed you.

SREAD

Read next record. Pass me the record stream with a key value immediately higher than the key value I have passed you.

KWRITE

Write a record by key. Store this record stream and associate it with the key value I have passed you. If a record stream is already associated with this value, replace it with the new record stream.

KDELETE

Delete a record by key. Delete the record stream, if any, which is associated with the key value I have passed you.

Fig. 3. The CDS (Control Data Sets) System issues only four I/O commands. Special non-data base access facilities are easily written to interface with CDS because they handle only the above four commands.

PROJECT CONTROL SYSTEM FILES

FILES IN SYMBOLIC NOTATION

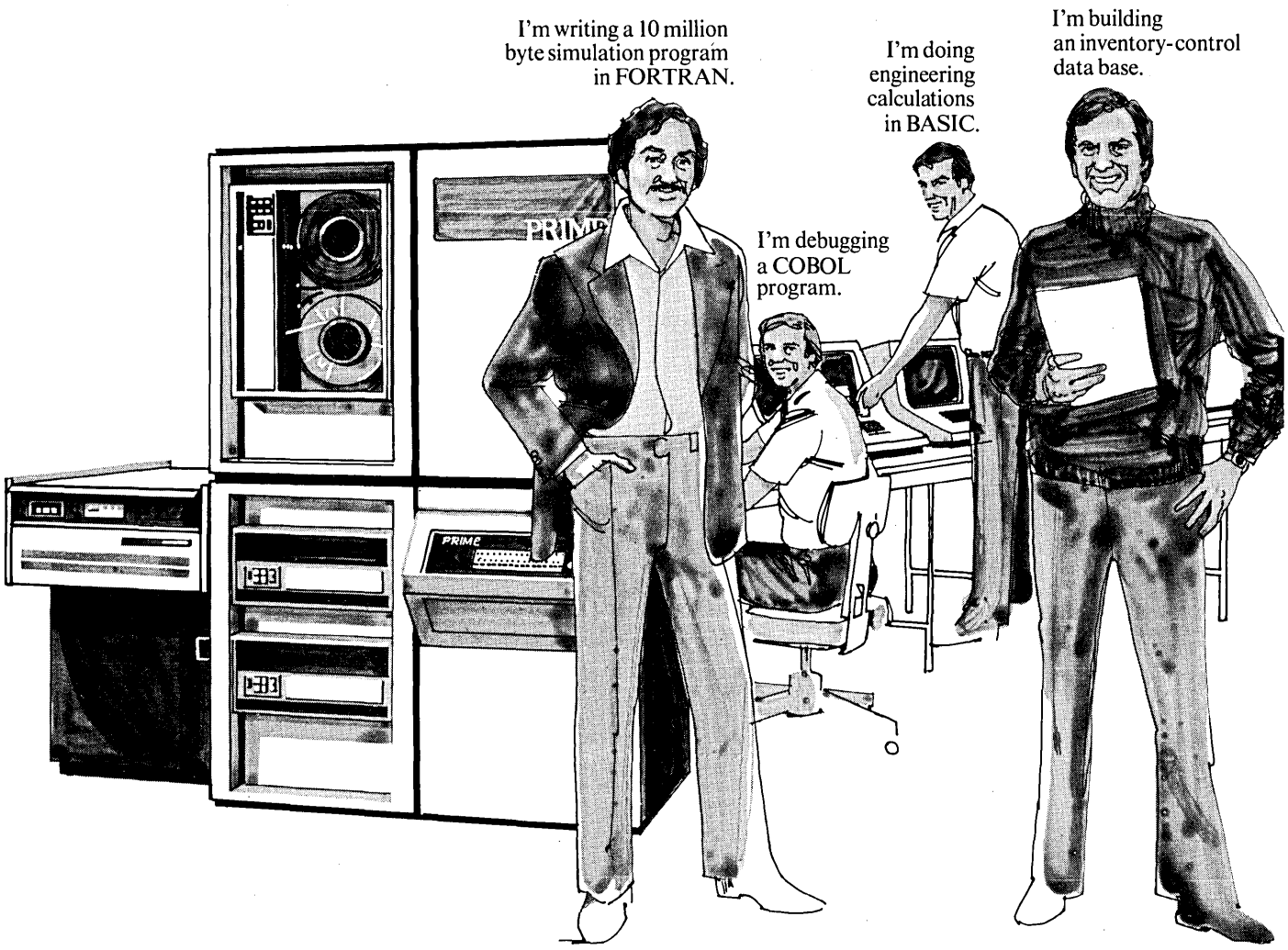
PROJCT (project #, phase #, leader #, start-date, scheduled-completion, actual-completion, date-of-last-change, descriptive-title)

EMPLOY (employ #, lastname, firstname, initials, address, city, state, zip-code, phone, job-title, supervisor#, date-of-last-change, department #, reporting-group #)

ASSGN (project #, phase #, employ #, percent, notes, start-date, scheduled-completion, actual-completion, date-of-last-change)

PCS (phase #, descriptive-title)

Fig. 4. The underlined data fields of the project control system files make up the record key (data entered in these fields become the unique identifier for the record). Under the CDS Data Base System, the user can create such files through interactive procedures and without programmer intervention.



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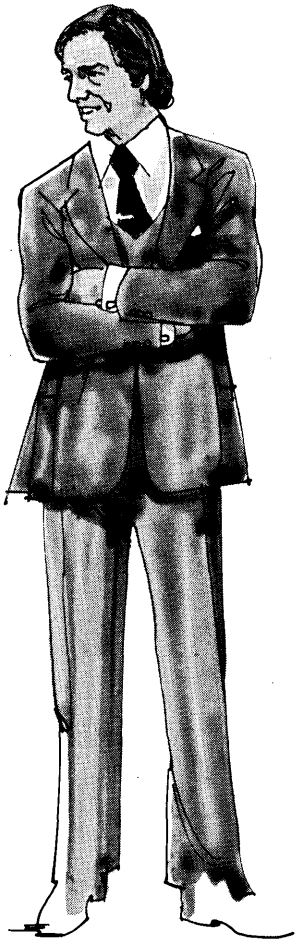

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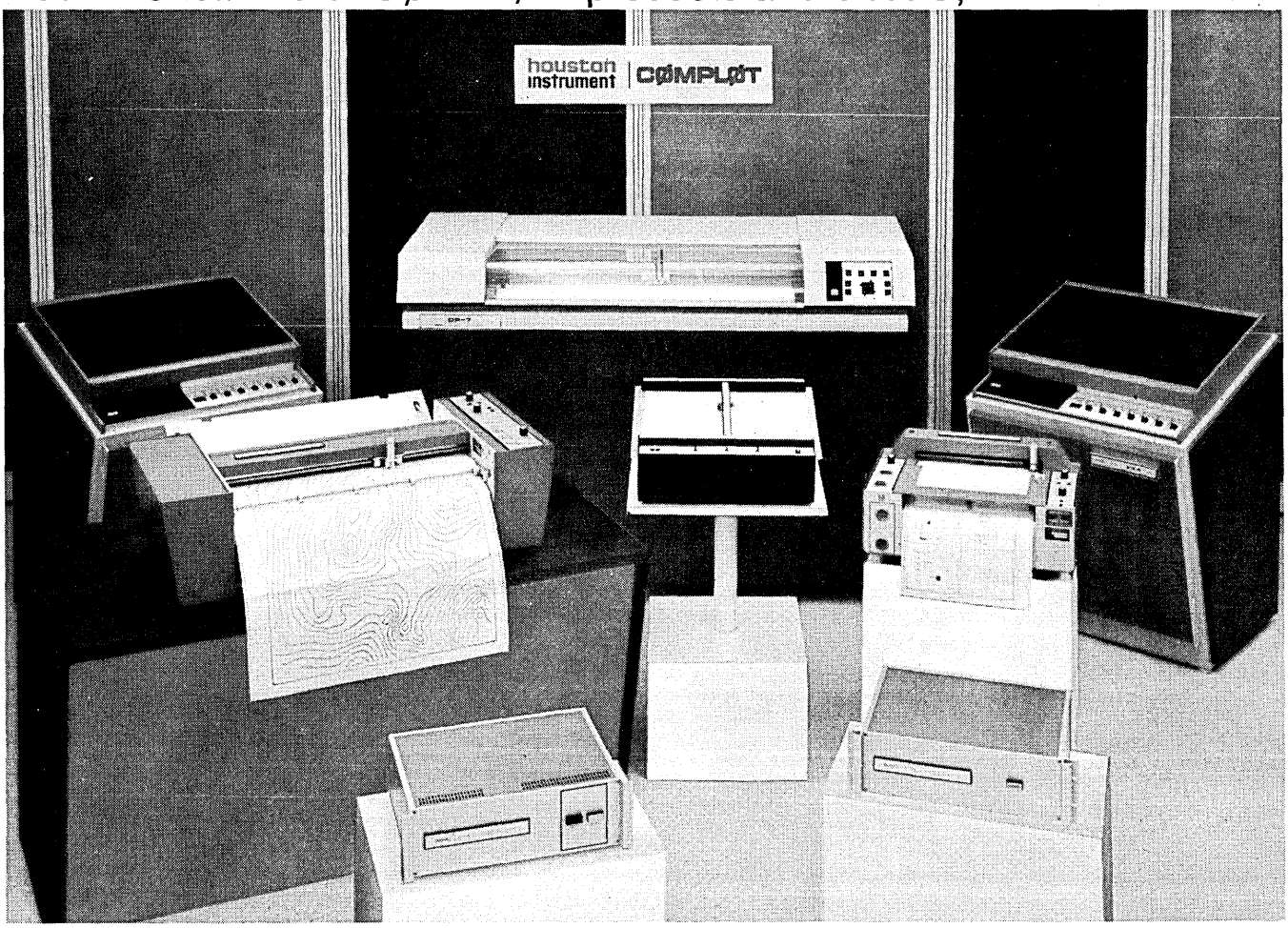

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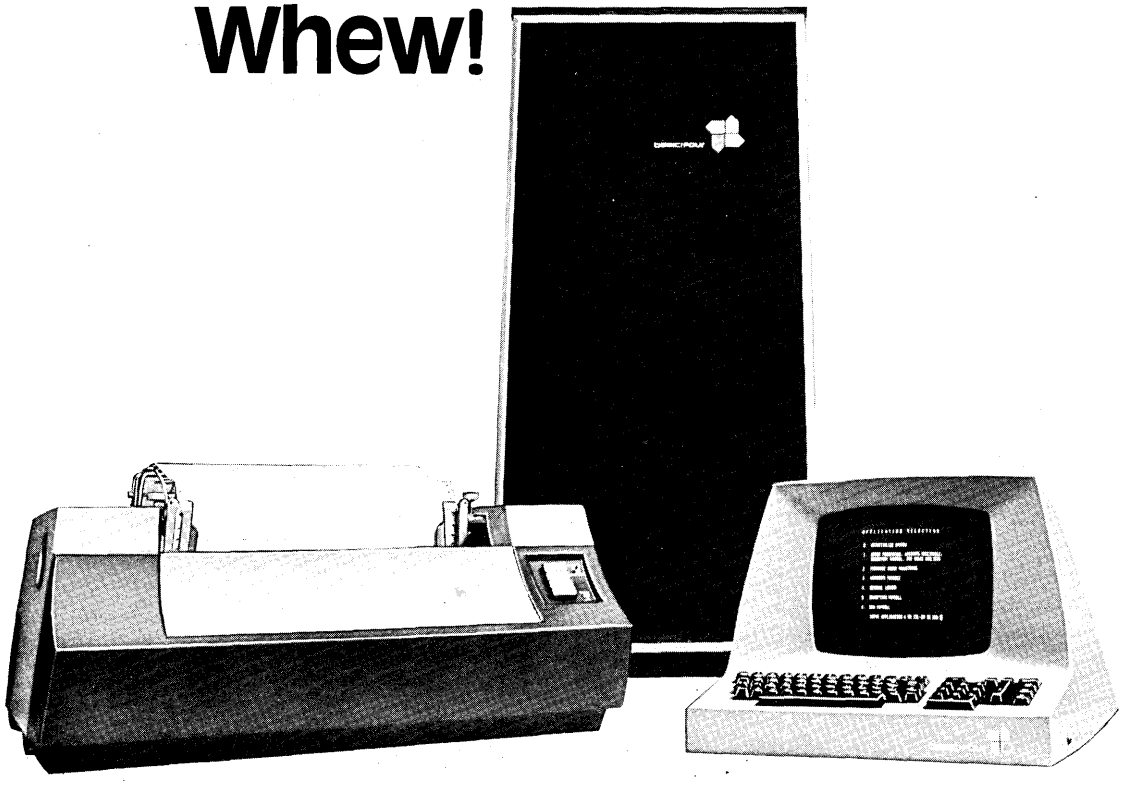

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the CDS System to share a production file with currently running production programs without disrupting the file or the programs in any way.

A sample application

The interactive nature of the CDS Data Base System greatly reduces the time required to develop on-line applications. This is due in part to the many automated features, including fill-in-the-blanks procedures, which give CDS the properties of a *very high level* language (where on-line applications are concerned). Also, the interactive nature of CDS functions allows the design, coding, and debugging phases of application development to be interwoven into a single self-supporting process.

One of the first applications brought up under the CDS System was the automation of a department-wide project control system. This system had been in use as a clerical system which produced more paperwork than it was worth. Originally the result of a forward-looking task force concerned with how projects should be structured, this project control system was composed of an intricate set of predetermined phases by which new project development should be structured. Although this intricacy should have been a step in the right direction, it in fact caused tremendous paperwork headaches for development personnel. We thought that if the excess paperwork could be eliminated, then the intricate predetermined development phases might be a boon to anyone attempting to structure a new application development project.

Automating the project control system under the CDS Data Base System required the development of four main interrelated files: (PROJCT) a file of current projects subdivided into predetermined project control system phases; (EMPLOY) a file of personnel information for all department employees; (ASSGN) a file of department personnel assignments subdivided by project, phase, and employee; and (PCS) a skeleton file of the project control system's predetermined project development phases along with descriptive titles (these files are described in more detail in Fig. 4, p. 111).

The files in the project control system are fully security protected and are even stored cryptographically on the data base disc files so that unauthorized dumping will result in garbage information. Each file has the full range of CDS fill-in-the-blanks updating and data editing features available to it. In addition, automated procedures are provided which: pull predetermined project phases and their titles from the PCS file; coordinate addition of new projects to the system; and keep running manmonth totals between the project and assignment files for ease in adding new projects to the system. The CDS System also enables one to ask impromptu questions of the project control system's files. Some examples are as follows:

- Compile a list of those employees who have some free time during March 1976?

- Compile a list of those projects which are behind schedule?

```
DISPLY YOU MAY DISPLAY ONE RECORD FROM ANY FILE IN THE CDS SYSTEM. PLEASE ENTER
USERID                FILENAME EMPLOY RECORDKEY 4444          AND HIT ENTER

                      EMPLOY: WSBA EMPLOYEE FILE

EMPLOYEE PERSONAL INFORMATION          EMPLOYEE ADDRESS INFORMATION
EMPLOY#  4444     (RECORD KEY)         ADDRESS  4523 ANGEL ROAD
LASTNAME DIETY                         CITY     HEAVEN
FRSTNAME HENRY                         STATE    CALIFORNIA
INITIALS G                             ZIP      94015
JOBTITLE SUPERCODER                    PHONE    4151112222

        EMPLOYEE REPORTING INFORMATION  AND DATE OF LAST CHANGE
        SUPER#   5555                 EMPLOYEE NUMBER OF SUPERVISOR
        DEPT#    810                  DEPARTMENT NUMBER
        GROUP    PROPHETS             REPORTING GROUP NAME
        DATE     76042                DATE OF LAST CHANGE YYDDD
```

The format from this sample record from the EMPLOY file displayed on an IBM 3270 screen was defined by the user at the time the file was created. The CDS System allows many fill-in-the-blanks procedures; for instance, by changing the verb (in the upper left corner) to UPDATE, the user can update any data field in this record by altering the field and depressing the IBM 3270's Enter key.

- Compile a list of all projects and activities to which employee, *X*, has been assigned?

- What is the ratio of completed projects to late projects for which employee, *X*, has been assigned?

- Of those employees who have some free time during March, which has the most experience in this type of project phase?

As mentioned, the CDS Data Base System greatly reduces the time required to develop an on-line application. But the full weight of this claim does not make itself felt until one discusses the time required to develop a system such as the project control system previously outlined. The complete development cycle for the project control system, from system design through system debug, occupied 24 hours of one person's time. This was spread over a five-day period and included entering "play data" into the four files and going through a complete system shakedown. It will take far longer than this to write the documentation on the system and go over the documentation with all the managers concerned; but, then an automated documentation service with menu formatted training aids could be the next project under CDS.

Conclusion

In retrospect the CDS data base system has been of greatest value in three areas. First, it has made possible a smoother transition to data base functions, and has saved hundreds of thousands of dollars in conversion costs. (These costs include the cost of rewriting current production programs which would become obsolete if their data files were converted to a new format.) Second, this system has saved a tremendous amount of programming time and dollars where development of new on-line interactive applications is concerned. And finally, it is proving itself of great value as a design aid in simulating the design of proposed systems before coding is started. ❋

Mr. Korns is in charge of planning and developing new software services to increase the productivity of Western States Bankcard Association's dp activities. He previously spent six years with IBM.

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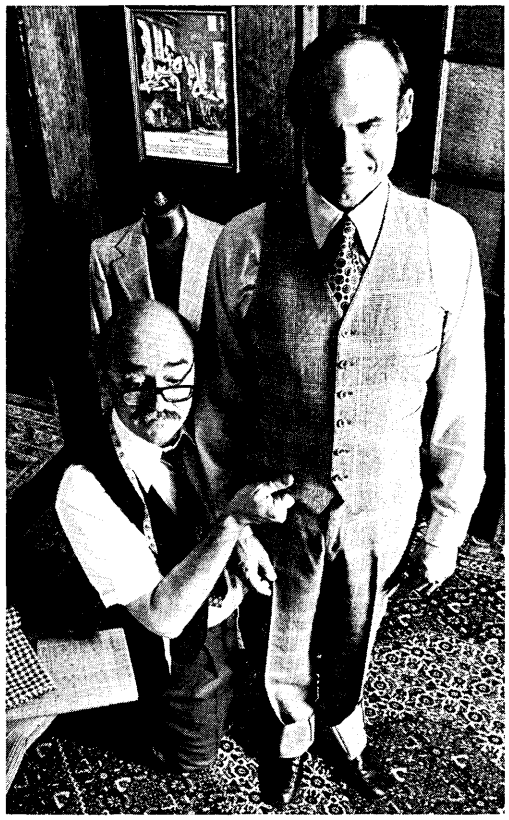

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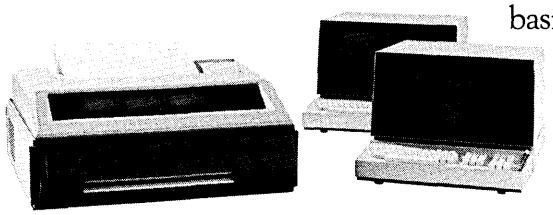

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Announcing the 3400

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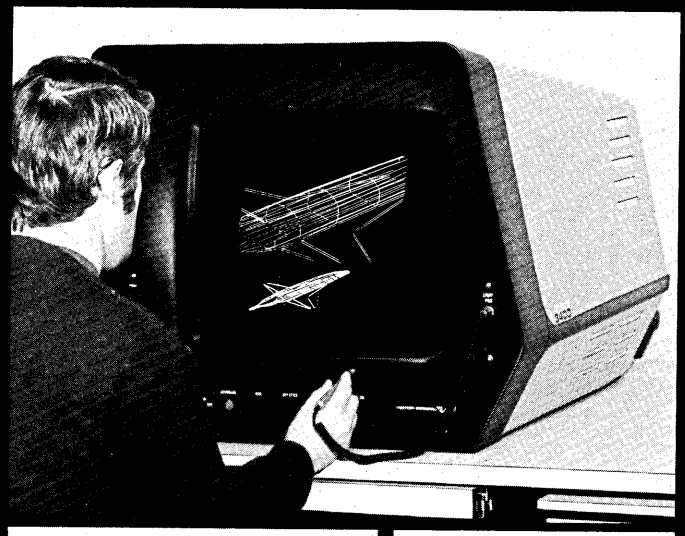

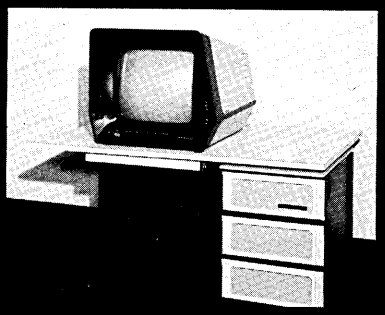

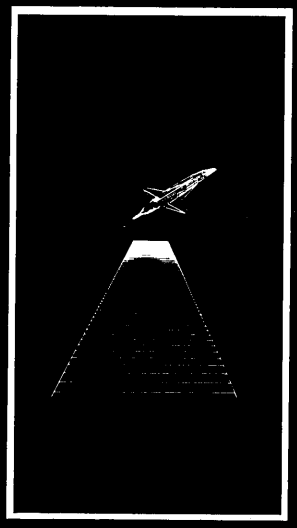

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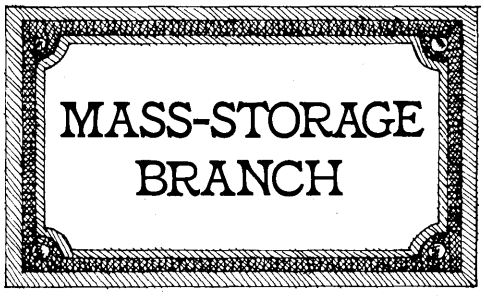

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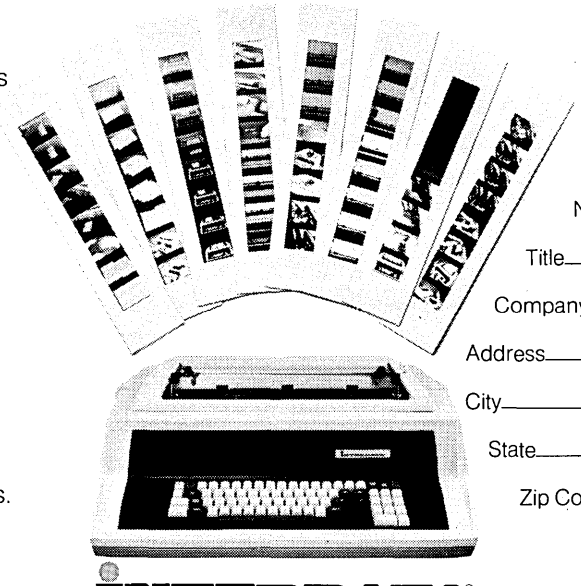

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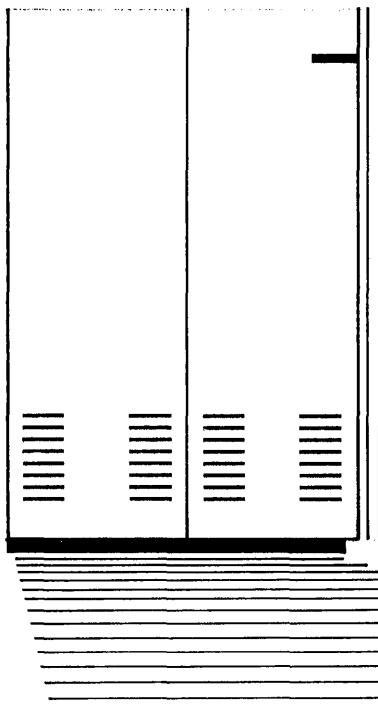


370/158 memory

Is Software Design "Wicked"?

by Lawrence J. Peters and Leonard L. Tripp

Wicked problems—i.e., troublesome and unpredictable—in software design present a challenge to the top-down approach.

Over the years, the process of design in general has been developed and refined in a number of different technical fields. When a new approach to design is proposed, it is scrutinized, tested by experiment, and evaluated by authorities in the fields of the particular design application.

In the last five years, program design activity in the software field has been evident, and a number of papers have been published. Various methods, schemes, techniques, and guidelines have been proposed. The more popular approaches to design are heralded as significantly more useful than other, less disciplined techniques. However, some facets of the design problem in general, including many software designs, are still waiting to be addressed.

Problems of design

At best, a design is an abstract representation of an object or process. The development of such an abstract concept, however, is normally less straightforward than one might think. Paths to even trivial designs have been strewn with unexpected chuckholes and snares. Why should this be the rule rather than the exception?

Basically, the designer is placed at a disadvantage. He is forced to use past experience and current technology to define or predict some future system. Unfortunately, unless the definition is correct, this future system will not come into existence.

Furthermore, the design process requires the designer to make constant conceptual oscillations between projections to some future data point and the present. This thrashing back and forth is one of sharpening the design by filling in details that were previously overlooked. New guesses and projections further refine the design with each succeeding pass. During this process, unpredictable aspects of the problem are encountered that may cause some or all of the designer's prior steps to be redefined. Not a very straightforward process, is it?

Top-down software design

Problems inherent in the design process in general are clearly evident in the design of software. As experience and maturity are gained in designing and developing software, various approaches are proposed which attempt to address these problems effectively. One approach receiving considerable publicity and relatively wide acceptance is top-down design. This approach is intended to reduce software design problems by introducing both discipline and a solution strategy into the design process.

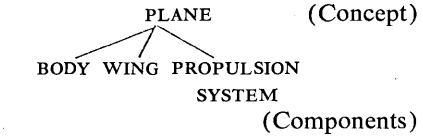
The strategy employed by top-down design is to break down a system into constituent parts, and then to break these parts into their constituent parts, and so on. In this way, the designer proceeds from general notions or concepts of the system to detailed aspects in a step-by-step manner. This process permits the designer to deal with a controllable amount of complexity, and he can focus attention on a particular facet since its relationship to the rest of the system is fixed and known.

This process of breaking the system down into intellectually manageable pieces is one of successive decomposition and refinement. Each refinement can be referred to as a level of abstraction. The constituents are successively broken down to form the next level of abstraction.

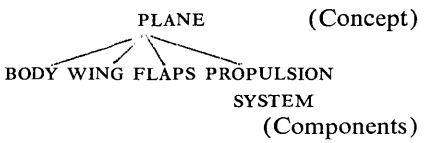
The design refinement process continues until a computer-sensible level of abstraction is attained. The process permits the designer to close off the "frontiers of inquiry" as he proceeds from one level of abstraction to another, since the system is completely defined at all levels.

Procedurally, the governing process and the guidelines are simple. The overall concept of the system to be designed is divided into the major concepts or processes of which it is composed. Generally, two guidelines are applied. One is that the concept include (or contain) its components; e.g. the concept of house does not include the concept of sine function.

The other guideline assures design consistency. It requires that each component be of equivalent detail. For example:



is correct; whereas:



is incorrect, due to the inconsistent

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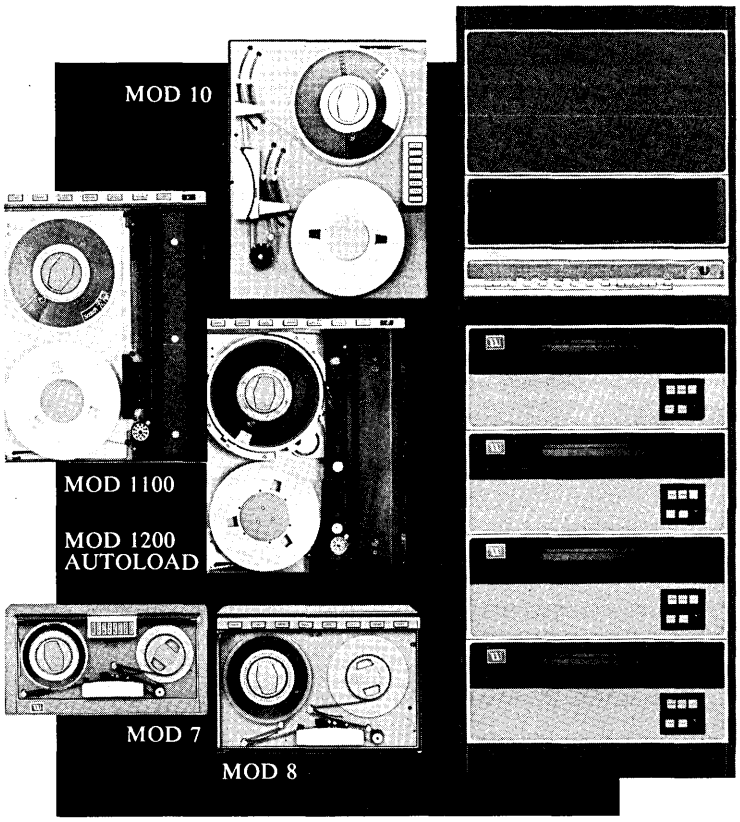

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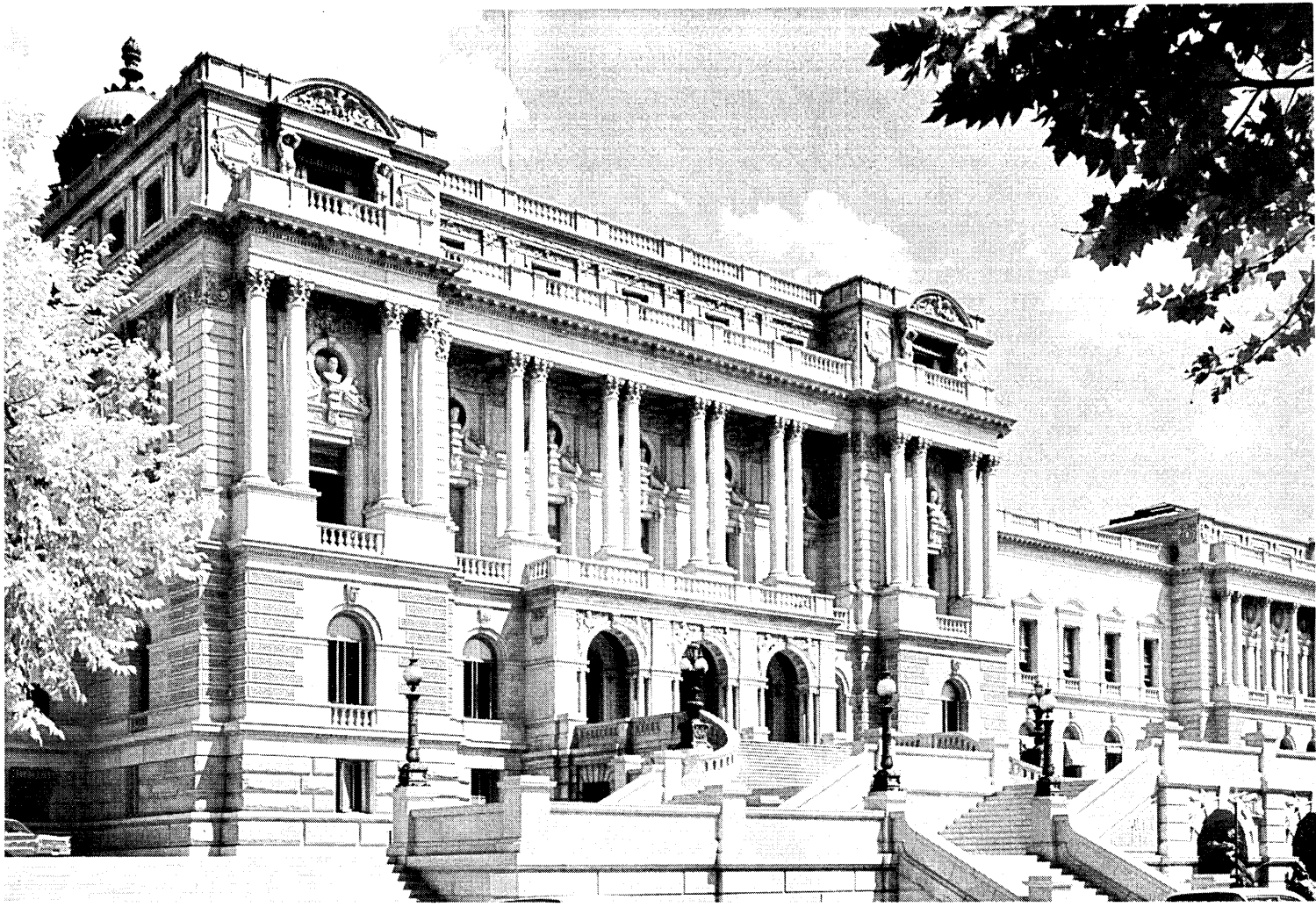

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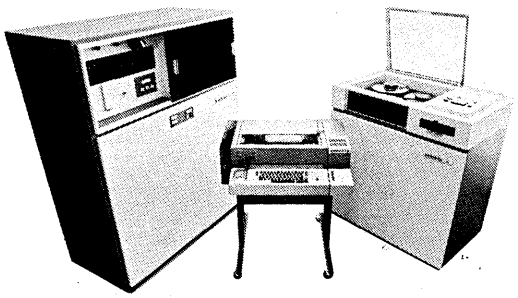

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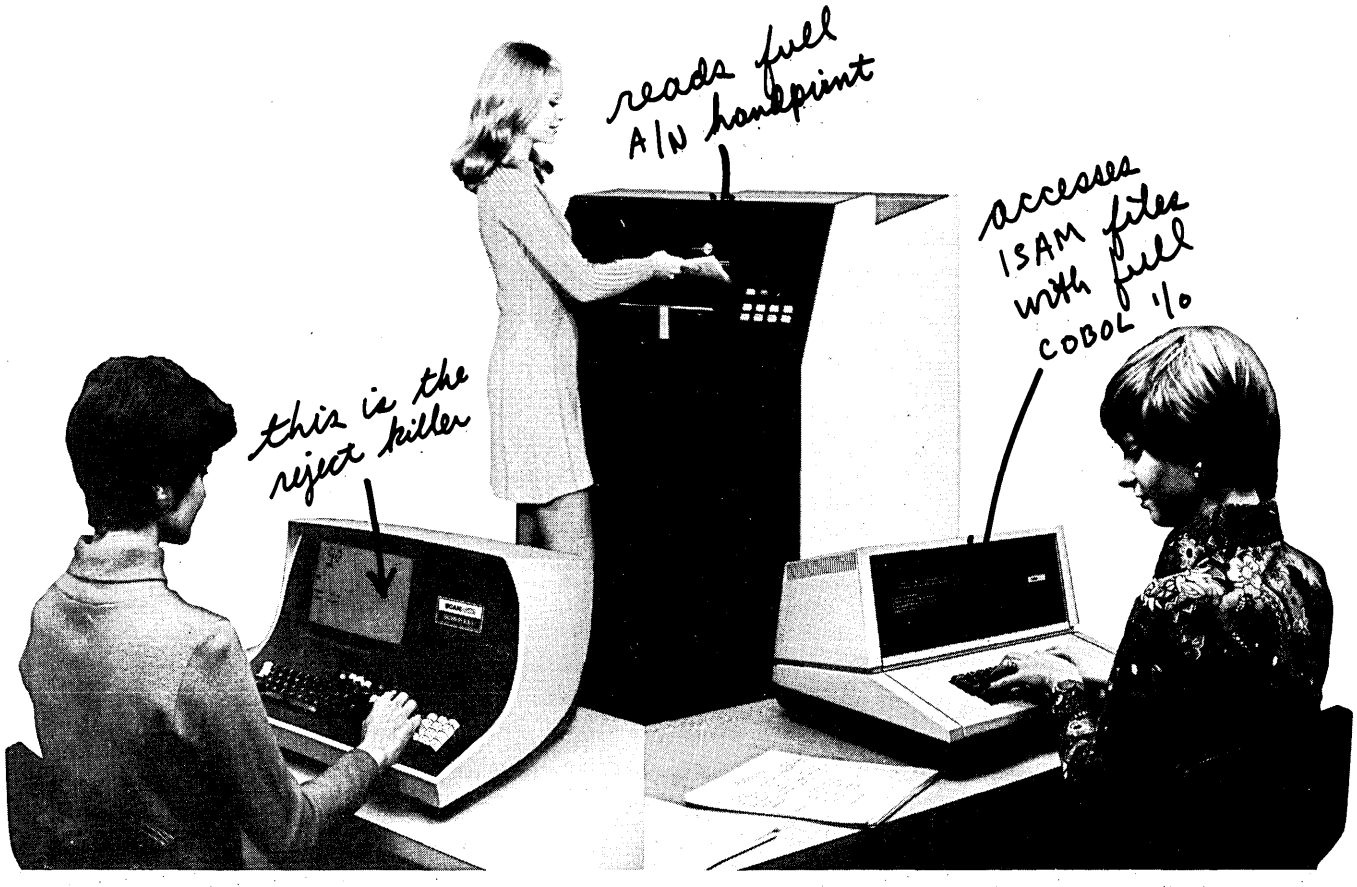

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level of detail present at the lowest level.

Each of the resultant components must be broken down in a similar manner. This process of decomposition continues until a level is reached that can be understood by a computer, be it a statement or a well understood group of statements in a high-level programming language, e.g., COBOL, FORTRAN, PL/1, etc.

There are also dynamic aspects such as interactions among the components on the same level; however these are not of concern here. Some system components are also less complex than others, and therefore do not result in as many levels of decomposition.

Top-down design appears to be well-suited to certain kinds of software design problems. Since the suitability of a technique or methodology depends on the problem's characteristics and the assumptions of the method, let's look at the assumptions of top-down design. These assumptions include the following:

- The design problem's functional requirement statement is complete before design activity begins. This is an essential property of the problem since successful decomposition of some ill-defined system does *not* appear possible.
- The problem's requirement statement does not change. If the problem statement is evolving, successful decomposition is unlikely.
- Through the decomposition process, problem perception is refined and a solution found.
- Systems can be represented in a hierarchical manner such as a tree.

"Wicked" problems

Significant design efforts have been successfully concluded in many technical fields; witness the Golden Gate Bridge, Hoover Dam, the Concorde, Saturn/Apollo, etc. The field of architecture, for example, has had to address the dual questions of design and implementation. Architectural design theories date back to the time of Caesar, and many of them view the process of design as procedural or sequential in nature. Concern has also been expressed that this form of design theory fails to recognize nonprocedural aspects of the design process.

Investigations by Rittel and others have formalized an intuitive belief that the design process could *not* be described accurately as a sequence of well-defined activities. Rittel characterized the problem of design as being "wicked" both because it is not always clear how to proceed and because the problem seems to change—often for the worse—during resolution. Although Rittel addresses architectural design problems, his comments have come to be recognized as characterizing the problem of design per se. Hence, they are applicable to software design.

Rittel formalized a definition of wicked problems by stating their properties; we restate them here in the context of software design:

1. Wicked problems have no definitive formulation. Whenever a formulation is made (such as a statement of requirements), additional questions can be asked and more information requested.

2. Every formulation of a wicked problem corresponds to a formulation of the solution (and vice versa). The information needed to understand the problem is determined by one's own idea or plan of a solution. In other words, whenever a wicked problem is formulated, a solution must be in mind. For example, if a graphics capability is lacking and is defined as a software design deficiency, a solution to that problem—the provision of a graphics capability—has already been stated.

3. Wicked problems have no stopping rule. When a solution is formulated, it can be improved or enhanced. The software designer could keep modifying and improving his design forever—he stops only because the system must be built and delivered, the schedule calls for it, he is out of money or out of patience, etc.

4. Solutions to wicked problems cannot be correct or false. They can only be "good" or "bad." In other words, it is a judgmental rather than an absolute issue.

5. In solving wicked problems, there is no exhaustive list of admissible operations. Any conceivable plan, strategy, or act is permissible in finding a solution, and none can be prescribed as mandatory.

6. For every wicked problem, there is always more than one possible explanation. The selection of an explanation depends on one's outlook, one's "weltanschauung" or overall interpretation of the relative value or importance of things in the world. The explanation one chooses also determines the solution to the problem. The high cost of developing a software system, for example, may be attributed to the type of computer, the complexity of features it must support, high programmer cost, etc.—each of which by itself or in their particular combination reflects the designer's point of view, his way of looking at things.

7. Every wicked problem is a symptom of another "higher level" problem; e.g. if the cost of maintaining a computer system is too high, this may indicate that the using company has insufficient funding.

8. No wicked problem or its solution has a definitive test. When any test is "successfully" passed, it is still possible the solution will fail in some other respect; e.g. if a system is designed to reduce or minimize the use of core to some limit, the response time may become unacceptable.

9. Each wicked problem is a "one shot" operation. There is no room for trial and error, and there is no possibility for experimentation. (Once a system is designed and built—there is no going back to the beginning to redesign and rebuild it.)

10. Every wicked problem is unique. No two problems are exactly alike and no solution can readily be copied for the next problem; e.g. even if two systems are designed and built for the same customer and for the same purpose, they will not be identical.

11. The wicked problem solver has no right to be wrong—he is fully responsible for his actions.

Software design problems

In designing software, experience reveals that not all design problems are equally demanding, nor are their chances for success equivalent. Each software design effort appears to be unique. However, an examination of the design problems shows that software design efforts can be divided into fixed categories. There are, in addition, some phenomena common to all nontrivial software design activities.

Freeman was one of the first to recognize that not all software design problems demanded the same thought processes or creativity. He described some efforts as "routine designs" and others as "discovery designs."

"Routine design" is a term used to describe the less demanding, less complex form of software design activity. In a routine design, the requirements are well understood since similar systems were successfully designed and built; and the task is merely the "tuning" of available methods and system elements to respond to this particular application. Problems which challenge the state of the art are not encountered nor anticipated. Few if any aspects of the design problem require a significant degree of systems requirements analysis.

Conversely, "discovery design" requires a more detailed analysis of nearly all aspects of the system. The requirements are not clear and must be derived through a combination of research, analysis, and interface meetings with the customer and/or user.

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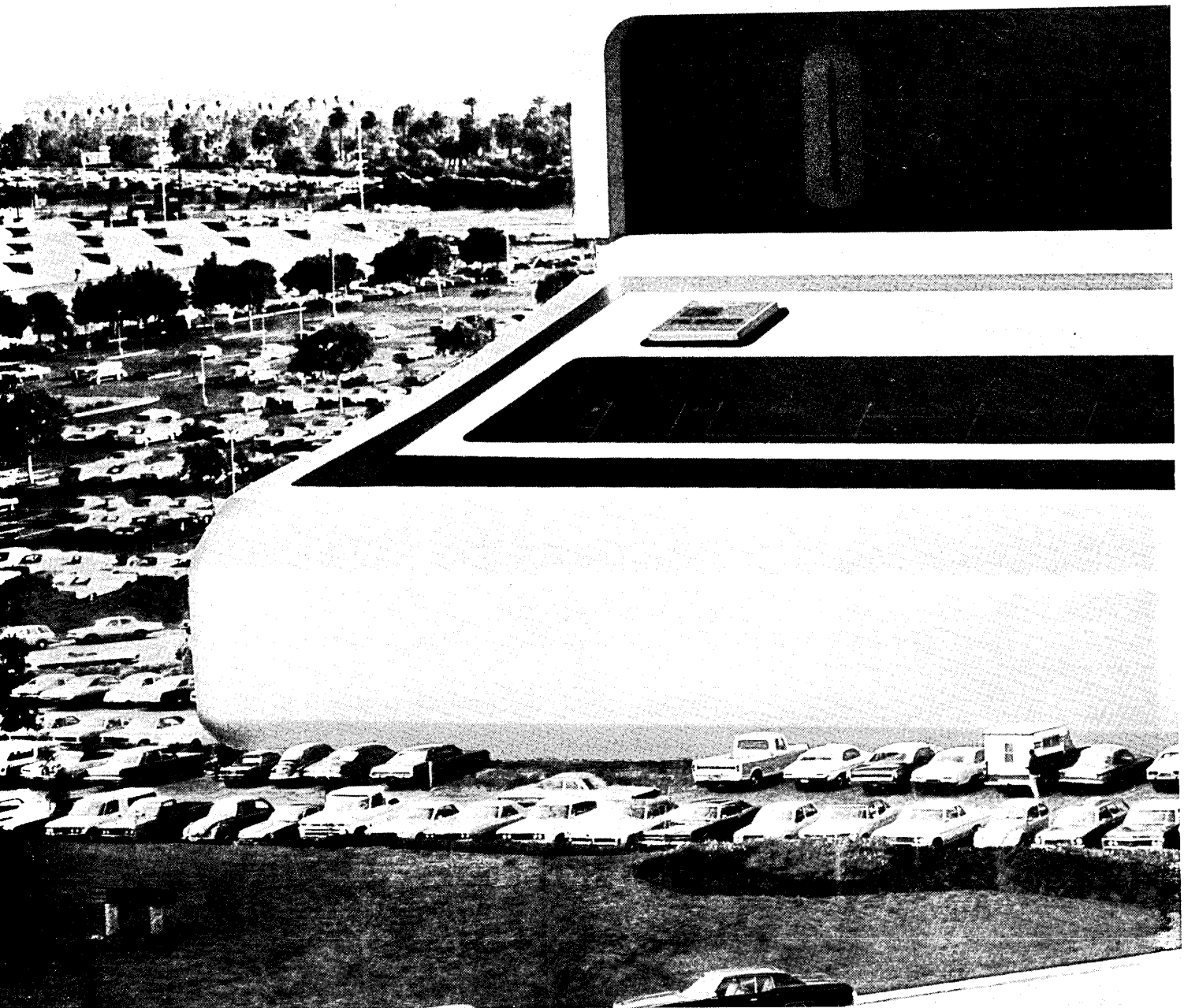

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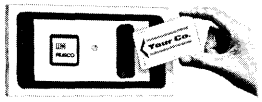

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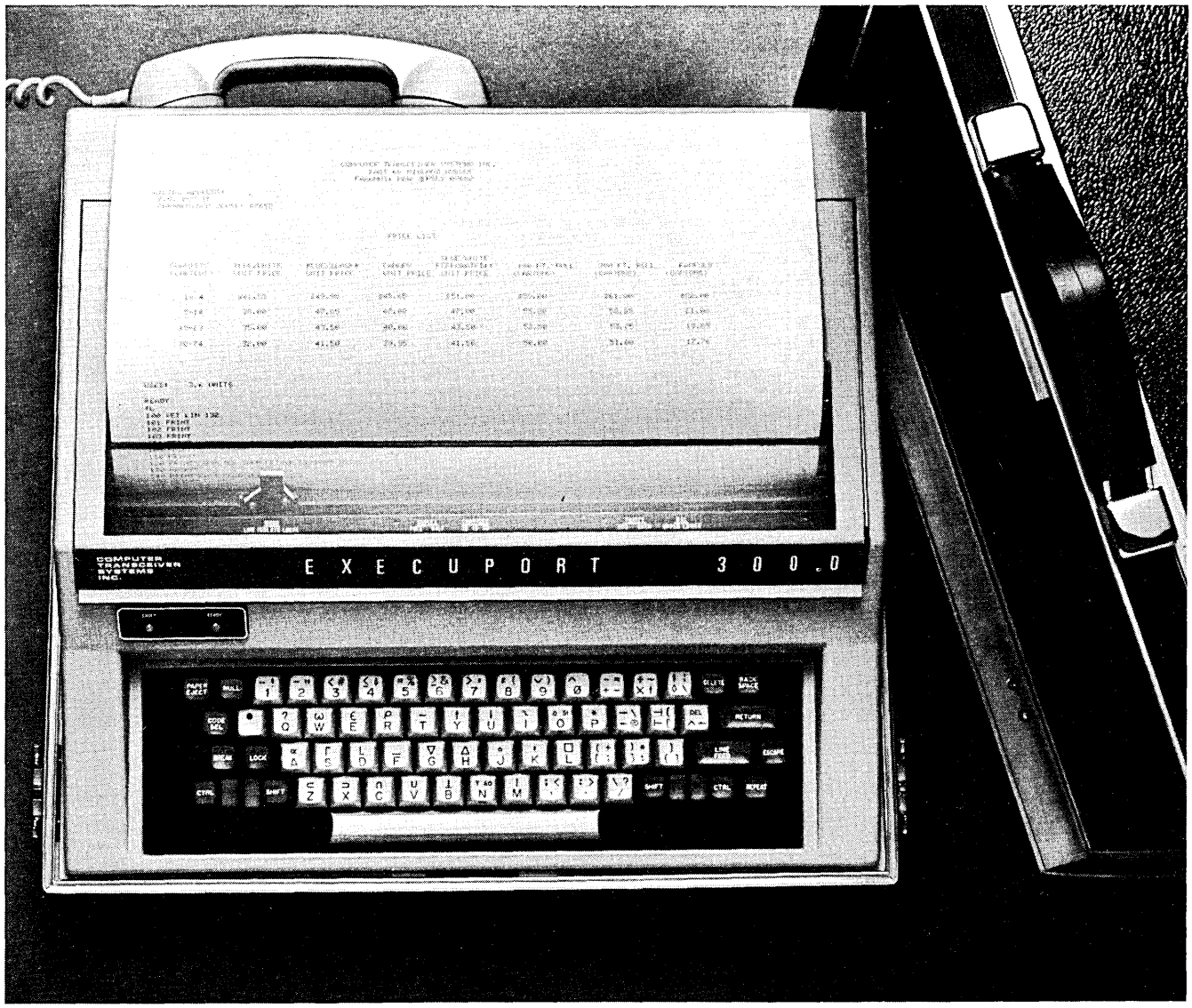

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IS SOFTWARE DESIGN "WICKED"?

Many of the more challenging stumbling blocks to the success of the project cannot be known at the outset. They are discovered as the design activity proceeds.

Although a significant amount of activity may be invested in defining requirements and describing the objective system, little guidance is historically available since no other system with these particular characteristics has previously existed. For example, the first passenger airline reservation system clearly attempted to improve customer service and flexibility. A whole new set of problems were encountered. As such systems began to proliferate, it became necessary for separate systems to be able to communicate and share information. Each successor to the first reservation system had to resolve new, unexpected problems.

The process of designing nontrivial programs or systems using the top-down approach encounters one or more of the following problems:

Lack of a well-defined rationale: The success of a top-down design approach in designing software depends on decomposition. This process is not clearly defined and tutorialized because decomposition is a creative act. Consequently, when a design is attempted using this technique, the designer must rely on his own decomposition devices (which depend on his own way of viewing the world, i.e. on his weltanschauung) rather than on a disciplined application of a method.

Procedural aspects emphasized: The user of a procedural approach has been described by several authors. However, the procedure recommends a limit of 50 lines of code per software unit, indentation of nesting levels, and types of statements, *while the structural aspects (i.e., packaging, module definition/identification) remain relatively unaddressed.*

Iteration: Even in trivial designs, each proposed design is refined in some way. These localized refinements usually "ripple through" the design so that certain features or attributes of the design cannot be decoupled or isolated from the remainder. Since the problem changes with each iteration, the solution (not necessarily the optimum solution) appears to elude the designer. It has already been observed that top-down design shows only one path in the tree because it assumes that only one problem is to be solved (see Goos, for example).

Nonsequential: The iterative nature of software design has an interesting quirk. When the process is begun, it is not known what factors or parameters will drive the design refinement in one direction or another. Furthermore, the relative importance of these factors changes unpredictably as the process continues. Thus, a set of steps and a sequence or selection rule is not possible.

Learning: The reason for the discovery aspects of software design is the designer's learning curve. As the system is studied, analyzed, and a design formulated, certain features are recognized as needing attention while others are overlooked. As it becomes apparent which features are lacking, priorities shift. Perception of the design and the system represented undergo a face lift and new problems are addressed. As this happens, more is learned about the system and a better understanding of the design problem is gained.

Perception Gap: The software designer attempts to address the problem(s) of which he is aware. In responding to these, he uncovers other problems (including inefficiencies) of which he was unaware. As he addresses the new problem(s), he discovers others, and so on. In a sense, his problem recognition appears to be out of phase with, or lagging behind, the design problem. One explanation for the lack of a stopping rule in software design refinement is the hypothesis that the gap may, with considerable effort, be narrowed but never eliminated.

Conclusion

A comparison of the attributes and problems associated with software design and the characteristics of wicked problems make it apparent that software design is itself a wicked problem. Top-down design does not appear to be based on assumptions which are compatible with such problems.

To reinforce this view, look at the types of problems used to demonstrate the application of this technique; for example, the "eight queens" problem (given a chessboard and eight queens, how do you position them so that no queen can capture another) has a well-defined solution. But the design of an airborne warning and control system, using a language and hardware as yet unavailable, is a "real-live" problem whose characteristics and solution(s) change almost whimsically. The latter problem does not lend itself to top-down design.

Top-down design, however, does appear to be more productive than other approaches (e.g. bottom-up) in that it can yield effective solutions to routine design problems quickly. The advantage of applying top-down design methods to wicked problems appears to lie in the rapid solution of their routine aspects, and/or as an aid to stabilizing or "boxing in" the wicked problem to make it routine.

More important, top-down design provides software designers with a methodology (a method *and* a rationale) where none had previously existed. It may not be perfect but it has distinct advantages over other methods which have been proposed.

Presently, it appears that improved software design methods directed toward wicked problems must continue to be pursued. Top-down design is a step in this direction. The development of such a methodology is, unfortunately, itself a wicked problem. ❋

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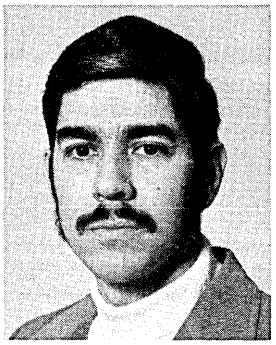

Mr. Peters is a computing methods specialist with Boeing Computer Services, Inc. He has developed real-time systems and scientific applications software in Canada and the U.S., and is a previous contributor to Datamation.

Mr. Tripp is a research specialist in software engineering for Boeing Computer Services, Inc. He has previously published in dp and aerospace journals.

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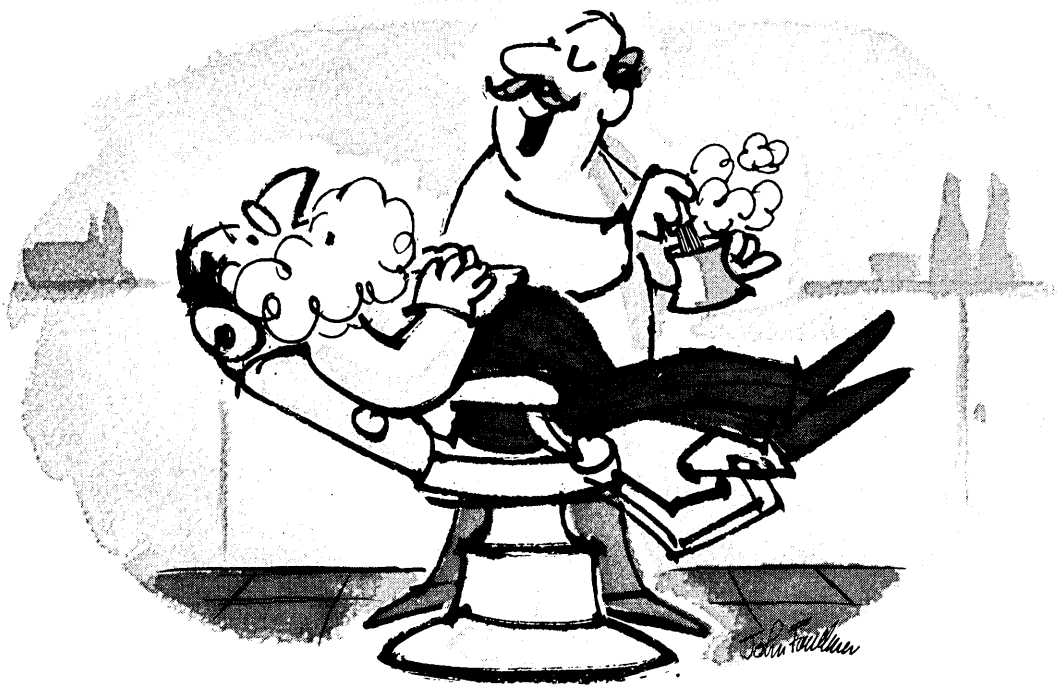

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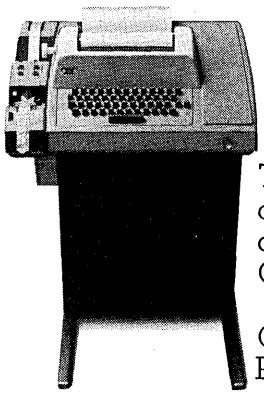

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The Mini: A Growing Alternative

by Edward K. Yasaki, Senior Associate Editor

Minis offer application independence, reduce priority conflict, reduce response-time problems, and can be less disruptive to current operating methods.

Users who are accustomed to the large, centralized dp facility were recently told that the $50,000 minicomputer has become an alternative to the $2 million giant. The tiny machines are providing new alternatives. "The first users worked directly with the computer. We have come full circle—the user is once again working directly with the computer," according to Hank L. Koehn, vp of Security Pacific Bank in Los Angeles.

Koehn spoke at a conference on minicomputers presented in San Francisco by the American Institute of Industrial Engineers in March. Some 190 attendees showed up for the 3-day educational meeting, which was organized and carried off with consummate skill.

"Minis offer application independence, reduce priority conflict, reduce response-time problems, and can be less disruptive to current operating methods," Koehn said. "Briefly, the mini offers an economic and processing alternative that cannot be ignored by any organization today."

The speaker foresaw a growing use of minis in dedicated applications, giving a department manager the chance to solve his piece of the total organization's data processing. He cautioned against such standalone systems, in physical isolation, being also in conceptual isolation from other systems. "Independent mini systems must automatically produce a compatible data interface to other related systems," he warned.

In a question-and-answer session that followed, Koehn said that a good understanding of the organization is required before an effective, mini-based time-sharing system can be set up in physical isolation from central dp. He also said the historical practice of keeping management uninformed about computers will also have to be changed . . . that in the era of the mini, we must get the message across.

Minis are multiplying

A broad look at the minicomputer and its place in the scheme of things was provided by Walter L. Anderson in a luncheon address. (Pointing up the educational nature of the conference, the AIIE considers the luncheons a session, too, and has a speaker for each one.) Anderson, who was formerly president of General Kinetics, has served as president of AFIPS, and is currently associate director for ADP in the General Accounting Office, said the feds counted 90,000 minis in use throughout the world at the end of '73. They figure an additional 50,000 were installed in 1974 and more than that again in '75. By 1978, minis will account for 60% of the number of computers installed. The number installed in the federal government rose from 3,700 in '67 to 8,600 in '75.

"It's interesting that about one-quarter of the computers in 1967 had a cost under $50,000, whereas more than half the computers in 1975 had a cost under $50,000," he observed. "So we can conclude that the use of computers is increasing in the federal government, and the percentage of lower dollar computers has been increasing at a faster rate, approximately double during the 9-year period."

> . . . 90,000 minis in use at the end of '73 . . . an additional 50,000 were installed in 1974 and more than that again in '75. . . .

A GAO study of the federal establishment, he continued, showed that 65% of the applications programs were developed by in-house personnel; 9% were received from the manufacturer; 11% from an independent software developer; and 11% came from a systems supplier. Three percent of users had more than one source for their applications programs.

As to the programming language used, 44% cited assembler or "machine language," 7% used BASIC, 11% said FORTRAN, *none* of the respondents used COBOL, 11% used other languages, and 26% said they used more than one language.

In an earlier presentation, conference keynote speaker Lawrence A. Goshorn (president and chairman of mini-maker General Automation) traced the historical, social, and technological developments that led to the current prominence of minis. He said inflation in the U.S. in the last 15 years has brought with it a need to increase productivity.

"The average industrial wage has more than doubled during this time, from $4,200 in 1960 to over $8,900 in 1975. Unfortunately the index of productivity, used to measure the actual output per worker, has only risen about 60% during this same period, from 79.8 in 1960 to 129.2 in 1975." Wages have risen more than production, increasing prices and setting off a wage-price spiral. "And I believe that the only way to get out of this spiral is automation."

Goshorn cited a number of minicomputer-controlled machines at his plant that he said have increased output per worker by a factor of 12.

In the future, Goshorn continued, we can look forward to minis that directly execute higher level applications languages. "In addition, the reliability of this hardware will have gone from 600 hours MTBF in 1960 to over 100,000 hours by 1980 through the added dimension of redundancy . . . Similarly system architecture will have advanced by 1980 to all solid state with no electromechanical peripherals . . ." He said that since 1960 the price/performance of minis has increased by 20,000 times.

Software as interference

A well received presentation was delivered by Thomas Bookwalter of The Computer Works, a systems house in Emeryville, Calif. He said the cost of software is the "interfering factor" in the proliferation of minicomputer systems. Hardware prices have been dropping these last few years, to where a large capability system can be had for $40-$70K, but the cost of the soft-

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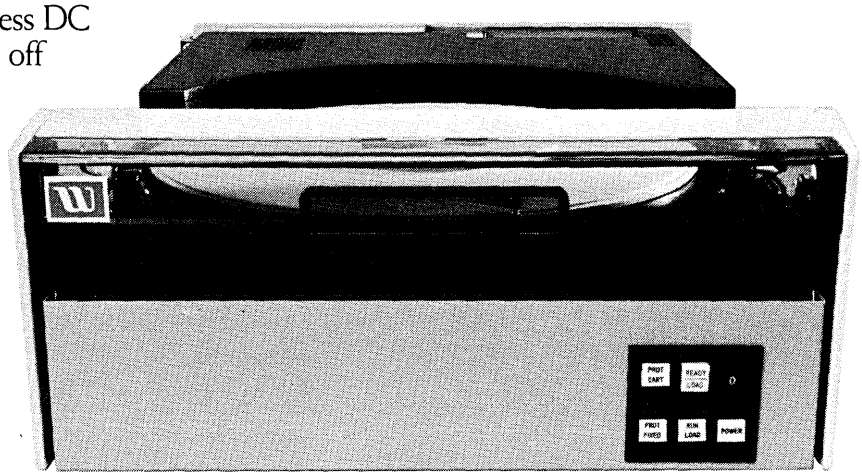

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ware can exceed that, he observed. Software, he added, costs 75 to 100% of hardware costs in the $30-$50K range—others say it's more, he acknowledged—whereas users think it should be in the 20% range. Bookwalter said he agrees with users, but added that it can't be done for that price.

Software development will continue to be a bad experience, he observed, citing user insistence on custom systems as one reason for this dilemma. Applications packages are the most common solution to this software problem. "Packages are only *a* solution," he added. "What's needed is *the* solution." But packages do provide a point of reference for discussions between a system developer and the user. The two parties can talk about what the package does and how it does those things, leading them to conclusions about what modifications are required. "If you take a package and install it 16 times, you have 16 packages," Bookwalter noted, because of the modifications made.

We must change minis from computers to business tools before they can enlarge their roles in the business world, he concluded. Fielding a question from the floor regarding the IBM System/32 and Industry Application Programs, he cautioned against getting one with the idea of customizing the package. To be cost effective, he said modifications must be kept to a minimum.

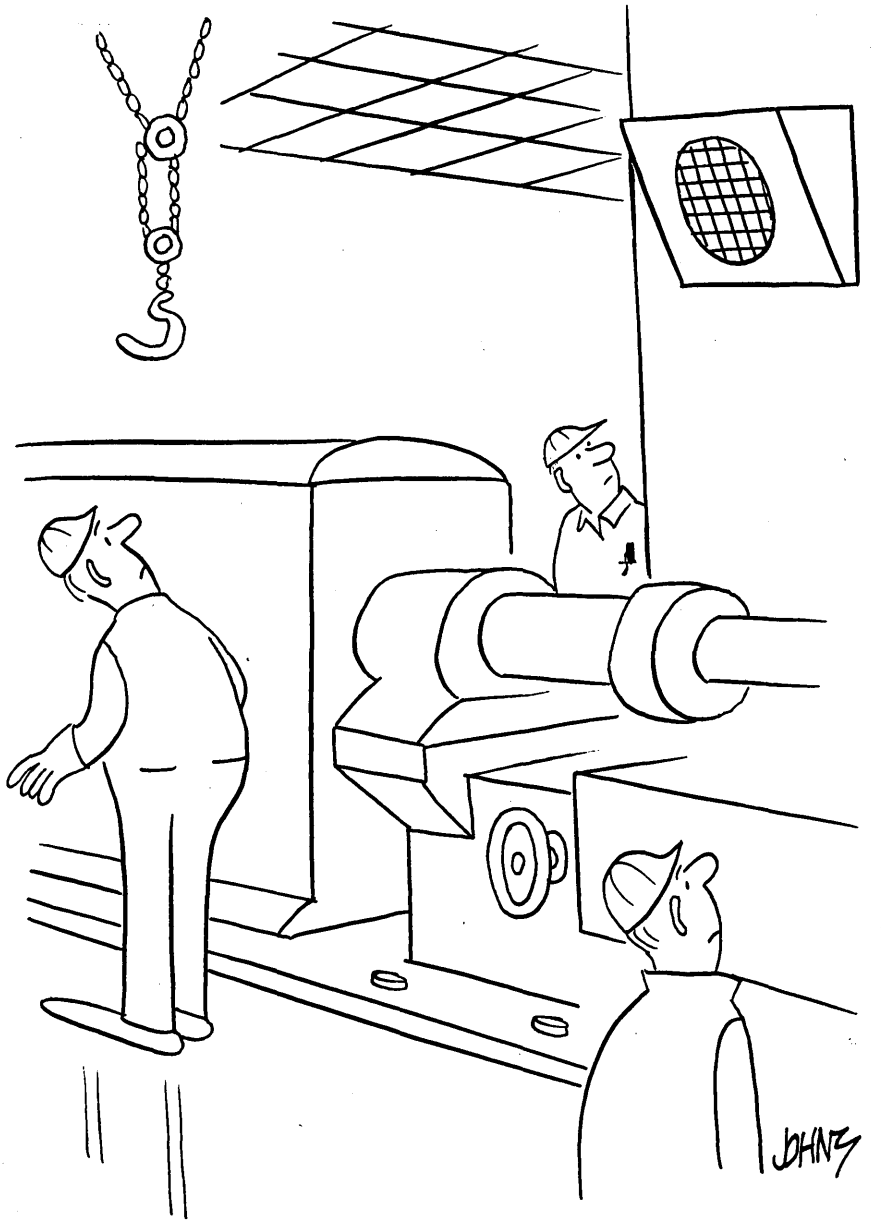
Minis in real-time applications were discussed by Richard J. Matlack of Dataquest in Menlo Park, Calif. He summarized the more significant trends in real-time systems. "The one thing that is very clear is that there will continue to be more, rather than fewer, real-time applications," he said. More batch-type systems will be going over to transaction-oriented systems too, he added, predicting that of each mini installed between now and the end of this decade some 85-90% will be installed in on-line systems. Matlack also foresaw the availability of better hardware and more on-line software.

"I would caution you *not* to shy away from the more complex systems," he said, explaining that there are more people experienced in the design of such systems today.

The market researcher said prices of minis would continue to fall at least 20% a year for the next five years. But that doesn't mean system prices will also fall; software costs are rising substantially, and systems prices will actually increase. But he said on-line systems will proliferate because they can save the user money . . . if he doesn't lose control of the project. "Productivity in this country isn't what it could be," Matlack observed, "and this is one way we can increase productivity in our industrial environment. However, to implement on-line systems will require careful planning . . ."

Matlack provided a sampling of real-time systems. He told of a city that somehow figured it was saving $50,000 a year from the use of its computerized traffic light system. He spoke of mini-based, transaction-oriented, business dp systems priced from $30-$50K, admitting the difficulty of determining how much money is saved, but said a user can save at least $10-$15K a year on clerical help alone. In the world of process control, he described an aluminum reduction plant, a system that cost between $200K and $300K, and said savings typically are $100-$200K a year; a lot of those savings reportedly are in the reduced consumption of electrical power.

Attendees at this seminar also received a feel for mini-based systems from some users. One was David Seibel of the Lawrence Livermore Lab in California, who mentioned their effort to develop a data base management system for a Digital Equipment PDP-11/40 being used primarily for inventory control purposes. He said that since this effort got underway, vendors have begun coming out with their own DBMS. This particular mini, he said, is located near the lab's computer center and thus is not linked to it by any communications lines; instead, mag tape is merely carted to the larger facility. "You can't beat the bandwidth of someone carrying 10 reels of tape," he quipped.



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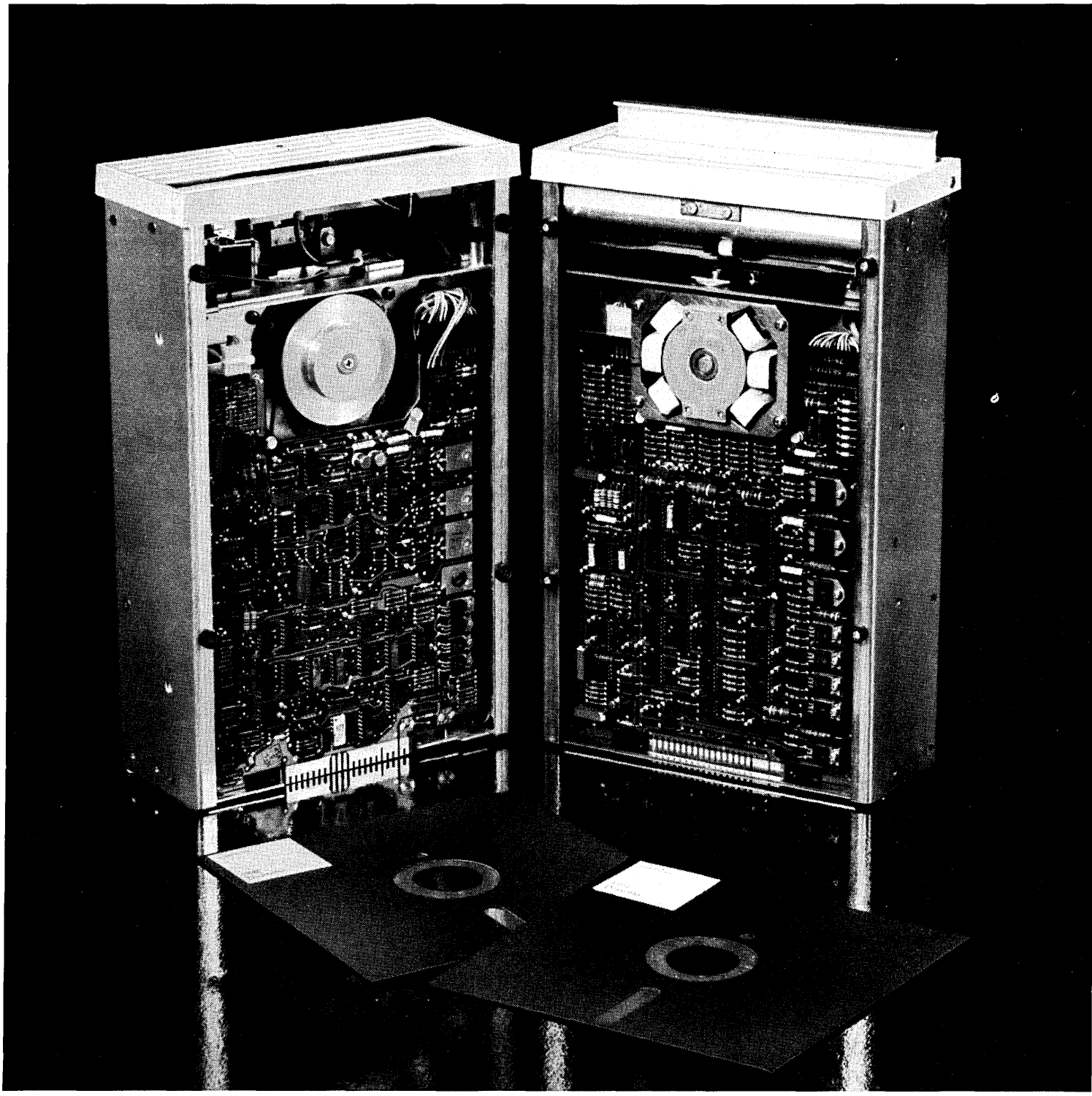

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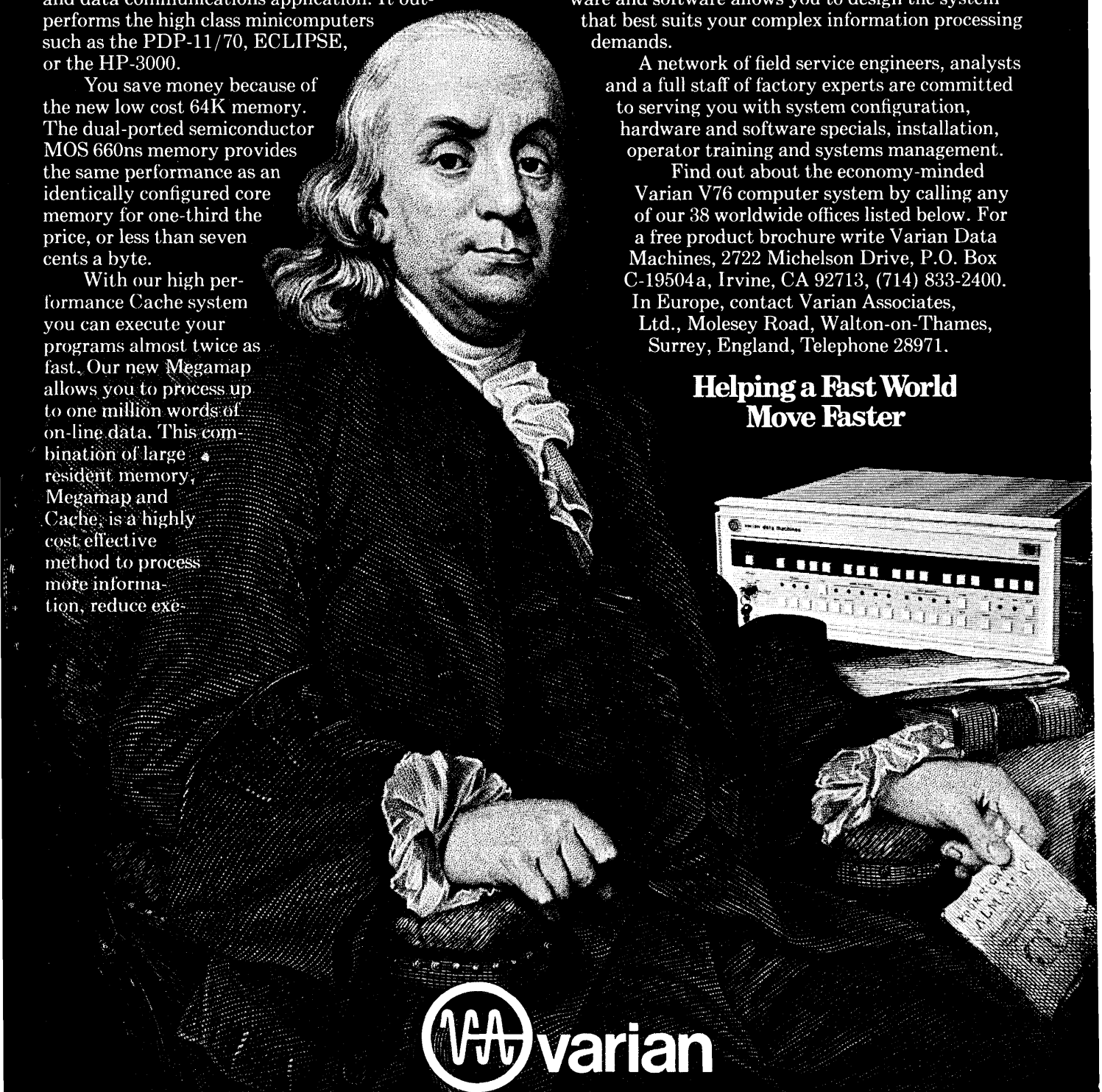

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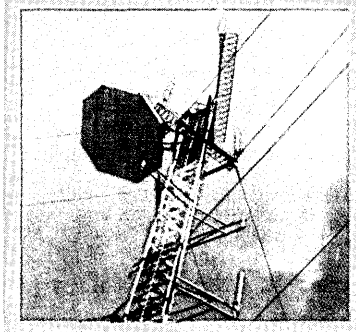

In an inflationary economy, it's nice to see someone holding the line on the wages of sin.

That's what they're doing at the Lake County Sheriff's Office. With a little help from INCOTERM.

A powerful INCOTERM SPD® 10/20 Intelligent Display terminal serves as controller for 50-odd mobile teleprinters in local and county police cars covering nearly 500 square miles of northern Illinois.

The officers on the road call in verbal reports and queries; they get hard-copy responses right in the cruisers. For the first time, police can receive such transmissions with no risk of unauthorized interception.

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And it does all this while cutting typical transmission times in half. Plus...the built-in INCOTERM memory lets the officer in the car interrupt incoming messages for emergency voice transmission—without missing a word.

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When it comes to computer networks, MODCOMP offers you a big advantage.

Experience.

At MODCOMP, we were pioneers in making the concept of resource-sharing computer networks a practical reality. The tieing together of multiple computers in distributed processing systems whereby several computers work together, sharing the work load.

Putting the computing power out where the work is, yet allowing each computer in the network to do not only its own job, but also draw upon the resources of every other computer in the system.

We developed MAXNET as a standardized operating system exclusively for this purpose. And MODCOMP systems using our network software have been in operation for more than two years.

We now have over forty network systems in the field, with another fifteen or so being readied for early delivery. Which means that we have more experience—both in length of time and in numbers of systems installed—than all our competitors combined.

In addition to traditional "host-satellite" networks, we have systems in operation that include so-called "ring" networks, "star" networks, and many more. The important thing is that you can link your computers together in any format you want. Provide each computer with whatever peripherals are best suited to your purpose. And leave the rest to MAXNET.

We figure the best way to give you an idea of what MAXNET can do is to give you some examples showing how other people are now using it.

We invite you to study these case histories. More important, we invite you to get in touch with us so you can get a first-hand look at how well they work. Which is a lot more convincing than just listening to us brag about them.

Meanwhile, we have a couple of brochures you should send for.

Our MAXNET brochure deals with computer networking, and how MAXNET makes it all happen.

The other is a thirty-two page booklet that explains in detail exactly what we mean by MODCOMP "TSP." The Total Systems Performance that has made MODCOMP first choice of many of the world's toughest computer buyers.

If you're into computers at all, the TSP brochure is "must" reading. If you're into resource-sharing networks (and if you're not, you soon will be), the MAXNET brochure is equally compulsory.

Write Modular Computer Systems, 1650 West McNab Road, Ft. Lauderdale, FL 33309. Phone (305) 974-1380.

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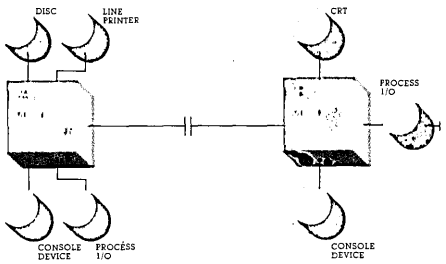
Case History No. 1
A giant aluminum company chose MODCOMP for this simple two-computer "network."
Computer A is at one of the Company's plants in Pennsylvania. Computer B at a research facility in Tennessee, several hundred miles away. The two computers communicate with each other over ordinary dial-up telephone lines. Using MAXNET, operators at either location have full access to all the resources of both computers. Data, programs, peripheral services can be freely exchanged.

For example, suppose a research engineer at Computer B needs to compile a new program. By a simple terminal request, he can call down language processors from Computer A, compile and edit his program on his own computer, and transmit his listing outputs back to Computer A for printing.

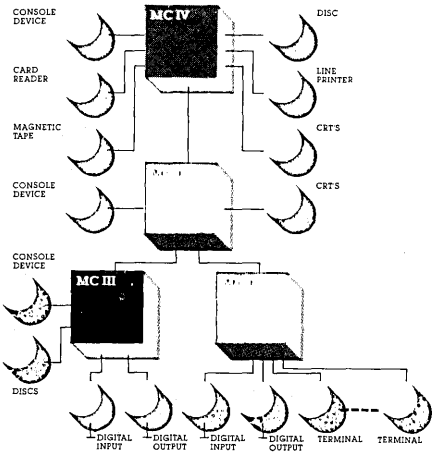
Alternatively, a programmer at Computer A can prepare a program and load it directly down to Computer B. Even though it's the break of day in Tennessee, and the computer is all alone in the office.



This relatively simple system illustrates the flexibility of MAXNET, whether the computers in your network are in adjoining rooms, or a thousand miles apart. It would work just as well if they were on different planets, but nobody's asked us to do that. Yet.

Case History No. 2
This MODCOMP Network is in operation at the central R&D facility of a major oil company. It's a good example of how MAXNET, coupled with across-the-board compatibility of MODCOMP hardware, allows you to start as small as you want to, and grow as big as you need to. Without a heavy initial investment. And without costly re-programming as your system expands.

It started, as part of a long-range plan, with the installation over two years ago of a MODCOMP III. Although this model has now been superseded in our line by later models of the MODCOMP II, it is indicative of the long-term compatibility of MODCOMP systems that the III remains today a vital part of this network.



As the system has since evolved, a 32-bit MODCOMP IV now acts as host computer. Replacing (at a fraction of the cost) the company's former stand alone IBM 1800, the MODCOMP IV is expected to provide 10 to 25 times the throughput of the big machine, which had long since reached its saturation point.

A MODCOMP II acts as communications controller between the host and satellite computers.

The satellites consist of 16-bit MODCOMP II's performing various data acquisition and control functions for a series of pilot plants. The MODCOMP III handles analytical instrumentation, providing simultaneous service to over 80 instruments of various types.

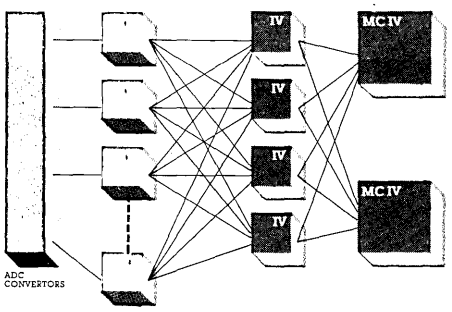
The advantages of this system are, firstly, it's computing power—many times that of the old stand-alone system. It's reliability (the MODCOMP system has had an overall availability of 99.3% of prime time over the past two years). It's expandability, which allows virtually unlimited future growth. And last, but far from least, it's economy and ease of operation.

Case History No. 3
A NASA prime contractor has installed this highly sophisticated MODCOMP hierarchical network to handle complex stress and fatigue test analyses.

Dual redundant 32-bit MODCOMP IV's at the "host" level communicate with an intermediate level of several smaller 32-bit MODCOMP IV's, screening data received from the satellite computers. A large number of 16-bit MODCOMP II satellites interface directly to the various processes. The entire system has built-in redundancy at each level.

Among minicomputer vendors, only MODCOMP has the capability to build a network of this size and complexity, using standard hardware and software products. At a small fraction of the cost for a single stand-alone computer large enough to perform the same multiple tasks. And with far greater efficiency.

It clearly illustrates the unlimited expandability of MAXNET in setting up any kind of network system you need to do your particular job.



For clarity, peripheral devices omitted from this diagram.

Note: The MAXNET systems shown here are all resource-sharing networks of the type commonly used in laboratory and industrial measurement and control systems. For dedicated telecommunications applications, MODCOMP offers a separate software system called MAXCOM. For more information, send for our Data Communications brochure.

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*TSP = Total Systems Performance.

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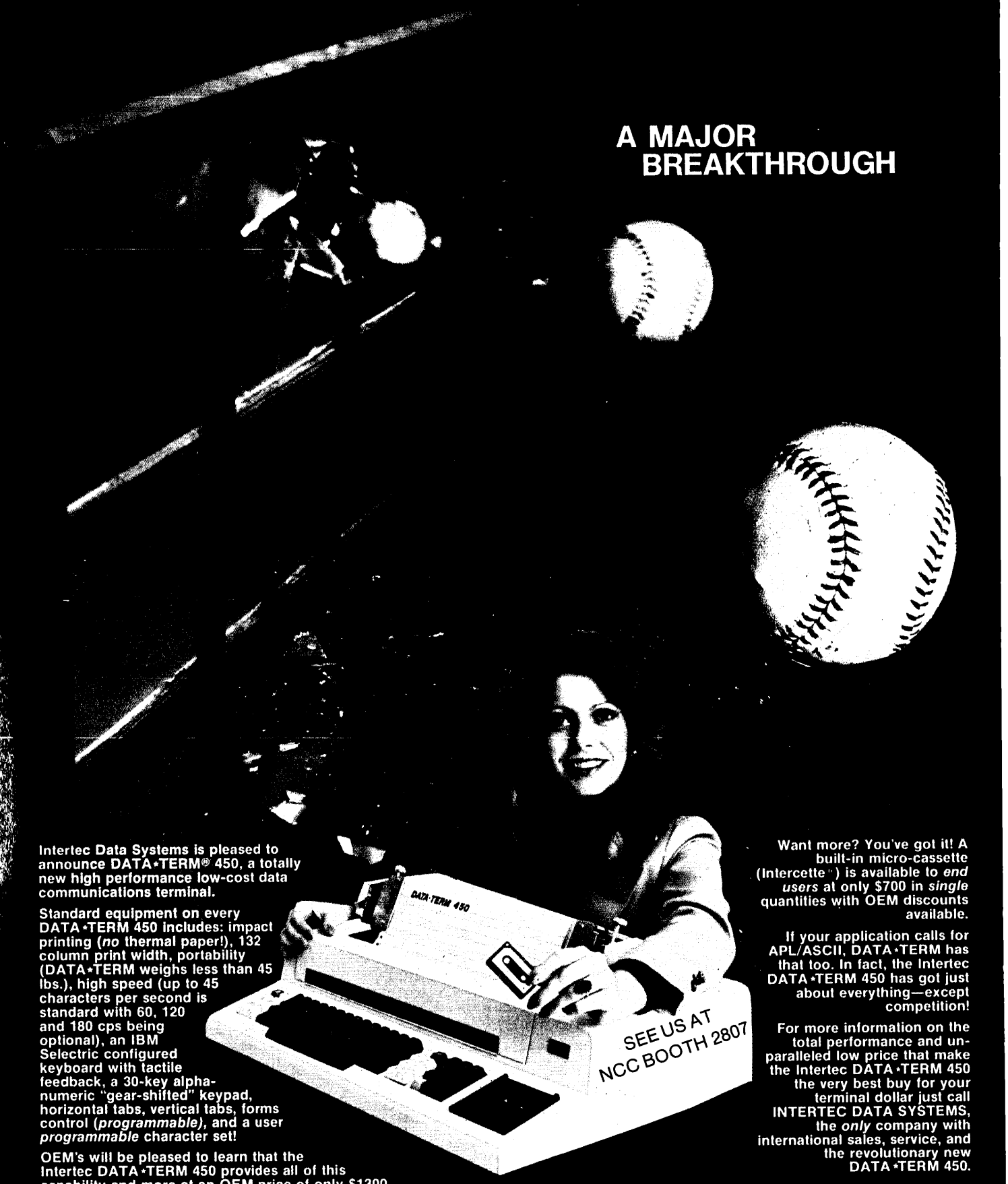

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Communications Processor Survey

by J. Burt Totaro

Born to replace hardwired controllers, these processors have carved out far greater roles for themselves and become critical network links.

A frequently discussed topic at the March 29-31 Data Communications Interface '76 trade show in Miami was communications processors. Most attendees wanted to know what was new and how they could save network implementation time and money through use of these processors.

In these discussions, two glaring problems became readily apparent. First, there was no easy agreement on what a communications processor is. Second, there was similar divergence of views over what functions it can or should perform.

This situation was best exemplified by a conversation with a spokesman for a company which was displaying its communications processor on the exhibit floor of the Miami Beach Convention Center. In response to the question, "What can your processor do for me?" he proudly responded, "What would you like it to do?"

It's clear from a wide variety of indicators, including the steady influx of new product announcements from the vendors of communications processors, that these products or systems are important, if not vital, components in current data communications-oriented systems, and especially so if any sizable network of computers and terminals is involved. Therefore, it will be worthwhile to describe these processors, to clarify their various possible roles, and to reveal their sometimes overglamourized advantages and generally disguised disadvantages.

A communications processor, in the context of this survey, is simply a digital computer that has been specifically programmed to perform one or more control and/or processing functions in a data communications system or network. It generally includes a specific set of user-modifiable software.

Such processors do not represent a new system design concept. During the industry's second generation, in the early 1960s, such processors were offered by several of the major mainframe suppliers, including Control Data's 8090/8050, General Electric's DATANET-30, and IBM's 7740. Also, as early as March 1963, Collins Radio Company delivered its first Collins Data Central programmable communications system. In almost all such early applications, the systems were used primarily in message switching, acting simply as a message router and dispatcher in a data communications network.

The principal differences in relation to today's processors lie in the diversity of the application areas, the flexibility of the devices, the relatively low cost of the units, and, by consequence, the trend toward widespread usage.

Listed below are some of the principal uses of programmable communications processors in current data processing systems. Though most can be installed as front-end processors, it is important to note that many can be used in more than one way, with specific sets of software and interface units provided for each application. The currently popular types of applications include:

Message switching. The message switching processor receives messages from remote terminals, analyzes them to determine their proper destination, performs any code conversions that may be necessary, and transmits them to other remote terminals. The sending and/or receiving remote terminals may themselves be computer systems. The programmable processor performs little, if any, processing on the messages; it acts principally as a traffic director.

Front-end processing. The programmable communications processor replaces a hardwired communications controller as the interface between the central data processing system and the data communications network. The front-end processor not only receives and transmits all data passing through the network, but also, significantly, can be programmed to pre- and post-process this data in a variety of ways in order to relieve the system's central processing unit from time-consuming overhead activities related to message formatting and control. This decentralized approach to the distribution of processing labor permits both communications and central procesors to perform their primary functions in parallel and with little interference. Data is passed between the processors only when necessary and with as high a degree of efficiency as is possible.

Line concentration. Communications processors sometimes fill the relatively simple role of communications line concentrators. Here the processor generally terminates a number of low-speed transmission lines and interfaces them to one or two higher-speed lines for more efficient and economical data transmission. Little, if any, processing of the transmitted data is performed.

Dedicated processing. Many of today's programmable communication processors have enough storage capacity and processing power to enable them to serve as self-reliant data processing systems at the various points or nodes in the communications network where they are located. In inquiry/response systems, for example, the communications processor can receive inquiry messages from remote and/or locally connected terminals, process the messages to determine the specific information required, retrieve the information from on-line random access storage units, and send it back to the inquiring terminals. All this can be done without recourse to the large, centralized system at the heart of the network. With communications processors of this type, application-oriented processing is of equal importance with message receipt and transmission.

Remote batch terminals. Communications processors are currently being used in numerous "intelligent" remote batch terminals. Here, the processor is the control component that regulates the operations of the on-line peripheral devices, performs small scale data processing operations locally, and also transmits and receives data through a communications link to and from a remotely located central processing system.

Some of the behind-the-scenes technical tasks that communications processors are often required to perform in order to effectively serve in the functional roles discussed above include the following:

1. Line control. This involves the periodic polling of remote terminals to determine readiness to transmit and receive data. Automatic call answering, acknowledgment, and dial-up can also

This article is based on "All About Communications Processors," a 32-page DATAPRO 70 report available for $12.00 (including postage and handling) from Datapro, 1805 Underwood Boulevard, Delran, NJ 08075; (609) 764-0100.

be handled.

2. Character and message assembly. Bits are assembled (and disassembled) into parallel characters, and control characters are recognized to permit the assembly and disassembly of entire messages. The host computer can be provided with only complete messages for processing. Data can be handled at varying line speeds and in synchronous or asynchronous formats, with start-stop bits and synchronizing characters handled automatically by the communications processor.

3. Data conversion. The data transmission codes (such as Baudot, ASCII, etc.) are converted into a common structure that is equivalent to the native data code (such as EBCDIC) of the host computer or intelligent terminals to facilitate efficient processing.

4. Data and message editing. This is a general function that can include application-oriented reformatting, removal of spaces and zeroes (and other kinds of data compression), and further data restructuring to permit more efficient data transmission on the one hand and more efficient processing by the host computer on the other.

5. Error control. Using both hardware and software techniques, the communications processor can detect and correct data transmission errors before they either reach the host computer or are further propagated throughout the system. As a result, the host computer can rightly assume that all messages it receives contain prevalidated data, ready for processing.

6. Message buffering and queuing. The communications processor can buffer several messages in its main or auxiliary memory before passing them to the terminal network or to the host computer, with the intention of interrupting that computer as infrequently as possible. Also, if the host computer cannot process incoming messages as fast as they arrive, the front-end processor can queue these messages in its own auxiliary storage units, such as discs, drums, or magnetic tape units, and can transfer these messages to the host when processing time becomes available.

7. Message recording. Vital inbound messages can be passed on to the host computer while being simultaneously recorded in the communications processor's auxiliary storage. Such message recording can assist in system restart operations in case the central system should malfunction and lose either its messages or the results of processing the messages. Also, the communications processor can store a journal record of every message received during each processing period.

8. Statistics recording. The communications processor can keep a running record of all data communications traffic, including such statistics as total number of messages processed, number of messages delivered to each destination, number of line errors, average length of time in queue, number of busy signals, etc. These statistics can be dumped on demand or in the form of reports at the end of each processing cycle.

If, in fact, communications processors can effectively perform the tasks and functions outlined above, then their potential advantages to an integrated information processing system are apparent. Most users feel that the following apparent advantages or system benefits impel them to learn more about and ultimately purchase communications processors:

Flexibility. Handling many line speeds and transmission characteristics in uniform or interchangeable circuitry.

Adaptability. Supporting a wide variety of remote terminals from the mainframe and independent suppliers, regardless of their transmission speeds, line control conventions, synchronization techniques, and data codes.

Expandability. Permitting relatively easy growth of the data communications network.

Performance. Handling more and higher-speed data communications lines than hardwired counterparts.

CPU relief. Controlling the entire data communications subsystem will relieve the system's central processing unit on two counts: processing time and main memory space.

Fail-softness. Adding a front-end processor to a central data processing system, can, if so designed, enable portions of the communications network to keep on operating—although in degraded mode—when the central processing unit malfunctions.

Reliability. Utilizing an integrated monitor unit, a system operator can interrogate a front-end processor at any time for information on the operational status of the data communications network. With these diagnostics, component failures can be readily identified and corrected.

High-level user interface. Permitting user programs to address the data communications network as a standard peripheral device. The complexities of the network can remain transparent to the user.

Even in the face of these apparent advantages, today's user cannot simply go out and evaluate the best system for his needs. He must first discover who makes communications processors (literally dozens of vendors) and how one source of supply differs from another. He must also learn how different vendor choices will in large measure determine the product specifications of the processor eventually selected.

Users who are designing a data communications system will probably first contact the supplier of their present or planned mainframe computer to investigate his offerings in data communications. If communications processors are strongly promoted as the best (sometimes only) way in which to construct efficient, fully supported systems, the designers will usually go along with the recommendations of the mainframe supplier. The designer is comforted by the belief that his data communications subsystem will be fully supported and will interface efficiently with the central processing system. It is in this regard that developments such as IBM's SNA and DEC's DECNET increase in importance to systems designers.

But not all mainframe suppliers are equally advanced in their data communications line, and not all offer a selection of programmable communications processors supported with product-line software. Recent computer system announcements have, however, brought forth a number of such new products from the major manufacturers, as they both follow and "legitimize" the trend toward use of these processors. Further, modular systems such as the IBM 3705 give the same effect as a selection of models.

The user not fully satisfied with the offerings of his mainframe supplier can investigate the wares of other promising vendors, most of whom offer assurances that their communications processors can be "plug-compatible" with either the hardwired or programmable communications controllers of the mainframe supplier, or at least with his data communications hardware and software interfaces.

The minicomputer manufacturers constitute another prominent group of suppliers who are actively pursuing the communications processor market with products that can either stand alone or interface smoothly with the mainframe equipment of other suppliers. Almost any currently marketed minicomputer is capable of serving as the fundamental building block of a programmable communications processor, yet comparatively few minicomputers have been integrated with communications hardware and specialized software packages to permit them to serve effectively as complete communications processing products. This is primarily due to the complexities and high costs of communications software design.

Nonetheless, some manufacturers of minicomputers are making concerted efforts to produce integrated communications products. The buyer

should be advised, however, that among even these suppliers, the completeness of individual offerings tends to vary substantially. Their offerings also vary significantly with respect to such major aspects as training, modifications, documentation, or growth. Still other manufacturers of minicomputers have decided to sell their products on an oem basis to other suppliers who will complete the communications product and sell it to end users.

Another major source of integrated communications processing products is the independent systems houses, especially those that specialize in data communications systems. Companies such as these will generally provide complete turnkey systems, including central computer interfaces. In many cases they will accept full responsibility for the design and implementation of the entire data communications system. Such independent companies are generally well qualified in producing effective data communications systems, but the prospective buyer still has to concern himself with two important items: dividing his total system responsibility between at least two principal suppliers (communications and central system), and assuring himself that the products and systems of the several involved suppliers will indeed interface properly and function harmoniously

Regardless of which type of supplier he selects, the buyer should show partiality to those vendors who will not only guarantee complete installation of their equipment, but will also provide plans for future growth. If the user is left to face the formidable challenge of interfacing and integrating a variety of impressive but highly dissimilar communications and processing equipment, the proposed system and its future enhancements may never get past the design stage.

Potential problems

Programmable communications processors are attractive because of their many apparent advantages over hardwired communications controllers, but there are potentially serious pitfalls to be avoided in acquiring one.

One potential problem is the question of overloading the front-end communications processor, with the resultant loss of data. Sophisticated data and message control programs will consume large quantities of the front-end processor's computing and memory facilities, just as they do in a centrally-based communications system. Since many front-end processors are based on mincomputers, the possibility of overloading is all the more real. A tendency toward overloading can easily negate any apparent advantages of expandability and growth potential.

Another serious question is that of software. The body of software required for terminal control, line control, and message control activities, not to mention application-oriented preprocessing, is unquestionably complex. It is also vital to the operation of these systems. The prospective user must determine whether or not the supplier is capable of supplying this software, at what level of completeness, with what assurance of bug-free stability, with what chances of interfacing smoothly with the central system software, and with how much installation assistance.

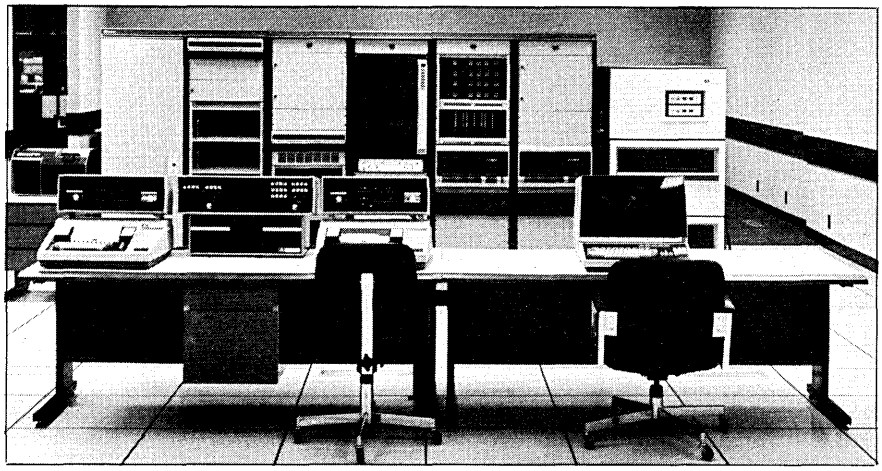
Obviously, if the software doesn't work properly, the system is of little value. From another point of view, a system whose software works but performs very few and very basic functions may still offer little more than a typical hardwired controller.

Another consideration is that the hardware/software combination that makes up a front-end processor may require far more time and effort to install and make operational than a hardwired controller, especially when the supplier of the front-end equipment is different from that of the host computer system. Apart from the traditional problems (real or imagined) of divided vendor responsibility, there exists the very real problem of integrating two completely different sets of hardware and software.

A currently operational data communications installation which is considering replacing its hardwired communications controllers(s) with a communications processor must carefully evaluate the problems of conversion. Beyond the usual problems of data integrity and the logistics of arranging the conversion process, the user may also be faced with the prospect of modifying either his central system control software or his body of application programs that use the communications network.

Evaluating a communications processing system on a cost/value basis is extremely complex and can be almost meaningless when performed in the abstract. Costs will vary with the size and diversity of the network being controlled, with the size and processing power of the processor, with the number of control and preprocessing functions incorporated (software is expensive, whether hidden in a "bundled" system price or not), and with the number of on-line peripheral devices. Keeping costs to an absolute minimum will probably result in a system that is capable of little more than the hardwired controller it is replacing. In this case, the cost differential is easily measured, but it will not likely be significant in either direction.

Adding functions that will permit use of "foreign" terminals, relieve the central processor of excessive overheads, and allow independent and backup processing may increase the costs as it increases the value. To evaluate the reasonableness of the cost of the communications processor and the potential cost savings throughout the system, specific dollar figures must be associated with the expected values to be derived from reorienting a host-controlled data communications system to an externally controlled one. In summary, it should be clear that costs and values of communications processing can be assessed only in terms of specific situations and specific systems.



The Collins Radio Group C 900 illustrates how large a message switch can get. (This dual processor system incorporates two Digital Equipment Corp. PDP-11s.) One of the old-timers in the communications processor business, Collins was delivering systems as early as 1963.

Buying guidance

Communications processors have not matured to the point where their descriptive terminology is in any way standardized or consistent. As a result, the prospective buyer must determine exactly what he will be getting and what he will not. The sales brochures and technical manuals are often not sufficiently informative (and some-

times unfortunately misleading).

First of all, there are at present two distinctly different kinds of these processors. The first and more basic variety is designed to simply replace the functions and services of the central system's hardwired controller. It is meant to be a plug-compatible replacement, requiring few, if any, changes to the central system's communications control software or the user's application programs. It does not necessarily relieve the central system of any software control overheads, but simply provides a more flexible interface to the communications network for accommodation of additional and varied lines and terminals in the future.

The most prevalent examples of this type of front-end processor are the many available units designed to replace or "emulate" the IBM 2701 Data Adapter Unit and the IBM 2702 and 2703 Transmission Control Units. These front-end processors function with the IBM System/360 or System/370 computer systems through standard BTAM, QTAM, and TCAM communications control software.

The second and more powerful variety of front-end processor is designed to replace not only the functions and services of the hardwired controller, but also most or all of the data communications control functions normally performed by the central system's processing unit and resident software. This variety of front-end processor, by freeing the central processing unit for productive work, provides valuable advantages not only in data communications flexibility, but also in systems throughput.

It is possible that a user may want to install the basic kind of front-end initially and then gradually add functions to it to relieve the central processing unit's communications overheads. However, the user must make sure that his selected front-end processor has enough processing and memory capacity to permit the gradual buildup of substantial message control routines, and that the various responsibilities of both the vendor and the user are clearly assigned.

Another buyer's tip is to look for that word "turnkey." Turnkey installation of front-end processors usually means that the supplier takes on full responsibility for hardware, software, and interfaces required to essentially "plug in" his product. From a user's point of view, this approach is highly desirable, since it can save him money, time and aggravation. But the user must still determine what product with what promised functions is being offered on the turnkey basis. It may still be a somewhat limited front-end product.

A low list price can be totally misleading, since it may include only a minicomputer and an associated communications multiplexor. The cost and effort of establishing the proper interfaces and writing the all-important software can be dropped squarely on the buyer, who may have been trapped by an attractive low-price bid.

Since software development is such a critical question, the buyer should determine early in the proceedings exactly what software is provided with the basic front-end system and at the basic price. If certain software is lacking, such as specific remote terminal handlers or message queuing routines, then implementation and integration responsibilities should be clearly fixed, and with firm price quotations.

The buyer will also ask the competing bidders for clear statements of service and support after installation of the front-end processor. Since data communications subsystems can be complex and demanding in any environment, it must be considered an extremely valuable system feature if the prospective supplier of the front-end processor offers to assume full operating and service responsibility for the externally controlled communications network that is directed by his product.

When considering a front-end processor from a source other than the supplier of the central computer equipment, the buyer should insist on receiving concrete performance data, drawn from installed systems, to substantiate the supplier's claims. The buyer should beware if the supplier refuses to back up his claims with actual case studies. As further evidence of proven performance, the buyer should personally contact as many previous users as possible, probing not only for their degree of satisfaction, but also for the extent to which the installed systems reflect his own intended system design and functional objectives. However, even in highly specialized, not directly related, reference accounts, meaningful information can be derived regarding the supplier's competence and willingness to help, and the basic reliability of the hardware/software package.

When the proposed supplier is a major mainframe manufacturer, the buyer will also want evidence of proven performance. This evidence should apply to the overall performance of the total, integrated data processing system, and not just the front-end subsystem. However, when the mainframe supplier offers a choice of a front-end processor or a hardwired controller (as several now do), then the buyer will again want specific, tangible performance data to justify selection of front-end processing. Of course, the mainframe vendor can forcibly persuade adoption of the front-end concept even without offering convincing performance data, by simply indicating that the newer product will receive all future support and that the former one will be essentially dropped from the product line.

Understanding the tables

The prospective buyer of a communications processor can learn a good deal about the various suppliers of this equipment and the specifications and prices of their wares by scanning the equipment comparison charts included here. These charts present the principal characteristics of today's commercially available communications processors.

The information in the charts was supplied and/or verified by the vendors during the months of November 1975 through January 1976. Their cooperation is acknowledged and greatly appreciated. *The omission of the products of any specific company from the charts means that the company either failed to respond to our repeated information requests, was unknown to us, or has discontinued its communications processor product line.*

Subject matter for the charts includes communications processors with such uses as front-end processing, message switching, data collection, line concentration, etc. Processors used strictly as controllers in remote batch terminals are not included, because these products are generally limited to one type of line or terminal. Minicomputers and their suppliers are only included when the manufacturer offers an integrated communications product, rather than a bare minicomputer, for sale to end users.

With two exceptions, hardwired communications controllers are not covered. The two exceptions are the IBM 270X hardwired controllers and their Memorex equivalents. It seems only fitting that these products should be included for comparative purposes, since they triggered much of the current interest in communications processors.

Most of the chart entries and their significance to prospective users of programmable communications processors are evident. A few deserve minor clarification:

Supported applications. This entry lists the key application areas for which each programmable processor has been designed. (If a given processor is listed as serving one particular application area, such as message

(Text continues on page 166)

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	Action Communications Systems Telecontroller	American Systems Nucleus 4000	Burroughs B 774	Burroughs B 776	Chi Communications Processor (front end)	Chi Communications Processor (remote concentrator)	Collins Radio Group C-System Model 8562	Collins Radio Group C 900 Series	Computer Automation LSI-1 & LSI-2	Computer Communications Inc. CC-8	Computer Communications Inc. CC-80
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	IBM/360, IBM/370	IBM/360, IBM/370, Burroughs B 1700, Data General Nova, custom	Burroughs B 4700/ B 3700/B 2700	Burroughs B 4700/ B 5700/B 6700/ B 7700	UNIVAC 1100 Series	UNIVAC 1100 Series	IBM/360, IBM/370, UNIVAC 1100 & 490 Series, custom	Custom	Application dependent	IBM/360, IBM/370	IBM/360, IBM/370, and custom
Host computer comm. software:								See Comments			
Used as is	No	Yes	MCPV-MCS	Yes	No	Yes	No	–	–	Yes	Yes
Altered	Yes	Yes	–	Yes	Yes	No	Yes	–	–	No	No
Alterations provided	No	Yes	–	Yes	Yes	No	Yes	–	–	No	No
Replaced	Yes	Yes	–	Yes	Yes	No	Yes	–	–	No	No
Replacement provided	No	Yes	–	Yes	Yes	No	Yes	–	–	No	No
SUPPORTED APPLICATIONS											
Front-end processing	Yes	Yes	Yes	Yes	Yes	–	Yes	No	No	Yes	Yes
IBM 270X emulation	No	Yes	No	No	No	No	No	No	No	Yes	Yes
IBM 370X emulation without NCP	No	No	No	No	No	No	No	No	No	Yes	Yes
IBM 370X emulation with NCP	Yes	No	No	No	No	No	No	No	No	Yes	Yes
Remote concentration	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Message switching	Yes	Yes	Custom	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Other supported applications	–	Inquiry/response; data collection; banking; retail credit network	RJE; time-sharing	Distributed communications	Security; spooling	–	Multiple mixed host CPU inter-processing	Funds transfer	Software modules permit constr. of emulator progs.	Intelligent network processing	Intelligent network processing
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	128	256	32	32	240	240	1024	256	Over 32	240	240
Narrow-band lines	128	256	32	32	240	240	1024	256	–	240	240
Voice-band lines	128	128	32	4	240	240	256	20	–	120	120
Wide-band lines	128	48	None	1	240	240	128	10	–	64	64
Maximum number of lines active simultaneously	128	256	32	32	240	240	1024	256	–	240	240
Effect of full-duplex operation	Reduces lines by half	Reduces line by half	Reduces line by half	Reduces line by half	No effect	No effect	–	No effect	–	No effect	No effect
PROCESSOR AND MEMORY											
Processor identity	Data General 1200, 800	DEC PDP-11 Series	Burroughs B 774-1	Burroughs B 776-1	Interdata 80	Interdata 80	C-8562A-1	DEC PDP-11/35 and PDP-11/05	LSI-1 & LSI-2	CCI	CCI
Word length, bits	16	16	16	16	32	32	32	16	16	16	16
Memory cycle time, microseconds	1.2/0.8/0.3	Function of DEC PDP-11 model used	0.5	1.0	0.27	0.27	0.9	0.9	1.6	1.0	0.54
Memory capacity, bytes	128		8K to 96K	40K to 96K	64K	64K	262K	64K to 256K	512K	8K to 512K	8K to 512K
Priority interrupt levels	64	–	–	–	4	4	0 (queue-driven)	Multi-level	256	32	32
On-line peripheral devices	Card reader, disk mag. tape, paper tape, printer	Disk paper tape, or any standard peripheral	None	Disk cartridge, mag. tape, card readers, punches, etc.	Card reader, disk, printer	Card reader, disk, printer	Moving head disk, mag. tape, card units, printers, others	Disk, mag. tape, CRT, card reader, etc.	Disk, mag. tape, CRT, card readers, line printer, etc.	Fixed and moving-head disk; CRT	Fixed/moving-head disks, mag. tape, printer, cards CRT, paper tape
Console performance monitor	Yes	Yes	No	–	No	No	Yes	Yes (+Op Console)	Yes	Yes	Yes
SOFTWARE											
Operating system	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Message control programs	Yes	Yes	Host	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Assembler	Yes	Yes	No	Yes (compiler)	Yes	Yes	Yes	Yes	Yes	No	No
Cross assembler	No	Yes	Yes	No	Yes; UNIVAC 1100	Yes; UNIVAC 1100	No	–	Yes; IBM 360/370	Yes	Yes
Terminal handlers	Most terminals	Most terminals; CRT's; async. and Bisync.; financial	Burroughs terminals; Teletype; Bisync. terminals	Burroughs terminals; Teletype; Bisync. terminals	IBM 2780; U 1004; IBM 360/20; Teletype	UNIVAC U-100 and DCT 2000	TTY; AT&T, WU TTYsys.;IBM 2780 & other BSC; Univac DCT 1000,etc.	SABRE Code; ATA; IATA; ASCII; SDLC; others	–	All IBM; TTY I/II; Univac; DS 40; DS V	All CCI, all IBM, TTY 33/35/37; others custom
Software pricing	Standard	Standard	$2,000 (purchase); $50/mo. (rental)	Standard	Standard	Standard	Standard	Standard	–	Standard and custom	Standard
Turnkey systems	Available	Available	–	–	Available	Available	Available	Available	No	Yes	Available
PRICING AND AVAILABILITY											
Purchase price	$100K to $1M	$30,000 and over; varies by model	$39,800 to $125,000	$68,230 (typical)	$40,000 (basic)	$30,000 (basic)	$500,000 to $2M	$350,000 to $950,000	$2,760 to $3,160	$46,500 (basic)	$74,500 (basic)
Monthly rental	$3,500 to $31,000	–	$850 to $2,900	$ 1,550 (typical)	$1,300 (basic)	$1,000 (basic)	Contact vendor	Contact vendor	–	3-year & 5-year leases	3-yr. and 5-yr. leases
Date of first delivery	1971	1974	January 1975	December 1975	August 1972	June 1974	March 1974	January 1975	September 1973	May 1975	March 1975
Number installed to date	75	9	–	–	–	–	Over 20	Over 10	–	2	12
Serviced by	Sorbus	American Systems & Digital Equipment	Burroughs	Burroughs	Chi and Interdata	Chi and Interdata	Collins	Collins	CAI	CCI	CCI
COMMENTS		Supports voice response; does not require IBM telecom. access methods	Microprogram controlled				System permits multiple host CPU's and flexible line terminations	System supports multi-mode environment and applications; Collins is now a subsidiary of Rockwell International	Marketed on an OEM basis to systems manufacturers	Competitor to IBM 3704; see other CCI models on next page	Emulation and network program multiprocessor

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	Computer Communications Inc. CC-8000	Computer Transmission Corp. M-3000	Comten, Inc. Comten 20	Comten, Inc. Comten 476	Comten, Inc. Comten 3650	Comten, Inc. Comten 3670	Control Data Corp. Cyber 1000	Control Data Corp. 2550 Series	Data General Nova 2	Data General Eclipse Nova 3	Data General Eclipse S/100
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	IBM/360, IBM/370, and custom	IBM/360, IBM/370, CDC 7600, DEC PDP-11, etc.	Custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	CDC 6000, Cyber 70, Cyber 170, 3000 Series	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom
Host computer comm. software:											
Used as is	Yes	Yes	–	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Altered	No	No	–	No	No	No	Yes	No	–	–	–
Alterations provided	No	No	–	No	No	No	Yes	No	–	–	–
Replaced	No	No	–	Yes	No	No	Yes	No	–	–	–
Replacement provided	No	No	–	Yes	No	No	Yes	No	–	–	–
SUPPORTED APPLICATIONS											
Front-end processing	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IBM 270X emulation	Yes	No	No	No	Yes	Yes	No	No	No	No	No
IBM 370X emulation without NCP	Yes	No	No	No	Yes	No	No	No	No	No	No
IBM 370X emulation with NCP	Yes	No	No	No	Yes	Yes	No	No	No	No	No
Remote concentration	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes
Message switching	Yes	–	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Other supported applications	–	Data PABX circuit switching, port contention	–	EFTS, combined message switching & front-end processing	Communications networking	Communications networking systems (CNS)	–	6671/6676 emulation	–	RJE, time-sharing	HASP, RJE, time-sharing
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	960	2048	128	256	128	384	32 to 512	256	128/mux	256/mux	256/mux
Narrow-band lines	240	–	128	256	128	384	32 to 512	256	128/mux	256/mux	256/mux
Voice band lines	240	–	128	256	128	384	32 to 512	256	4/mux	32/mux	32/mux
Wide-band lines	240	–	64	128	64	192	32 to 128	128	1	4/mux	4/mux
Maximum number of lines active simultaneously	960	2048	128	256	128	384	32 to 640	256	All	256/mux	256/mux
Effect of full-duplex operation	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	Reduces lines by half	Reduces lines by half
PROCESSOR AND MEMORY											
Processor identity	CCI	–	Comten	Comten	Comten	Comten	Control Data	Control Data	Data General Nova 2	Data General Nova 3	Data General Eclipse w/ERCC
Word length, bits	16	–	16	32	16	16	27	16 + 2	16	16	16
Memory cycle time, microseconds	0.54	–	0.9	0.75	0.65	0.65	0.9	0.65	1.0	0.7	0.2 to 0.8
Memory capacity, bytes	8K to 512K	–	8K to 65K	32K to 512K	16K to 256K	16K to 512K	24K to 192K	48K to 512K	8K to 64K	16K to 256K	16K to 256K
Priority interrupt levels	32	–	128	64 to 384	256 to 768	256 to 768	4	16	16	16	64
On-line peripheral devices	Fixed/moving-head disks, mag. tape, printer, cards CRT, paper tape	–	Disk, mag. tape, card reader, printer, paper tape	Disk, mag. tape, card reader, printer, paper tape	–	–	Fixed/moving-head disk, mag. tape, card reader/punch, line printer	Moving-head disk, line printer, card reader	Fixed/moving-head disk, mag. tape, card reader, line printers, diskette	Fixed/moving-head disk, mag. tape, line printers, cassette tape, card reader, paper tape units, diskettes, CRTs, others	
Console performance monitor	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes (CRT, TTY)	Yes	Yes	Yes
SOFTWARE											
Operating system	Yes	–	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Message control programs	Yes	–	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Assembler	No	–	No	Yes	No	No	Yes	No	Yes	Yes	Yes
Cross assembler	Yes	–	Yes; IBM 360/370; Comten 476	Yes; IBM 360/370	Yes; IBM 360/370, Comten 476	Yes; IBM 360/370, Comten 476	No	Yes; CDC 6000, Cyber 70, 170	Yes; IBM/360	Yes; IBM/370	Yes; IBM/370
Terminal handlers	All CCI, all IBM, TTY 33/35/37; others custom	–	None	TTY 28/33/35/37, all IBM, SDLC, others	TTY 28/33/35/37, all IBM, SDLC, others	TTY 28/33/35/37, all IBM, SDLC, others	TTY;IBM BSC ter.; AT&T, WU TTY systems; TC 500, TTY 40; others	TTY 28/33/35/38, CDC 200 UT, 731, 734, 711, 714, 713, others	TTY 33, IBM 2780	TTY 33, CRT's, IBM 2780/3780, BSC, ASCII, SDLC	TTY 33, CRT's, IBM 2780/3780, BSC, ASCII, SDLC
Software pricing	Standard	–	Optional	Standard	Standard	Standard	Standard, opt.	Standard	Standard	Standard	Standard
Turnkey systems	Available	–	No	Available	Available	Available	Available	Optional	None	None	None
PRICING AND AVAILABILITY											
Purchase price	$125,000 (basic)	$100,000 (typical)	$60,000 to $120,000	$100,000 to $350,000	$50,000 to $150,000	$100,000 to $400,000	$250,000 to $1,500,000	$50,000 to $150,000	$4,550 to $75,000	$2,900 to $50,000	$9,200 to $75,000
Monthly rental	3-yr. and 5-yr. leases	$1,360 (2-year)	–	–	$1,000 to $3,000	$2,400 to $8,000	$5,000 to $35,000	$2,500 to $7,500	Third-party lease	3rd-party lease	–
Date of first delivery	October 1970	1973	March 1971	September 1975*	March 1975	March 1972	March 1969	September 1975	September 1973	1975	April 1975
Number installed to date	6	10-12	Over 50	Over 50*	Over 60	Over 150	58	15	20,000 (all types)	20,000 (all types)	–
Serviced by	CCI	TRAN	Comten	Comten	Comten	Comten	Control Data	Control Data	Data General	Data General	Data General
COMMENTS	Message switch multiprocessor	Supports all std. interfaces: EIA RS-232, CCITT V.24, MIL Std., CCITT V.35, etc.	Used as remote concentrator in large networks	*476 is successor to Comten 40/45 and 60/65, first delivered in June 1969					See Comments for other Data General models	Each mux supports up to 9600 bps per line (asynch. 256 lines/synch. 32 lines); the DCU 50 user-programmable communications preprocessor supports 16,000 char/sec throughput each, or 48,00 char/sec per DG system	

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	Data General Eclipse S/200	Data General Eclipse C/300	Data Pathing Inc. Series 2000	Data Pathing Inc. System 150-30	Data Pathing Inc. System 150-60	Data Pathing Inc. Series 2100	Digital Communications Associates Smart/MUX	Digital Computer Controls Inc. D-116	Digital Equipment Corporation Front End System Base	Digital Equipment Corporation PDP-11 Family	GSC Data Systems T-578 System
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, custom	IBM/360, IBM/370, others	DECsystem-10, IBM/360, IBM/370, others	IBM/360, IBM/370, others	IBM/360, IBM/370	–	IBM/360, IBM/370
Host computer comm. software:											
Used as is	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Altered	–	–	Yes	No	No	No	Yes	Yes	No	No	No
Alterations provided	–	–	Yes	No	No	No	Yes	No	No	No	No
Replaced	–	–	No	No	No	No	No	No	No	No	No
Replacement provided	–	–	No	No	No	No	No	No	No	No	No
SUPPORTED APPLICATIONS											
Front-end processing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
IBM 270X emulation	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No
IBM 370X emulation without NCP	No	No	No	Yes	Yes	Yes	No	No	No	No	No
IBM 370X emulation with NCP	No	No	No	No	No	No	No	No	No	No	No
Remote concentration	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Message switching	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	Yes
Other supported applications	HASP, RJE, time-sharing	HASP, data base systems (INFOS), RJE, time-sharing	Data collection	Data collection, source data management, stand-alone applications, 3270 emulation		Data collection, source data management	Time-sharing, RJE	Data collection	None	IBM 2780 emulation; RJE	–
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	256/mux	256/mux	6	11	31	10	128	128	NA	–	128
Narrow-band lines	256/mux	256/mux	0	0	0	0	128	128	Groups of 16	–	128
Voice-band lines	32/mux	32/mux	6	11	31	10	4 to 6	128	Groups of 1	–	32
Wide-band lines	4/mux	4/mux	0	0	0	0	2	128	Groups of 1	–	1
Maximum number of lines active simultaneous	256/mux	256/mux	6	11	31	10	All	128	NA	–	128
Effect of full-duplex operation	Reduces lines by half	Reduces lines by half	No effect	No effect	No effect	No effect	No effect	Reduces lines by half	–	–	No effect
PROCESSOR AND MEMORY											
Processor identity	Data General Eclipse w/ERCC	Data General Eclipse w/ERCC	DPI 2103	DPI 2015 & Intel 8080	DPI 2106 & Intel 8080	DPI 2104	DEC PDP-8 Series	DCC	DEC PDP-11/10, 11/40, 11/50	DEC PDP-11/10, 11/40, 11/50	IBM 1130, GA 18/30
Word length, bits	16	16	16	16	16	16	12	16	16	16	16
Memory cycle time, microseconds	0.2 to 0.8	0.2 to 0.8	8.0	1.0	1.0	2.0	1.2	1.2/0.96	0.9/0.9/0.3	0.9/0.9/0.3	1.2
Memory capacity, bytes	32K to 256K	64K to 256K	16K	32K to 128K	32K to 256K	32K	8K to 48K	256K	56K	56K to 256K	128K
Priority interrupt levels	64	64	16	7	7	NA	NA	16	Multi-level	Multi-level	8
On-line peripheral devices	Fixed/moving-head disk, mag. tape, line printers, cassette tape, card reader, paper tape units, diskettes, CRTs, others		Mag. tape	Disk, mag. tape, printers, CRT, others	Disk, mag. tape, printers, CRT, others	Mag. tape, disk, CRT, printers, drum	Disk, mag. tape, card reader, line printer	Disk, mag. tape, card reader, printer, punch, CRT, paper tape, etc.	Line printer, card reader	Disk, card reader, line printer, mag. tape	Disk, mag. tape, printers
Console performance monitor	Yes	Yes	No (op. console)	No (op. console)	No (op. console)	No (op. console)	Yes	No	Yes	Yes	Yes
SOFTWARE											
Operating system	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Message control programs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Assembler	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cross assembler	Yes; IBM/370	Yes; IBM/370	No	No	No	No	Yes; DEC PDP-10, IBM/360, IBM/370	No	No	No	No
Terminal handlers	TTY 33, CRT's, IBM 2780/3780, BSC, ASCII, SDLC	TTY 33, CRT's, IBM 2780/3780, BSC, ASCII, SDLC	DPI data collection	DPI data collection, TTY, 3270 BSC, others	DPI data collection, TTY, 3270 BSC, others	DPI data collection	ASCII, BSC, IBM 2741 (corres.); SDLC planned	Most prominent terminals	TTY; DEC LA36, VT50; IBM 2741	TTY; DEC LA36, VT50; IBM 2741	All IBM and TTY, Wiltek, Mohawk
Software pricing	Stnadard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard, optional
Turnkey systems	None	None	Available	Available	Available	Available	Available	Available	No	No	Available
PRICING AND AVAILABILITY											
Purchase price	$16,300 to $100,000	$30,000 to $250,000	$24,150	$105,000 to $160,000	$105,000 to $160,000	$85,050 to $109,410	$6,000 to $50,000	$2,975 to $29,370	$32,000 to $56,000	$10,000 to $90,000	$150,000 to $500,000
Monthly rental	–	–	$812 to $900	$2,852 to $5,251	$2,852 to $5,251	$2,276 to $3,123	3rd-party lease	–	–	–	$4,500 to $15,000
Date of first delivery	March 1975	July 1975	1967	1973	1973	1970	August 1972*	Jan. 1972	June 1972	February 1972	December 1969
Number installed to date	–	–	85	100 of 150 Series	100 of 150 Series	150	Over 100*	2,340	150	Over 300	15
Serviced by	Data General	Data General	DPI	DPI	DPI	DPI	Data 100	DCC and representatives	DEC	DEC	GSC Data Systems, Inc.
COMMENTS	Each mux supports up to 9600 bps per-line (asynch. 256 lines/synch. 32 lines); the DCU 50 user-programmable communications preprocessor supports 16,000 char/sec throughput each, or 48,00 char/sec per DG system		Turnkey support for data collection systems	Turnkey support for data collection/management information systems	Turnkey support for data collection/management information systems	Turnkey support for data collection, source data management systems	*Previously sold as models PTC 8 and PRC 8	Turnkey support for data collection			

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	GTEIS IS/1100	GTEIS IS/1101	GTEIS IS/1102	Harris Corp. 4705	Harris Corp. CO-65	Hewlett-Packard 3000CX Series	Honeywell System 700	Honeywell Datanet-30	Honeywell Datanet-2000	Honeywell Datanet-355	Honeywell Datanet-6624
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	IBM/360, IBM/370, CDC 3000/6000 Series, Honeywell 425	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370, CDC 6000/7000, UNIVAC 1100 Series	–	Honeywell Series 200, 2000, 6000;	Honeywell Series 200, 400, 600	Honeywell Series 200, 2000	Honeywell Series 600, 6000	Honeywell Series 60 Level 66
Host computer comm. software:											
Used as is	Yes	Yes	Yes	Yes	No	NA	Yes	Yes	Yes	Yes	Yes
Altered	Yes	No	No	No	Yes	–	No	No	No	No	No
Alterations provided	Yes	No	No	No	Yes	–	No	No	No	No	No
Replaced	Yes	Yes	Yes	No	No	–	No	No	No	No	No
Replacement provided	Yes	Yes	Yes	No	No	–	No	No	No	No	No
SUPPORTED APPLICATIONS											
Front-end processing	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
IBM 270X emulation	Yes	Yes	Yes	Yes	No	–	No	No	No	No	No
IBM 370X emulation without NCP	Yes	Yes	Yes	Yes	No	–	No	No	No	No	No
IBM 370X emulation with NCP	Yes	No	No	No	No	–	No	No	No	No	No
Remote concentration	Yes	No	No	No	No	–	Yes	No	No	Yes	Yes
Message switching	Yes	No	No	No	No	Yes	No	Yes	No	Yes	Yes
Other supported applications	–	–	–	RJE	RJE	DBMS with QUERY; RJE; Time-sharing	RJE	–	None	–	None
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	–	–	–	255	24	32	128	128	120	200	56
Narrow-band lines	256	24	96	255	0	32	128	128	120	200	56
Voice-band lines	128	16	16	24	24	32 (all to 2400 bps)	64	10	120	32	32
Wide-band lines	64	16	16	0	8	(real-time proc.)	4	7	–	16	16
Maximum number of lines active simultaneously	Variable	40	112	180	24	32	128	128	120	200	56
Effect of full-duplex operation	No effect	–	–	No effect	No effect	No effect	–	–	Reduces lines	No effect	No effect
PROCESSOR AND MEMORY											
Processor identity	GTEIS	GTEIS	GTEIS	Harris	DEC PDP-8	HP 3000CX	Honeywell 700	Honeywell	Honeywell	Honeywell	Honeywell
Word length, bits	16	16	16	16	12	16	16	18	16	18	18
Memory cycle time, microseconds	0.75	0.75	0.75	1.0	1.5	0.9	0.775	6.94	0.755	1.0	1.2
Memory capacity, bytes	128K	128K	128K	128K	6K to 96K	96K to 128K	131K	16K	64K	32K/64K	48K/64K
Priority interrupt levels	16	16	16	30	16	253	64	1	64	256	256
On-line peripheral devices	Disk, mag. tape, card reader/punch, printer, paper tape reader/punch	None	–	Console	Console, printer, mag. tape, card	Plotter, printer, disk, mag. tape, card I/O	Printer, mag. card, paper tape, reader, punch, tape cassette	Disk, mag. tape, card units, printer	Disk, TTY	Card reader, printer	Disk, TTY; card reader, printer, mag. tape opt.
Console performance monitor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
SOFTWARE											
Operating system	Yes	Yes	Yes	Yes	Yes	Yes (MPE/C)	Yes	Yes	Yes	Yes	Yes
Message control programs	Yes	Yes	Yes	No	Yes	–	Yes	Yes	Yes	Yes	Yes
Assembler	Yes	Yes	Yes	Yes	Yes	Yes (SPL)	Yes	Yes	Yes	No	No
Cross assembler	Yes	Yes; IBM/360, IBM/370	Yes; IBM/360, IBM/370	Yes; IBM/360, IBM/370	Yes	–	–	–	No	No	No
Terminal handlers	IBM, Data 100, TTY, GTEIS, Honeywell 716	IBM, Data 100, TTY, GTEIS	IBM, Data 100, TTY, GTEIS	All IBM terminals except SDLC	CDC, Harris, and IBM terminals	CRT, TTY, PTP, graphics, BSC	TTY, Honeywell VIP CRT's, BSC	TTY; Honeywell 100 computers,760 CRT; GE TermiNet 300; IBM 2741	TTY 35, 35; most Honeywell terminals; IBM BSC; others	All HIS hard copy and CRT terminals and Remote Network Processors; all TTY; IBM 2741; GE TermiNet 300/1200; Execuport; IBM 2780; and many others	
Software pricing	Optional	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Turnkey systems	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
PRICING AND AVAILABILITY											
Purchase price	$25,000 (base)	$25,000 to $40,000	$30,000 to $90,000	$40,000 to $140,000	$150,000 to $400,000	$99,500 (basic)	$12,950 to $139,070	$37,160 to $65,475	$45,750 to $175,000	$118,320 to $840,000	$85,380 to $168,660
Monthly rental	$750 (base)	$754 to $2,000	$1,075 to $2,425	$1,000 to $3,500	$3,000 to $10,00	3rd-party lease	$449 to $4,582	$2,000 to $4,000	$1,221 to $4,700	$2,620 to $18,345	$1,676 to $3,507
Date of first delivery	April 1971	–	–	1970	1968	November 1972	July 1972	August 1963	December 1972	November 1970	July 1974
Number installed to date	approx. 100	200	100	–	–	250	–	–	–	–	–
Serviced by	GTEIS	GTEIS	GTEIS	Harris Corp.	Harris Corp.	Hewlett-Packard	Honeywell	Honeywell	Honeywell	Honeywell	Honeywell
COMMENTS						Supports HP's IMAGE data base management system with QUERY language		No longer in production			

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	Honeywell Datanet-6632	IBM 2701	IBM 2702	IBM 2703	IBM System/370 Model 125 with ICA	IBM 3704	IBM 3705 Version I	IBM 3705 Version II	Interdata Model 8/32	Interdata Model 6/16	Interdata Model 7/32
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	Honeywell Series 60 Level 66	IBM 360, IBM 370	IBM/360, IBM/370	IBM/360, IBM/370	Stand-alone computer system	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370
Host computer comm. software:											
Used as is	Yes	Yes	Yes	Yes	–	Yes	Yes	Yes	No	No	No
Altered	No	No	No	No	–	No	No	No	Yes	Yes	Yes
Alterations provided	No	No	No	No	–	No	No	No	Yes	Yes	Yes
Replaced	No	No	No	No	–	No	No	No	Yes	Yes	Yes
Replacement provided	No	No	No	No	–	No	No	No	Yes	Yes	Yes
SUPPORTED APPLICATIONS											
Front-end processing	Yes	No	No	No	–	Yes	Yes	Yes	Yes	Yes	Yes
IBM 270X emulation	No	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IBM 370X emulation without NCP	No	–	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes
IBM 370X emulation with NCP	No	–	–	–	–	Yes	Yes	Yes	No	No	No
Remote concentration	Yes	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Message switching	Yes	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other supported applications	None	Field-developed programs for many applications	Field-developed programs for many applications	Field-developed programs for many applications	Field-developed programs for many applications	Field-developed programs for many applications, remote NCP mode	Field-developed programs for many applications	Field-developed programs for many applications	RJE, Time-sharing	RJE, Time-sharing	RJE, Time-sharing
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	380	2	15	88	22	32	352	352	255	128	255
Narrow-band lines	380	4	31 (200 bps)	176 (165 bps)	16	32	352	352	255	128	255
Voice-band lines	96	4	15 (600 bps)	24	6	32	128	352	255	128	255
Wide-band lines	48	4	–	–	1	2	8	32	40	20	40
Maximum number of lines active simultaneously	56	4	31	176	22	32	352	352	255	128	255
Effect of full-duplex operation	No effect	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half	Reduces lines by half
PROCESSOR AND MEMORY											
Processor identity	Honeywell	Hard-wired controller	Hard-wired controller	Hard-wired controller	IBM 3125	IBM	IBM	IBM	Interdata 8/32	Interdata 6/16	Interdata 7/32
Word length, bits	18	–	–	–	32	–	–	18	32	16	32
Memory cycle time, microseconds	1.2	–	–	–	0.480	–	1.2	1.0	0.3	1.0	0.75
Memory capacity, bytes	64K/128K/256K	–	–	–	98K to 262K	16K to 64K	16K to 240K	32K to 256K	128K to 1MB	8K to 65K	32K to 1M
Priority interrupt levels	256	–	–	–	16	–	4	4	1024	255	1024
On-line peripheral devices	Disk, TTY; card reader, printer, mag. tape opt.	None	None	None	All standard S/370 devices	None	None	None	All Interdata peripherals	All Interdata peripherals	All Interdata peripherals
Console performance monitor	No	No	No	No	Yes	No	No	No	Yes	Yes	Yes
SOFTWARE											
Operating system	Yes	–	–	–	Yes	Yes	Yes	Yes	Yes (OS/32MT)	Yes (OS/16MT)	Yes (OS/32MT)
Message control programs	Yes	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Assembler	No	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cross assembler	No	–	–	–	NA	No	Yes; IBM/370	Yes; IBM/370	Yes; IBM/370	Yes; IBM/370	Yes; IBM/370
Terminal handlers	See Honeywell Datanet - 355 and Datanet - 6624 preceding page	TTY; all IBM including BSC and 2260 (but not SDLC)	TTY; all IBM (except SDLC) operating at up to 600 bps	TTY; all IBM except 2260 and SDLC terminals	All IBM, TTY terminals (except SDLC, unless 370X is used)	All IBM, TTY terminals	All IBM, TTY terminals	All IBM, TTY terminals	IBM BSC, and asynchronous terminals	IBM BSC, and asynchronous terminals	IBM BSC, and asynchronous terminals
Software pricing	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Optional (ITAM/32)	Optional (ITAM/32)	Optional (ITAM/32)
Turnkey systems	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
PRICING AND AVAILABILITY											
Purchase price	$128,474 to $597,594	$12,400 to $80,500	$40,000 to $77,600	$83,748 to $350,000	$385,000 to $615,000	$35,000 to $122,000	$49,500 to $700,000	$46,800 to $600,000	$50,000 to $500,000	$2,000 to $25,000	$1,500 to $1,500,000
Monthly rental	$2,519 to $12,283	$308 to $1,800	$993 to $1,800	$1,790 to $7,000	$8,500 to $14,600	$852 to $2,800	$1,285 to $17,700	$1,250 to $16,000	–	–	–
Date of first delivery	September 1974	1965	1965	–	April 1973	May 1973	July 1972	August 1976	July 1975	Spring 1976	July 1974
Number installed to date	–	–	–	–	–	–	–	–	100	–	–
Serviced by	Honeywell	IBM	IBM	IBM	IBM	IBM	IBM	IBM	Interdata	Interdata	Interdata
COMMENTS											

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	Intercomputer i5X	Memorex 1270 Model D4A	Memorex 1270 Model D5A	Memorex 1270 Model D6A	Memorex 1380	Microdata 1600/60	Modular Computer Systems Modcomp I	Modular Computer Systems Modcomp IICP	Modular Computer Systems Modcomp IVCP	Norfield Electronics, Inc. DCS 400	North American Philips DS 714/xx
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	IBM/360, IBM/370, custom	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	UNIVAC 1108	None	IBM/360, IBM/370, CDC 3000/6000/ Cyber, custom	IBM/360, IBM/370, CDC 3000/6000/ Cyber, custom	IBM/360, IBM/370, Univac	Custom
Host computer comm software:											
Used as is	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes
Altered	No	No	No	No	No	No	Yes	Yes	Yes	Yes	No
Alterations provided	No	No	No	No	No	No	No	No	No	Yes	No
Replaced	No	No	No	No	No	No	No	No	No	No	No
Replacement provided	No	No	No	No	No	No	No	No	No	No	No
SUPPORTED APPLICATIONS											
Front-end processing	Yes	No	No	No	Yes	No	No	Yes	Yes	Yes	Yes
IBM 270X emulation	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	RPQ
IBM 370X emulation without NCP	Yes	No	No	No	Yes	No	No	No	No	Yes	RPQ
IBM 370X emulation with NCP	Yes	No	No	No	Yes	No	No	No	No	No	RPQ
Remote concentration	Yes	No	No	No	No	No	No	Yes	No	Yes	Yes
Message switching	Yes	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Other supported applications	Spooling, IBM 2821 emulation	None	None	None	–	–	Custom	Process control/ Maxnet, custom	Process control/ Maxnet, custom, HASP, RJE	HASP	Telex/TWX/Gentex packet switching; process control
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	250	32	64	96	240	256	48	256	256	64	–
Narrow-band lines	250	32	64	96	240	256	48	256	256	64	31,000
Voice-band lines	24 to 48	32	64	96	120	256	4	256	256	4	3,968
Wide-band lines	2 to 8	6	6	6	16	256	1	256	256	1	112
Maximum number of lines active simultaneously	250	32	64	96	240	256	48	256	256	32	Varies
Effect of full-duplex operation	No effect	No effect	No effect	No effect	Reduces lines by half	No effect	No effect	No effect	No effect	Reduces lines by half	Reduces lines by half for voice and wide-band
PROCESSOR AND MEMORY											
Processor identity	i5X	None used	None used	None used	CCI CC-80	Microdata	Modcomp I	Modcomp II/CP	Modcomp IV/CP	–	Philips
Word length, bits	18	–	–	–	8	16	16	16	16/32	16	36
Memory cycle time; microseconds	1.0/0.25	–	–	–	0.560	1.0	0.8	0.8	0.5	0.96	2.0
Memory capacity; bytes	128K	–	–	–	64K to 512K	128K	64K	128K	512K	128K	1 million
Priority interrupt levels	14 to 21	–	–	–	8	1	4 + 128 vectored	16 + 128 vectored	16 + 128 vectored	8	128
On-line peripheral devices	All	None	None	None	None	Microdata peripherals	Disk, mag. tape, card reader, printer, etc.	Disk, mag. tape, card reader, printer, etc.	Disk, mag. tape, card reader, printer, etc.	Terminals, printers	Drum, fixed/moving-head disk, card reader/punch, line printer, etc.
Console performance monitor	Yes	No (CE panel only)	No (CE panel only)	No (CE panel only)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SOFTWARE											
Operating system	Yes	No	No	No	Yes	No	Yes (MAX I)	Yes (MAXCOM)	Yes (MAX IV)	Yes	Yes
Message control programs	Yes	No	No	No	No	Yes (firmware)	No	Yes	Yes	Yes	Yes
Assembler	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cross assembler	Yes 360/370	No	No	No	No	Yes	Yes; IBM/370, CDC 6000	Yes; IBM/370, CDC 6000	Yes; IBM/370, CDC 600	No	No
Terminal handlers	"All"	No	No	No	TTY, CRT, ASCII, all IBM (except SDLC now)	Hazeltine 2000, ADDS 580	None	TTY, IBM BSC, CDC 200 UT	TTY, IBM BSC, 2780/3780, CDC 200 UT, Univac 1004	DS 40, TTY, TWX, IBM 2780/3780	Computek, IDI, CCI, & Delta CRTs; TTY/TWX; Telex; custom
Software pricing	Standard	–	–	–	Standard	Optional	Standard	Standard	Optional	Standard	Standard, custom
Turnkey systems	Available	–	–	–	–	Not available	Not available	Not available	Not available	Available	Available
PRICING AND AVAILABILITY											
Purchase price	$20,000 to $180,000	$30,000 to $50,000	$40,000 to $80,000	$60,000 to $100,000	$60,000 to $140,000	$10,000 to $25,000	$3,600 and up	$16,000 and up	$29,500 and up	$14,900 to $41,500	$400,000 (basic)
Monthly rental	–	$800 to $2,000	$1,100 to $3,200	$1,700 to $4,000	$2,000 to $8,000	–	–	–	–	$520 to $1,470	$8,000 (basic)
Date of first delivery	January 1973	August 1972	October 1973	May 1971	January 1976	July 1973	October 1971	March 1973	December 1975	March 1975	1967
Number installed to date	36	500	300	300	2	–	Over 50	Over 60	–	10	67
Serviced by	Sorbus and third party	Memorex	Memorex	Memorex	Memorex	Microdata	Modcomp	Modcomp	Modcomp	Northfield	North American Philips
COMMENTS		Hard-wired replacement for IBM 2701, 2701, 2703 and 2906	Hard-wired replacement for IBM 2701, 2702, 2703 and 2906	Upgrade of D1A model and expansion from D4A and D5A models	SDLC in 4th quarter of 1976		Dedicated special-purpose CPU; custom configured	Front end or message switch; up to 16 programmable transmission rates; 4-port memory	Front end or message switch; up to 16 programmable transmission rates; 4-port memory	50,000 bps maximum throughput	

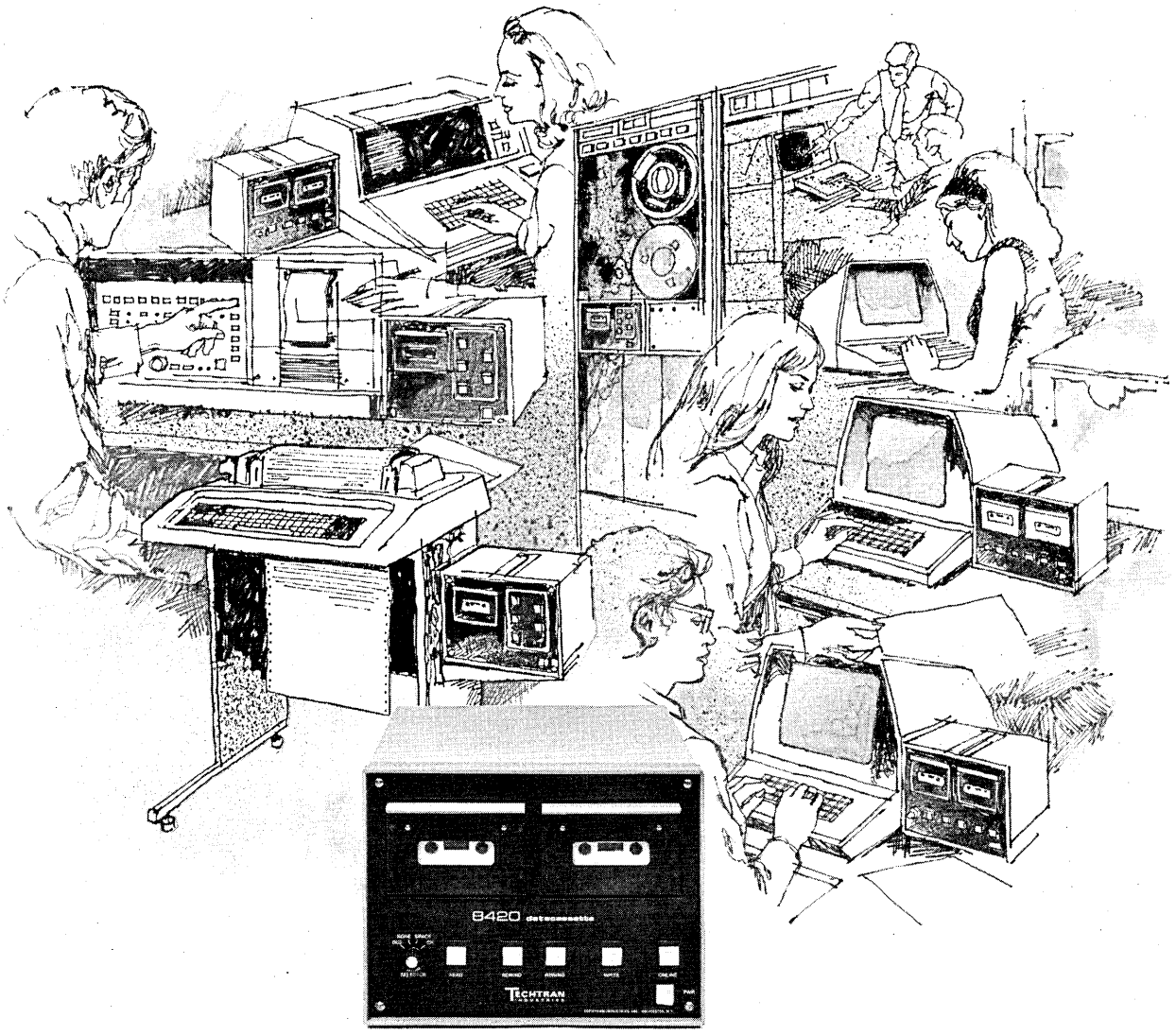
COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	North American Philips DS 18	North American Philips DS.7	Omnus Computer Corporation Omnus-1/CU	Periphonics T-Comm 7	RCA Global Communications Miniplus	Systems Engineering Laboratories SEL 32	Telefile Computer Products TCP-64	Telex 6705	Texas Instruments EMS II	Texas Instruments DXS	Texas Instruments Model 700 TPS
COMPUTER SYSTEMS INTERFACED											
Manufacturers and models interfaced	Custom	Custom	Univac 1100 Series	IBM/360, IBM/370, Burroughs (all), NCR, Honeywell, others	IBM/360, IBM/370 others	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370	IBM/360, IBM/370, DECsystem 10	IBM/360, IBM/370	IBM/360, IBM/370
Host computer comm. software:											
Used as is	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Altered	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Alterations provided	No	No	–	Yes	Yes	Yes	No	No	No	No	–
Replaced	No	No	No	Yes	No	No	Yes	No	No	No	–
Replacement provided	No	No	No	Yes	No	No	No	No	No	No	–
SUPPORTED APPLICATIONS											
Front-end processing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
IBM 270X emulation	RPQ	RPQ	No	Yes	No	Yes	Yes	Yes	No	Yes	No
IBM 370X emulation without NCP	RPQ	RPQ	No	Yes	No	Yes	Yes	Yes	No	Yes	No
IBM 370X emulation with NCP	RPQ	RPQ	No	Yes	No	Yes	No	No	No	–	No
Remote concentration	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	–
Message switching	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	–
Other supported applications	Telex/TWX/Gentex packet switching; process control	Telex/TWX/Gentex packet switching; process control	Store and forward; full network control	IBM 2803, 2848	–	Dedicated communications	RJE, HASP	Multiplexing, DDS, network management	None	EFTS, hospital accounting	–
COMM. LINES CONFIGURATION											
Maximum number of half-duplex lines	–	–	384	93	180	128	512	244	256	60 (FDX)	4
Narrow-band lines	375	512	384	93	180	128	512	244	256	44	–
Voice-band lines	60	60	384	93	16	–	112	244	6	16	4
Wide-band lines	–	4	16	5	4	–	80	–	8	–	–
Maximum number of lines active simultaneously	Varies	All	384	All	–	128	512	244	256	All	4
Effect of full-duplex operation	No effect	Reduces lines by half	No effect	No effect	No effect	–	No effect	Reduces lines by half	Reduces lines by half	No effect	–
PROCESSOR AND MEMORY											
Processor identity	Philips	Philips	Omnus-1	DEC PDP-11	General Automation SPC-16	SEL 32	Lockheed LEC 16	Own	TI 980B	TI 960B (multiple)	TI 960B
Word length, bits	16	16	16	16	16	32	16	16	16	16	16
Memory cycle time, microseconds	0.84	1.0	0.65	1.0	0.96	0.6	1.0	1.2	0.75	0.75	0.75
Memory capacity, bytes	64K	32K	32K to 262K	16K-2M (Peri-Pacs)	256K	1,024K	8K to 128K	128K	128K	128K	48K
Priority interrupt levels	64	1	32	8	–	128	16 to 64	4	3 to 64	1	3
On-line peripheral devices	Drum, fixed/moving-head disk; mag. tape cassette, line printer, paper tape	Drum, fixed/moving-head disk, mag. tape cassette, line printer, paper tape	Disk, drum, mag. tape, card reader, paper tape reader/punch	Disk, mag. tape, printer, cassette TTY	Disk, mag. tape, paper tape, CRT, teleprinters	Standard types	Drum, disk, mag. tape, card readers/punches, ppr. tape rdrs./punches, etc.	None	Disk, mag. tape, card reader, printer, console	Disk, mag. tape, card reader, printer, console	TI "Silent 700" terminal (742)
Console performance monitor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes (see below)	Yes	Yes	Yes
SOFTWARE											
Operating system	Yes	Yes	Yes	Yes (Peri-Comm)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Message control programs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Assembler	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cross assembler	No	Yes, DS 714	Yes, UNIVAC, IBM, Xerox, DEC	Yes, IBM 360/370	–	No	Yes; IBM/360, IBM/370	–	Yes; IBM/360, IBM/370	Yes; IBM/370	No
Terminal handlers	TTY/TWX; Telex; custom	TTY/TWX; Telex; custom	UNIVAC DCT 500/1000/2000, U 100, 1004; IBM 2741, 2780, TTY	CRT, teleprinter, banking, and POS devices, etc.	Most prominent	TTY, CRT, etc.	IBM 2740/2741/2260; TTY 28/33/35; BSC terminals	IBM I, II, III, BSC; TTY; 83/B3; HASP, 2740, 2780, 2260, 3270	TTY, TI 700, GE TermiNet, Wiltek, Dataspeed	TI 913/914 CRT, TI "Silent 700" data terminals	TI "Silent 700" data terminals
Software pricing	Standard, custom	Standard, custom	–	Optional	–	Standard and custom	Standard	–	Standard	Extra	Standard
Turnkey systems	Available	Available	Available	Available	Available	Available	Available	–	Available	Available	Available
PRICING AND AVAILABILITY											
Purchase price	$100,000 (basic)	$35,000 (basic)	$43,000 to $400,000	$80,000 (basic)	$70,000 to $200,000	$75,000 to $200,000	$40,000 to $200,000	$30,000 to $75,000	$60,000 to $300,000	$40,000 to $500,000	$37,800
Monthly rental	$2,000 (basic)	$1,000 (basic)	$2,500 to $100,000	$2,500 (basic)	$2,000 to $15,000	–	$1,500 (basic)	$900 to $2,500	–	$2,000 (Excl. Maint.)	$1,200 (inc. maint.)
Date of first delivery	1972	1974	June 1974	1st qtr. 1971	1972	October 1975	June 1969	October 1973	1973	1972	1976
Number installed to date	14	12	3	Over 200	17	12	15	40	–	–	–
Serviced by	North American Philips	North American Philips	Omnus	Periphonics	RCA	SEL	Telefile	Telex	Texas Instruments	Texas Instruments	Texas Instruments
COMMENTS			Replacement for Univac C/SP or CTMC	System can also include voice response module (Voicepac 2000)	Pricing is for single-processor system		Hard-wired controller (synchronous) has DMA and operates on data block basis	Console offers command and control, display, trace and alter		DXS stands for Data Exchange System	TPS stands for Terminal Polling System

COMMUNICATIONS PROCESSOR SURVEY

MANUFACTURER AND MODEL	UNIVAC C/SP	UNIVAC 3760	Varian Data Machines V 72	Varian Data Machines V 73/V 74	Varian Data Machines V 75	Varian Data Machines V 76	Western Union Information Systems C2100
COMPUTER SYSTEMS INTERFACED							
Manufacturers and models interfaced	UNIVAC 1106, 1108, 1110	IBM/360, IBM/370	IBM/360, IBM/370, CDC 3000/6000, Burroughs 300/3500	IBM/360, IBM/370, CDC 3000/6000, Burroughs 300/3500	IBM/360, IBM/370, CDC 3000/6000, Burroughs 300/3500	IBM/360, IBM/370, CDC 3000/6000, Burroughs 300/3500	Univac 1100, 490 Series, 418
Host computer comm. software:							
Used as is	Yes	Yes	Yes	Yes	Yes	Yes	No
Altered	No	No	No	No	No	No	Yes
Alterations provided	No	No	No	No	No	No	Yes
Replaced	No	No	No	No	No	No	No
Replacement provided	No	No	No	No	No	No	No
SUPPORTED APPLICATIONS							
Front-end processing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IBM 270X emulation	No	Yes	No	No	No	No	No
IBM 370X emulation without NCP	No	Yes	No	No	No	No	No
IBM 370X emulation with NCP	No	No	No	No	No	No	No
Remote concentration	Yes	No	Yes	Yes	Yes	Yes	Yes
Message switching	—	No	Yes	Yes	Yes	Yes	No
Other supported applications	—	Broadcast statistics; line testing	RJE, data base management, (TOTAL), TSS	RJE, data base, management, (TOTAL), TSS	RJE, data base management, (TOTAL), TSS	RJE, data base management, (TOTAL), TSS	Line multiplexing and demultiplexing
COMM. LINES CONFIGURATION							
Maximum number of half-duplex lines	128	384	512	512	512	512	256
Narrow-band lines	128	384	512	512	512	512	256
Voice-band lines	128	384	512	512	512	512	64
Wide-band lines	16	6	128	128	128	128	8
Maximum number of lines active simultaneously	128	384	512	512	512	512	256
Effect of full-duplex operation	Reduces lines by half	Reduces lines by half	No effect	No effect	No effect	No effect	No effect
PROCESSOR AND MEMORY							
Processor identity	UNIVAC	UNIVAC	Varian V 72	Varian V 73/V 74	Varian V 75	Varian V 76	Hard-wired/own microprocessor
Word length, bits	16	16	16	16	8, 16, 32	8, 16, 32	18
Memory cycle time, microseconds	0.63	0.75	0.66, .99	0.33, .66, .99	0.66	0.66	0.9
Memory capacity, bytes	32K to 131K	16K to 131K	512K	512K	512K	512K	16K
Priority interrupt levels	5	4	64	64	64	64	Scanner logic
On-line peripheral devices	Card reader/punch, printer, paper tape	None	Disk, mag. tape, card reader/punch, printer	Disk, mag. tape, card/reader/punch, printer	All common peripherals	All common peripherals	—
Console performance monitor	Optional	Yes	Yes	Yes	Yes	Yes	—
SOFTWARE							
Operating system	Yes	Yes	Yes	Yes	Yes	Yes	Firmware
Message control programs	Yes	Yes	Yes	Yes	Yes	Yes	—
Assembler	Yes	No	Yes	Yes	Yes	Yes	Yes
Cross assembler	Yes; UNIVAC 1100 Series	Yes; IBM/360, IBM/370	Yes; IBM/360, IBM/370	Yes; IBM/360, IBM/370	Yes; IBM/360, IBM/370	Yes; IBM/360, IBM/370	Yes; Univac 1100
Terminal handlers	All UNIVAC, all TTY, and all IBM BSC terminals	Most IBM terminals and all UNIVAC terminals	TTY and equiv., IBM 3270, BSC, common financial terminals	TTY and equiv., IBM 3270, BSC, common financial terminals	TTY and equiv., IBM 3270, BSC, common financial terminals	TTY and equiv., IBM 3270, BSC, common financial terminals	"All"
Software pricing	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Turnkey systems	No	Available	Available	Available	Available	Available	Available
PRICING AND AVAILABILITY							
Purchase price	$80,000 to $175,000	$55,000 to $325,000	$10,500 to $200,000	$10,000 to $300,000	$35,000 to $200,000	$8,000 to $200,000	$88,300 to $250,000
Monthly rental	$2,000 (basic)	$1,200 to $7,000	Lease plans available	Lease plans available	Lease plans available	Lease plans available	—
Date of first delivery	March 1972	January 1973	October 1973	October 1972	August 1975	March 1976	October 1973
Number installed to date	—	—	Over 250	Over 500	—	—	—
Serviced by	UNIVAC	UNIVAC	Varian	Varian	Varian	Varian	Univac
COMMENTS							Hard-wired controller with programmable line adapters

This data has been carefully collected and presented; however, the vendors are the final authorities for their products and services. Please contact them directly for additional information or clarification. For the convenience of the reader, we have provided a vendor index on page 164.



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Vendor Index

Further information on the products listed can also be obtained by circling the appropriate numbers on the reader service card bound into this issue.

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10300 N. Central Expressway, Dallas, TX 75231. (214) 750-3000
CIRCLE 220 ON READER CARD

American Systems Incorporated
123 Water Street, Watertown, MA 02172. (617) 923-1850
CIRCLE 221 ON READER CARD

Burroughs Corporation
Second Avenue at Burroughs, Detroit, Michigan 48232. (313) 972-7000
CIRCLE 222 ON READER CARD

Chi Corporation
11000 Cedar Avenue, Cleveland, OH 44106. (216) 229-6400
CIRCLE 223 ON READER CARD

Collins Radio Group
Rockwell International, Dallas, TX 75207. (214) 690-5000
CIRCLE 224 ON READER CARD

Computer Automation Inc.
18651 Von Karman Avenue, Irvine, CA 92664. (714) 833-8830
CIRCLE 225 ON READER CARD

Computer Communications, Inc.
2610 Columbia Street, Torrance, CA 90503. (213) 320-9101
CIRCLE 226 ON READER CARD

Computer Transmission Corporation (Tran)
2352 Utah Avenue, El Segundo, CA 90245. (213) 973-2222
CIRCLE 227 ON READER CARD

Comten
1950 W. County Road B-2, St. Paul, MN 55113. (612) 633-8130
CIRCLE 228 ON READER CARD

Control Data Corporation
Box O, Minneapolis, MN 55440. (612) 853-8100
CIRCLE 229 ON READER CARD

Data General Corporation
Southboro, MA 01772. (617) 485-9100
CIRCLE 230 ON READER CARD

Data Pathing Inc.
370 San Aleso Avenue, Sunnyvale, CA 94086. (408) 734-0100
CIRCLE 231 ON READER CARD

Digital Communications Associates, Inc.
135 Technology Park/Atlanta, Norcross, GA 30074. (404) 448-1400
CIRCLE 232 ON READER CARD

Digital Computer Controls Inc.
12 Industrial Road, Fairfield, NJ 07006. (201) 227-4861
CIRCLE 233 ON READER CARD

Digital Equipment Corporation
146 Main Street, Maynard, MA 01754. (617) 897-5111
CIRCLE 234 ON READER CARD

GSC Data Systems, Inc.
(formerly Wells TP Sciences, Inc.) 99 West Sheffield Avenue, Englewood, NJ 07631. (201) 569-7711
CIRCLE 235 ON READER CARD

GTE Information Systems, Inc.
5300 E. La Palma Avenue, Anaheim, CA 92807. (714) 524-4431
CIRCLE 236 ON READER CARD

Harris Corp., Data Communications Division
11262 Indian Trail, P.O. Box 44076, Dallas, TX 75234. (214) 620-4400
CIRCLE 237 ON READER CARD

Hewlett-Packard Company
1501 Page Mill Road, Palo Alto, CA 94304. (415) 493-1501
CIRCLE 238 ON READER CARD

Honeywell Information Systems, Inc.
200 Smith Street, Waltham, MA 02154. (617) 890-8400
CIRCLE 239 ON READER CARD

IBM Corporation
Data Processing Division, 1133 Westchester Avenue, White Plains, NY 10604. (914) 696-1900
CIRCLE 240 ON READER CARD

Intercomputer Corporation
2201 East University Drive, Phoenix, AZ 85034. (601) 267-7545
CIRCLE 241 ON READER CARD

Interdata, Inc.
2 Crescent Place, Oceanport, NJ 07757. (201) 229-4040
CIRCLE 242 ON READER CARD

Memorex Corporation
San Tomas at Central Expressway, Santa Clara, CA 95052. (408) 987-1000
CIRCLE 243 ON READER CARD

Modular Computer Systems
1650 W. McNab Road, Fort Lauderdale, FL 33309. (305) 974-1380
CIRCLE 244 ON READER CARD

Norfield Electronics, Inc.
3 Depot Place, East Norwalk, CT 06855. (203) 853-2777
CIRCLE 245 ON READER CARD

North American Philips Communications Corp.
91 McKee Drive, Mahwah, NJ 07430. (201) 529-3800
CIRCLE 246 ON READER CARD

Omnus Computer Corporation
1538 E. Chestnut Street, Suite E. Santa Ana, CA 92701. (714) 547-8444
CIRCLE 247 ON READER CARD

Periphonics Corporation
75 Orville Drive, Bohemia, NY 11716. (516) 567-1000
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SURVEY—vendor index

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Telefile Computer Products Incorporated
17131 Daimier St., Irvine, CA 92705. (714) 557-6660
CIRCLE 251 ON READER CARD

Telex Corporation
Box 1526, Tulsa, OK 74101. (918) 627-1111
CIRCLE 252 ON READER CARD

Texas Instruments, Inc.
P.O. Box 1444, Houston, TX 77001. (713) 494-5115
CIRCLE 253 ON READER CARD

UNIVAC (division of Sperry Rand Corporation)
P.O. Box 500, Blue Bell, PA 19422. (215) 542-4011
CIRCLE 254 ON READER CARD

Varian Data Machines
2722 Michelson Drive, Irvine, CA 92806. (714) 833-2400
CIRCLE 255 ON READER CARD

Western Union Information Systems, Inc.
82 McKee Drive, Mahwah, NJ 07430. (201) 529-4600
CIRCLE 256 ON READER CARD ❋

SURVEY

(Continued from page 154)

switching, it is likely that it can be adapted to other uses with the addition of some hardware interface units and specialized software packages.)

Communications lines configuration. This entry summarizes the communications line handling capacity of each processor. These figures are at best meant to serve as general guidelines, since a specifically tailored processor system may be able to handle considerably fewer lines than the listed maximums.

Processor and memory. Note that main memory capacity can directly affect overall performance; the larger the main memory, the more and larger data buffers can be allocated, and the more software processing routines can be resident and instantly accessible in main memory.

The number of priority interrupt levels is listed to indicate how the processor's hardware can assist in line control operations.

The charts also list whether or not the processors include console performance monitors. These devices may be a panel of lights and switches, crt display units, simple teleprinters, or highly specialized units. But in any case, depending on how comprehensive the software programs that support them are, they can provide the

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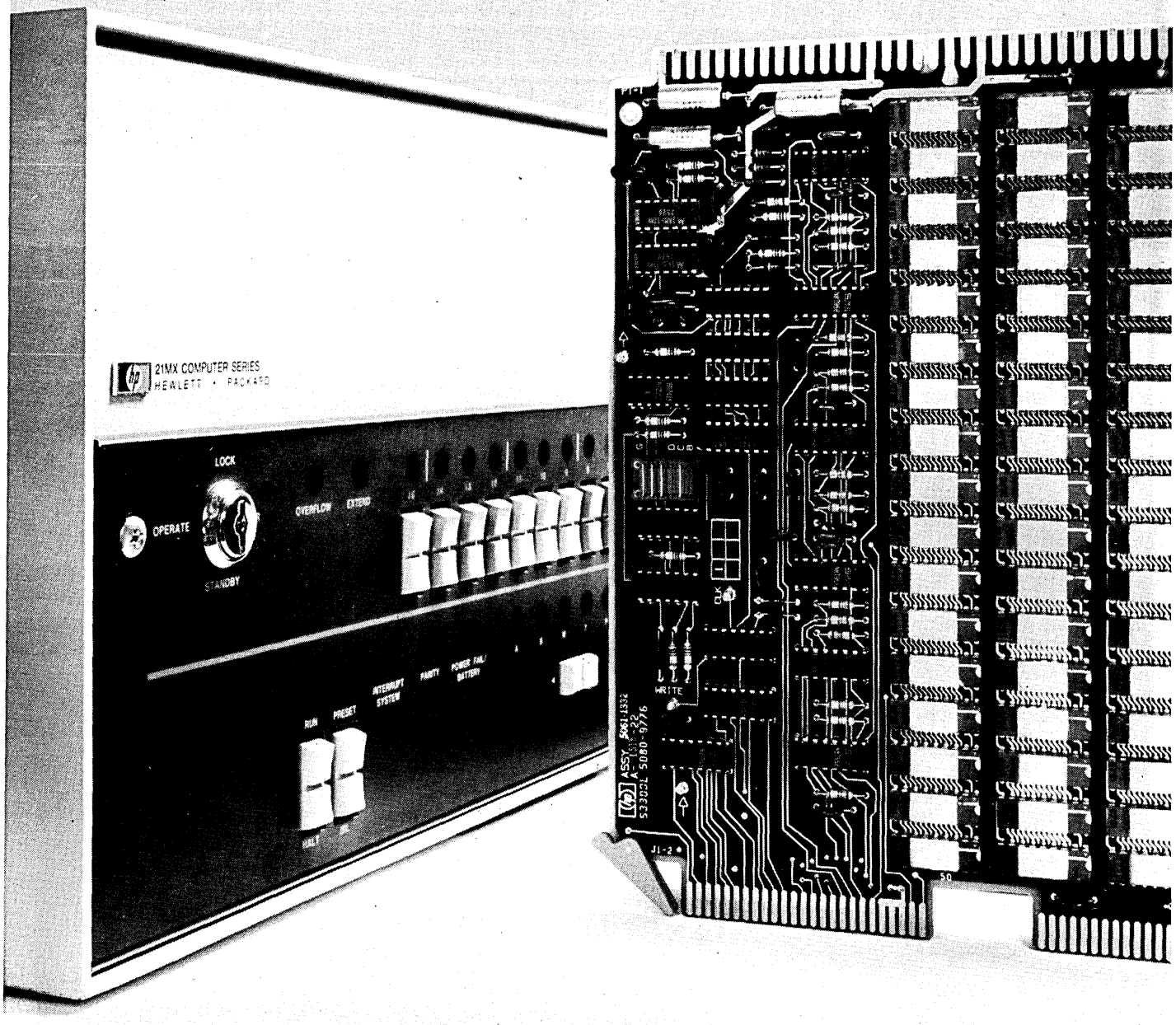
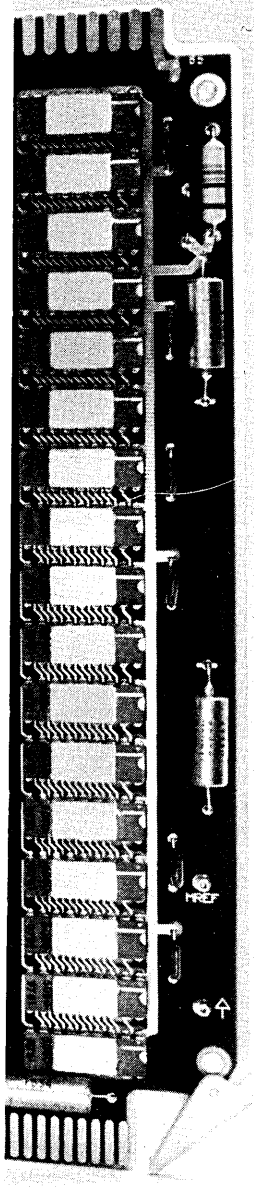
The Hewlett-Packard 21MX minicomputer sets a new price/performance standard.



Announcing 16K word memory with parity for $1386.*



Because the majority of a minicomputer's cost is its memory, the $1386 price for HP's new 16K word parity memory module is a significant price/performance breakthrough. And when you consider the low-cost memory along with the other features of the 21MX, it's a combination that's hard to beat. At any price.

Proven 4K RAM Reliability. Hewlett-Packard pioneered minicomputers with 4K RAM memory. Our unequalled field experience with more than 250,000 4K RAMS has proven their reliability. Solidly.

Doubled Memory Capacity. Now pack double the memory into your dynamic 21MX minicomputer. Put up to 32K words in 5¼" of space, or up to 128K in 13", without giving up a single powered I/O slot.

21MX Performance Extras. Each HP 21MX gives you more of what you buy a minicomputer for. Standard features that often are extra-cost options from others include floating point and extended arithmetic, brownout-proof power supply, ROM bootstrap loader, power-fail interrupt capability, and a full front display panel.

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We're Shipping Now. The 21MX minicomputer family with the new 16K memory board is available and being shipped today.

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	16K Add On Parity Memory	Computer† with 64K Word Memory
HP 21MX	$1386.*	$11,038.*
DEC 11/34	$2046.*	$12,995.*
Nova 3/12	$2368.*	$14,528.*

†Includes CPU, parity memory, memory management, EAU and battery backup. Source: Datapro
*U.S. domestic price. OEM quantity 50.

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system operator with immediate access to the status of all lines and can provide statistics on the performance of the network.

Software. This entry shows what levels of software are provided with the processor, in addition to the specific supported applications discussed above, and also whether the software is supplied along with the hardware ("standard") or is priced separately ("optional").

Note that the entries also list whether or not the processor comes equipped with an assembler so that the user can write and modify control and processing routines as required during the installation lifetime of the processor.

Pricing and availability. The charts list the purchase and monthly rental prices for each processor. In many cases, price ranges are listed, indicating that actual prices in specific situations will be determined by such items as number and type of lines controlled, amount of main memory selected, number and type of on-line peripheral devices selected, and number and extent of software functions desired. As mentioned earlier, it can be extremely dangerous to casually compare the prices of two apparently similar programmable processors without knowing precisely what is included. The charts can at best serve as rough guidelines on the relative pricing of these processors.

The suppliers of these processors were asked to provide two other significant items of information: date of first delivery (actual or expected) and number of processors installed to date. In most cases, they provided this information; those that declined are clearly indicated. ❄

Mr. Totaro is vice president of marketing for Datapro Research Corp. His 14 years experience in the computer field includes a term as manager of product analysis for Univac, and one with Burroughs, where he was responsible for assisting customers in a three-state area install computer systems.

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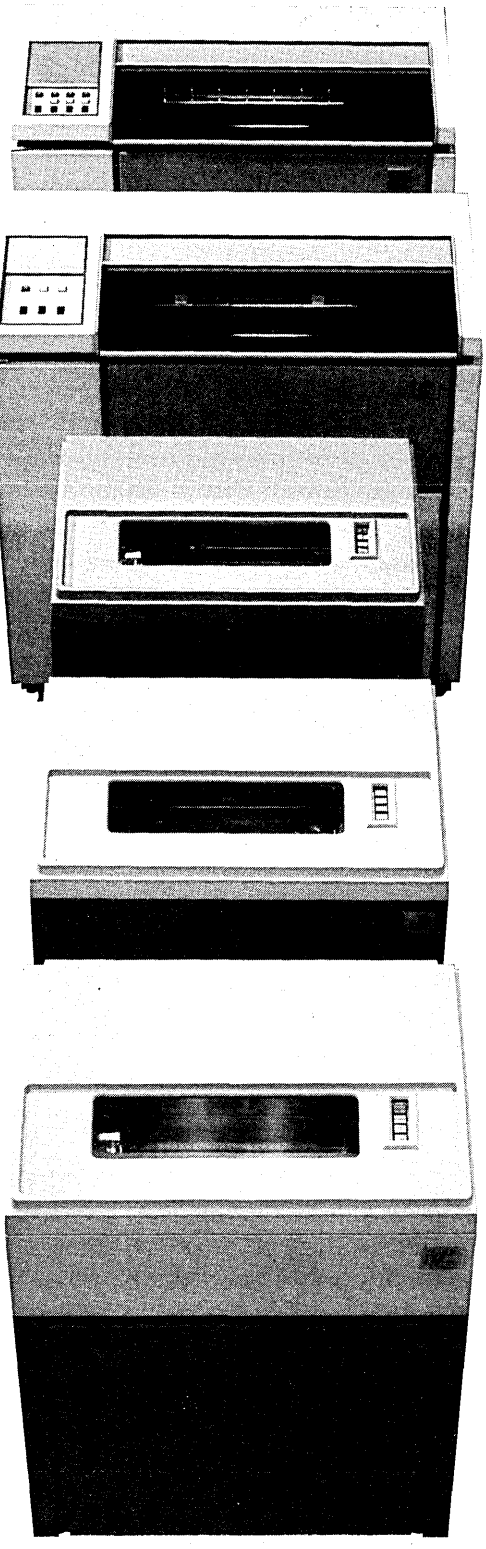

If you're coming to the National Computer Conference in New York to check out the premier line printers and core memory systems, simply stop at booth 1329.

And you won't have to read this ad.

But if you can't make the NCC this year, there are two salient facts to keep in mind:

1. Dataproducts is the world's leading independent line printer manufacturer;

2. Dataproducts delivered more core memory systems last year than anyone in the field.

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Our newest printer (and the newest member of the acclaimed 2200 series family) is the 900-LPM model 2290.

Its initial cost is an inflation-fighter, and it operates economically at 9600 baud and up.

The 2290 features include our patented system for automatic detection of lack of paper movement; a 90° swing-open gate for fast ribbon and paper loading; an adjustable paper stacker; an optional direct-access vertical format unit (which eliminates paper tape) to allow printing of new formats direct from CPU. Plus complete interface compatibility and a high degree of component commonality with the rest of the family: the 2230 (300 LPM) and the 2260 (600 LPM).

PRINTER COMPONENTS

Dataproducts is now making available the

STOPPERS BOOTH 1329

patented Charaband® horizontal-font carrier (featured in our highest speed printer) and the patented Mark IV hammer bank, the key element in all our line printers.

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ARMS-9 is a special, ruggedized 16K system designed specifically for military use.

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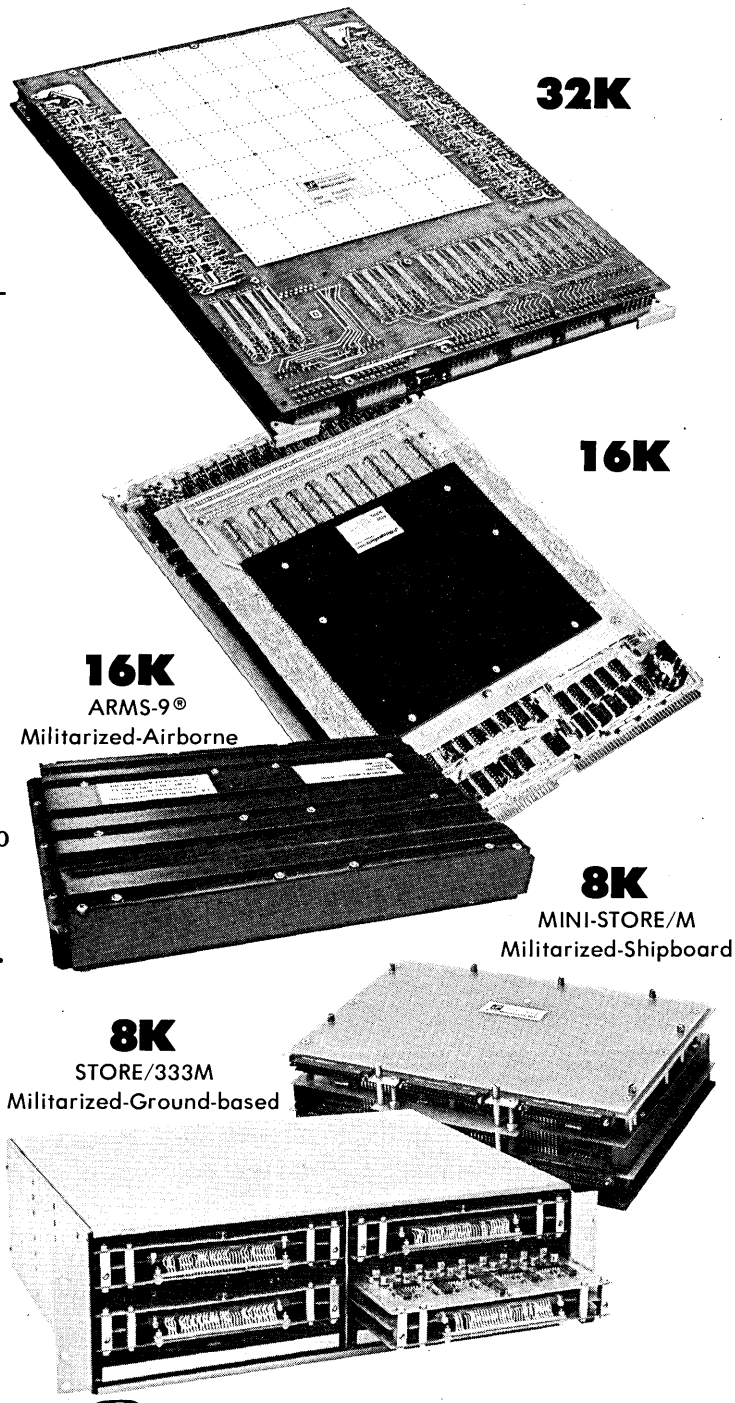

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(Continued from page 49)

tionships that must be considered when designing a microprocessor-based digital system. Price: $49.95 (quantity prices available). CREATIVE COMPUTER, 1901 Old Middlefield Way, Mountain View, Calif. 94043.

Datapro Seminar Series

Several 3-day seminars of interest to managers include *Data Base Management Systems: Administration and Control* to be held in New York City (May 26-28), Washington, D. C. (June 2-4), Chicago (June 16-18), and San Francisco (June 28-30). Another seminar is *Data Communications: Advanced Concepts and Systems* to be held in Chicago (May 26-28), New York (June 2-4), San Francisco (June 21-23), and Washington (June 28-30). Others are *Small Computers in Distributed Systems* in San Francisco (June 2-4) and Washington (June 21-23) and *Word Processing: An Appraisal for Management* in Washington (June 2-4) and San Francisco (June 7-9). These seminars are also available for in-house instruction. Price: $425. DATAPRO RESEARCH CORP., 1805 Underwood Blvd., Delran, N. J. 08075.

Data Base Technology

A 5-day course on data base technology and its practical implementation includes Ian Palmer, author of *Data Base Systems: A Practical Reference* and *Data Base Management*, as principal instructor. The first day is a special one-day session for managers, which is followed by an intensive four-day course. It will be held in Hamilton, Bermuda (June 7-11), Toronto (June 14-18), and Washington (July 19-23 and Aug. 23-27). Price: $595 ($150 for special one-day course; $495 for four-day course). CACI, INC., 75 Rockefeller Plaza, New York, N. Y. 10019.

Course Series

Another entrant into the dp education market is Q.E.D. Information Sciences, Inc., which has scheduled several courses. *Future Shock in DP Management* is to be held in Washington (May 24-25), Chicago (June 23-24), and San Francisco (July 19-20). *Structured Design* is scheduled for Washington (June 14-15), Chicago (July 12-13), and San Francisco (Aug. 9-10); *Data Base Principles and Practices*, Washington (June 2-3), San Francisco (June 23-24), and New York (July 21-22). Other courses are *Structured Programming, Designing the Data Base: A Workshop, Application Systems Design in a Data Base Environment*, and *Advanced Systems*

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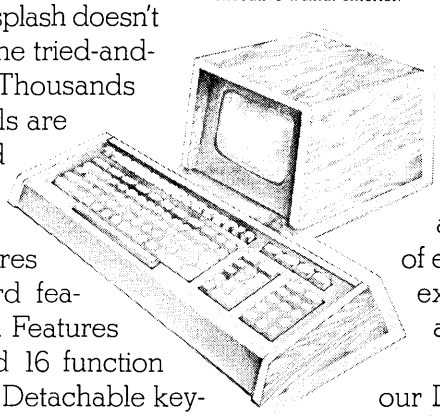

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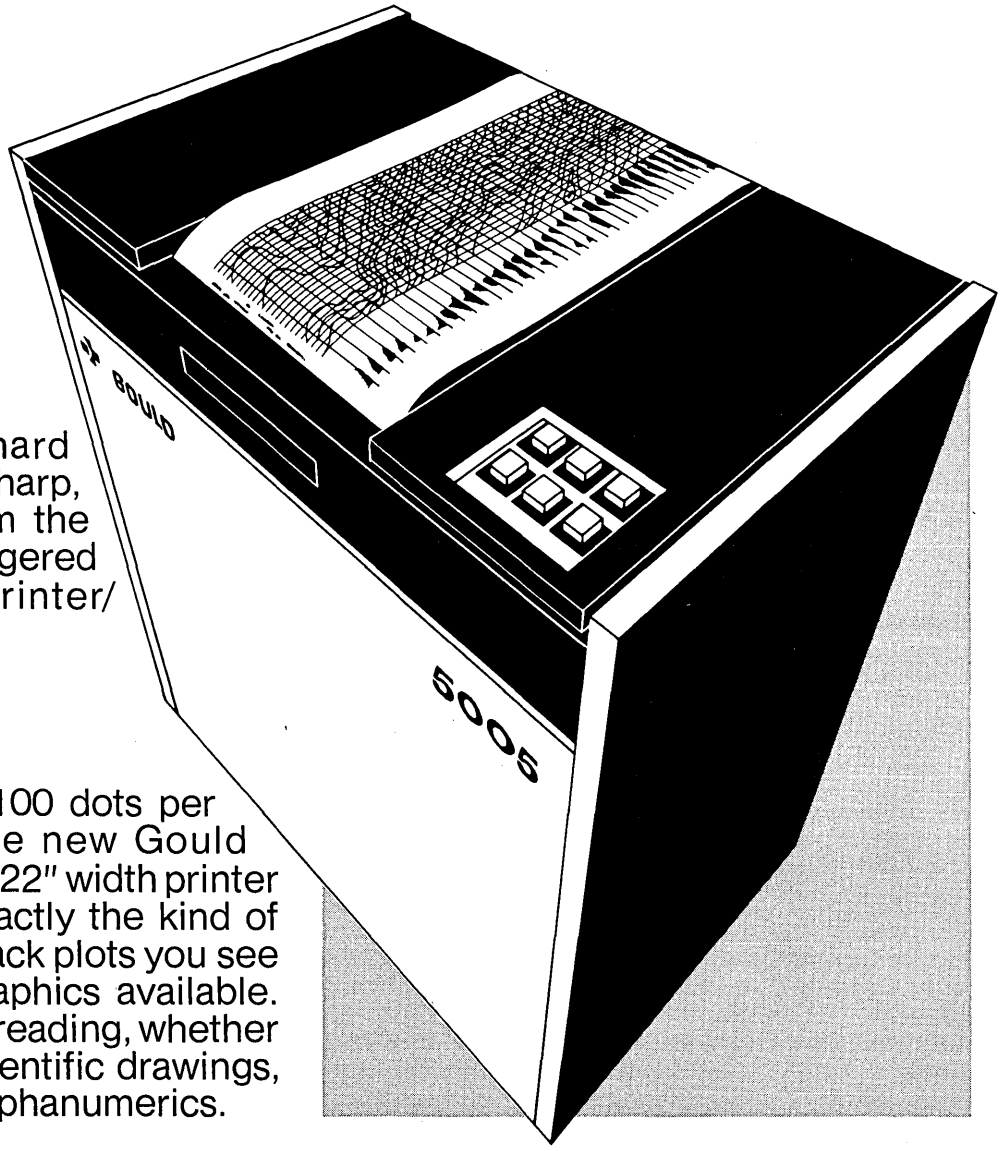

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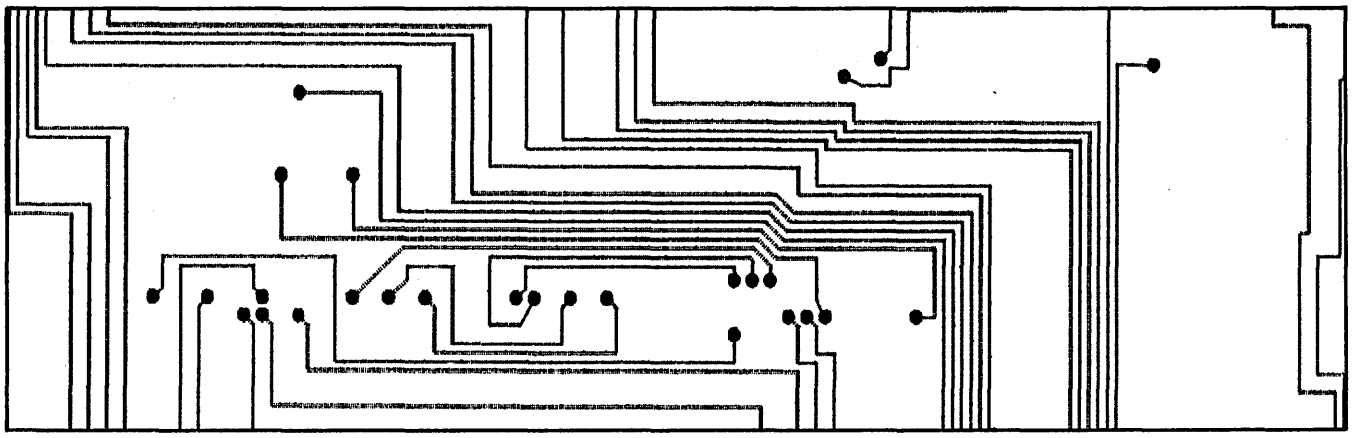

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Programming: The Key to Increased Productivity. Prices: 2-day course, $275; 3-day course, $400; 4-day course, $525 (discounts available if more than one course is taken). Q.E.D. INFORMATION SCIENCES, INC., P.O. Box 181, 141 Linden St., Wellesley, Mass. 02181.

periodicals

Data Base Systems

An ACM quarterly, *Transactions on Database Systems*, begins publication this spring. Its aim, according to editor-in-chief David K. Hsiao of Ohio State Univ., is "to serve as a focal point for an integrated dissemination of database research and development on storage and processor hardware, system software, applications, information science, information analysis, and file management."

The first issue contains selected papers from the International Conference on Very Large Data Bases held in Framingham, Mass. on Sept. 22-24, 1975. "The Entity-Relationship Model —Toward a Unified View of Data" by Peter Pin-Shan Chen, "A Database Management Facility for Automatic Generation of Database Managers" by David W. Stemple, and "Optimal Allocation of Resources in Distributed Information Networks" by S. Mahmoud and J. S. Riordon are among the articles. Subscription: $40/yr. ($15/yr. for ACM members). Single copies: $15 ($8, ACM members). ASSOCIATION FOR COMPUTING MACHINERY, P. O. Box 12105, Church St. Station, New York, N.Y. 10249.

Codasyl COBOL Journal

The 1976 edition of the *CODASYL COBOL Journal of Development* contains all approved Codasyl COBOL specifications as of Jan. 1, 1976. In addition it contains the most recent version of the COBOL Data Manipulation Language specifications. The 584-page journal may be purchased alone (at $7.50) or as part of a subscription service which includes the journal in loose-leaf form, plus all subsequent sets of page changes as authorized by the Programming Language Committee (PLC) during 1976. Subscription: $20 (checks to be made payable to "The Receiver General of Canada"). Dept. of Supply & Services, MATERIEL DATA MANAGEMENT BRANCH, 5th Floor, 88 Metcalfe St., Ottawa, Ontario, Canada K1A OS5. ❋

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Privacy

Costs, Codes, People And the Constitution

Those Who Cope with Privacy Laws Talk it Over in Phoenix Symposium

The word privacy doesn't appear in the Constitution. This fact comes up in just about every discussion of the morass that is the draft privacy legislation floating around in all legislative bodies at all levels–from federal to townships.

At a Honeywell Information Systems sponsored symposium on Computer Security and Privacy in Phoenix last month, Harry Robinson, vice president of electronic installations for Metropolitan Life Insurance Co. said most of the draft legislation "assures rights for the individual far beyond the Constitution." There was a consensus at the symposium that most of the draft legislation is too general.

HARRY ROBINSON
". . . beyond the Constitution"

Phoenix attorney Ronald Meyer, a teacher of constitutional law, believes that the Constitution does guarantee the right to individual privacy under two amendments which probably are more general than much of the draft legislation that is the subject of so much concern in the data processing community.

The two amendments are–

9. The enumeration in the Constitution of certain rights, shall not be construed to deny or disparage others retained by the people.

10. The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the states respectively, or to the people.

Meyer predicts that the Supreme Court, final arbiter of all laws as they reflect the intent of the Constitution, will look to these two amendments when it inevitably is called upon to weigh an individual's right to privacy against business' need for information, and will restrict the collection, retention and dissemination of personal information and will uphold laws that protect the right to privacy.

EDWARD J. BRENNAN, JR.
". . . motherhood and apple pie"

Speakers at the Honeywell symposium were in agreement that restrictions are coming and that this is a likely year.

"It's a motherhood and apple pie issue and this is a major election year," said Edward J. Brennan, Jr., vice president and general manager of TRW Credit Data.

Symposium keynoter, C. W. (Clancy) Spangle, president, Honeywell Information Systems, said the privacy issue "has a liberty bell ring to it." Spangle defended the computer as "a tool that can be used for the protection of privacy."

The mysterious art

"You can't deny the fact that a danger to individual privacy exists," said the HIS president. "And there is a widespread fear of computer technology as a mysterious art but the computer isn't the heavy, it's a passive instrument. It can forget and forgive, which man can't."

C. W. SPANGLE
". . . a liberty bell ring"

Spangle called the computer "the only true economical answer" to protect privacy. "Computer manufacturers do recognize their responsibilities."

Just what these responsibilities and those of the collectors, retainers and disseminators of personal information are was far less clear at the end of the sym-

posium than was the inevitability of restrictive legislation.

There were horror stories to illustrate both the need for restrictions and possible dangers of too much too fast.

Meyer told of an experience he'd had in late 1971 when, as a member of the county attorney's office for Maricopa county (Arizona) he was helping to set up a system for skip-tracing–collection of delinquent bills. He attended a meeting of the California County Collection Assn. where he saw a demonstration in which a social security number was entered into a crt terminal and back came an individual's name, present and past address, and a pretty complete personal history.

On the other side of the coin, TRW's Brennan said "a number of bills around would literally put us out of business overnight." He said the one time notice requirement of some (a requirement that maintainers of files containing personal information must notify the subjects) "would cost us 20 percent more than our gross revenues."

Eliminate the link?

He also worried about proposals to curtail or limit the use of social security numbers or other universal identification numbers. At TRW Credit Data, he said, such i.d. numbers are used to organize files, match data, and assure accuracy. "The fear is that the i.d. numbers will be used to link data bases together. Why not just prohibit the linking together of unrelated data bases?"

Metropolitan's Robinson said much of the draft privacy legislation existing would "increase insurance costs for the honest insurance customer." The insurance industry, he said, "takes big risks for small premiums and needs information–personal information–to price the risk. The insurance industry obtains and has more information on policy holders than other businesses have on their customers. This assures that an individual insurance purchaser pays only his fair share."

Robinson worries that allowing policy holders access to information an insurance company has about them could, "over and above the expense to the company," be dangerous. "Medical information is not excepted and this is, by nature, technical and not readily comprehensible. It could confuse and lead to anxiety on the part of the patient. It could have a devastating effect. Doctors could become reluctant to give us information."

Robinson believes that much of the proposed privacy legislation "would appear to give individuals the ability to harass business generally." He said the insurance industry's Life Office Management Assn. has established a joint task force on privacy to "oppose all federal and state legislative efforts until the Privacy Commission report is public."

Probe of TRW

TRW's Brennan, whose company is the subject of an FBI probe of an alleged scheme to doctor credit records, would like to see one kind of legislation passed soon. "We need stiffer laws for those who would intentionally misuse data bases." He feels this is "the only way to protect individuals' privacy ... that there is a tendency to leniency in the courts in fraud and conspiracy cases and an attitude of who was hurt, just a few big businesses?"

In the TRW case under investigation, the supposed victims were banks, credit card companies, oil companies and the like who granted credit on the basis of falsified records. A TRW employee was reported to have been involved.

Brennan and others criticized the broad nature of much of the proposed privacy legislation. "American business," Brennan said, "is just too complex to be legislated by broad generalizations."

The concern about broad generalizations centers on omnibus type legislation. At least one speaker, Metropolitan's Robinson, said he didn't think omnibus legislation is inevitable. He said it is business' responsibility to alert government to the financial problems to business that omnibus legislation would create.

Bad news?

Dr. Robert Goldstein, University of British Columbia, said he had come to the symposium prepared to "suggest bad news in scope (of legislation to come)." He had felt that legislation drawn along industry lines or by type of information was not too likely but, "since I've been in Phoenix I'm not so sure."

He wasn't unsure either. "What worries me is applications could tie up legislators for a long time. There would be problems deciding which law would be applicable in which context. We probably will get an omnibus bill."

Goldstein has developed a model for costing out privacy compliance based on provisions of the Privacy Act of 1974 (October '75, p. 65), an omnibus bill applying to personal data systems operated by federal agencies.

This model came in for some criticism from Robinson of Metropolitan. "We tried to use Goldstein's model," he said. It didn't work. "The model assumes all systems are automated. In our company the number of manual systems is greater and computing the cost of compliance for manual systems is a bigger factor than for automated systems."

He said he believed the model could be used to advantage by small companies with a single electronic system.

"In considering costs of revising forms and scratching forms it (the model) assumes one person is responsible for all forms. In our company it is many people. He felt the model's biggest drawback for large companies is "it doesn't cost out changes in traditional business practices." He sees a potential danger in wide distribution of the model in that it could lead to "cost figures lower than are realistic and could refute industry's stand that cost figures are almost impossible to get."

A Language for Security

A new programming language came into the public domain late last month which is expected to see widespread use in applications requiring a high degree of security.

Called Euclid after the Greek geometrician, it was developed by a five-man team with a common interest in verifiability of software. Team coordinator, Gerald Popek of UCLA, said verifiability was the goal of the development effort. He sees the biggest use of the language coming in secure systems.

Popek said he was approached by the Advanced Research Projects Agency (ARPA) to "pursue the notion" of a verifiable language. "This provided the impetus," he said, "but a lot of the why had to do with the common interest of the team members."

In addition to Popek they were Butler Lampson and Jim Mitchell, Xerox Palo Alto Research Center; James Horning, Univ. of Toronto; and Ralph London, Univ. of Southern California, Information Sciences Institute. London has done a considerable amount of work in the penetration of operating systems.

Popek said the development took two months and a minimal investment for travel. "We weren't trying to develop a new piece of research but to consolidate existing knowledge into one coherent language."

He said they made considerable use of the principles of Pascal, a programming language developed some five years ago by Nicholas Wirth, for people attempting to write software for purposes requiring a high degree of reliability. He described Pascal as "simple and clean in design structure."

The language definition was published April 21 and copies are circulating on a limited basis. "We are asking for comments," Popek said. "We will take these comments into account and possibly make adjustments based on them." He said a final draft probably would be published by the end of this month. ✲

Goldstein told of two large organizations which maintained access usage logs which would comply with Privacy Act requirements and found systems overhead ranged from 5 to 7% which is "roughly in line with my model." He later identified the two as a state government computing center and IBM's Advanced Administration System."

Change assumptions

He admitted in a question and answer session that there is "very little" business experience to support making cost projections. As for the assumptions in his model, he said, "If it is felt that the assumptions are bad you can change them and then compute numbers when assumptions change."

Goldstein offered what he called "some good news" on the timing issue. "There probably will be no federal legislation until the Privacy Commission has made its report and that's 15 months away. There will be discussion after that so we have a couple of years breathing space. But we can't sit back and not do anything for two years. This time should be used in getting ready for legislation in systems design activities."

Which is a large subject unto itself. It was generally agreed that 90% of protecting the integrity of a computerized personal information system involves people. For the 10%—the security of the hardware and the software—it was agreed 100% protection is impossible but steps are being taken to approach this.

Spangle said "Honeywell was interested in computer security long before it became popular." He said, "There has been more security testing done on Multics (Honeywell's Multiplexed Information and Computing Service) than on any other computer system in existence, yet it can be broken. I don't believe it is possible to create a system so secure that no one in the world could break it."

Peter S. Browne, General Electric Co., speaking on secure time-sharing systems agreed "there is no such thing as 100% security." He admonished hardware vendors. "You've failed us." He was particularly critical of existing operating systems. "Most of us (time-sharing services) have had to modify or rewrite operating systems with security as a design objective."

Security, said Browne, "is becoming of primary importance in the competitive scheme. Awareness of security is growing. Customers are reluctant to put sensitive data on a system not under their control. They are demanding security requirements. Their specifications are including these requirements."

Dr. Peter Neumann of Stanford Research Institute shares Browne's opinion of operating systems. "Most operating systems resemble Swiss cheese and the holes are connected."

He feels there must be some way to be able to certify and verify the security

DR. PETER NEUMANN
"like Swiss cheese"

properties of a system. "Multics today presents the only claim to being secure and it is notably a system for bigger computers. It is not in anyway portable and there is no description of the system except for the code itself and it is impossible to verify that code."

Neumann said Honeywell and the Air Force are modifying Multics. He hoped that Multics would be fixed by: a re-do of the existing design, a re-do of the existing language ("PL/1 is not suited to providing corrections"); and a re-do of existing implementations ("define exactly what each function is supposed to do").

Verification is feasible

"Verification is becoming feasible," said Neumann. "In the next four to five years it will be possible to demonstrate feasibility. The costs of verification are coming down." He spoke of a new programming language, Euclid (see related story) as promising for security applications.

Neumann was particularly concerned about the security of Electronic Funds Transfer Systems (EFTS). "The Mafia could have its own computer and the most serious penetration studies are not going to give you much peace of mind. Considering the excessive cost of being cheated, verification seems cheap."

Clark Weissman, manager, systems security department, System Development Corp., advocated an EFTS security policy which would include: positive user and transaction identification; theft proof identification; and restrictions of transactions as a function of time ("a customer with a money card and a $100 limit couldn't access one terminal for $100 and ten minutes later access another of the same amount.") He also advocates use of the National Bureau of Standards encryption algorithm in a network cryptographic device in EFTS systems.

Stephen Kohn, Ernst & Ernst, was disturbed because "security and auditing are not considered significant in EFTS relationships." He noted that an EFTS report done by A. D. Little for the American Bankers Assn. contained only one line on security.

Another auditor, John Nuxall, a partner in Peat, Marwick & Mitchell, was more encouraged. He noted that his company had been called in by Savings Association Central Corp., a consortium of Southern California Savings & Loans, to look over design specifications of an EFTS network it is proposing, before implementation.

The Privacy Act of 1974 so far is the only major piece of privacy legislation in effect and there seems to be considerable confusion as to how to comply with it. The Office of Management and Budget has published guidelines but Goldstein said, "it is not at all clear to me that complying with OMB guidelines is complying with the Privacy Act."

The General Services Administration recently sent a memorandum to all federal agencies stating: "Agencies are specifically advised that the FTS (Federal Telecommunications System) normally does not have security features to protect against either loss of, errors in, or interception of information. Therefore, the security and confidentiality of information transmitted over the FTS is not ensured."

The Privacy Act of 1974 requires federal offices to establish technical and physical safeguards to ensure the security and confidentiality of records and to protect against hazards to their security that could result in harm or embarrassment to individuals. The GSA memo urges "employees responsible for design, development, operation, or maintenance of such systems" to "appropriately consider the security capabilities of the EFTS."

And back at Health Education and Welfare (HEW) whose report "Records, Computers, and the Rights of Citizens" (September '73, p. 112) is the basis for much of the draft privacy legislation kicking around, employees are being advised "It is up to you to decide what data is to be made secure and it is up to you to take the steps necessary to make it secure when it is outside the main DMC (HEW's Data Management Center) computer area." HEW recommends use of the Bell Labs-developed Safegard encryption routines.

—Edith Myers

Control Data's Education Offering: "Plato Would Have Enjoyed PLATO"

"This is the biggest thing since the beginning. Did you hear Bob Morris say that? This is the biggest thing since the beginning of computers," enthused a newspaper reporter at a New York press conference where Control Data Corp. announced the commercial offering of PLATO (Programmed Learning and Teaching Operation). The computer-based education (CBE) system developed at the Univ. of Illinois over the last 17 years now is officially a CDC product and service for business, government and education.

Reporters wandered for hours from terminal to terminal at the mid-April affair, watching demonstrations of courses on English, Russian, chemistry, genetics, accounting. Frogs jumped, flies multiplied, and checkers moved across a board created on incredibly flexible plasma displays. Yesteryear promises of computer assisted instruction as the solution to staggering educational costs, illiteracy and poverty were reawakened. "The biggest thing since the beginning."

It certainly promises to be just that for CDC, if its own prognostications are correct. Robert Morris, CDC vice president in charge of CBE products and services, said the firm is betting much of its future on this market. In fact, he estimated that by 1985, PLATO-related revenue could account for 50% of CDC's business. Presumably it plans to capture a fair portion of the annual $20 billion business said to be involved in training for government, industry and "certain segments" of higher education.

Many educators are disappointed that CDC's announcement really emphasized industry and not education. They also wistfully recalled prognostications from the Univ. of Illinois that the per hour cost of PLATO would be down to $.50 to $1.00 an hour by now. CDC's offering is far from that. Courses taken in its "learning centers" will be $12-$15 an hour typically. Organizations renting PLATO terminals on-line to CDC's central facilities will also pay healthy rates. For example, for 64 terminals or more, users will pay $630 a month per terminal on a two-year lease and $1,150 a month on a one-year lease. Add line costs to that and yearly costs for that category start somewhere around $500,000. CDC says that purchasing a PLATO system will run around $5-$6 million.

High, but economical

Obviously, the cost is prohibitive for elementary and secondary education, as well as for many colleges and universities. But educators admit that the only way a system like PLATO can reach the development and economies of scale necessary to bring prices down is through mass marketing to people with the money. Employee time in training is a definable cost to a company; PLATO has shown time savings and learning improvement, so for many the cost will be justified. For example, the Federal Aviation Agency reports 30% savings in training time in its current tests of PLATO.

The situation for education is not hopeless. Robert Morris, who has long had an interest in social implications for computing, emphasized that no matter what the initial CDC thrust, his major interest is in bringing CBE to "children and the developing countries."

PROGRAMMED LEARNING AND TEACHING: System distributes instructional materials in the form of text, numbers, animated drawings and other graphics for individualized, self-paced learning.

CDC is projecting that PLATO will come down in cost sufficiently that it will be in "general use at all levels of education in six to eight years." This is based on current trends. Figures by the Dept. of Health Education and Welfare show that over the past 10 years traditional instruction costs "have been increasing at an average compounded rate of about 8.2% a year, and in the last three alone . . . at about 13%." Technologies for computer-based education are decreasing about 5% yearly, says CDC, coupled with a 10% increase in performance. What this means for future instruction rates is not clear, but one example is that the plasma display terminal—a key element in PLATO—should drop from its $9,000 price tag to $6,000 within five years.

CDC's plans for PLATO have been germinating for several years. It became the hardware supplier for the experiment in the late '50s with a 1604. Subsequently, the installation at Illinois grew to a 3600, then a 6000, and finally the current Cyber 73. Five years ago CDC set up its own education department, hired university professors who had been working on computer courseware, and ultimately began using PLATO for internal training.

Over the last two years it has been negotiating licensing, courseware royalties, and other agreements with the Univ. of Illinois. Its announcement last month came complete with installations, orders, established "learning centers," and future plans. In addition to the Cyber 73 center in Arden Hills, Minn., CDC will open East and West Coast facilities within a year. Too, its Brussels headquarters will be on-line to PLATO.

Home terminal

Commercial Credit Corp., CDC's big financial subsidiary, will be running the learning centers, offering management and accounting courses on the plasma terminals. Seven centers are open now, with many more planned across the country. Control Data Institute will increase its usage of PLATO for computer and other training courses in its schools. Control Data itself will market the terminals and complete systems. Magnavox and Owens Illinois currently manufacture the terminal, but CDC has a prototype of a 28-pound portable version it will manufacture. Within three years this terminal will be available for use in the home.

Morris projected that 500 terminals will be in use at learning centers and customer facilities by the end of 1976 and 1500-2000 by the end of '77. Also by '77, five computer systems will be installed at organizations and institutions.

In addition to the Univ. of Illinois, which started it all, Florida State Univ.

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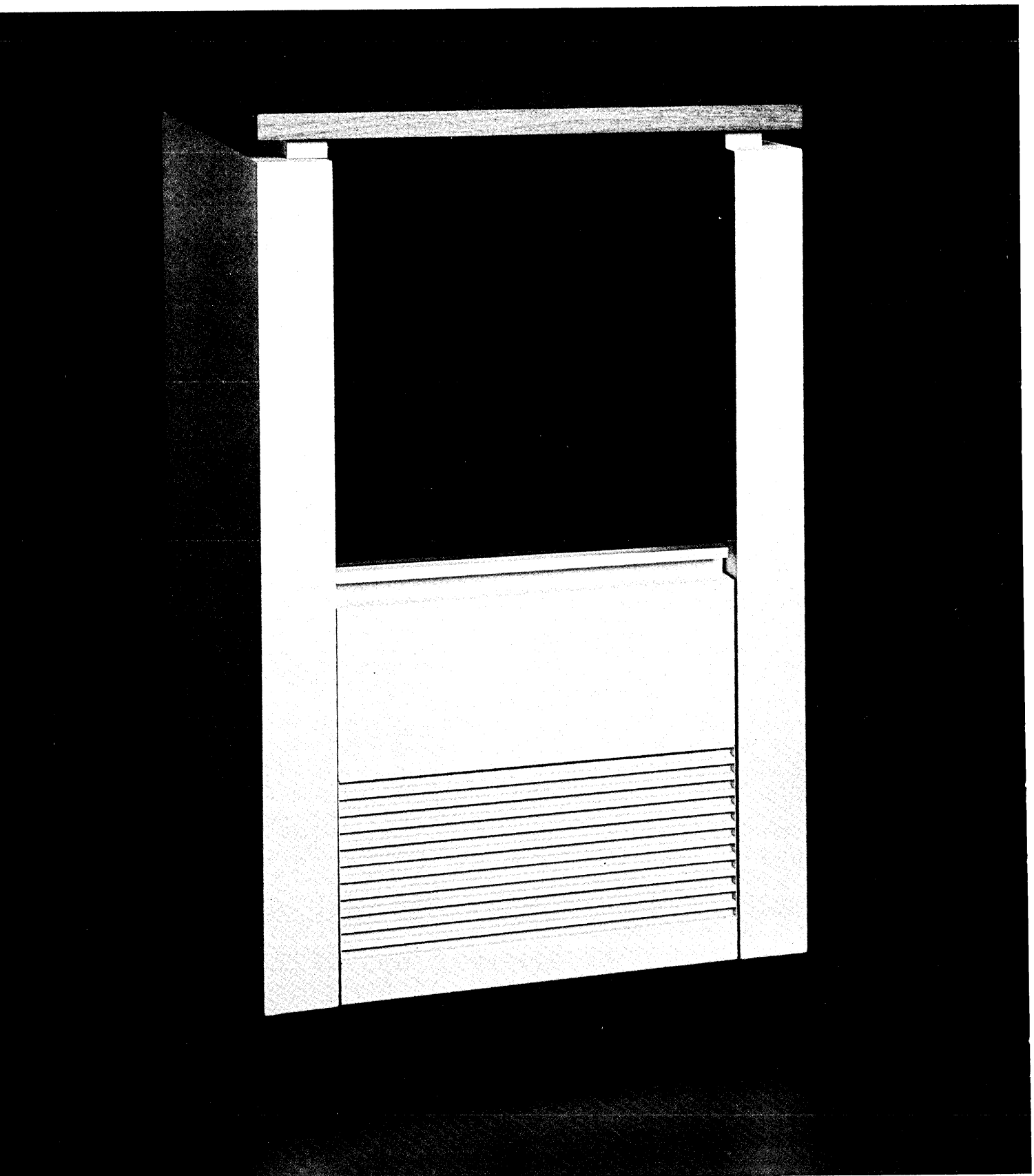

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The 4000-Plus series: a lot of plusses.

The one big minus? The Model 4000/15 timesharing system costs $35,950—representing a $20,000 reduction over the previous lowest-cost 4000. The bigger 4000/25 and 4000/35 systems are available at similar savings.

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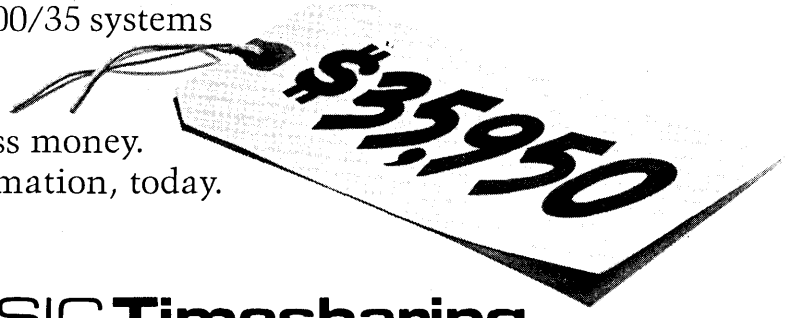

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has had its own facility in for more than 18 months. The first center outside the U.S. will be at the Univ. of Quebec in Canada. A Cyber 73 on the Quebec City campus will be owned and operated by CDC for the university and other customers. The arrangement is a double plus for CDC, since the university will develop courses in French that CDC will use for its expansion into international markets. CDC is also planning to work with Quebec on communications techniques, a major research effort at the school.

Additionally, CDC has experimental projects in remedial and secondary education. For example, terminals are being installed at the Minnesota Dept. of Corrections for remedial and vocational skills instruction.

Control Data already has several education efforts in developing and Eastern European countries. It has entered into a 10-year scientific cooperation agreement with the Soviet Union, which includes education technology. One source says that CDC demonstrated PLATO to a packed Russian audience a year or two ago and there was a lot of interest. It's believed the next day a Russian agency came back with an order for 500 terminals, but at the time there were manufacturing problems with the plasma display terminal and the U.S. backlog alone was enormous.

Agreement in Iran

One rather rich developing nation, Iran, has hopes of developing a nationwide PLATO system to help solve its huge manpower and literacy problems. CDC has signed an agreement there to manufacture plasma display terminals; while Iran intends to export this product, ultimately a large user will be the Iran educational network.

CDC readily admits the enormity of the task ahead on all levels. Many of the technological problems that have plagued computer-based education have been solved by PLATO and its new counterpart, the MITRE-developed TICCIT system. (TICCIT is based on two Nova 800s, so it is cheaper but more limited in the number of terminals and courses that can be handled at once.) The main barrier had to do with the limitations on student interaction due to available terminals.

The plasma display (see accompanying story) was a major breakthrough, invented by the Univ. of Illinois and brought to commercial reality by Magnavox and Owens. It is amazingly flexible, capable of providing animated graphics and handling a touch panel, microfiche projection, audio, and a host of other features in development. The TICCIT system uses a less expensive, but again more limited alternative —a Sony television with memory refresh, plus video tapes and a digitized audio disc.

Another problem for computer-based education has been the development of courses themselves. The educational system has been caught up in a vicious circle—wanting to see results before it invested, but needing investments to get results. Outside of Univ. of Illinois and a few other institutions, courseware development survived on small scattered grants, and even those dried up in the late 1960s. Then in 1972, the National Science Foundation took heed of advice and plowed $6 million into TICCIT and $10 million into PLATO.

The CDC effort should also help in course development, since it is paying royalties to authors whose courses it uses.

Shotgun approach

Quality is another issue—the art and science of systematizing teaching. The Univ. of Illinois, in order to involve large numbers of teachers and students in PLATO, has purposely used a shotgun

PLATO's Plasma Terminal Solves Student Interface Problem

Computer-based education, as conceived in PLATO, involves direct-instructional interaction and computer-managed instruction. The courses are designed so that the student is given any of a combination of lesson forms via the terminal: drill-and-practice, tutorial, inquiry, dialogue, simulation, computer games, and problem solving. Under computer-managed instruction, each student is guided through a curriculum along a learning path designed for him by the instructors and education administrators. Analysis of ongoing test results is used to prescribe subsequent learning activities.

Such flexibility is the result of several hardware and software developments. Perhaps the major hardware breakthrough was the invention by the Univ. of Illinois of the plasma display terminal. Its great flexibility in handling graphics and other media virtually solves the student interface problem. Another powerful tool is TUTOR, the author language developed at Illinois, which gives the teacher great leeway in constructing the myriad of lesson forms needed. At the central site, the use of extended core storage as the swapping medium achieved the CDC breakthrough in handling large numbers of terminals at minimum response time. Its transfer rate is 100 times that of disc or drum memories: 10 million 60-bit words a second.

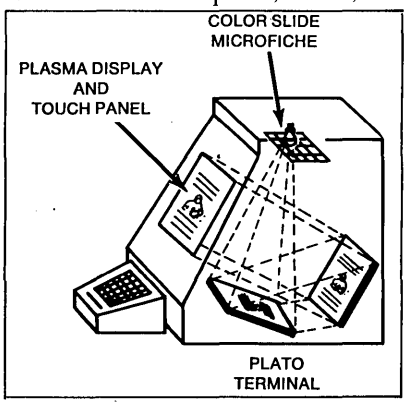
PLATO, simply, consists of the plasma display terminal, a communications network, and a Cyber 70 or 170 series computer. Software includes TUTOR, the KRONOS/NOS time-sharing system, and a compiler and executor for lesson materials. Using up to 32 site controllers and a computer interface unit, a maximum of 1008 terminals can be linked to the cpu.

The terminal has a plasma screen, a translucent plastic-covered glass panel which provides an 8.5 x 8.5 inch viewing screen. The screen consists of a 512 x 512 grid—262,144 intersections—of fine electrodes imbedded in two plates of glass separated by a space containing neon glass. Each section can be addressed, meaning each cross point is ionized, glowing as a small orange dot. The dots form 63 characters per line, 32 lines. Unlike the crt display, the plasma display needs no refreshing.

The terminal's memory contains 126 fixed-characters and an additional 126 characters which may be created or changed by an author to represent other alphabets or portions of pictures. The keyboard itself is redefinable, so that the student can use the same keyboard no matter whether he's communicating in English, Russian, or graphic symbols.

Optional touch panel

In addition to keyboard entry, a touch panel is optional on this terminal. And since the plasma display screen is translucent and flat, it is possible to rear-project color transparencies on the screen with a microfiche slide projector. Currently under development is a random access audio device which will permit storage of up to 22 minutes of speech, music, etc.



that can be programmed to play during a lesson. Multimedia devices for voice synthesis and recognition are other possibilities being researched.

The other flexible tool, TUTOR, consists of 200 commands and allows the author to interactively develop, test and change his material. The author can program a variety of allowable answers by the student and in any of several forms—alpha, numeric, mathematical expression. The answer also can consist of a word, phrase, or sentence. The system also can be programmed to decide the correct answer according to author rules. ✲

approach to course development. Little strict control was exercised over quality, although it has recently begun an effort to analyze it. The end result to date, however, is there are many courses (60 full courses, more than 1,000 lessons) whose quality varies from the superb, such as highly lauded chemistry courseware by Stan Smith and an advanced curriculum in veterinary medicine . . . to terrible.

Both Florida State Univ., using PLATO, and Brigham Young Univ., using TICCIT, have been developing courses slowly and methodically. The general quality is thought by some to be higher than Illinois'. However, fewer courses result and fewer teachers and students are involved.

Educators are careful not to criticize either approach, since both have great validity and contribute to knowledge on CBE. TICCIT and PLATO are both being analyzed by the Educational Testing Service in Princeton, N.J., under a grant by NSF. Before year end, ETS will complete its PLATO report; TICCIT will be completed by next spring.

These two systems are the nation's major contributions to CBE. Among the manufacturers, outside of Control Data, the efforts to attack the problems or the market have been halting in the last decade. IBM's system offering, based on the 1500, was withdrawn some time ago. It does offer a language for course development, COURSEWRITER 3 (version 3). IBM has a large library of courses it and its users have developed, since the first COURSEWRITER was offered on the 1400 series.

Univac recently announced a CBE language, called ASET, which the Bureau of Census is using on its terminals for employee training. Neither Univac nor IBM have any special hardware for education. However, IBM is licensed by the Univ. of Illinois to produce the plasma display terminal. It is already offering four different versions for targeted industries such as banking and retail; a fifth is due out by year end and for manufacturing, and seven more are rumored to be on the drawing boards. One is probably for education. IBM has already indicated that one of the prime initial markets for its proposed domestic satellite is education. CDC and PLATO now have the edge, but the scramble is on. **—Angeline Pantages**

Communications

Protocol for Packet Networks: The Question is Implementation

A protocol is a protocol if it's implemented.

Early this spring in Geneva, an international standards study group arrived at a protocol for data sent over packet networks. Its effect would be to provide a means by which network users with different types and makes of terminals and computer equipment may communicate with each other.

But the standard, recommended by the Consultative Committee on International Telephone and Telegraph, (CCITT), still has to be approved at a plenary meeting this fall and then be implemented by carriers and systems suppliers. There is little doubt that the plenary session will approve the recom-

mendation, but the implementation stage leaves a big question mark.

Shortly after the study group meeting in Geneva, two carriers—Telenet in the U.S. and the Trans-Canada Telephone System (TCTS)—announced they would implement the protocol, known as Recommendation X25. In Canada, the protocol would be used on Datapac, a new packet switched network that is to go into operation in July. Telenet said it would implement the new protocol in the U.K., France and Japan.

At the recent Data Communications Interface '76 conference in Miami, spokesmen for Digital Equipment Corp. and International Business Machines Corp. indicated their companies planned to support the new protocol. But they neglected to say how long it will take to make the necessary changes in their existing control schemes—Decnet and SNA, respectively.

The CCITT recommendation (see Fig. 1) also specifies the manner in which data terminal equipment (DTE) is to be attached to data circuit-terminating equipment (DCE)—typically, the interface between a user-provided terminal and a carrier-supplied modem.

Three interface levels

Thus the new protocol, which may resolve a complex, protracted international debate among carriers, private network operators and others, incorporates three interface levels: One bounded by DTE and DCE, one bounded by the user's terminals and the network node to which it is attached, and one bounded by the data communications device at either end of the message path (e.g. a computer front-end and a remote concentrator, or more specifically, the computer side of the front-end and the terminal side of the concentrator).

There is one more level of control needed before on-line communication is possible. It regulates information interchange between the "user processes" carried on within the terminal or computer equipment at the extremities of the message path. At this level, codes may be needed to define data fields and to indicate different message priority levels, among other functions. X25 reserves a "facility field" in which such codes can be recorded. Although the user is allowed to develop his own facility codes, he must abide by a number of rules which reduce his options.

X25 supports two basic types of transmission—permanent and switched virtual calls. Both require a duplex, point-to-point synchronous link between the sender and receiver and his network node. Between the two network nodes there is a connection only so long as the call is active. Since the precise path that one packet of information takes between these node points may be different than the path followed by the next packet, it's a "virtual" or "logical" rather than a "physical" connection.

A "permanent" virtual (logical) connection is one in which all the packets moving over the related channel flow between the same two terminals. It's the packet network equivalent of a point-to-point leased line.

Eliminates cost, delay

One big benefit of leasing a permanent virtual channel is that it eliminates the cost and delay of setting up each call, as is required with a "switched" virtual channel. But this setup operation (analagous to dialing a telephone call) enables the customer to reach any of several different terminals over the *same* channel. (The customer must complete one call, however, before beginning the next one, and can't communicate with more than one distant terminal concurrently—sending one packet of a multi-packet message to each one in turn, for example—unless leasing a separate logical channel to support each exchange).

The customer opts for permanent

and/or switched virtual service upon signing up with the carrier, or through subsequent modification of the service contract.

The terminal devices covered by X25 must be programmable. Non-programmable equipment—like teletypewriters—can be connected, but a device-dependent interface is necessary and these remain to be standardized by CCITT.

Basically, X25 defines a set of binary codes which: control the start and termination of a call; regulate the flow of information between the ends of the message path to prevent congestion; keep track of packets that have been received correctly; permit the normal message flow to be interrupted so that urgent information can be transmitted by the user at either end, and reset/restart the flow of packets after an error occurs.

A separately formatted packet is specified for each of these functions (see Fig. 2, page 190). This diagram shows the detailed format of a "call request packet"—the first one transmitted by a sender to a receiver.

The first three octets are laid out essentially as follows: in octets 1 and 2, the last 12 bits are reserved for a logical channel number. This number stays the same for all subsequent packets included in the same call (or "session," as IBM refers to it). Octet 3 is reserved for a type code to distinguish this as a call request packet from all the other types included in the standard.

The format of these three octets and their functions remain the same for all control packets. Beginning with octet 4, however, different formats and functions are specified.

In the call request packet, octet 4 is

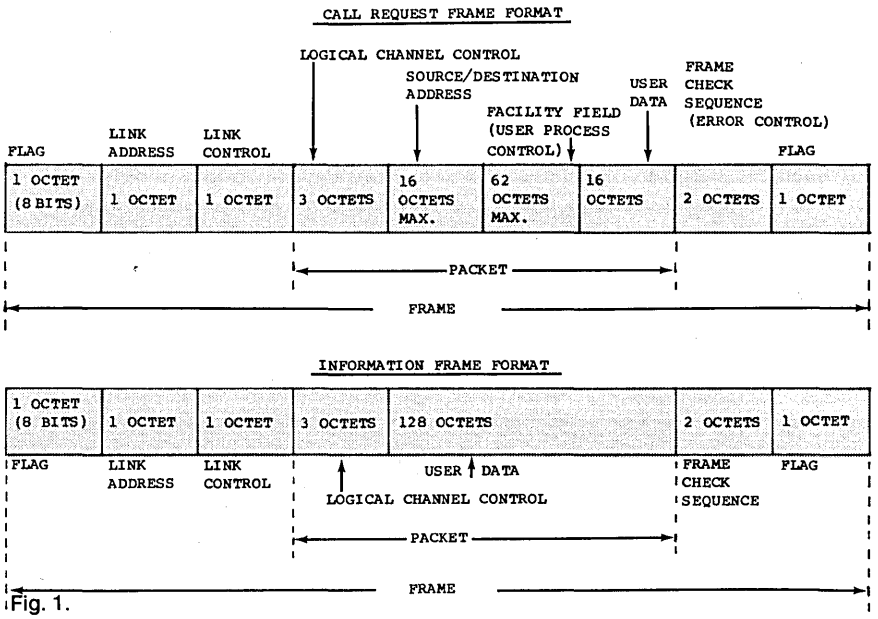


Fig. 1.
INTERNATIONAL PROTOCOL: Diagrams show two of the frame formats specified by CCITT's recommendation X25: First three blocks in each diagram (flag, link address and link control) plus the last two (frame check sequence and flag) comprise a "high level data link control" (HDLC) which has been the subject of a separate international standardization effort. In effect, X25 incorporates the latest version of the HDLC proposal. If the International Standards Organization (ISO), which is working on HDLC, finally adopts a different format, it presumably will be cranked into X25.

divided into two 4-bit groups ("semi-octets") in which the lengths of the calling and the called DTE addresses are recorded. Octet 5 is reserved for the actual address codes. Up to 14 additional octets can be reserved for this latter information. Next comes the facilities field which can be up to 62 octets, and after that, the 16-octet user datafield.

The receiving terminal responds to the call request with either a "call accepted" or a "call clearing" packet. The latter explains why a dialog can't be established. Clearing codes are specified in X25 for such things as "number busy," "network congestion," and "out of order."

Assuming the call is accepted, the two stations then transmit data packets to each other in a scheme, similar to the one IBM developed for SDLC. It enables each terminal to keep track of the error-free packets it has received and permits one terminal to tell another that a particular packet or packets must be re-transmitted because the message didn't come through accurately the first time. Another field indicates that more data is coming in a subsequent packet or packets.

The data field of a data packet, under the standard, can contain up to 128 octets. Optionally, individual networks can support fields containing 16, 32, 64, 255, 256, 512, and/or 1024 octets.

The 62-octet facilities field in the call request packet is the place where a user who prefers "datagram" to virtual call

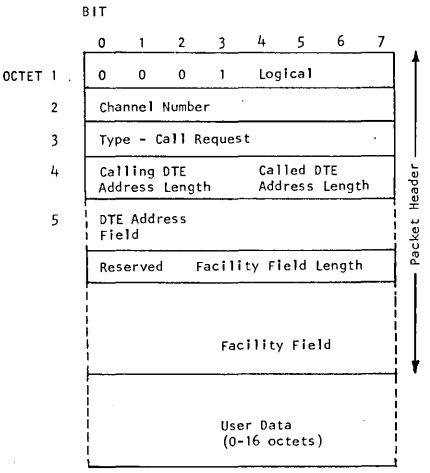


Fig. 2 CALL REQUEST PACKET

service can insert his own end-end logical channel control codes and possibly supplant those specified in X25. An individual agreement must be negotiated between the customer and the carrier before a datagram protocol can be used, however—which makes some users nervous.

This may not be a problem in the United States, where competitive packet networks are likely to be operating within the next few years (ITT and MCI each have filed FCC applications for systems which would vie with Telenet). But in Europe, where government policy favors operation of a single network within each country, the situation is considerably different. By refusing to allow use of some or all datagram protocols instead of X25, the PTTs—which are largely or completely government-owned—conceivably could limit the development of private networks.

The ideal solution would be to develop a set of standard datagram protocols for user groups having a need to communicate with each other, and permit these codes to be used in conjunction with or in place of X25. It's far from certain this will happen, though. One major difficulty: the carriers can't charge as much for datagrams as for the full virtual call service they've specified in X25. **—Phil Hirsch**

CDC to Implement Protocol in '77

Control Data Corp. is the latest to offer a new link control protocol, called Con-

trol Data Communications Control Program (CDCCP).

First unveiled late last year at a CDC users group meeting, the new protocol is being implemented initially on the recently-announced 2550-series network processing unit (NPU) which interfaces to Cyber 170, Cyber 70, 6000 or model 3000 lower series computer systems.

A company spokesman says the new NPU currently is emulating older CDC protocols. The first application using CDCCP is expected to begin operation on a Cyber 170 during the first quarter of 1977.

The new protocol "spans the entire set of bit-oriented protocols now in the process of standardization and implementation," said the spokesman. "These include IBM's SDLC, ANSI's ADCCP, and ISO's HDLC. CDCCP is, therefore, geared to satisfy any of these requirements by use of a subset of the CDCCP protocol. Control Data is also closely following developments leading to standardization of device control and message formats. These functions would be contained within the I (information) field of CDCCP, and would convert the protocol into an equivalent of IBM's SNA scheme. Target date for completion of this upgrade is next fall, said the spokesman.

The CDC protocol is designed to interface with the company's newest operating systems—NOS and NOS/BE (batch environment)—through a network access method (NAM) that has been coded and is now being tested and system-integrated, explained the company spokesman. Commercial release of NAM is projected for next October or November, he added.

According to a recent CDC brochure, NAM "allows diverse communications applications to simultaneously access the same communications network." This network architecture (CDCCP plus NAM) "allows networks to be configured which range from a single Cyber 170 host with a single front-end processor, all the way to large multi-host networks with many communications nodes. Capability exists for the attachment of multivendor (i.e. non-CDC) hosts and terminals if a specific system has this requirement." ✲

User Groups

Togetherness: A Long Time Coming

A milestone of sorts was reached in April when the RCA Spectra computer user group, called the Computer Users Assn. (CUA), now under the wing of Sperry Univac, met in joint sessions with the older Univac Users Assn. (UUA). It was last October that the two user groups voted to merge and form the Americas Univac Users Assn. (AUUA), and it was that combined group that met in Denver.

"This merger is a recognition that the CUA members trust Univac," says Westinghouse's William E. Bender, president of the AUUA. "It's been a long time coming."

Gerald Raulinaitis of Connecticut General Life Insurance, prominent user of the Spectra mainframes, says that in the old days the sentiment among RCA users was for the preservation of the CUA as a sort of security blanket. RCA had abandoned them, and they were not at all certain they could trust another vendor.

They've come a long way.

Formation of the AUUA came about four years after Sperry Univac agreed to acquire the RCA customer base, following the latter's announcement in September 1971 that it was withdrawing from the mainframe business. At that time there were said to have been about 1,000 RCA computers installed. Most of the systems on order, it can be assumed, were cancelled. Many of those who had newly installed systems jumped ship, muttering that they should have known better than to have gone with one of the dwarfs.

And since that time, the Spectra users who had to upgrade to larger systems went to something like an IBM 158 or 168. Univac tried to lure them to the larger 1100 series, but could offer them no conversion tools. Subsequently Uni-

vac developed two "bridge" systems to the Univac line, the 90/60 and 90/70 and the low end of that line, the 90/30, which is generally seen as being too small to serve as a bridge for Spectra users.

Pressure to transfer

At this first meeting of the new AUUA, in sessions for so-called Series 70 users (formerly Spectra), there was some furor over the lack of support for the old operating systems, DOS and TDOS. Univac's position, that those operating systems are mature products with not much more to be done with them, was being viewed as pressure to get them over to native Univac systems.

This is not to say that there's rampant dissension in the ranks. Speaking of the old gang from RCA, Connecticut General's Raulinaitis says the treatment they're getting from the vendor is about the same as one gets from any other vendor. "I think most of them had a level of expectation that was not that great. I think they're pretty much getting what they expected . . . I don't see that much difference between the level of support they got from RCA and are getting now from Univac."

No user is ever 100% happy with the treatment from his vendor, he adds. "The kind of complaints I hear users making today are the same kinds of complaints I heard them making back in '69 and '70 under RCA." They're saying that too many recommendations from the users are being rejected. And why does the vendor take such an oddball approach in his software? At the last few CUA meetings, the complaint was that there were too many marketing people from Univac in attendance, and not enough technical people, those capable of fielding technical questions. "I can remember the same complaint under RCA," he observes.

WILLIAM E. BENDER
Trust is a word called AUUA

Raulinaitis says that right after its acquisition, Univac seemed to be more cost-conscious; when users made recommendations, the vendor seemed to be making a bottom-line analysis before replying. Under RCA, he adds, "you didn't get the feeling that they were doing a cost study on what you were asking for." He notes some relaxation of this practice in more recent times.

400 turned out

The AUUA represents all the domestic Univac users except for those in the large 1100 series. That group, formerly called the Univac Scientific Exchange, now goes by USE Inc. It remains the larger of the two, although the AUUA has about 1,400 member installations. Almost 400 of them showed up in Denver, compared to the 500 to 600 who attend USE meetings.

The software library that formerly was an appealing part of user group activities, where users donate applications programs and utility routines they developed, shows signs of petering out. Westinghouse's Bender says USE has a couple of thousand programs in its Program Library Interchange, but they were all donated before the current pro-

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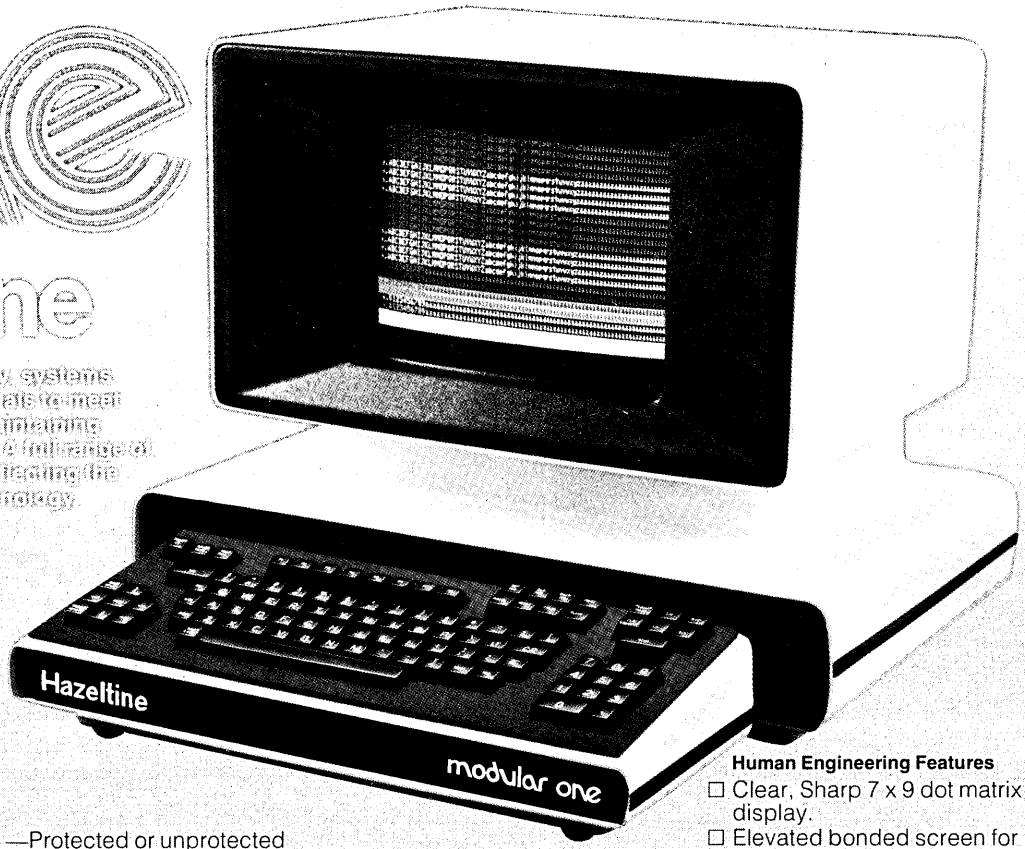

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prietary feeling developed. The old UUA had been trying to build up its library, but has only about 130 programs.

"In the mid-'60s it was possible to do that," he explains. "Right now, I think, most companies' managements feel that programs and software packages are proprietary. They've spent thousands of dollars developing those things, and maybe they're worth something, in terms of their salability, and they're not so willing to give them away. So I'm not so sure that our timing here isn't too late to be starting a library interchange." The AUUA's executive board, he adds, is still hopeful of having a library. But he notes that Westinghouse is selling its own programs and thus would not donate to the common pool.

But attendees at these conferences received the added benefits of being able to compare notes and exchange ideas with others on the same machine or the same operating system (one participant noted there were 51 installations of Series 70 gear represented, and a count showed 40 sites where vs9 was in use). On another day, users met according to their industry—education, finance, manufacturing, government, etc. And at each session there was at least one representative from Univac on hand to try to answer any questions.

Distributed system

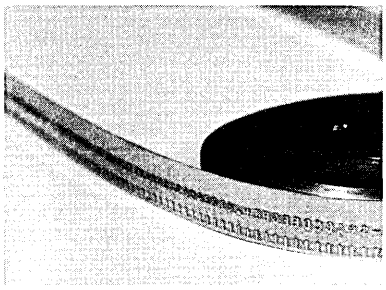
In a session on the distribution industry, Gene Kuebler of Interstate Brands Corp. described his company's attempt to install a distributed processing system. The firm, based in Kansas City, has more than 400 distribution centers and a large fleet of trucks, handling baked products that are sold through more than 100,000 retail outlets. They have a 9480 at their headquarters, along with two minis handling the data communications, and, to date, 11 Qantel mini systems at plants around the country. Maintenance of their network, which became operational in January 1975, was a problem that almost brought them to their knees, he said. Observing that minis don't have the reliability and sophistication of larger computers, Kuebler said they averaged 4.5 service calls per plant that first month, but got this down to their target of 1.5/month/plant by the middle of the year. Hardware maintenance has been their biggest problem, he said. And the six or eight systems people they have in Kansas City spent 60% of their time last year on problems in the field. It now is down to 30%, a figure he finds reasonable.

In a session for users from manufacturing firms, Robert Kallstrom described an apparel maker's experiences with a high-level program generator, Score, from Programming Methods Inc. Kallstrom, of I.C. Isaacs & Co. in Baltimore, said his firm had made an unsuccessful attempt to use tab gear back in the early '60s. It was thrown out. In 1969 it installed a computer system that stayed for less than two months. "Management and the users had a very bad attitude toward data processing," he said.

But with the growth of paperwork, management decided in 1973 to try again. Kallstrom's approach was to produce early results with a computer, build up the confidence of management and users, and to respond quickly to any special requests from the users. In software, his first decision was to use COBOL. And to get jobs done quickly, his company looked at various packages—report writers, data base managers and file management report writers, and high-level program generators. It settled on Score, which generates COBOL source code from a few parameter cards.

Starting with a Series 70/45 running 360 simulation, a configuration selected for the development stage to keep hardware costs down, they now are installing

Why Documation can sell you a 2250 line printer for the price of many 1200 line printers.

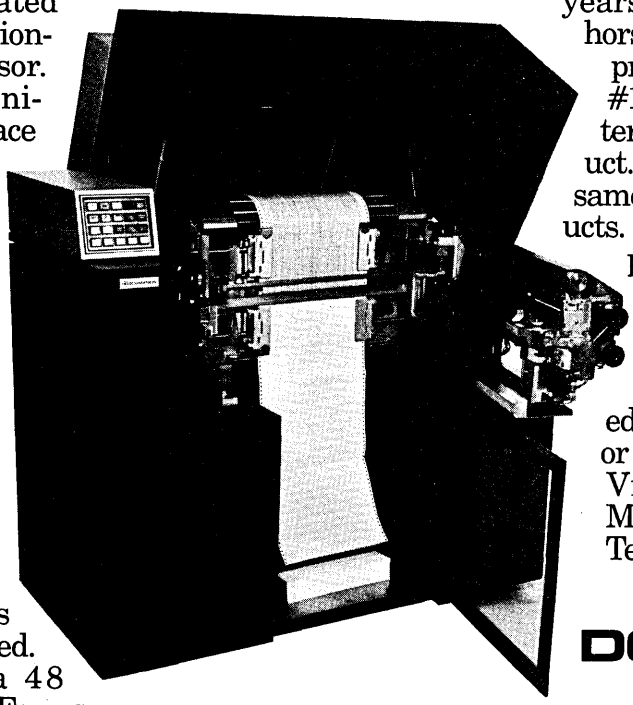


It's a simple, provable fact: Documation's DOC 2250 offers more output for less money than any other printer on the market. Here's why.

At Documation, "Research & Development" is a bit more than a name on the door to the engineering lab. Quite a bit more. Instead of sitting on their slide rules waiting for some genius to come up with a great new technical application, Documation's engineers constantly research ways to build more efficient equipment at a price advantage. One secret of the DOC 2250's cost efficiency is its integrated controller – a Documation-developed microprocessor. The controller communicates through its interface with the host system, decodes all commands, controls the printer hardware and reports various errors and status.

Other advances our design department made standard on the DOC 2250 are: • Fully-buffered print line. • Interchangeable character arrays. • A Universal Character Set buffer that allows any character set to be used. • 2250 LPM with a 48 character set. • Vertical Forms Control buffer that allows format control for pages up to 24 inches in length and establishes either 6 or 8 lines per inch. • A powered forms stacker accommodating forms 3 to 24 inches in length. • Accoustically-insulated powered cover that holds operating noise to 74 dba. • Resident micro-diagnostics and maintenance independent of host system. • Up to 6 part forms. • Paper slew up to 100 inches per second.

After we design and develop it, we build it. Documation's facility is an integrated manufacturing plant not just an assembly line. Tour our plant and you'll see stacks of metal waiting to be turned into precision parts for our printers and card readers on our computer-controlled automatic milling machines, circuit boards being manufactured, and finally, painstaking assemblage and testing of all Documation equipment. What this means to you is that we don't get hung up on somebody else's production schedule or somebody else's price boost.



Frankly, DOC 2250 is our first entry in the highly competitive printer field. But, just as frankly, we know it's the best on the market. All we ask is the chance to prove it to you. A few years ago we were the dark horse candidate in the card processor field. Today we're #1 – because we built a better, more cost-efficient product. We intend to follow the same course in printer products. And if you'll compare our product, feature for feature with any other printer, you'll see how our printer can give your system a real competitive edge. For more details, call or write Mr. Roy Ostrander, Vice President, Box 1240, Melbourne, Florida 32901. Telephone (305) 724-1111.

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a Univac 90/30. Using Score, which was installed in July of 1974, Kallstrom said that he, an analyst, and a programmer have produced 400 running programs. "It does generate more code than you would use," he admitted, but it gets the job done quickly. Even if the programs required an extra 2K of core, it wouldn't bother him, he said, adding that he didn't think there were excessive inefficiencies in the programs generated. His largest program is about 50K, but most fit into a 32K slot.

—Edward K. Yasaki

Personnel

The Elusive Man For All Seasons

You've hired this kid with a brand new diploma in computer sciences and he doesn't understand data bases? Worse yet, he lacks an adequate education in business to interface with your users in Marketing and Accounting? If that's bothering you, you'll be happy to hear that some people are trying to remedy these types of problems.

More than 30 industry heavyweights, most of them representing the computer user community, met last month in Chicago. The objective of the intensive one-day workshop was "to identify specific steps that industry can take to stimulate the development of improved programs for educating information systems professionals." The invitational meeting was called by the Education Foundation, a one-year-old nonprofit group of the Data Processing Management Assn., Park Ridge, Ill.

A large number of action items emerged from the skull sessions, the essence of most of them being the need for an improved flow of information between colleges and employers. There's a need for a mechanism to implement interaction between industry and academics, it was suggested. How about a directory of industry people with special knowledge who are willing—indeed, anxious—to serve as guest lecturers, run a seminar, or whatever? In the opposite direction, how about more programs for industry to bring in guest lecturers?

According to Prof. James McKenney of Harvard's Graduate School of Business, one of the participants, Harvard sends teams of students to companies like Xerox and Celanese to study systems and organizational problems surrounding information systems functions. The students receive a closeup view of real life situations and, after five or ten days, return to produce a case study. Michael Samek of Celanese and Dr. Paul Strassmann of Xerox both agreed that these visits were valuable.

Jobs for teachers

"Another thing that appears to be badly needed," says workshop program chairman George Glaser, "is a directory of internship, sabbatical, and thesis opportunities, where industry might say, 'Is anyone out there in academia interested in working on this type of problem?' " It is a chance for industry to find a bright student or professor to join them for three months, say, as a member of a task force to examine perhaps the idea of implementing a distributed processing or data base system. Glaser, a former AFIPS president and a regent of the foundation, adds that it could be useful to a student looking for a thesis topic, providing him again with hands-on experience and perhaps a few dollars, as well.

In one of three prepared papers presented, Frederic G. Withington of Arthur D. Little Inc. looked at the variety of ways in which industry and academics can interact. One of them is a fellowship for professors, usually for a summer but also for as much as a year. Current sponsors of such programs include Pennzoil, A.D. Little, and the Civil Service Commission. "The sponsors usually match the faculty member's academic

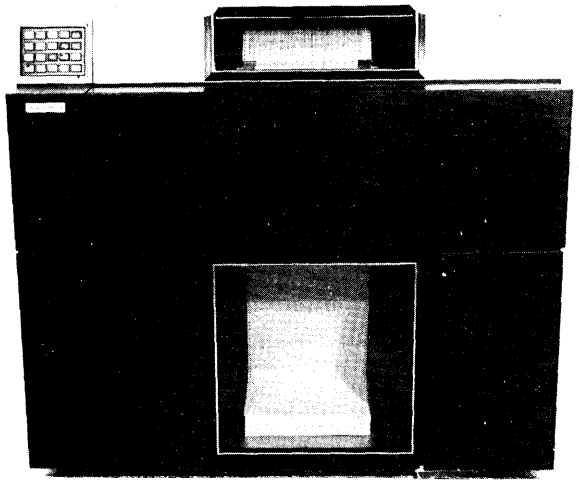
DOCUMATION'S PRINTER/READER/PUNCH: YOUR IBM 360/370 WILL THINK IT'S IBM. THE PRICE PERFORMANCE RATIO WILL TELL YOU IT'S DOCUMATION.

Documation just introduced a new Printer/Reader/Punch Subsystem you should introduce to your IBM System 360 (Models 22 through 85 and 195) or 370 (Models 115 through 195).

When you replace your IBM 2540 Reader Punch and IBM 3211 or 1403 Printer with Documation's new Printer/Reader/Punch Subsystem, your main frame won't notice the difference.

But there are some very significant differences *you* will notice. Starting with the fact that Documation's Subsystem can be tailored to give you as much function as you need.

You can take your choice of two printer models — our DOC 2250 (printing 2250 lpm with a 48 character set) or our



DOC 2250 OR DOC 1800

DOC 1800 (printing 1800 lpm). Either model can appear to your system as either an IBM 3211 or 1403. With some extra advantages thrown in.

Operating in the 3211 mode, the DOC 2250 prints 10% faster than the 3211. That's advantage #1. Advantage #2 is price. The DOC 2250 costs less than half as much as the 3211. Advantage #3 is space. The DOC 2250's integrated microprocessor controller eliminates the need for a separate controller. And because the DOC 2250 has built-in, comprehensive microdiagnostics, maintenance can be done off-line without tying up the host system.

The DOC 2250 also offers: buffered vertical format control including indexing and line spacing; fully-buffered print line; operator-changeable character arrays; a 432-position Universal Character Set Buffer (UCSB) that allows any character set to be used; up to 6-part forms; high-speed paper slew up to 100 inches per second; power cover; power stacker.

The DOC 1800 offers all the features of the DOC 2250, but at a reduced printing speed. And a reduced price.

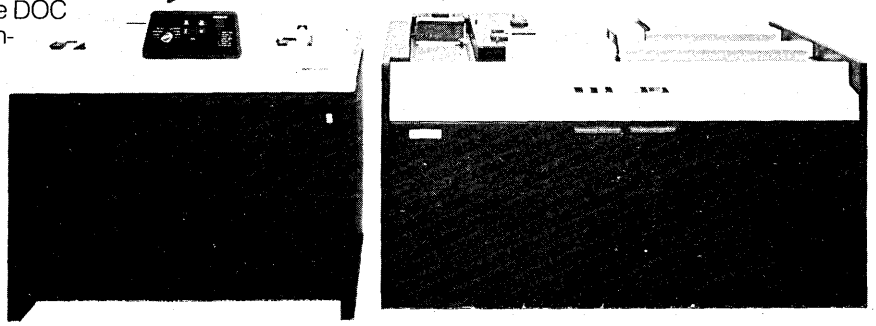
The 1403 compatibility feature allows both models to operate in the 1403 mode. This feature includes: paper tape loop; operator selection of line spacing (6-8 lines per inch); dualing; manual indexing with rotary dial; use of 1403 UCSB feature or other standard non-UCSB character arrays. Your CPU will think it's working with a 1403. You'll know you're getting a 2250 or 1800 lpm printer for just about the cost of an 1100 lpm printer.

The read/punch side of the Subsystem (the PC 6000 Reader and the PC 50 Punch) recognizes the same command set as the IBM 2540. All data and control signals transferred between the host and the PC 50 and PC 6000 pass through a subsystem microprocessor controller built into the PC 6000. Utilizing Documation's own patented riffle-air pick and stack system, the PC 6000 reads 1000 cards per minute and stacks them in one of two stackers. The input hopper holds 6000 cards and can be loaded on the fly. Stacker 1 card capacity is 5500; Stacker 2 holds 3500 cards. PC 6000 options include 51 Column Card Read, Optical Mark Read and Read Column Eliminate.

The PC 50 Punch Model 3 punches a minimum of 50 cards per minute; Model 4 punches 100 cpm. The PC 50's microprocessor controller enables it to detect and correct punch errors automatically without operator or host system intervention. With the Pre-Read feature Model 3 reads 300 cards per minute, Model 4 reads 400 cards per minute. Other PC 50 options include a 51 Column Card read/punch feature, an interpret feature, a second input hopper to enable off-line reproduction of card decks; a Read Column Eliminate feature and Optical Mark Read. Off-line, the PC 50 will gang-punch, gang-punch and interpret, reproduce, reproduce and interpret, or just interpret — eliminating the need for extra pieces of equipment to perform these off-line functions.

The ruggedness and reliability of Documation equipment in the field is legendary. What that means to you is less downtime. Documation equipment has proven itself so reliable in fact, that card-handling equipment users ranked Documation their #1 preference in 1975 media surveys. The reason? All Documation products are designed in-house. Then all parts and machines are fabricated in our own sophisticated precision manufacturing facility, giving Documation a unique control over product quality and reliability.

Documation provides sales and service in major metropolitan areas. Documation's service is as reliable as Documation's equipment. When your Documation equipment needs maintenance, we don't want you to have to wait for us. So we have a service team of Documation-trained field engineers waiting for your call. Documation's maintenance contract provides maintenance and parts 24 hours a day, 7 days a week.



PC 50 PC 6000

You have an IBM 360 or 370. We have the Printer/Reader/Punch that offers the most cost-efficient subsystem available. Let's get together. For more details, call or write Mr. Roy Ostrander, Vice President, Box 1240, Melbourne, Florida 32901. Phone (305) 724-1111.

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salary and try to provide him with work which both supports his research interest and helps the employing firm," said Withington. He suggested the establishment of a clearinghouse for summer fellowships, matching industry's needs with the interests of teachers.

Model of resources

Xerox' Strassmann expressed an interest in developing an input/output model of poeple resources for the industry. The columns across the top would show the sources of people, perhaps ranging from Ph.D. programs down to home study courses. The rows to the left would indicate the "sinks" for those talents, maybe broken out by industry or job requirements. The matrix might show, for example, that a specific industry's information systems effort requires each year five Ph.D.s, 50 master's, and 5,000 bachelor's degree holders. And over all it would show where the imbalances between supply and demand lie, thus serving as a guide for the nation's educational efforts. "We're actively pursuing this idea," says Glaser. "... I really believe it could be a very useful tool."

The difficulty of determining the nature, content, and objectives of academic programs was also brought up. It's the kind of information available to anyone who sends away for college catalogs, but would be much handier in compendium form. It could aid the employer in determining which programs are heavy in theory and which ones might be producing graduates who could come right in and begin writing useful COBOL programs. "A catalog of catalogs, that's what it amounts to," says Glaser.

"One group suggested we codify what the field is. I blanched at that," he continues. But Glaser says the input/output model would force someone to do this, for it requires a knowledge of what talents are required and how they are to be used.

The need for realistic kinds of career information was also mentioned. A very senior manager who heads the national dp effort for a major oil company said, "Everyone with a master's degree thinks he's going to take my job in six months." He couldn't understand why some graduates think a master's degree qualifies them quickly for any top job they see. Perhaps the career brochure should explain how the graduate would use what he has learned but, more importantly, what he has yet to learn.

Dilemma

Glaser says he was surprised at the number of similar comments made by several participants—that they were really looking for broadly educated people, rather than the narrowly trained . . . people who can solve problems and can communicate, those with a command of the English language. "Their view of this was much more toward the Renaissance Man than the highly trained guru on data bases," he says. But then some of these same participants later complain that today's graduates don't know anything about data bases. "So I think they're torn between whether they want this broad-gauge problem solving guy who's a master at dealing with people . . . or someone who knows how to handle the intricacies of a data base. And that's a dilemma. We didn't even put a dent in that one."

Comments arose on the fact that the group was being too tough on schools, that if they offered every course people said they wanted from graduates, the schools wouldn't have any time to teach the basics. Others said students are lacking a basic understanding of activities in the business world—what people do in marketing and accounting, for example. It was suggested that a semester's work in business administration-type courses would be very useful to graduates headed for industrial jobs.

The Education Foundation, with only

five volunteer members, must now pick those ideas they deem worth pursuing, and then recruit volunteer task force members to see about implementing them. It was suggested that the foundation needed some high-level industry endorsement. "The most meaningful endorsement," says Glaser, "would be financial sponsorship."

—E.K.Y.

Personal Computers

Hobbyists off on a Weekend: Prizes For Chess, Backgammon and Radio

What do you do with a home computer?

This was the big question when some 700 persons who have them gathered in Albuquerque, New Mexico—static electricity capital of the U.S.—in late March to exchange answers. Occasion was the first World Altair Computer Convention. Albuquerque is headquarters for MITS, Inc., producers of the Altair computers.

Altairs belong to ham radio buffs, engineers, students, physicians . . . and to a few programmers and dp managers. They traveled to Albuquerque at their own expense, to see the new MITS factory, to listen to sales pitches, and to find out about each other.

Trying to find out what people are doing with their home computers turns out to be like trying to find out how a friend is doing in the stock market.

Most of the computer hobbyists at the convention are in the hardware checkout phase of their projects or they're looking for more hardware to build. There was a strong hardware emphasis. Relatively few of the attending hobbyists have a background in systems or programming. They went to Albuquerque to see new hardware.

Since it was for hobbyists, this was a weekend convention, kicked off on Friday evening with a Mitsmobile seminar without the mobile. It proved to be the grand finale for the widely copied, camper-full of computer equipment that MITS took throughout the country over a ten month period. The traveling seminars were free at first but later played to paying prospects. The convention finale was the greatest show yet, marred only by disappointed customers who were turned away when the room where it was held had filled.

The traveling seminar will be replaced by video taped presentations at dealerships as MITS shifts its emphasis from mail orders to sales through dealers. The firm plans to have dealerships in every major U.S. city.

One hundred of the conventioneers were from the Southern California Computer Society, Los Angeles. Long a hot bed of everything connected with hobby computers, this club has reflected the growth of the computer hobby industry, growing from 125 to 3,000 members in nine months. The SCCS, like many local hobby clubs nationwide, came into existence in the wake of the Mitsmobile seminars, where names and addresses were collected.

Representatives from the hobby computing publishing business topped off the convention's second day.

Ted Nelson, author and publisher of *Computer Lib,* a book printed in August 1974 for the computer hobbyist, a breed that didn't even exist then, predicted the numbers of computer hobbyists will climb rapidly to the 200,000 to 300,000 level and then level out in about two to three years. Hobby computing will remain a cult, he said, "a minority hobby until the machines can be made much simpler."

He said the Alto machines (outgrowths of the Dynabooks) under development at Xerox' Palo Alto Research Center, show one way to the future, "a way that might revolutionize our ideas

about computer languages as well as hardware."

Nelson predicts the personal computer of the future will look like a book with a keyboard. The keyboard might be like an organ keyboard or like a function menu. "We will program these things using lambda-calculus based languages, relatives of TRAC, LISP, and Smalltalk." Nelson's personal computer of the future will be more likely to have a shoulder strap than lots of complicated switches and blinking lights.

He believes that we need "canned systems served up as black boxes." He compared the evolution of hobby computers to that of home stereo systems: "Nobody needs to know anything about stereos anymore. They come in boxes from the local discount houses."

"We will be in the market for cheap time-sharing, under 22 cents per hour," Nelson said, "but it will be a low intensity usage mode that will be cheaper to provide. We'll need games too, and, already Computer Recreations Inc. in New Jersey is offering lots of BASIC games for $3.50 an hour."

In the area of games, Nelson favors the high emotional involvement of educational simulations like Diplomacy, a non-computer game for those occasions when "you've got seven very smart people for six hours." He criticized most Star Trek-type games. "They reflect the mentality that mired us in Vietnam: preoccupation with body-counts and with a single-minded task—killing Klingons." Nelson would introduce alternative possibilities, such as negotiation.

The *Computer Lib* publisher's final suggestion was to use home computers to archive the past. He feels, he said, that we tend to preserve unimaginative data and to destroy the ephemera—his favorite stuff.

Cataloging records

Carl Helmers, editor of *Byte*, a magazine for computer hobbyists, described how he uses his home computer to catalog his record collection—after assuring his audience that "the use of computers improves our lives."

Helmers, addressing the question what do you do with a home computer, noted that the "modeling and simulation people seem to have found exciting uses for them." He told how the MIT (the university, not the company) Model Railroad Club used computers to elaborate their modeling. "They even print waybills!"

Railroading, Helmers pointed out, "need not be the only model industry. Take the steel industry and call the hobby industrial modeling. The furnaces and rolls could be eliminated entirely in favor of simulation. Why do it? Modeling and simulation offer the same fascination that gets people interested in programming: creating your own world and controlling it."

Dave Ahl, editor of *Creative Computing*, a magazine in the education field, said that while he's in the education business, he prefers Altair conventions and Star Trek conventions to teacher's meetings. He's a games fan. While with Digital Equipment Corp., he authored *101 BASIC Games*, a book he says outsold all other DEC books combined in one and one-half years.

Ahl predicts computers will "liberate education." He referred to the improvements possible with calculators. "No longer do the answers have to come out even. Freed from the tyranny of whole numbers, today's children can learn about right triangles other than the 3:4:5 cliché. Computers will be used in projects which teach kids to cope with changes, not just to solve fixed problems."

User oriented

Ahl said he expects kids to study computer science in "a practical, user-oriented class rather than in a theoretical or hardware course." He likened the

situation to the use of autos. "Driver training is more popular than auto mechanics."

The video disc, Ahl predicted, "will really bring computers into the home." He pictured a 40 cent, 12 in. disc, capable of recording the entire Encyclopedia Brittanica on one side.

Nelson interrupted to deny the feasibility of video disc technology. He claimed to have been "a charter victim of video disc promises in 1947, back when it was called Phono Vision."

The convention was complete with contests. Altair computer owners competed with interesting applications they've developed. First prize went to Don Alexander of Worthington, Ohio, an amateur radio enthusiast. He entered an amateur radio teletype contest, using radio and computer gear he'd made himself, trying to make as many different radio contacts he could, over the weekend. His program detected duplicate call signs and helped him log the required documentation of the contacts. His system won him a floppy disc.

Chess in Basic

Randy Miller of Tempe, Ariz., and Wirx Atmar of University Park, N.M., tied for second place. Miller showed a computer chess player running in BASIC. His presentation during the judging was characterized by careful documentation and thorough preparation. He carried the banner for good software.

Atmar won his prize for a voice synthesizer. No record-player approach, Atmar's synthesizer has a metal larynx. The noise source was modulated with filters to simulate acoustic resonances in the mouth. The speech was stored as phonemes. The spoken phrases were presented in alternation with video display output, aiding the intelligibility of the speech output. The machine commented that it spoke with a "heavy accent."

Both second place winners will receive Altair 8800B computers (a new model not yet in production).

Steve Grumette and Danny Kleinman of Los Angeles were third place winners. They brought a backgammon machine to the convention. An Altair 8800 computer, running in BASIC, was connected to a custom backgammon keyboard and to a color tv. The machine could play at ten different skill levels against a person, or could referee a game between two people. Grumette and Kleinman won a 16K-byte memory board for their entry.

How many people will come to the second World Altair Computer Convention next year? Figures like two thousand and five thousand were bandied about. It's a certainty the ranks of home computerists will swell in the coming year. Just as certain is that next year, they'll still ask, "What do you do with a home computer?"

—Richard Heiser

(Richard Heiser, with his wife, Lois, owns and operates the Computer Store in Santa Monica, Calif.)

Litigation

Bell's DAA Charges Challenged in Suit

The AT&T manufacturing subsidiary, Western Electric, has been ordered to defend the data access arrangement (DAA) charge that's been imposed on users of modems manufactured by Western Electric licensees.

A federal district court judge in Miami told the company it would have to stand trial on a complaint by modem manufacturer ICC/Milgo alleging that the DAA charge violates the Consent Decree signed in 1956 by AT&T and its subsidiaries, including Western Electric.

As compensation for the alleged violation, Milgo is seeking $44 million in punitive damages from Western Electric.

One provision of the 1956 decree requires Western Electric to encourage competition by adopting a non-

discriminatory patent licensing policy. Milgo has contended that the DAA charges constitute discriminatory licensing which discourages competition.

The case probably will go to trial next September; it could affect the battle over the FCC's order, last October, establishing a certification/direct connection program for modems and other "foreign attachments."

The telephone company has insisted for a long time that this program will increase users' costs. The commission, in its October order, agreed to "restrict specific instances or classes of interconnection" if convinced this is necessary to prevent "economic harm." A massive FCC inquiry into the economic harm question is now underway. If Milgo wins the suit in Miami, the decision will help counteract the telephone company's arguments.

This battle with Western Electric is only the latest of several launched by Milgo. More than four years ago, the company filed suit in Wichita, Kansas, charging infringement of its patents by United Business Communications and United Telecommunications–and won a preliminary decision a few months ago. Soon afterward, Milgo filed suit against Western Electric, Codex, and three of their customers, charging infringement of some of the same patents. All these cases are now awaiting trial. ✲

Interconnection

Support Grows for The "Bell Bill"

The telephone company's widely publicized effort (the "Bell Bill") to rewrite the Communications Act of 1934 and weaken the common carrier regulating authority of the Federal Communications Commission appeared this spring to be picking up support in Congress.

Fifteen additional congressmen late in April had introduced legislation in the House designed to accomplish AT&T's objectives, following submission of the first measure early in March by Rep. Teno Roncalio of Wyoming (April, p. 118). It may be significant that one of the sponsors–Sam Devine of Ohio –is the ranking Republican on the House Commerce Committee, which initially will consider the "Consumer Communications Reform Act of 1976." Another sponsor, John Slack of West Virginia, besides being a good friend of Commerce Committee chairman Harley Staggers who also is from West Virginia, heads an appropriations subcommittee that passes on the FCC's budget every year.

In the Senate, a consumer communications reform bill was introduced in late March by Vance Hartke of Indiana and cosponsored by Wyoming's two senators–Gale McGee and Clifford Hansen. (Later, Senators John Sparkman (Alabama) and James O. Eastland (Miss.) said they'd cosponsor the bill.) Hartke, assuming he's reelected in November, will become chairman of the Senate Commerce Committee's communications subcommittee next January. The present chairman, John Pastore of Rhode Island, is retiring.

A Senate source, however, says Sen. Pastore opposes the telephone carrier-sponsored legislation so strongly he wouldn't even let it be referred to his group for consideration. So it's still before the full Senate Commerce Committee headed by Warren Magnuson of Washington. The source reports that there has been "some discussion" of conducting a study in this session of the issues underlying the bill, but he doubts whether any substantive hearings can be arranged until next session.

There are two versions of the Consumer Communications Reform Act of 1976, one a subset of the other and both following almost word-for-word a draft

written by AT&T and the U.S. Independent Telephone Assn. The National Assn. of Regulatory Utility Commissioners and the Communication Workers of America have publicly endorsed the measure.

The version introduced by Rep. Roncalio (HR 12323) and subsequently by several other representatives, contains a set of Congressional "findings." One finding declares that the revenues produced by "integrated" interstate communication service help keep the cost of local exchange service down. Another says the states should have sole power to regulate attachment of independently-made terminals to the dial-up network. No FCC policy decision could be inconsistent with any of these findings.

Charge more

Other provisions of the House legislation would force the commission to abandon certain policies it has already adopted or endorsed. For example, it couldn't require a carrier to charge more for a particular service than is required to cover the related incremental costs. This would prevent adoption of rates for competitive services based on full-allocated costs, as recommended recently by the common carrier bureau, and possibly enable AT&T to cut its charges for private line services to a point where the specialized carriers could no longer compete.

Another provision of the Roncalio bill would permit acquisition of one domestic common carrier by another if the FCC decided the takeover was "in the public interest." Now, at least in AT&T's case, such acquisitions are barred by the antitrust laws. Some of the other House bills also contain this provision, but it's missing from all of the rest, including the bill introduced in the Senate by Sen. Hartke, which is cosponsored by McGee and Hansen. The two versions are identical in all other respects.

Torbert H. Macdonald, although retiring as chairman of the House communications subcommittee, will remain a member until the end of the session, when he intends to leave Congress because of poor health. His views almost certainly will be given serious consideration by the new chairman and the other members, though. In the statement he issued just before announcing his resignation from the chairmanship, Macdonald said:

"There is no consumer advantage to be gained from denying the established carriers the opportunity to take advantage of economics inherent in their operations. That is why I have told the carriers that I would work with them to insure that fair ground rules for competition are framed in a timely manner."

Meanwhile, AT&T's chairman John D. deButts was continuing to sell his stockholders on the legislation. At a press conference during the company's annual meeting in Philadelphia, deButts said he was concerned about federal regulatory policies that he contended have been cutting sharply into AT&T's revenues (which in the first quarter have soared to $7.84 billion from $6.79 billion the year before). He said the company had lost 11,700 private trunk exchanges, 20,500 key systems and almost 10,000 private lines to competitors who had been providing specialized services under FCC regulations. "The annual rate of revenue lost is $200 million and we are concerned that it might become worse," he said. His point is that consumers would suffer from concessions made to business users.

Philip N. Whittaker, president of Satellite Business Systems, the IBM-Comsat General-Aetna Insurance Co. joint venture which is trying to launch a commercial domestic satellite system, says the consumer communications reform legislation, "if enacted, would appear to make it virtually impossible for any specialized carrier to compete with the existing monopoly communications carriers."

"Quite obviously," Whittaker added, "this legislative effort is in direct conflict with the pro-competitive policies supported by the FCC, the White House, and Justice Dept. and Rep. Macdonald. SBS supports these pro-competitive policies." **—P.H.**

News in Perspective
BENCHMARKS

What's Patentable Software?: The Supreme Court further defined what software is and isn't patentable when it rejected a claim for a bank record keeping system. The court said essentially that a software system, even one which converts a computer into a special-purpose "apparatus," still isn't patentable if premised on elements obvious to those "skilled in the applicable art." The seven to zero high court decision, written by Justice Thurgood Marshall, involved a claim for a software "apparatus" filed by Thomas R. Johnston. It enables a bank's customers, by adding simple code to their checks and deposits, to receive monthly bank statements containing classified listings of their expenditures for various preselected purposes, such as automobile maintenance, medical care, and credit card purchases.

The Seventh for Amdahl: South-Western Ohio Regional Computer Center, Cincinnati, took delivery of the seventh Amdahl computer. The $4.7 million 470V/6 was on the air within 35 hours of its arrival at SWORCC, the firm said. Like its six predecessors, this Amdahl machine replaced an IBM computer, in this case a 370/168. Dr. Robert Castor, center director, said the Amdahl computer performed 70% faster than the 168 in benchmark tests and throughput was 1.6 to 3.0 times higher.

From RCA—A Microprocessor: A microprocessor for industrial and consumer applications has been introduced by RCA Corp.'s solid state division. It's been described as fast and low priced. The CMOS microprocessor is a tiny semiconductor chip containing some 5,500 transistors. The firm said it can perform multiple calculations in 2.5 microseconds. It can be used as the primary processing unit of miniature electronic computers in industrial process controls, machine controls, automotive ignition, and diagnostic systems, home video games and other areas where quick calculations are needed to control equipment.

A Rate Increase by AT&T: AT&T has imposed a rate increase worth an estimated $6 million/year on users of low speed (series 1000) telegraph-grade circuits. The Federal Communications Commission allowed the increase after turning down a number of objections it said "failed to raise the kind of substantial questions which would warrant suspension. . . ." But the FCC raised some questions of its own—notably about the projected costs of series 1000 main station terminal equipment. The commission ordered a "hearing investigation" on this question and related matters.

CDC, ICL Get Together: Control Data Corp., and International Computers Ltd. agreed in principle to form a jointly owned company, Control Dataset Ltd., to manufacture and market computer media and supplies in the United Kingdom. Terms of the agreement call for Control Data's business products operation in the U.K., and those of Dataset, a wholly-owned subsidiary of ICL, to be transferred to the new company. Control Data will own 75% and ICL 25% of Control Dataset Ltd. Initial assets are valued at approximately $5 million but do not include Control Data's manufacturing facility at Brynmawr, South Wales.

It's 37 Now for the CIA: The Computer Industry Assn. added three new corporate members boosting its total membership to 37. The new members are Management Assistance, Inc., New York; Nixdorf Computer Inc., Chicago; and Hudson General Corp., Great Neck, N.Y. Management Assistance is a varied data processing company with subsidiaries including: Basic/Four Corp., a manufacturer of small business computer systems; Sorbus Inc., an independent data processing service and maintenance company; Genesis One Computer Corp., engaged in marketing of peripheral equipment; and MAI International Corp., which oversees marketing of MAI products and services outside the U.S. Nixdorf Computer is the U.S. division of international computer manufacturer Nixdorf Computer AG, Paderborn, West Germany. Hudson General is engaged in the leasing of computer peripheral equipment.

Music Printing Computerized: The production of printed music is still pretty much a hand operation. As such its cost continues to rise. The hand drawing is done most cheaply in the Orient, costs four times as much in Europe, and ten times more in the U.S., says Prof. Leland Smith of Stanford Univ.'s Center for Research in Music and Acoustics. Smith, working on the DEC PDP-10 at Stanford's Artificial Intelligence laboratory, now being upgraded to a KL10 processor, has computerized the process. Sitting at a crt terminal, he shows how he can call up a five-line music staff onto the screen, then the C clef. A few keystrokes later notes beginning appearing on the staff until one line is full. He then goes back to join the quarter-notes, cross his Ts, and put in his punctuation marks (See photo).

"It's somewhat akin to but more complex than a typesetting program," he explains. You want to justify your lines. But unlike typesetting, you also must align notes vertically so that they're played together. He shows how computer commands are available to allow him to design his own symbols, occasionally muttering at the slow response time from the system at midday. Working without any formal sponsorship but rather strictly on his own, Smith at times went to the lab at 4 a.m. to take advantage of the lighter load on the system in the early hours. His output from a CalComp plotter is reduced to page size in the reproduction process.

The system was developed for academic purposes, facilitating the production of scores by graduate students for their degree requirements. But Smith foresees the day when hundreds of computer-produced scores will be stored in digital form at the Library of Congress. Anyone could then retrieve the full score of a symphony, say, and have it transmitted by facsimile or printed locally. *

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CIRCLE 80 ON READER CARD

LOOK AHEAD

(Continued from page 18)
and undisclosed terms. Honeywell feels it won that one. Meantime it still has to face the ICS lawyer, Tom Christo, in another case: Colorado Blue Cross.

On another battlefront, Honeywell is working on a letter from the Honeywell User Group asking for changes and details on its controversial second user software policy. The contents of the letter are undisclosed, but HIS is using HUG recommendations in trying to figure out whether it will change those policies. Presumably, something will happen in July when a "summit meeting" between Honeywell and the HUG coordinating council will address the issue once again.

TO CATCH A THIEF...AND MAYBE PUNISH

TRW Credit Data hasn't been indicted. Neither has an employee (now ex). Both are still the subjects of an extensive FBI investigation (p. 181) into an alleged scheme to falsify credit records. Edward J. Brennan Jr., vice president and general manager of TRW Credit Data, said the company has "no liability" in the matter and that security and privacy controls have been increased since the matter "came to light." He said the same thing couldn't happen again. Brennan is a charter member of a Purdue University sponsored Information Privacy Research Center which will begin a five year project in July, first to investigate the privacy needs and whys and hows from a businessman's standpoint. Brennan feels most legislation today punishes business but lets go the individual who "intentionally mis-manipulates data."

TWO COPS AND...A COMPUTER?

What does it take to talk to a wounded Android who's lost his voice? Why a computer, of course. At least that's what Paramount Studios thought when they were making "Future Cop," a pilot film for a hoped-for tv series. It features cop partners, not unusual these days but these are. There's Cleaver, who's human, played by Ernest Borgnine and his partner, Haven, an Android, played by Mike Shannon.

Haven gets wounded in the pilot. He can't tell Cleaver where it hurts. His developer comes to the rescue with a computer which isn't really a computer but an Informer Inc. PA 301 portable terminal in an attache case, but it does the job. Haven is able to tell his maker where it hurts (via crt) and he gets fixed. The series, if there is one, will be called Cleaver and Haven and it's billed as a comedy.

FAREWELL TO A TOP SALESMAN

The retirement of Hamilton S. Styron as western sales manager of Datamation magazine on April 30 leaves a deep sense of loss among many western data processing vendors. He joined the magazine in 1958, the year after it was established, and followed the magazine from a skinny 48-page bi-monthly with a circulation of 24,000 to a monthly of more than 250 pages and an advertising volume last year of more than $3 million. In one year, he wrote $1,050,000 in advertising volume, a feat that hasn't been duplicated in trade publishing. He reached the mandatory retirement age of 65 on April 18.

RUMORS AND RAW RANDOM DATA

It's rumored IBM will announce a plasma display terminal for industrial applications in December; seven more such terminals are said to be on the drawing boards (see p. 183)...Jewel Stores, Chicago are beating the banks at their own game. They're negotiating a multi-million dollar terminal contract (vendor unknown) for what will be, in effect, a retail ACH (Automated Clearing House)...Stanford Research Institute is in the final phases of a study which could spread holy water on Addressograph-Multigraph's security technique for mag-stripe cards (Jan. p. 135). The technique, which involves imbedding aluminum reflectors in the mag-stripe in random fashion, is being studied by SRI in a project funded by Interbank which runs Master Charge... Technology Management, Inc., Cambridge, Mass., is involved in a highly secret project for the Treasury Dept. to develop an "automated link" between Treasury and the Federal Reserve...Dan McGurk didn't make it to Congress (Jan. p. 11). He didn't even run. But he made it to Washington, starting work May 3 as Associate Director for Economics in Government in the Office of Management and Budget...While NCR Corp. was quietly introducing its new Criterion Series of general purpose computers in the U.S. it already was selling hard in Australia, offering a $2 million Criterion 8570 (top of the line so far) for the Queensland Government's proposed central computer complex.

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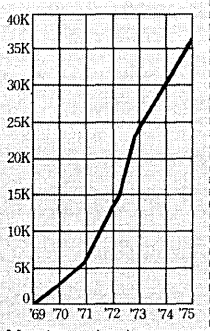

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Off-line

Fully five years after its introduction, the first GRAFIX I system sold by Information International, Inc., of Los Angeles is undergoing final tests in the central office of the British Department of Health and Social Security (DHSS), at Newcastle-Upon-Tyne, England. The totally microfilm-oriented system is unique in several regards, including its ability to accept intermixed alphabetic and numeric characters in a variety of print styles: it was important to DHSS that employees not have to change their handwriting. Despite this rigid specification, the GRAPHIX I managed to read in excess of 150 cps of mixed hand-print and computer printing with a rejection rate of less than two percent and a substitution rate of less than one-half percent.

A new wear-resistant alloy that makes it possible to significantly extend the life of magnetic heads has been developed by Carpenter Technology of Reading, Pa. Nortronics, one of the principal head manufacturers in the field has confirmed that Wear-Resistant Hy Mu 800 wears up to ten times longer than the high permeability materials currently used with no significant sacrifices in head performance.

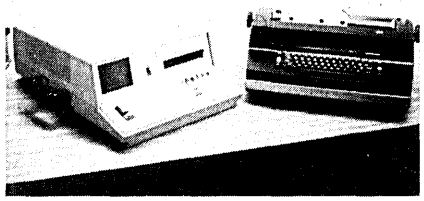
Tork, Inc., Mount Vernon, N.Y., has found a way to get more production out of its IBM System/3 model 10 without resorting to overtime pay for employees. An automatic timer is wired into the system's power circuit that can be adjusted to turn the system off after the final run of the day has begun processing. One month the firm ran 65 hours more than normal using the technique, and has managed to use a slower, less costly printer than would normally be necessary to keep reports timely.

Qume Corp., just two years after its founding, has shipped its 5,000th high-speed daisywheel printer. To give an indication of the popularity of 30-60 cps serial printers, the company's 1000th printer was shipped less than one year ago.

Oops Dept. The price of Delta Data Systems (Cornwells Heights, Pa.) model 4500 crt terminal is $4K, not the $14K listed on p. 58 of March's Product Preview section for the Interface '76 show.

IBM 5100 Peripheral

One of the first products offered for attachment to IBM's 5100 desktop computer by an independent vendor is actually another IBM peripheral, the venerable IBM Selectric typewriter. The 5100 user is thus provided with high quality hardcopy output, upper/lower case capability, and up to 156 print



positions. The Tycom 5100, as the unit is called, seems like a good way to present finished reports developed on the 5100 to management. The Tycom 5100 comes complete with a self-contained, desktop control unit consisting of power supply and interface card with a self-test feature. In operation, programmed data is transferred at a maximum of 15.5 characters per second. The Tycom 5100 is priced at $2,495 with the use of a customer-owned Selectric I or II. Two month delivery times are being quoted. TYCOM SYSTEMS CORP., Fairfield, N.J.

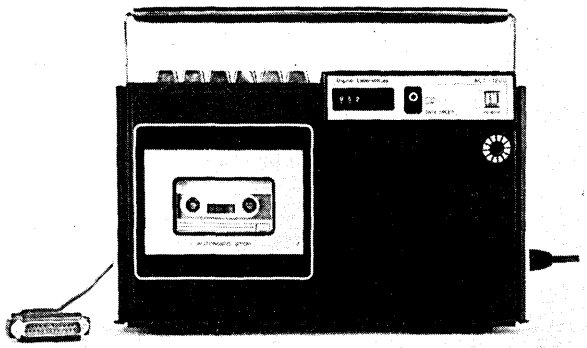
FOR DATA CIRCLE 271 ON READER CARD

CDC Minicomputers

Control Data Corporation has come in from the cold. With most every other manufacturer building minicomputers, why shouldn't the builder of the world's fastest commercially available systems?

There isn't just one model offered as a tentative step into miniland, but rather a family of four called the CYBER 18 series, with one of them, the model 18-17, using previously announced SYSTEM 17 processors. The other three models are called the 18-10, 18-20, and 18-30. The 18-10 is being directed at the distributed dp market where it can function as an intelligent terminal to process routine data on-site and send larger jobs to a

product spotlight



Data Storage

What looks for all the world like a Japanese transistor radio and tape player is actually an RS232C storage device that can be plugged into any computer or terminal's standard serial asynchronous port and record and play back data at data rates up to 1200 baud. The manufacturer is aiming the ACT-1200 primarily at the oem with a population of dedicated minis that have to be occasionally loaded with new programs for upgrading, but our guess is that the user community might have a large assortment of applications for the 1200. Most users can use existing paper tape software with the 1200. For example, with editing type programs the ACT-1200 can be used to record source programs following a PUNCH command and reenter following a READ command. Similarly, the output of an assembler or compiler may be recorded for future loading via standard object loader programs. The ACT-1200 is priced at $975 and delivery is nearly immediate, depending on quantity. DIGITAL LABORATORIES, Cambridge, Mass.

FOR DATA CIRCLE 270 ON READER CARD

central system. Firmware options for the 18-10 allow it to emulate IBM 2780 and 3780 terminals.

The 18-20 will support a variety of business dp applications and comes complete with a report program generator (RPG II, no less) and there are plans for distribution and manufacturing software releases.

It's questionable whether the largest member of the series is a mini, but if you're familiar with CDC offerings it is by comparison, at least. The 18-30 comes with dual processors, more than 500,000 bytes of shared main memory and time-sharing software allowing it to serve up to 64 terminals. This system will be marketed to small and medium-scale educational users.

The CYBER 18-17s are designed for real-time applications in production control, oil movement and control in refineries, telemetry and key-to-disc data entry.

For hardware, users can get from 8-512K bytes, and from 512 to 4,096 microinstructions, each 32-bits in length. Microprograms in semiconductor memory control the systems, execute the system instruction set, operate programmed I/O channels, and service interrupt and program protect systems. They also control the operating mode or emulation capability of the processor and interface with main memory. Up to four parallel, unrelated operations can be performed in one microinstruction, and several microinstructions are executed during a single 750 nsec main memory cycle to increase data processing speed.

Peripherals offered with the series include storage module and flexible disc drives, a conversational display unit, card readers, line printers, and magnetic tape drives.

Software offers up two operating systems, RTOS, a standalone, real-time operating system for small, multiprogramming installations, and MSOS 5, a Mass Storage Operating System that includes macro- and micro-assemblers, a FORTRAN compiler and requires 16K bytes of memory compared to RTOS' 3K. RTOS has an initial fee of $140 and monthly royalty of $80 (or a paid up license of $2,540), and MSOS 5 has an initial fee of $500 and $120 per month royalty, or a paid up license of $4,100.

Pricing can go all over the place given the range of power of the systems, but to prove that they are indeed minis, one can get a CYBER 18-10 with 32K of memory, 300 cpm card reader, 300 lpm printer and controller, crt, and synchronous communications capability for $39,840. Lease plans are also available. CONTROL DATA CORP., Minneapolis, Minn.

FOR DATA CIRCLE 272 ON READER CARD

Disc Rebuilding

Repair and service of all makes of cartridge discs for front loading IBM 2315 type and top loading 5440 type cartridge disc drives on a fixed price basis is this vendor's new service. For a flat rate ranging from $38-45 per cartridge, the unit is disassembled, inspected, cleaned and repaired using factory parts and equipment. The completed unit is fully guaranteed to perform exactly to the original specifications. The vendor reserves the right to judge those cartridges having gross damage as non-repairable, in which case they will be returned to owner without charge. The service should also be considered by users who have used their disc media for a prolonged length of time or have moved the discs around within the installation, as the hubs often get

somewhat warped in the process, we're told by users. DICAL, INC., San Jose, Calif.
FOR DATA CIRCLE 273 ON READER CARD

Cassette Tape Cleaner

This product might just be a first—but at the price of cassettes we're not sure whether it's warranted or not. User applications and procedures will probably dictate the success of the CTC-300. It cleans and rewinds any Philips-type digital, word processing, or dictating cassette. Up to 90% of the dirt, dust

and oxide debris particles that cause "permanent" tape errors can be removed. An operator inserts the cassette and the CTC-300 does the rest. A sapphire cleaning blade and automatically advancing tissues are used to process the tape. The CTC-300 is priced at $495. KYBE CORP., Waltham, Mass.
FOR DATA CIRCLE 274 ON READER CARD

Floppy Disc Medium

This manufacturer has developed a new floppy disc that is said to offer dramatically improved performance and exceptional durability for a price competitive with current offerings. The model FD-3200S features a newly developed binder system that makes possible a very fine dispersion of magnetic powder for highly accurate recording. It's claimed that the disc is exceptionally smooth which is a key to the durability. The developers are claiming 10 million passes per track without error at the 3200 bpi density. The capacity is 243,000 bites (sic) on the seven tracks. The FD-3200S is priced at $8.50 each. MAXELL CORPORATION OF AMERICA, Moonachie, N.J.
FOR DATA CIRCLE 275 ON READER CARD

Communications Mini

The SMART/MUX mini has been equipped with improved network management and usage statistics, link error reports, and serializers to provide a 30% performance increase. New software on the mini attempts to provide error-free communications between remote terminals and the host computer, fewer telephone links through statistical multiplexing, less terminal control hardware at the host resulting from automatic baud-rate detection and dynamic host selection. The object is improved front-end processing for 360 and 370 systems emulating 270X equipment. The new serializers are two-port modules, eight of which are located on a single pc card in the mini, that provide compatibility with synchronous and asynchronous terminals, 5-8 bit character handling, stop-bit selection, "break" detection, echo, and variable baud rate detection. Base prices for SMART/MUX systems are $5,700 and nearly immediate delivery is being quoted. DIGITAL COMMUNICATIONS ASSOC., Atlanta, Norcross, Ga.
FOR DATA CIRCLE 277 ON READER CARD

Commo Processor

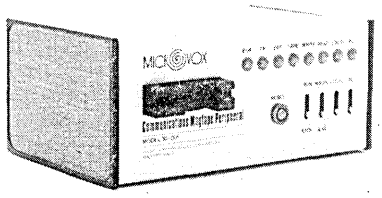
PIX, one of the first products to kick off the distributed computing trend, has been brought up to SDLC (IBM's latest communications protocol) capability, with the introduction of PIX II. In essence the PIX II extends the multiplexor channel of IBM 360s and 370s to allow the host cpu to communicate with remotely located peripheral devices by using standard I/O com-

mands. A 32K 16-bit microprocessor is at the heart of the PIX II controlling actions using a 53 instruction repertoire, the average execution time for which being about 2.5 usec. The memory cycle time is 500 nsec.

With SDLC protocol the PIX II can operate over a variety of facilities that include Direct Data Dial (half- and full-duplex), leased private lines, wide band transmission, digital networks and even satellite transmission links. Data rates range from 4800 to 56,000 baud. All error control is performed by the PIX II, eliminating the need for IBM remote job entry software. Typical systems rent for approximately $1,600/-month on a two-year lease. Initial units have gone to the field. PARADYNE CORP., Largo, Fla.
FOR DATA CIRCLE 276 ON READER CARD

Cartridge Peripheral

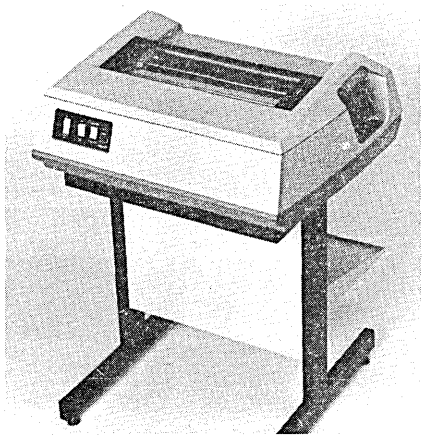
If your application can accept a continuous-loop type of recording medium, then you can take advantage of this peripheral and its low price. Data is recorded on 35-foot tape "wafers" that store 20K characters and sell for only $3.50 each. Operating rates are the standard communications data rates of 110, 300, 600, and 1200 baud.



The unit is fully double buffered and capable of operating under both local and remote control. Front panel switches are used for local control; standard ASCII characters control it remotely. Five of the tape wafers are included in the $895 price of the peripheral, MICRO COMMUNICATIONS CORP., Waltham, Mass.
FOR DATA CIRCLE 279 ON READER CARD

Serial Printer

Tally has been rounding out its printer product line nicely in the last two years, and the model 1200 is the latest addition. It's a 120 cps dot matrix unit that features 132 column printing widths, dual tractor engagement above and below the print line for positive paper advancement and positioning, and a convenient snap-in ribbon cartridge for easy ribbon replacement. The slew speed is 10 ips. An original plus four carbon copies can be printed by the 1200 at widths ranging from 4-15 inches. Specifications include six



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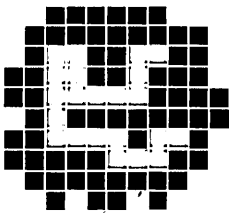

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lines per inch spacing, 10 character per inch character spacing, a 64-character ASCII set and a 9×7 half-space matrix character. Options include upper/-lower case 96-character set, and a two-channel vertical forms unit. A selection of interface controllers for data communications applications is coming, and the 1200 can also be directly buttoned up to most popular minis. The 1200 is priced at $2,575. TALLY CORP., Kent, Wash.

FOR DATA CIRCLE 280 ON READER CARD

Floating Point Processor

A floating point unit is now available for Intel MDS and SBC (Single Board Computers) that should make some even more exciting microprocessor-driven devices possible. The 8080 instruction set is thus expanded to include the following functions: binary floating point decimal conversion; all trig functions (inverse and hyperbolic), logarithms and powers (natural, common, x-power-y), multiplication, division, addition, and subtraction of 12-digit numbers in the range $10^{\pm 99}$; coordinate transformation; and mean and standard deviation. The module requires no user "driving" software and is called from the user program like an assembly language subroutine. The unit is nonvolatile and operates when the power is turned on. As is the case with most microperipherals or components, this one, too, costs more than the 8080 or SBC it will complement: the price is $1,050. MICROPROCESSOR SYSTEMS DESIGN, Los Altos, Calif.

FOR DATA CIRCLE 281 ON READER CARD

Label Printer

Label printing of alphanumeric characters up to two inches high is what this firm's Label Printer does best. The unit contains an integral digital processor that performs control functions. The printer can generate a line of one-inch high characters on an 11 × 14 7/8-inch label in just under two seconds. Data can come from any device that has an EIA RS-232 serial interface, and that includes punched card readers, crt keyboards, or directly from a computer. The unit can be used in harsh industrial environments and contains a heavy duty blower for ventilating and cooling, and a filter to trap dust and other particle contaminants. The integral processor has a self-test routine to help pinpoint malfunctions. Prices start at $14K; delivery is approximately four months. DIAMOND ENGINEERING, Redmond, Wash.

FOR DATA CIRCLE 282 ON READER CARD

Bar Code Scanner/recorder

The STOR/SCAN 100 is a portable scanner/recorder for reading bar coded labels. The device accommodates labels with up to 32 digits of information. Scanned information is recorded on a tape cassette (Philips-type) with capacity for storing 144,000 digits of information. A numeric keypad permits entry and recording of variable, non-labeled data such as quantity or date/time. Options include an impact printer for multiple copy listings, and a

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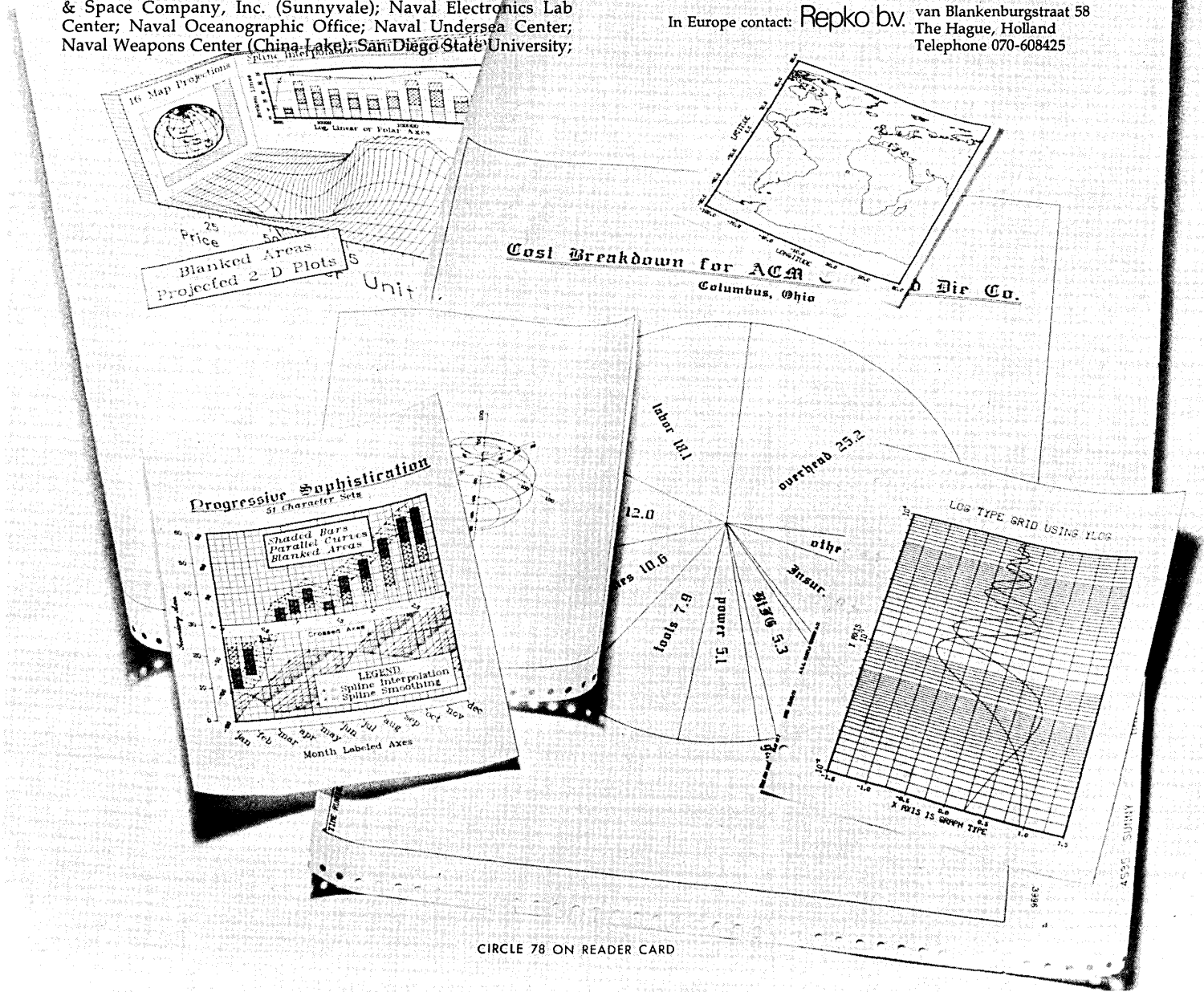


hardware

checksum feature useful for verification or audits. Several versions of the system are available for IBM-compatible recording on magnetic tape, and battery-operated units. Prices start at $2,900. DANYL CORP., Pennsauken, N.J.

FOR DATA CIRCLE 283 ON READER CARD

Printer Controller

Systems houses looking for a way to attach a serial printer to a Data General or Digital Computer Controls mini need look no further: this firm is offering a pc card interface that attaches the GE Terminet 120 line printer to the mini. The interface is supplied as a complete package including controller board, all required cabling, installation instructions and software diagnostics. Units are fully compatible with the minicomputer's software. The series 160, as the unit is called, is priced at $750. CUSTOM SYSTEMS, INC., Minneapolis, Minn.

FOR DATA CIRCLE 284 ON READER CARD

8080 Development System

The 8/16 is a complete standalone development system for writing, debugging, and executing programs on an Intel 8080 microprocessor. The system comes complete with an 8K memory, an alphanumeric crt display, ASCII keyboard, two cassette tape units, and software. Included in the software is a monitor/debugger, editor, and assembler designed to take advantage of the high-speed multiline crt display and tape I/O. The memory can be expanded to 32K, and features write protect where each 1K page of memory can be write protected under software control. The crt displays 24 lines of 40 characters. Also included in the package are a crystal controlled programmable real-time clock with 32 usec resolution, interrupt driven I/O, eight-level vectored interrupt processing, and a bootstrap loader in a programmable read-only memory. The 8/16 is priced at $3,850. MICROKIT INC., Santa Monica, Calif.

FOR DATA CIRCLE 285 ON READER CARD

Financial Terminals

IBM has expanded its 3600 series of financial communications systems with the announcement of teller terminals that can be used in small banks, thrift institutions and credit unions. The teller terminals feature a keyboard display and document printer in a compact design that can be easily installed for countertop use at main or branch locations. The models 5 and 6 of the 3604 teller terminals take up approximately 40% less space than previous similar offerings. They display 120 and 240 characters of information, respectively, and either terminal can be placed in front of the model 3610

Personal I.D. keyboard pad.

model 4 document printer. The complete terminal thus occupies an 18 × 18-inch square. A personal identification number keyboard pad is also featured on the 3604 that allows consumers, for example, to inquire about account balances, credit verifications,

or electronic funds transfer authorizations. The customers can enter their unique identification numbers during a transaction and protect against unauthorized use of credit cards, passbooks, and checks. Purchase prices for

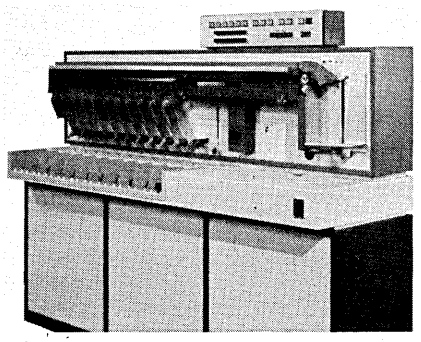
3604 teller display and 3610 document printer.

the two new teller keyboard displays are $1,575 and $1,825, respectively, or $60/69 under IBM's five-year lease. The new document printer is priced at $2,225. First shipments are scheduled for the first quarter of next year. IBM CORP., White Plains, N.Y.

FOR DATA CIRCLE 278 ON READER CARD

MICR Reader/Sorter

NCR has developed a faster replacement for the 670 Magnetic Ink Character Recognition reader sorter that has been on the market some time. The new model 675-101 handles varying sizes of MICR-encoded documents at a rate of 750 six-inch documents per



minute. A variety of sizes and documents can be sorted, including checks, card stock, and postal money orders. It has 11 pockets for receiving documents, each with a capacity of 225 documents. The input hopper capacity is 1,750 documents. The sorter operates either as a free-standing unit or as an on-line input peripheral with a Century series NCR computer. The 675-101 sells for $58K and rents for $1,350. NCR CORP., Dayton, Ohio

FOR DATA CIRCLE 286 ON READER CARD

Advanced Circuitry

The company that brought us the write-only memory on April 1 two years ago has come out with another revolutionary device called the "Gnomonic Utopian and Recondite Ultimate" Device, or "GURU DEV" on April 1 of 1976. The advanced circuit is the first example of CSI (Cosmic-Scale Integration) "which is infinitely better than large scale stuff," say the developers. The circuit is destined for use in Empathuters (analogous to a "subjective computer") where the GURU forms the heart of a section known as the "Compressed Narthex Shrove Unction System, or CONSHUNS. The GURU works closely with a FOM (Fish-Only Memory) which fishes for remembrances of things past. Results of the comparison are electronically transferred to the write-only memory and are stored permanently—and never seen again. The developer claims to be the home of the world's most intelligent pet rocks. NATIONAL SEMICONDUCTOR CORP., Santa Clara, Calif. ❋

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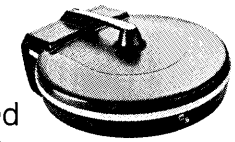

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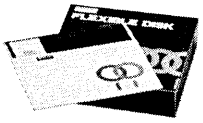

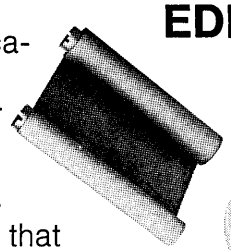

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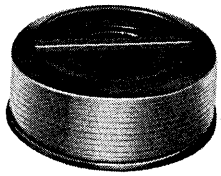

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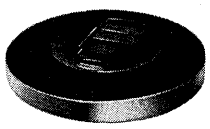

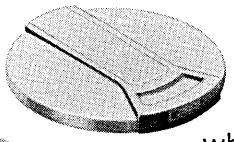

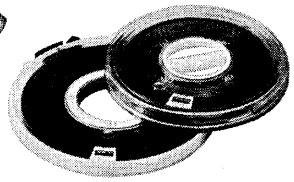

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Updates

After installing lotteries in Nebraska and Delaware, Mathematica, Inc., Princeton, N.J., has been awarded a $540K contract to do the largest such system to date for Ohio. The COMPU-INSTANT system, a set of computer programs, operating procedures, management reports and data is key to the installation. The instant lottery calls for a minimum of 50 million tickets to be in existence.

Client Information System, a software application that cost the Illinois Department of Public Aid $1 million to develop, is expected to save that state's taxpayers in excess of $1.5 million this year alone says the State Public Aid Director, James L. Trainor. Already, 500 cases of duplicate food stamp eligibility cards have been eliminated, and 2,000 additional recipients found to be ineligible. Correction of only these two conditions led to an annual saving of $1.2 million, plus the system oversees assistance cases receiving medical aid and income grants. CIS links the department's headquarters office in Springfield with 125 county and district offices throughout Illinois. CIS runs on an IBM 370/168 together with 2741 hardcopy and 3270 intelligent terminal displays.

Here's a different way of thinking about the logic of a computer program: "Computer software and electrical systems have similarities," says John Rankin, sneak circuits analysis manager at Boeing's Houston, Texas facility. "For example, an arithmetic instruction is analogous to an electrical load. The start of a computer program is similar to an electrical power source, while a program stop approximates an electrical ground." Boeing has routinely used elementary electrical equivalents to analyze problems known to exist in software programs for the B-1 bomber, the Morgantown Personal Rapid Transit System, and the E-3A airborne warning and control system.

As if there weren't enough divisive factors in this industry, adherents of programming languages are beginning to take militant stands. A recent bumper sticker observed in California read: Happiness is Cobol-ing.

DOS Management

This vendor's DOSSIER product, which provides current information about programs catalogued on an IBM DOS user's core-image and relocatable libraries, has been outfitted with a new module, called Program Analysis. The CPA facility compares the user's relocatable library modules with the core-image library to produce five reports on module usage and management. This is done in two stages: first by reading the desired relocatable library to build an extract file with information about each entry point in all user (non-DOS, non-GRASP) files. The second phase determines which entry point code occurs in a given core-image phase. This information, together with other extracted data is sorted using the DOS Sort/Merge program to produce five reports; a called-program usage report, synonym report, no-auto entry list, and an external reference list. Though CPA doesn't strictly require DOSSIER in order to perform, for the time being it is being marketed as a major design enhancement to DOSSIER, which rents for $75/month on a one-year lease. COMPUTER CONCEPTS, INC., Portland, Ore.

FOR DATA CIRCLE 262 ON READER CARD

On-line Access

On-line access and updating of files using up to 10 tty-compatible terminals is now possible on NCR Century 101 or larger systems with at least 48K words by using MATR II, Management Access to Records. Information requested can by displayed on visual display terminals like the NCR 796, or in printed form. A simple conversational language is used to set up inquiries. Record selection techniques include random, sequential and reverse sequential. Selection criteria can be chained for example to search for all salesmen from a certain region, over a certain age, married with more than two children, whose year-to-date sales are at least $100K. An activity log is maintained to show all user sign-ons, data files either opened or modified by each terminal operator, and sign-offs. A password scheme is incorporated to allow access and/or modification file and record protection. To implement the system, users simply specify which data files are to be accessed by means of conventional NEAT/3 file specification sheets, record definitions and field definitions. Available for immediate delivery, MATR II rents for $40/month and a one-time charge of $1,500. NCR CORP., Dayton, Ohio

FOR DATA CIRCLE 264 ON READER CARD

Mini Time-sharing OS

The total system resources of a General Automation SPC/16 mini can now be offered up to 64 terminals with TSOS-16, a new time-sharing monitor. Multiple users are free to create, test, modify and execute programs as if the system were dedicated to them. Access to restricted and open files is controlled by password identification techniques. Files are accessed through an indexed/random file access package which allows simultaneous updating of public files by multiple users. Scheduling is on a round-robin priority basis which allows each user to get as much service as any other. It's claimed that up to 32,000 users can be supported on 63 terminals and the system console. TSOS-16 is priced at $3K. APPLIED DIGITAL TECHNOLOGY, INC., Chicago, Ill.

FOR DATA CIRCLE 265 ON READER CARD

Cobol Flowcharting

FLOBOL is an automatic flowcharter for COBOL source programs which additionally produces a comprehensive cross reference listing. Connectors are provided where needed to reflect entries and exits to closed sub-programs. The system is composed of three COBOL programs with imbedded COBOL sorts. Input is the source program itself on any reasonable input device, including disc, drum, card reader, mag tape, paper tape, etc. FLOBOL is written in ANSI Standard COBOL and will flowchart COBOL programs including most vendor extensions. The package is priced at $480 and the documentation an additional $9. There are approximately $7,250 source statements in FLOBOL. COSMIC, UNIV. OF GEORGIA, Athens, Ga.

FOR DATA CIRCLE 266 ON READER CARD

Manufacturing

IMS/66 is an extended materials requirements planning package that runs on Honeywell Level 66 large scale systems. The product is a data base and transaction-oriented system that integrates product structure and cost control, inventory and order control, material requirements planning, and optionally statistical forecasting. This latest version of IMS/66 can detect and react to the need for rescheduling open and released supply orders to enable

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Manager, Technical Planning and Development
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"Programmer acceptance of MARK IV is excellent. Since it does away with so much of the busywork of Cobol, it lets analysts become programmers and vice versa. Our people can get involved in the whole problem.

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FOR DATA CIRCLE 261 ON READER CARD

Disc Space Management

DMS/OS is an IBM disc management system that attempts to provide users with more control over the disc storage facility. The table-driven package can be set up by the user to specify which elements of data are to be included and the nature of editing to be employed. A dynamically maintained control stack maintains a continuous audit trail of the module in control and all higher level modules in the execution sequence. It collects in one control block the entry point, return address and pointers to the save area and parameter list for all of these modules. DMS/OS is not confined to data maintained by OS in the data set control block or a small set of special purpose files. The package can be used on-line with such teleprocessing submonitors as CICS, TASK/MASTER, INTERCOMM, IMS/TP, and others.

Four reports are produced, including a data set dictionary, volume attribute summary, free space detail report, and a space availability summary. The package is priced at $8,900. A billing module is available for an additional $1,200 as are teleprocessing interface modules. SOFTWARE MODULE MARKETING, Sacramento, Calif.
FOR DATA CIRCLE 263 ON READER CARD

Fortran Graphics

Anyone familiar with FORTRAN can create and manipulate relatively complex graphic images on Sanders SA 500 interactive graphic display systems using GSS-3, says the manufacturer. The major functions of GSS-3 include allowing the application programmer to organize display information into

software spotlight

Business Graphics

An interactive business graphics package is now available on General Electric's MARK III time-sharing, network computing and remote batch computer service. PLOT*** uses simple English commands to generate a variety of plot types, including line graphs, bar graphs and scatter diagrams. The package can run with customer supplied data, but as an added bonus, it also interfaces to GE's FAL II, a financial analysis language, also via simple commands. More than 30 terminals are qualified for use with PLOT***, including the GE TermiNet models 30, 300, and 1200; tty models 33, 35, and the Zeta Resear h Plotter at 300 and 1200 baud rates. Most other character printers also qualify. Elimination of the time-consuming job of manual preparation of graphs was said to be high on the list of design goals for PLOT***, and the package doesn't require familiarity with a programming language to use, making it ideal for non-dp oriented managers. The photo shows a printout produced on a TermiNet 1200 terminal generated from 20 short input lines and produced in two minutes. GENERAL ELECTRIC INFORMATION SERVICES, Vienna, Va.
FOR DATA CIRCLE 260 ON READER CARD

IDMS

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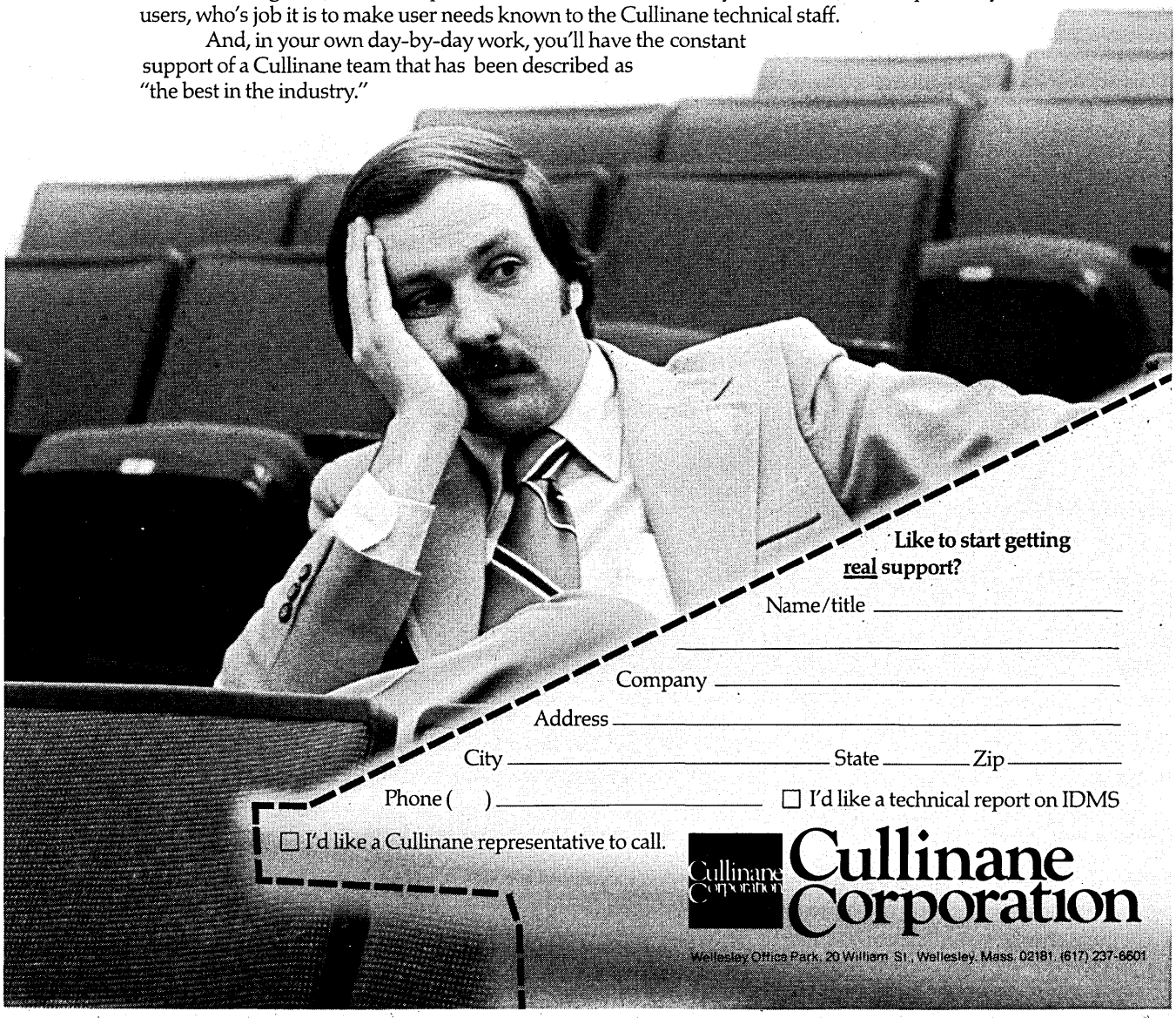

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independent "pages"; a tty simulator at each operator station for keyboard input, and a "mark" within pages so the application programmer can perform random access updates to displayed information. The minimum SA 500 configuration comprises a display generator with page register option, display processor (a PDP-11) with 24K words of core and extended instruction set, display indicator, (keyboard, lightpen, trackball or joystick optional), disc cartridge control and drive, tty terminal, bootstrap loader, clock, RSX-11M operating system and a second disc drive, tape, or cassette unit. After accumulating that configuration, GSS-3 will only set you back an additional $1K. SANDERS ASSOCIATES, INC., Nashau, N.H.

FOR DATA CIRCLE 267 ON READER CARD

Data General Cobol

When one asks Data General why they're implementing a full ANSI COBOL compiler on its minicomputers at this stage of the game, one receives a reasonable answer: there have never been more COBOL programs in existence than today, which is a guarantee that the language will be around for some time, like it or not. There are two other considerations as well: IBM installations run gobs of COBOL, and the advent of distributed processing gives DG a chance to say "consider our ECLIPSE C/300 mini before ordering an additional IBM 370 model 115, 125, or even 135."

It isn't that simple, of course, but it never is. DG is seeking out "IBM's more sophisticated users" for the COBOL, because it's going to take some shoehorning and in-house work to get it to run. For example, there isn't any fancy JCL capability, which can be both a blessing and a curse. The compiler is said to be complete, however, except for the report writer and telecommunications support (which can be obtained by using DG's Communications Access Manager, CAM). There are said to be extensive data management capabilities, an interactive debug module, English-language error diagnostics, and cross-referenced source listings. You'll need a C/300 with a minimum of 128K bytes of memory, and the mapped RDOS monitor to get started. At press time the price hadn't been firmly established but was projected to be in the $7-10K range. DATA GENERAL CORP., Southboro, Mass.

FOR DATA CIRCLE 268 ON READER CARD

letters

(Continued from page 8)

was to attempt to reduce the cost from $73 million to $65.7 million, a saving of some $7.3 million, annually—from an investment of $240,000, remember.)

I was aware that the investment in hardware would be accompanied by other costs, and that the potential return on that investment would not—could not—be realized in the single year under consideration by the finance committee. I am also aware of the short-term imperatives of expense-reduction programs. In other words, I was psychologically prepared to have my proposal rejected.

What I was not prepared for then, or since—and even now—is the strength of the convictions that appeared to undergird objections to my proposal. I had expected opposition to be based mostly on the short-term imperatives of expense reduction. Instead, the proposal was attacked on the ground that it was unrealistic—"academic."

I was quite disappointed that the finance committee did not even regard the proposal as worthy to be the basis for a permanent, large-scale expense-reduction program. (One should not be surprised that this same committee also rejected my suggestion that "the computer" could be used to "make money for the company," not just reduce avoidable expenses.)

Despite my consistent lack of success, I remain convinced that the idea has sufficient merit to warrant its being called to the reader's attention.

ROBERT M. GORDON
Director
Computer Services Centre
Victoria University of Wellington
Wellington, New Zealand

Poetic praise

To David Diamond, BRAVI!
For his Programmer's ABC.
For his eloquent verse
He richly deserves
A place in posterity.

PETER MARTIN
Mountain Lakes, N.J.

Mr. Diamond replies:
With modest blush you make me burn
But praise for praise I will return.
Peter, my first and only fan,
You are a most discerning man!

Coincidence

The article in your March issue ("Huge New Markets in Telecommunications," p. 181) on the Office of Telecommunication's upcoming Task Force final report on barriers to telecommunications growth is, by and large, fair and accurate. You have, however, connected the report to certain pending Congressional leigslation, specifically, HR 9630, and this connection is invalid.

Your statement that the "report . . . is being drawn up in anticipation that Congress will make available $1.25 million in the next fiscal year" is simply inaccurate. I concede that in terms of program emphasis, there is indeed some similarity between the report and the legislation in question. This is, however, attributable entirely to coincidence. Our draft report, completed last October, was not in any way intended to inspire or to influence HR 9630, and our final report is not being designed to conform to it.

To repeat, your article was, overall, a satisfactory summary of OT's Task Force draft report. I write this only to insure that you understand that our final report will be the product of our own efforts and is certainly not being composed to correspond to HR 9630.

LOIS H. ADAMS
Public and Technical Information Officer
U. S. Department of Commerce
Office of Telecommunications
Washington, D. C.

Computer backgammon

I need to improve my backgammon game drastically before retiring early to the Caribbean. Do any of DATAMATION's readers know of any programs that play backgammon? Or that simulate strategies for bearing off, doubling, etc.?

GEORGE GLASER
225 Warren Road
San Mateo, California 94402

Chilled Tapes

To Mr. Geller's interesting suggestions for the care of chilled tapes ("Erasing Myths about Magnetic Media," March, p. 65), I'd like to add an old cold-weather trick to avoid condensation. Since condensation occurs most when warm, moist air comes near a cold object, wrap the tapes in air-tight plastic bags *before* moving them out of the cold. They'll take longer to dry, which is all right, but they won't get so wet as if you had brought them directly. This technique works for any moisture-sensitive object which must be moved from cold air to warm—a camera used outdoors in winter, or a voltmeter used inside a walk-in freezer, for instance.

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A Vision of the Millennium

I dreamed one night about a place,
Where I shall never stand.
"The heart goes where no footstep
may,
Into the promised land."

For there their mode of programming
Was strange to me, and new,
For each delivered product
Did what 'twas promised to.

They specified each project,
And planned it from the start,
And drew up detailed flowcharts,
That outlined every part.

While managers were seeking
(Lest any single wheel
Should ere be reinvented)
From somewhere else to steal.

And if they couldn't steal it,
They would design it so,
Into the next man's project,
Their module would go.

They worked in little increments,
Their modules each were small,
And each was tested separately,
Lest one should upset all.

They'd implement and document,
And test it with a will,
And never would let go of it,
While it was buggie still.

Their maintenance was easy,
Each user wore a grin,
They are not bothered much by bugs,
Who never put them in.

And when they did enhancements,
They found that easy too,
For they had kept the documents,
Which told them what to do.

I asked if I might stay there,
And with them find employ,
Because of my experience,
They made me office boy.

Sadly I woke from dreaming,
Now my sorrows none can cheer;
That happy land I dreamed of,
"You can't get to there from here."

Don't ask me why I tremble,
Or code with shaking hand,
"The heart goes where no footstep may,
Into the promised land."

—David H. H. Diamond

A man had a robot named Sadie,
Which was an impeccable lady,
though unspeakable cads
who wrote of her in ads
as "cheap and fast" made her sound shady.

—Gloria Maxson

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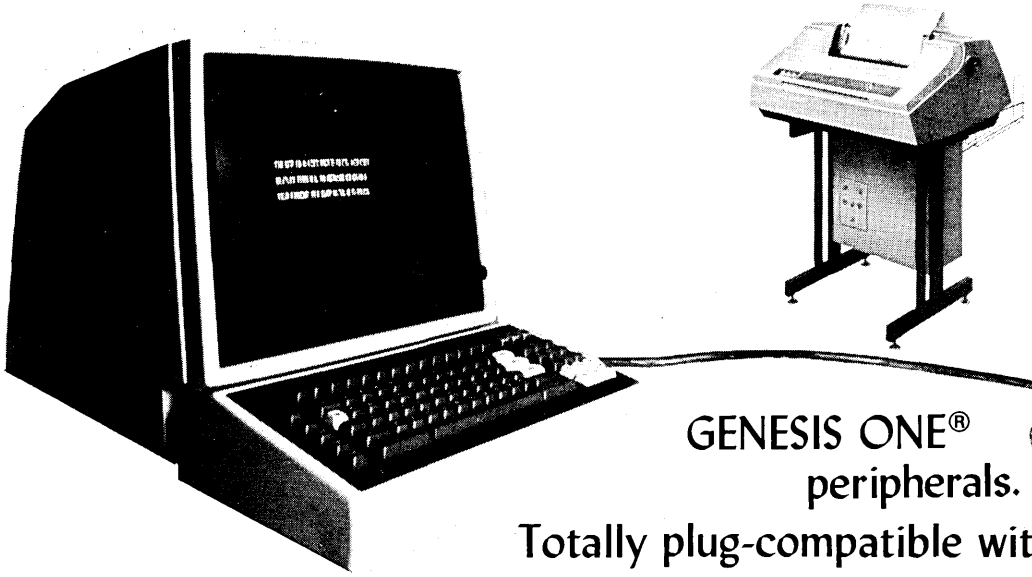

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Bill Taylor, Southland Life
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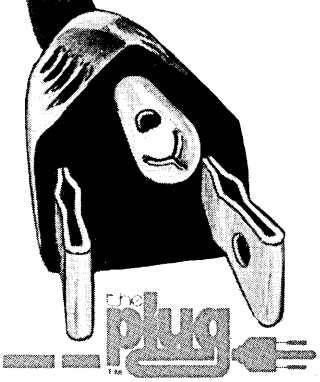

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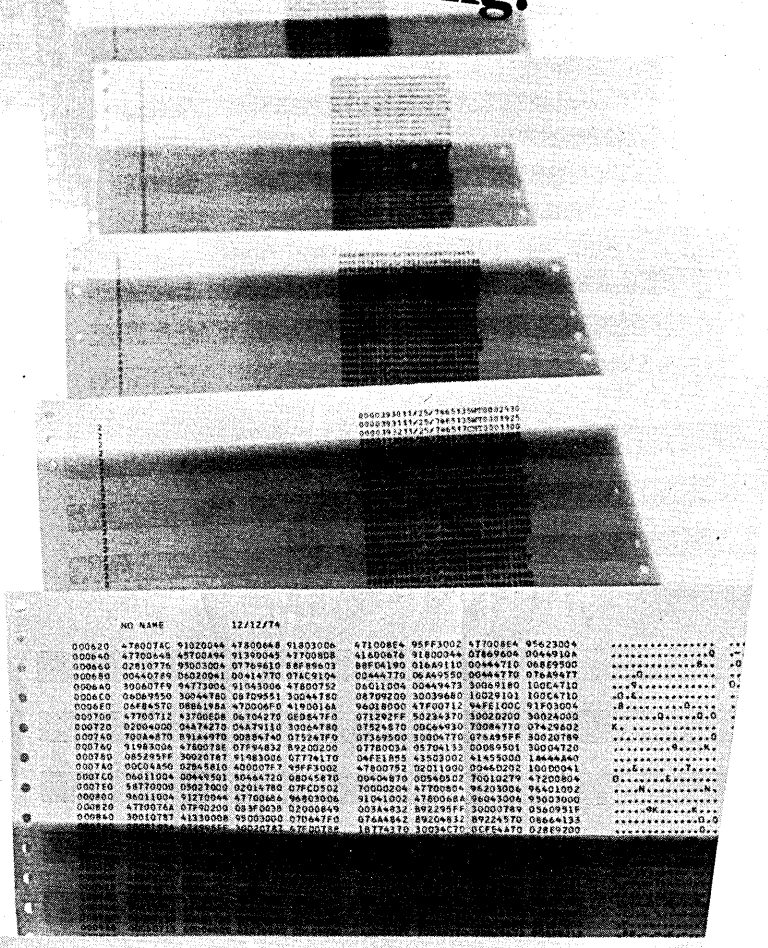

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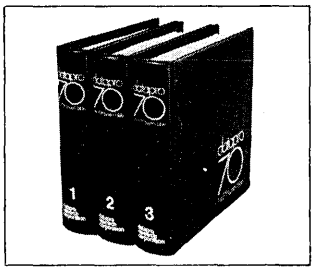

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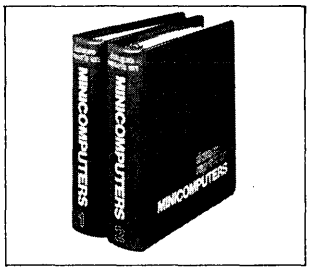

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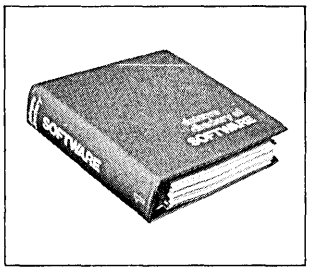

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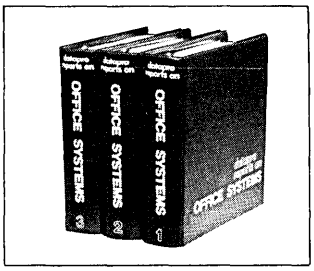

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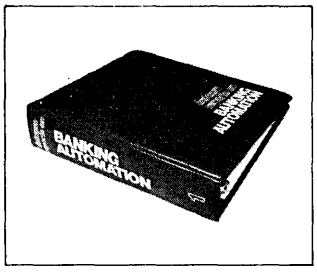

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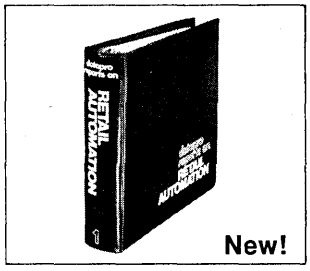

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This forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

the forum

Let's Hear it For COBOL!

COBOL has the worst press of any programming language. Maybe that doesn't matter; considering that COBOL is used twice as much as all other languages combined, users may not care greatly what other people think of it. But they should. The combination of ignorance, apathy, misunderstanding, and hostility regarding COBOL that one faces among leaders of the profession *is* damaging. These negative attitudes hamper proper education, impede the dissemination of new techniques, and slow the process of evolution that is essential to the orderly development of any language.

Lest it be thought that I am knocking down straw men, let me cite a few instances:

- In a major address on programming and programming languages a few years back, one of the top leaders of the field managed to talk for an hour without so much as mentioning the word "COBOL."
- Last year I asked one of the organizers of a conference on software reliability what had most favorably impressed him about how the conference had gone. Answer: the absence of hallway discussions of structured FORTRAN and COBOL. Odd, in view of the high interest in those very subjects throughout the industry. (ACM chapters around the country have set attendance records at my talks on structured COBOL, and I really don't think that is a tribute to my good looks.)
- Many leading innovaters in computing simply don't know COBOL very well, and toss off derogatory remarks about it that range from seriously exaggerated to simply false. (Sample: "The COBOL nested IF is impossible, and nested IF's are essential to structured programming, so COBOL is no good for structured programming." Well, the COBOL IF syntax isn't *that* bad, and structured programming is neither for nor against nested IF's.)
- While arranging for a visit to a certain university, I asked the chairman of the Computer Science Dept. if he could put me in touch with the people involved in teaching COBOL. He said he didn't know much about COBOL at his school; it *certainly* wasn't taught in *his* department, but he would see what the business school might have. (Turned out they had six sections of three different COBOL courses.)

With attitudes like these among industry leaders, would the proverbial visitor from Mars ever guess that a majority of programmers—worldwide—routinely use COBOL to get productive applications work done?

I think the answer is simply that COBOL has gotten a bum rap. It ain't as bad as you think, fellas!

Better than you think

In particular, COBOL is a lot better for structured programming than some folks seem to think, and with a few small changes (really!) it could be very much better than that. Let me take up the two points of that assertion

separately after saying what I mean by structured programming.

I understand structured programming as a style of programming in which control logic is restricted to just three elements (sequence, selection, iteration) in an attempt to write programs that are as understandable as possible. Highly understandable programs are more likely to be right in the first place, are easier for others to check, are faster and

cheaper to debug, and are a tremendous help in maintenance—which is where most of the agony of programming is.

COBOL, just as it is today, permits the writing of programs that, for the most part, are fully structured and which are very easy to understand. The necessary language elements are there: the IFTHENELSE is directly available, the PERFORM UNTIL is an acceptable variation of a DOWHILE. The CASE structure, if and when it is really needed, can be implemented with a chain of IFTHENELSE's if small to medium, or with a GO TO DEPENDING ON if large. With reasonable attention to such good programming practices as the use of meaningful data names, consistent indentation and the absolute prohibition of the obscene ALTER statement, programs written in this style are as easy to understand as any I have seen—and better than most.

The programming techniques involved are fairly simple to learn. The fundamentals can be presented in a couple of hours, or make it a couple of days if you want to allow a lot of time for doing case studies. The ideas are not difficult but some of them are sufficiently different from what an experienced COBOL programmer has been doing that they take

the forum

some practice to become comfortable with. Many thousands of people have gone through this process by now with no known cases of trauma. Based on what I see in my travels, I would estimate that perhaps a quarter of all COBOL shops are now using some form of structured programming, as defined above, alone or in combination with such other techniques as structured walkthroughs, top down development, etc.

COBOL programmers who want to see what all the shouting is about and get some guidance on getting started if they choose to do it, might look into the recent IBM publication "An Introduction to Structured Programming in COBOL."

Better still

Although COBOL is much better for structured programming than its detractors would have us believe, it certainly could be better. The syntax of the IF statement does leave something to be desired, especially the way it interacts with the AT END and INVALID KEY phrases of the READ and the ON SIZE ERROR phase of the arithmetic verbs. The code controlled by a PERFORM can only be out-of-line, which sometimes detracts from understandability. It would occasionally be nice to have a variation of the PERFORM in which the test of the condition is made at the end of the execution of the controlled code instead of before. An explicit CASE structure would be helpful in some applications.

It turns out that all of these features could be incorporated into COBOL in such a way that compilers built to accept the new features could process existing programs without change and without special control cards. This means that the new features would be optional: use them or not, even mixing new and old within one program if it suits your fancy, and the compilers could cope. This is said not to recommend poor programming practice, but to emphasize the evolutionary nature of the changes. And evolutionary change is surely the only real hope for something as big as COBOL, with literally billions of dollars in existing programs and with something over a hundred thousand programmers to retrain when changes are made.

Readers who share my excitement about these changes in COBOL and want to see them in the language sooner than later, might drop a note to that effect to the Programming Language Committee of CODASYL (928 Garden City Drive, Box 124, Monroeville, PA 15146).

Let's go, COBOL!

COBOL is the most widely used language in the world by a very wide margin, and it will stay that way for at least a decade. So let's work to make the best use of it, and to improve it gradually but steadily. Just think—if all the COBOL programmers in the world could become, say, 30% more effective, that would be the equivalent of tens of thousands of additional programmers available to work on new applications or to reprogram the most horrible dogs that are still running. I think that is an entirely obtainable goal.

I say, let's get on with it and not sit around moaning about the horrible state of programming languages while waiting for some utopian solution that never seems to get any closer. Remember: the best is the enemy of the good! These kinds of programmer productivity gains are available *today*.

—**Daniel D. McCracken**

Dan McCracken is the author or coauthor of 15 books on programming, the latest of which, perhaps not surprisingly, is "A Simplified Guide to Structured COBOL Programming." He is a member of the ACM Council and chairman of its Committee on Computers and Public Policy.

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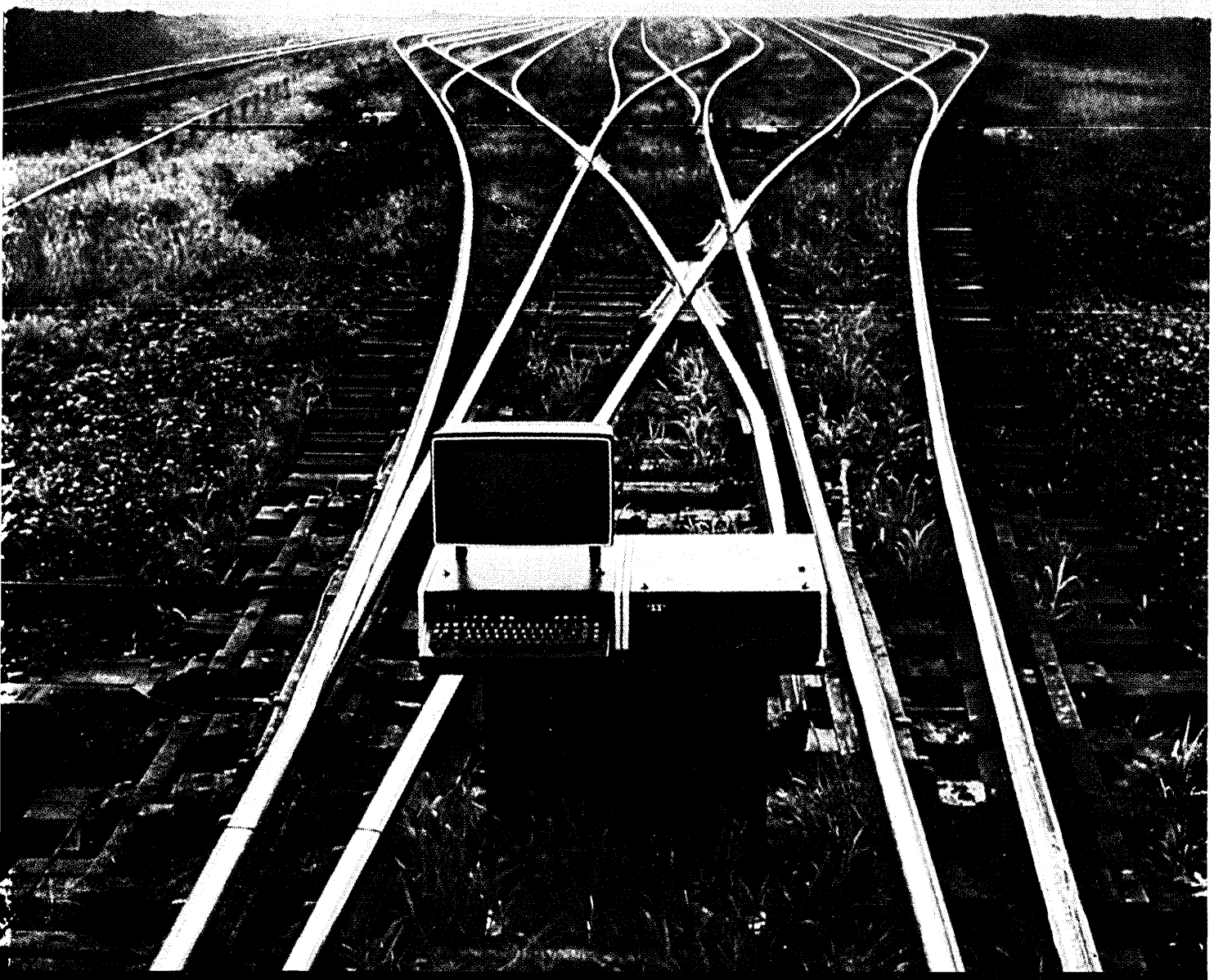

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