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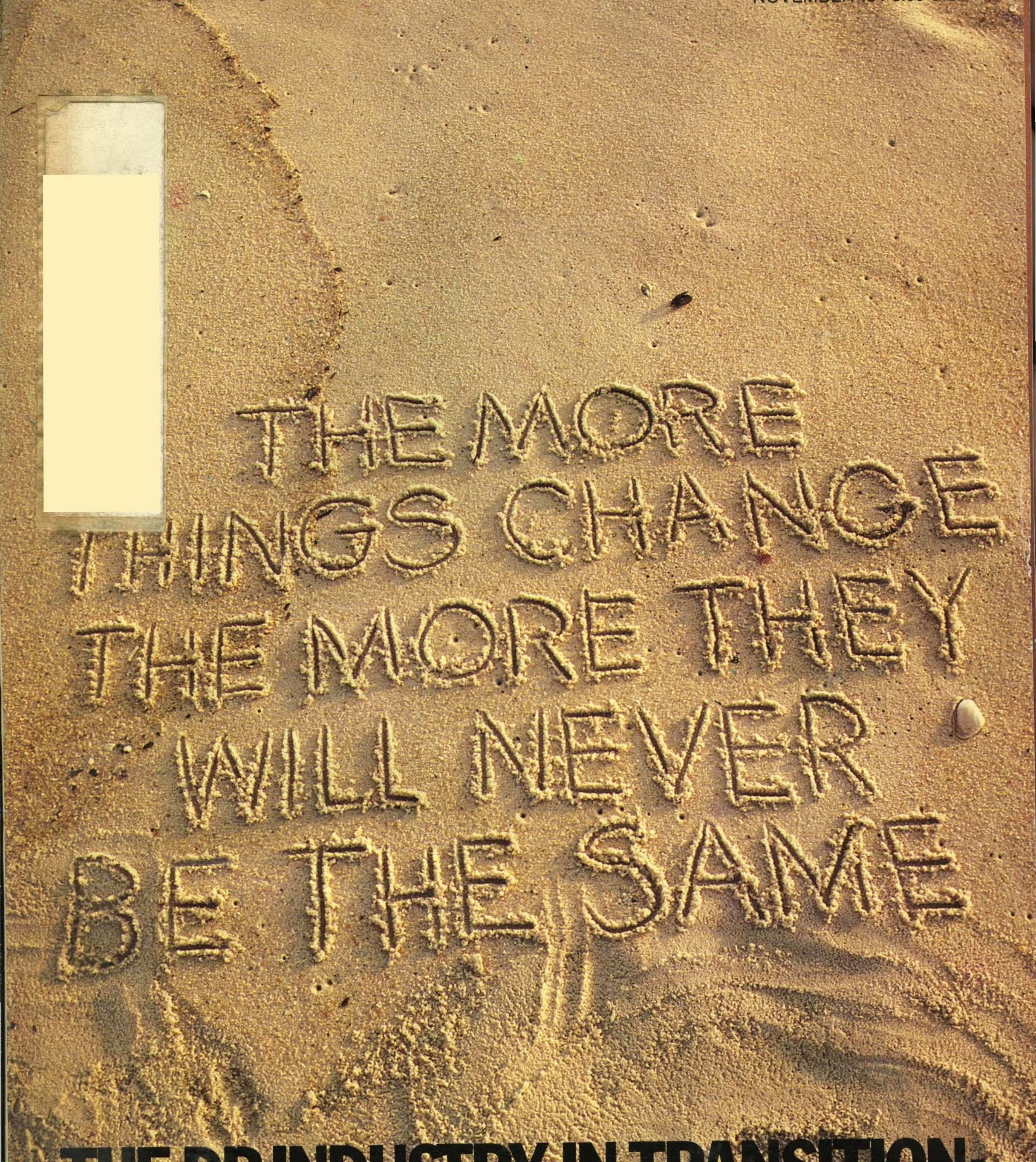

THE DP INDUSTRY IN TRANSITION: A DATAMATION SPECIAL REPORT

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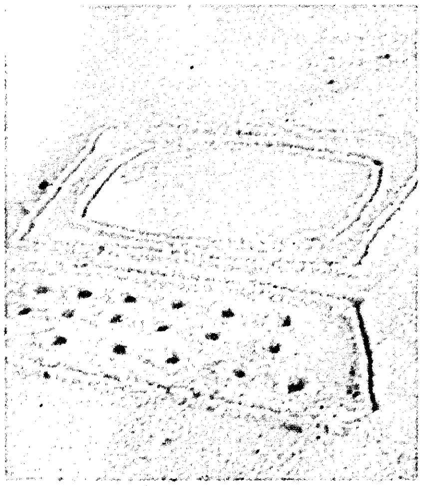

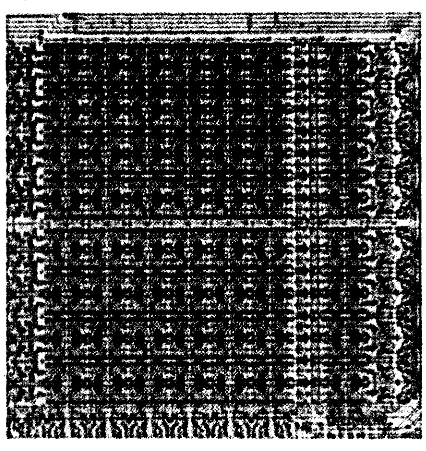

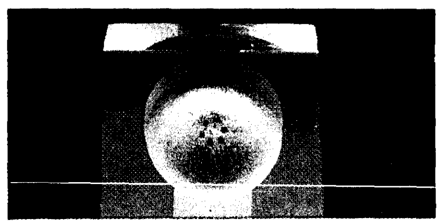

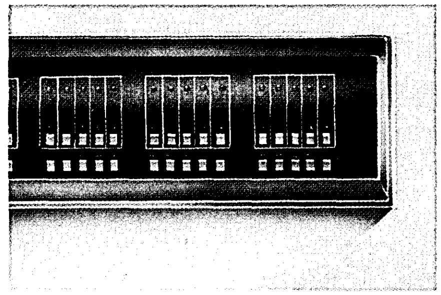

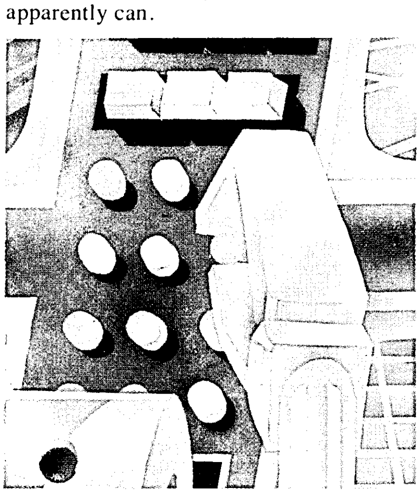

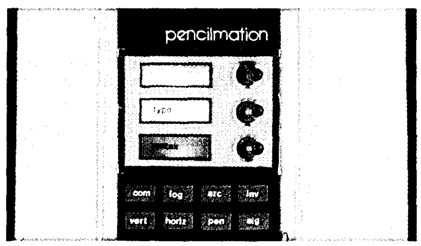

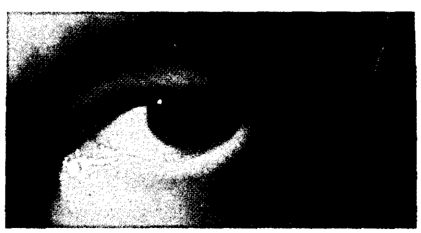

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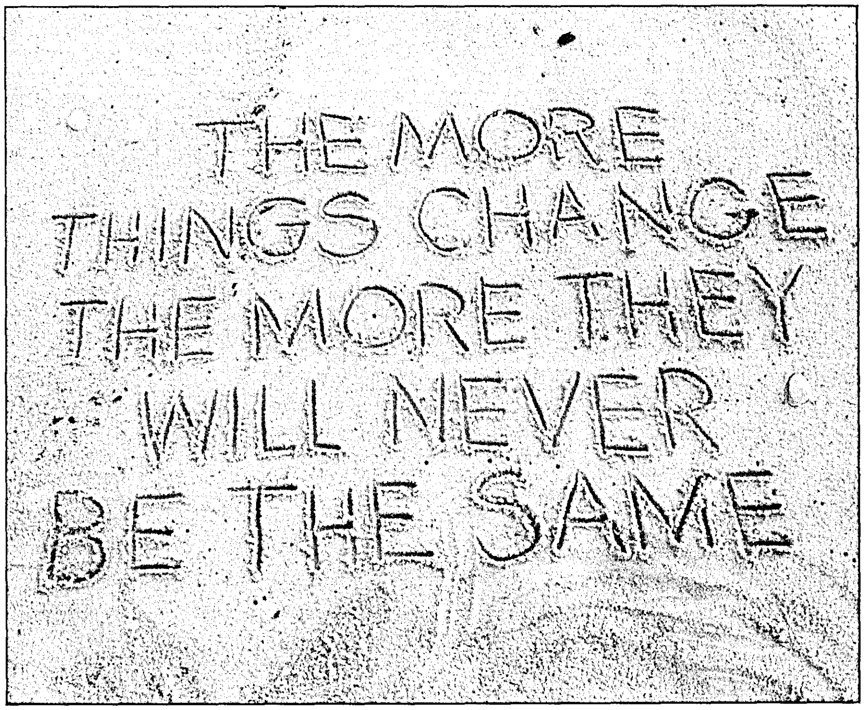
EDITOR'S READOUT

TRANSITIONS



"The world is too much with us, late and soon," observed William Wordsworth who then went for a quiet walk on the beach to calm his ruffled sensibilities.

Unfortunately, those of us in the business world, particularly if we're involved with the computer industry and data processing, live in less leisurely times. Our world is not only too much with us, it's changing with a rapidity that is nearly incomprehensible.

And that's the reason for this special report. Our theme is change, and our content is an attempt to bring some order to the contemplation of our kaleidoscopic industry.

Of course, the computer industry has always been a hotbed of changes, many causing profound alterations to our business and social institutions—but, in the past year or so, the pace has accelerated. We seem to be like the character in the Stephen Leacock story who leapt on his horse and rode madly off in all directions.

Fundamental to much of this feverish activity is that miniscule silicon chip, the microprocessor. Dropped into our midst like a tiny pebble into a pond, it has caused waves, not ripples. Nothing in our industry will ever be the same. It's made possible personal computing, intelligent terminals and networks, and distributed processing; it's helped slash costs on the big systems and made minis and microcomputers available in staggering quantities.

But those little pieces of treated sand are only one of the factors complicating our industry. Other forces are at work involving money, politics, and power.

There's the wonderfully complex international scene and transborder data flow. Involved are the governments of all the developed countries of the world and many Third World countries as well. There is intrigue, political rivalry, jealousies, and rampant chauvinism. All of this will significantly impact global communications for decades to come.

Japan, with its delayed but still impending invasion of the world computer markets, is a major player on the international stage.

In the U.S., we are witnessing a spate of mergers and acquisitions that have thinned the ranks of the undercapitalized and brought new names to the forefront of the industry—names like Exxon, Northern Telecom, and Sun Oil.

Almost overnight a new, booming market has emerged as small businessmen everywhere have had their data processing consciousness raised. Streetfront computer retail stores, as well as IBM, DEC, and the other mini and micromakers, are being swamped with inquiries and orders. Sensing opportunity, thousands of overnight entrepreneurs, known variously as systems integrators or oem distributors, are buying the new hardware at discount prices, writing applications packages and selling dp to the mom and pop shops in every town.

At the same time, dp managers in the large corporations are having to deal with the fact that data processing, data communications, electronic mail, FAX, and word processing are beginning to converge. The boundary between voice, picture and digital signals is beginning to blur as well.

The federal government's response has been to launch computer inquiries; the courts, to press on with lingering antitrust trials. But the industry won't stand still for a moment and decisions are outdated on the day they are made.

All this presents an interesting challenge for those who would manage corporations and their data processing central nervous system. Long-range planning often gives way to frenzied firefighting. And those brave companies that decide to pioneer the latest techniques often wind up with more than their share of arrows.

Our hope is that the articles in this issue will add to your awareness, comprehension, and control of the dp environment in which you find yourself. And perhaps even let you set aside some time for a long, quiet walk on the beach. *

Verbatim
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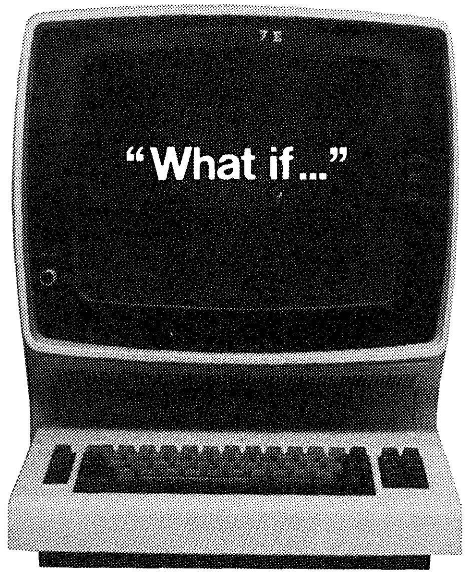
ASI/INQUIRY

The IMS DB/DC QUERY LANGUAGE

USED BY MORE IMS INSTALLATIONS THAN ANY COMPETING PRODUCT



ASI/INQUIRY is an IMS DB/DC query language that operates completely as an interactive Message Processing Program. The design of ASI/INQUIRY is such that the *structure of the data base is transparent to the user*. Moreover, one need not have familiarity with DL/1 segment logic or the complexities of multipathing. Extremely rapid response time is assured.

MAJOR HIGHLIGHTS

- ☐ End-user oriented
  - —Easy-to-use language
  - —Requires no knowledge of IMS
  - —Comprehensive diagnostic messages
- ☐ Rapid response time for even the most complex queries
- ☐ Dynamic priority scheduling to maximize system performance
- ☐ Availability of default as well as user-defined screen formatting

Additional features and functions include:

- Supported under both IMS DB/DC and TSO
- Full support of IMS/VS secondary indexing
- Open-ended computation facilities
- Ability to SORT display output
- Complete security through password protection
- Comprehensive log of all session and run statistics
- Unlimited data base concatenation and referencing
- Optional usage of qualified SSA's

In summary, ASI/INQUIRY represents the state-of-the-art product in an IMS/DC or TSO-supported environment. Contact us and learn why organizations such as *Hughes Aircraft, Standard Oil of Indiana, Hydro-Quebec* and *EXXON* are processing queries like "What if . . . ." and obtaining a return on their investment many times over.

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CIRCLE 77 ON READER CARD

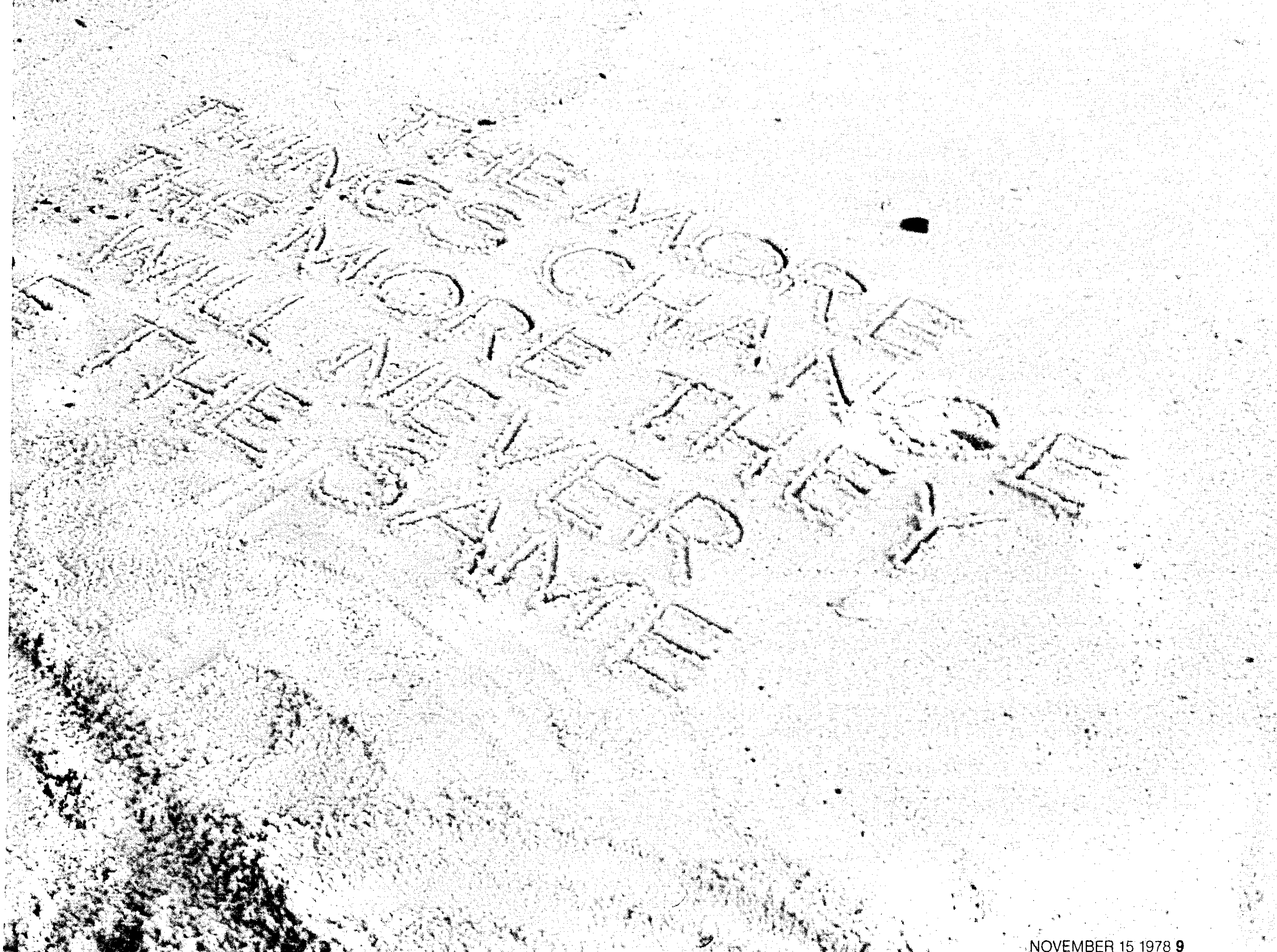

PHOTOGRAPH BY STEVE PHILLIPS

TRANSFORMATION OF THE INFORMATION INDUSTRIES

by F.G. Withington

☐ The microprocessor will have at least as great an effect on society as the small electric motor. ☐ The communications and data processing industries will merge until the two are indistinguishable. ☐ Word and image processing will become more important than data processing. ☐ Every home will be equipped with multipurpose computers and will be served by a wide variety of electronic mail and interactive information services. ☐ The structures of businesses, governments, and society itself will be profoundly changed as a result.

Statements such as these appear with increasing frequency in popular press. They may very well be true, but they are not very helpful. They do not help the president of a business plan the evolution of its operating methods. They do not help the president of a computer manufacturer plan his future



Economy of scale has almost disappeared: it matters little whether a manufacturer builds or buys its components, or needs few or many.

product strategy. Planners need more precise information. They need to know how fast things will change (obviously the above forecasts cannot all come true for at least several decades). They need to know which products and services will develop soonest and which latest (if at all). They need early warning of major structural changes: will IBM be making consumer appliances? Will Japanese fiber optic technology dominate world communications? Will managers work largely from their homes, reducing transportation and business real estate needs?

No crystal ball is clear enough to confidently answer questions like these. However, it is possible to stand back from the day-to-day avalanche of new product announcements and review the basic structural forces shaping the information industries. These forces change slowly, and some do not change at all. This article takes such a structural approach, attempting to cast a realistic light on the nature of the transformation that will be occurring in the information industries.

CHANGING STRUCTURAL FORCES

Economy of scale in manufacturing used to be a structural force constraining the number of information appliance manufacturers. This force has weakened (compare the proliferation of word processing and terminal manufacturers, and of plug-compatible, personal and minicomputer manufacturers). The cost per unit of electronics has dropped so low that all systems manufacturers employ large-scale, general-purpose integrated circuits in their products regardless of volume, and these can be obtained economically in any quantity from the semiconductor industry. In varying degrees, the same effect has occurred in peripheral equipment (disk drives, terminals, and printers). The total demand has grown so large that a highly competitive group of specialist suppliers has developed for each type of device. Economy of manufacturing scale has almost disappeared as a force in the information industries: it matters little whether a system manufacturer builds or buys its components, or needs few or many.

Cost of high speed digital communications has constrained the growth of data and text processing networks, and virtually precluded both high-speed image networks (teleconferencing and facsimile) and interactive consumer services. This cost is dropping, for several reasons. Most importantly, common carrier organizations all over the world are upgrading their facilities, a process that will take many more years. Progress can be accelerated for specific services by incorporating more complex electronics in the devices that send and receive data. For example, facsimile transmission becomes faster as more advanced bandwidth compression logic is incorporated in transmitters and receivers, and both tv and FM broadcast stations can transmit data in unused time slots to suitably equipped receivers. Finally, satellite communications can provide point-to-point high speed communications via orbital satellites. The costs are still high but will come down as volumes rise. A few private users and numerous communities use satellite communications now. In the early 1980s medium-size businesses should be served economically, and in the 1990s small businesses and, conceivably, homes. These developments will increasingly affect both the structure of the communications industry and the structures of the information providers (radio and tv, newspapers, movies, mail, and business information services).

Need for lease financing used to be a punishing constraint on the growth of small information appliance manufacturers, but the need is diminishing. Computers used to be very expensive, their users were uncertain of the future, and technological change was rapid. Therefore, users preferred to lease information appliances in order to retain freedom of action, even though it was not economic for most to do so. Now users have more experience and confidence, and for the most part, hardware comes in smaller, less expensive modules. Technology still changes, but interface standards have evolved for each system manufacturer that must be observed if existing customers are to run their existing programs and use existing digital files with new products. Most users insist on doing this, and realize that the manufacturers will comply. Users are now willing to make longer-term commitments, and either purchase the equipment or enter into long-term leases with third parties. As a result, small manufacturers can grow more rapidly.

NEW STRUCTURAL FORCES

Digitized text and pictures are growing in importance relative to digital data. Digital word processors are already in widespread use. As suitable communications services become available, many organizations will link word processors together to form internal electronic mail networks (thereby impacting the U.S. Postal Service, which may introduce a comparable service of its own). With these networks will come digital text filing and retrieval systems, and common-user information retrieval services will grow (e.g., for standard government contract clauses). At the same time, nonimpact printing techniques (xerographic and ink-jet) are increasingly being used with data processing systems: they can reproduce any image including forms, pages, and pictures. Adding digitized tv (already routine) and the improved high-speed digital communications services mentioned above, facsimile transmission and teleconferencing are likely to grow. Perhaps filing and retrieval systems for digitized images will then grow too, and common-user services (such as for distribution of catalogs, maintenance instructions, etc.). Within a decade, digitized text and image communications volume will probably far exceed data volume, attracting the attention of information appliance manufacturers and communications carriers.

Microcode is being substituted for fixed electronic logic in virtually every kind of information appliance, from the hand calculator and tv set to the largest computers (which are increasingly being designed to directly execute high-level languages). This is occurring because general-purpose microprocessors with specialized microcode have become less expensive than specialized electronics.

Microcode can be changed at any time. Also, microprocessor-controlled devices can easily incorporate in the microcode internal conversion of input-output data to a standard form. As a result, information appliances and their peripheral devices are tending to become clusters of modules, each performing a specific system function and intercommunicating in a standard symbolic language. Markets are growing for suppliers of many kinds of information processing modules, each incorporating a microprocessor and microcode as well as the controlled device, whether electronic or mechanical. However, who will determine the standard symbolic language for intercommunication between modules? And who will establish the overall architecture of the system within which the modules fit? Are these standards even necessary when microcode is flexible and can be changed? But then, who will do the changing? Certainly not the user himself. The structural implications to the industry are not obvious, at least to this writer.

Programming complexity is declining. All information appliances must be programmed, and their use has always

	1975		1976		1977	
	DP Revenue	% of Total	DP Revenue	% of Total	DP Revenue	% of Total
IBM	11.1	50	12.7	50	14.8	49
Next 6 companies	6.8	31	7.7	31	9.3	30
Rest of Top 50	4.3	19	4.9	19	6.3	21
	22.2	100%	25.3	100%	30.4	100%

Table 1. Dp revenues of the Top 50 companies in the U.S. data processing industry ($ billion).

Source: DATAMATION (figures slightly restated for consistency).

Newspapers	$15 billion
Periodicals	$ 6 billion
Commercial Printing	$16 billion
TV and Radio Broadcasting	$ 9 billion
Cable TV	$ 1 billion
	$47 billion

Table 2. 1978 revenues of U.S. text and image information industries.

Source: U.S. Department of Commerce.

Voice telephone service	$46.3 billion
Data service	$ 3.3 billion
Independent sales of telephone equipment to end users	$ 0.7 billion

Table 3. U.S. common carrier revenues in 1978.

Source: U.S. Department of Commerce.

Copiers	$2.7 billion
Typewriters	$0.4 billion
Word processors	$0.4 billion
Microfilm equipment	$0.3 billion
Facsimile equipment	$0.2 billion

Table 4. Shipment values of office machines sold in the U.S. in 1978.

Source: U.S. Department of Commerce, Arthur D. Little, Inc., estimates.

been constrained by the cost and complexity of programming. Several evolutionary trends are improving the situation:

—Users are being offered programming languages that are easier to learn. Interpretive languages have always been the easiest to learn, but are wasteful of computer resources. As computers decline in cost, the use of interpretive languages is increasing and improved ones are emerging. Also, for the nonprofessional programmer interested only in preparing a new report or a new type of display on a terminal, interactive question-and-answer methods are appearing that make professional-level knowledge unnecessary.

—Systems programs that manage files and communication networks, allocate system resources, etc., are becoming more automatic, partly through implementation in modular microcode as discussed above. As they do so, it becomes less necessary for the user organization to employ systems programmers to prepare or modify them.

—A body of engineering principles is developing that helps users and vendors prepare programs more quickly, with fewer errors, and with lower life-cycle costs of modification and control.

Programs of steadily increasing complexity are being undertaken, so, in many instances, the result is only a standoff. However, for the small computer user, the casual user (e.g., a financial analyst), or the user interested in only a limited application (e.g., an order entry network), a substantial decrease in programming complexity has already occurred. Continued expansion of the market for information appliances will result, and more vendors with limited programming resources will be able to develop them. This process should continue slowly for many years.

A new international structure in the information industries is emerging. International mergers are occurring with increasing frequency. In the late 1960s American companies were acquiring foreign ones. The pattern has recently reversed: in the last two years more than a dozen American firms in the information industry were acquired by larger European and Canadian ones. Few acquisitions of American firms by Japanese ones have yet occurred, but they seem inevitable since the forces that have influenced the European acquirers are even stronger in Japan: relative shifts in currency and equity values, desire to acquire advanced technology, and desire new markets.

At the same time, a tide of economic nationalism is rising, particularly strongly in the information industries. All over the world, governments perceive increased dependence on products and services of the information industries, and workers (rightly or wrongly) perceive that new information appliances pose increasing threats to jobs in offices and factories. Barriers to imports of foreign-made products are rising along with requirements for local ownership of competing companies, and barriers to international information exchange may also rise.

The trends appear to be conflicting and, enmeshed as they are in national politics, it is difficult to foresee the result. It appears safe to say, though, that during the next two decades the climate for the traditional centrally owned multinational corporation will continue to worsen, while the climate for various kinds of cooperative partnerships will improve. National governments will increasingly be either silent or active members of such partnerships. U.S. companies are likely to be at a greater disadvantage both at home and abroad if the present antagonism between business and government in the U.S. continues.

UNCHANGING STRUCTURAL FORCES

Perhaps the most important group of forces to emphasize, these constrain the rate at which new technology can be introduced and indicate the degree of concentration likely to remain in the information industries.

Local distribution and service will continue to be essential to successful competition. Information appliances are the most complex products ever offered for general distribution, so customer demands for quality and responsiveness of local service and support are the greatest that any industry has ever faced. Until recently every supplier of information appliances and communication services has been required to maintain its own network of service and support offices, a

Within a decade, digitized text and image communications volume will far exceed data volume.

vastly expensive and complex challenge. The new and changing forces described above have altered the picture somewhat: the less expensive and more completely "packaged" products (personal computers, word processors, electronic games and tv recorders) can now be distributed through sophisticated retail outlets. Examples are the computer stores and the system houses that offer packaged hardware-software complexes, partly assembled from standard products and partly custom programmed. Sophisticated information appliance retailers will proliferate and evolve to match their product and market opportunities. The giant full-line companies will adapt their distribution and service structures accordingly.

Despite the growth of retail outlets, the large user organizations will continue to require integrated networks that are geographically dispersed. The large vendor's ability to offer a common level of service at all necessary locations will continue to be a powerful competitive advantage.

Regulation of communications carriers must continue. Those using broadcast techniques must share a limited radio frequency spectrum. Interference between signals must be minimized and the public interest must be served; many applications for spectrum space must be refused by some regulatory body. As noted above, clever techniques for time-sharing the use of existing frequencies are promising, which makes room for more broadcasters. It would appear, however, that those presently possessing licenses and equipment (the broadcasting companies in the U.S. and government agencies elsewhere) are best positioned to take advantage of these techniques rather than new entrepreneurs.

Communications carriers using switched land lines must continue to be regulated, for two reasons. First, if private telephone service to remote locations is to continue, it must be subsidized; such subscribers cannot afford the true cost of their service. This means that an artificial (and therefore regulated) rate structure must be retained. Second, it remains impractical for duplicate competing networks of local lines and switching centers to be established: a natural monopoly exists that must also be regulated.

As noted above, over the years, point-to-point communication services will evolve that bypass land lines: first for large corporate users, eventually perhaps for private users. Such services may bypass the monopoly local land line installations, but they will use the radio frequency spectrum. Therefore, they, too, must always be regulated.

Cost of collecting, packaging and distributing information will continue high. Program development cost is dropping, as noted, but most user demand is for data processing or information services, not for computing. For business users the cost of data collection in a timely, accurate and complete manner is high and will remain so, being people-intensive. The trends discussed above offer little help in reducing data collection costs.

Some help may come, however, from increased use of partially shared information collection and management facilities. The tools of on-line data entry, computerized data bases and low-cost data communications are being employed best by specialized firms whose entire business derives from meeting users' information needs. These include on-line service bureaus with widespread data networks (already used by many firms to collect private data), and providers of data of common interest: stock prices, business statistics, reservations, weather information. The tv networks and newspapers are also well into the use of advanced networks to collect and distribute the information they presently handle. They also understand best how to process and package information of general interest. As text and image material increases in importance relative to data, it seems inevitable that the talents of the mass media will increasingly be combined with those of specialized network services to fill many private and semiprivate needs, as *The New York Times* information service already does.

In the future, evolved mass media are likely to be the primary agents of information collection, packaging, and distribution. If the present publishing and tv organizations are to dominate, they must move more into selective data collection and distribution systems but many are well started (Dow-Jones, Dun & Bradstreet, McGraw-Hill, Storer Broadcasting). If the service bureau networks are to dominate they will have to match the publishers' software and information packaging ability, which seems harder. Microprocessor-controlled games, for example, were first introduced by the electronic industry, but the business was taken over by the games manufacturers, who better understand software and product packaging for the games market. The tv industry is already gaining experience because of the rapidly growing corporate use of tv, with an accompanying increase in demand for the services of professional producers. Whoever the successful competitors may be, the result will surely be a growing richness of services to both businesses and individuals, and at least some reduction in the need for information system users to support dedicated data collection activities.

Simulation of human behavior will continue to be difficult. Humans excel at pattern recognition (a familiar face, a significant pattern of data) without knowing how they do it. Efforts to program computers to do the same thing have had very limited success, even though large amounts of research have been performed over many years. Very large potential markets exist for products incorporating human-level pattern recognition, such as:

—information retrieval systems for unstructured personal files

—voice-actuated typewriters

—reading devices for unconstrained handwriting

—foolproof personal identification systems

—generalized systems to extract signals from noise

The profit motive will cause research to continue and improvement in the present state of the art will occur. Partially effective products may prove to have large markets, and breakthroughs may occur. However, the rate of progress to date indicates that the pace of improvement will be slow.

Every human employs the sense of touch and the body's feedback control systems to assemble things, fix things, and move things. Millions of jobs in factories, repair shops, etc., are based on these capabilities, even though the simpler repetitive ones have already been automated. General-purpose industrial robots capable of varying their activities have been in development for years, and again progress has been slow: it is extremely difficult to automate motor processes the human learns to perform instinctively. Here, however, the rate of progress is accelerating. Low cost microprocessors and better sensors make it conceivable that industrial robots may become practical within the next decade for at least semirepetitive jobs. If so, it is certain that many manufacturers of information appliances will attempt to enter this market.

Regardless of innovations in the information appliances available for use in the office or factory, pioneering vendors have discovered (sometimes to their

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CIRCLE 88 ON READER CARD

Mass media are likely to be the primary agents of information collection, packaging, and distribution.

sorrow) that humans prefer certain levels of personal interaction: working in teams rather than alone, establishing "contacts," providing mutual support, varying their roles. These behavioral preferences will presumably not change rapidly (if ever), and will strongly constrain the acceptability of new information appliances.

The future will also be shaped by many other forces of an economic, demographic, political, and sociological nature. Some of them (shortage of energy, changes in the labor supply) may affect the evolution of the information industries as much as the forces addressed here. Information about them is widely available elsewhere, however, and because they are less specific to the information industries so they will not be discussed further in this article.

On balance, these changing forces appear to indicate that concentration in the data processing industry will diminish. With small firms able to manufacture hardware and software competitively in the form of microcoded modules and free of lease financing pressures, IBM and the other giants may lose market share. A glance at Table 1 shows that such a forecast must be made with caution, however. It shows the distribution of data processing revenues of U.S. vendors over the last three years and compares IBM, the next six largest grouped together, and the remaining 43 grouped together. Only in 1977 did IBM and the next six lose a little share to the smaller 43. The forces that would decrease concentration have already been at work for some time, and one would expect to see more effect than this.

Perhaps the counterforces are the dominant ones: the giant vendors' abilities to set network standards, and the continuing importance of their support and service networks. If so, only the growth of new distribution networks (e.g., computer stores) and information collection and management services will eventually erode the giants' shares. And the giants will not stand still. IBM is already close to being in the retail business, and nothing prevents it from selling consumer information appliances (e.g., digital tv sets) as well as business ones. Also, in 1979 IBM becomes free to offer computing services again; it could develop information networks. On balance, it appears that the existing concentration of the data processing industry will continue despite technological trends.

Table 2 provides further support to the forecast that the mass media will play an increasingly pervasive role in the information industries. Their combined revenues are 50% greater than those of the data processing industry; their ability to employ advanced technology and desire to grow are as great. Their information packaging and software skills seem certain to become increasingly significant in the future, as digital text and image information grows in importance, and (perhaps equally important) most of them have learned to live in an at least partly regulated environment. Since the growth of the information industries in the future will increasingly involve common carrier and broadcast communications, all major competitors will have to accept some degree of regulation.

Table 3 shows the concentration of common carrier revenues in 1978. It shows the overwhelming predominance of voice telephone revenues, despite growing data communications. Novel equipment and services associated with voice communications represent the largest market potential in communications, at least for many years. And this potential is already beginning to be realized: in 1978, $700 million worth of telephones and related equipment will be sold directly to end users in the U.S. by providers other than communications carriers. Small in proportion to the whole, this volume is impressive when one recalls that such sales in the U.S. were zero (by law) only a few years ago. So far most of the independent suppliers are foreign firms but this need not continue. Will IBM be selling electronic telephones, perhaps with limited data and text capability?

Finally, Table 4 shows the 1978 shipment values of office machines sold in the U.S. Despite all the attention given to these products, their sales volumes are still small compared with the revenues of the industry groups shown in the preceding tables. (Tv set volume in the U.S. is also relatively small at $2.2 billion in 1978. This compares with the $9 billion 1978 revenue of the U.S. broadcasters. Is this indicative of the future ratio of software and service revenues to hardware revenues?) As these office products evolve into new forms oriented to digital communication and processing, their markets will surely grow. The giant industry groups listed in the first three tables will all converge on this growth area, with complex results.

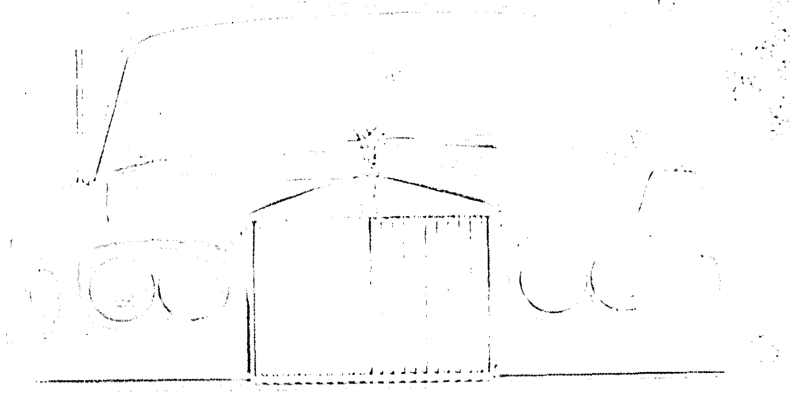
Some plausible new business scenarios can involve every one of the existing information industry groups, focused around novel office products. For example, a publisher might offer a specialized billing service. Acquiring specialized modular terminals, it might install them on customer premises to forward both billing data from the customer's computer and catalog text and images, using common carrier lines. At its central site, the publisher would then prepare combined invoices and promotional messages, in which the promotional material is tailored to the content of the invoice. Then the combined messages would be distributed. The specialized presses of the publisher would prepare printed material for mailing in most cases. If the recipient of the material had a high speed digital communications line, however, the combined messages would be transmitted for reproduction at the recipient's site, with selected video messages added to the page images for printing.

Overlaid on all this (which has considered the U.S. only) will be the new patterns of international competition and of relationships between the information industries and national governments. Since political processes work slowly, these new patterns will take many years to evolve, constraining the rate of change made possible by technology alone. However, these new international government-industry relations are likely to cause more profound changes in the information industries (and the governments themselves) than could occur within the boundaries of single nations.

The overall result of this transformation of the information industries may not become clear until the year 2000, if then. It is certainly not clear now. However, despite this uncertainty, an individual firm which provides or uses the products of the information industries can plan rationally. Consideration of the structural forces discussed in this article should suggest guidelines and limits which can be applied to near-term plans. And with uncertainty comes opportunity, as the information industries move into their most dynamic growth period ever. ✲

FREDERIC G. WITHINGTON

A 25-year veteran in the computer industry, Mr. Withington heads the data processing industry analysis activities for Arthur D. Little, Inc. He has written four books and 20 articles and papers, and is a long-time contributing editor to DATAMATION.



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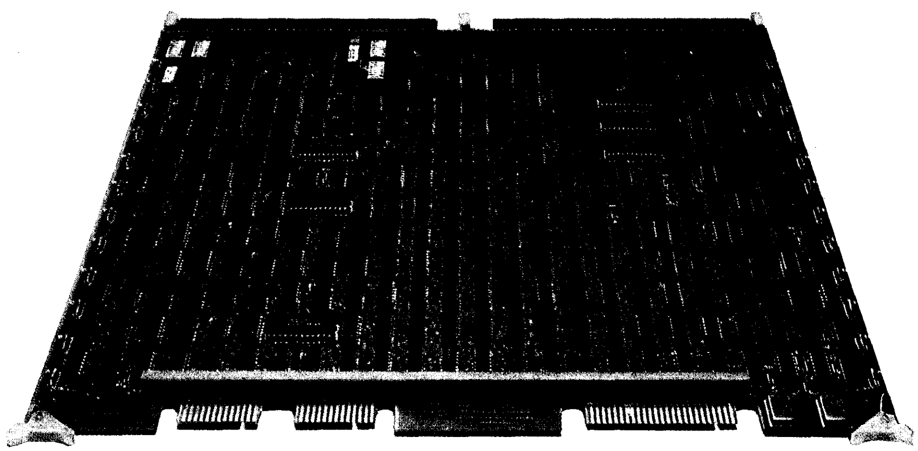

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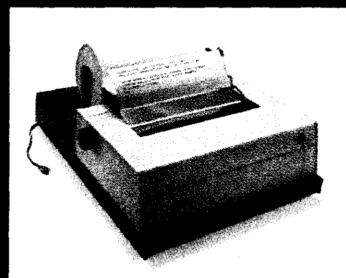

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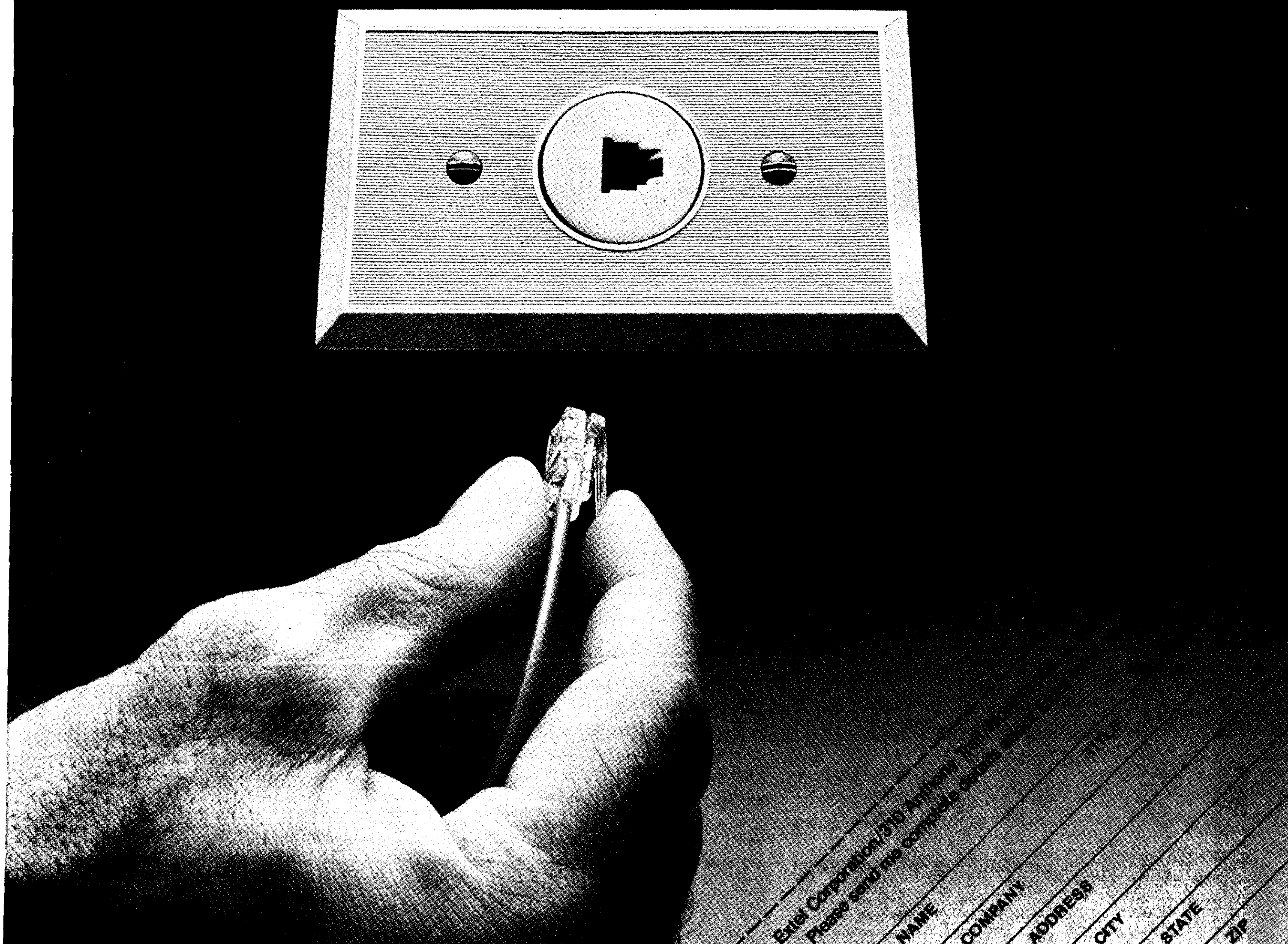


CIRCLE 107 ON READER CARD

The 1980s will be the era of more than one million components per chip.

HARDWARE

THE TECHNOLOGY SWIRL

by Lowell Amdahl

For years we have been talking about the maturing computer industry. This would seem to imply an orderly, predictable environment wherein evolution has largely displaced revolution.

Could anything be further from the truth? Despite the fact that computers have established a permanent niche, the basic products and range of applications are in turmoil. Computer manufacturers, large and small, continue to have at least the same level of concern that they have had in years past for the effectiveness and life of their products.

In my college days I recall reading about a professor at an obscure school in the Midwest who had determined that geometric figures which are conventionally described by mathematical elements like line segments and arcs of circles could instead be described in terms of "zig-zag" and "swirl." I never really found out what this was all about, but one suspects that the changes in the computer industry could possibly be described in these terms. If so, the swirl component must be very large at this time—and perhaps the maturing of the industry has been to remove a little of the zig-zag.

FORCES OF CHANGE There are significant forces currently at work—hardware technology in computers and communications on the one hand, and reactive forces from a large number of emerging applications on the other. All of this, of course, is nurtured by the intermediary—software—and by an impatient set of prospective users.

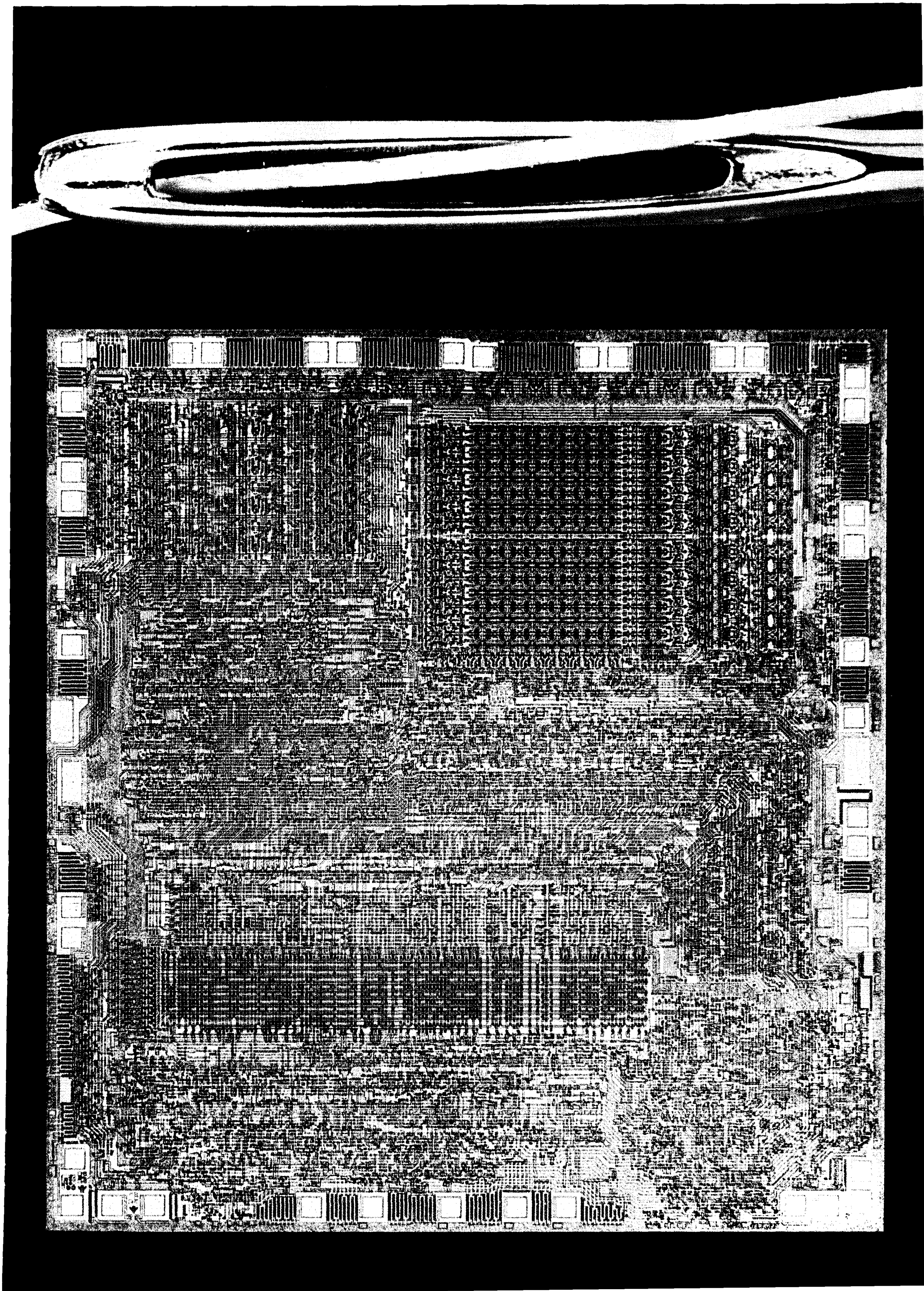
The most dramatic force is the fervent pace of semiconductor technology. Moore's Law (enunciated in 1965 by Dr. Gordon Moore, now president of Intel Corp.) simply predicts that single chip LSI devices can be built with circuit element complexity that doubles each year. Remarkable. Basic physics mandates the ultimate repeal or modification of this law, a fact well recognized by its author. But not to worry, Moore's Law has worked for more than a decade and has every prospect of working for several more years. The improvements required to cause this to happen will come about in part by semiconductor processing methods such as electron beam lithography, permitting reduced line widths and increased chip size. The 1980s will usher in the era of very large scale integration, (VLSI), with more than one million components per chip.

Assuming that price/performance trends for LSI devices approximate Moore's Law for integrated circuit complexity, what are the implications? While existing applications for these devices are rapidly cost-improved, more importantly, a variety of new applications are created. Hand-held calculators were a new use of complex circuits, and the early $200 model in a few short years sold for under $20. The volume production of calculators spawned the single chip microprocessor, triggering other new applications such as electronic games and gas pump meters. Related devices found use in digital watches, appliances, and automobile ignition controls. While few people will expect their autos, washing machines, or microwave ovens to cost appreciably less by their use, it is reasonable to expect more functionality and reliability.

Dp continues to reap its own harvest from advances in semiconductor technology. Microprocessors now abound in terminals, peripheral controllers, communication devices, and small standalone computers. Semiconductor memories are rapidly improving the price/performance characteristics of computers of all sizes. It is interesting to note that today's intelligent terminals may contain as much memory as did second-generation business computers. LSI memory is perhaps the best match between the economics of high volume production of standard parts by the semiconductor industry, and the apparent insatiable demand for low-cost random access memory by computer users.

Random access memory (RAM) chips containing 16K bits each are now in high volume production. These devices are of the dynamic type, requiring occasional refresh to maintain the contents of memory. The refresh activity is performed at a hardware level, and is typically designed to cause only very minor interference with program execution. Static RAM chips are also available which eliminate the need for refresh action, but with fewer bits per chip. For either type of RAM, memory contents are lost when power is removed. Understandably, this characteristic has added impetus to software techniques for recovery from power failure, hardware assists

At right...**This is a photomicrograph of a Zilog Z80 high-performance 8-bit microprocessor containing 8,500 transistors. Its dimensions are 193 mils by 180 mils, about the size of the head of a paper match. This monolithic chip was diced from a thin silicon wafer four inches in diameter that had previously been processed and tested. Photo courtesy of Zilog Inc.**



The notion of computer-related expenditures being 1%–2% of the total corporate budget will fade away...

such as read-only memory, and power accessories such as battery backup.

Higher memory bit density can be achieved if a shift register design is employed. Charge-coupled devices (CCD's) use this technique, with 64K bit CCD chips being manufactured in volume. DP applications of CCD's have been rather slow to emerge. Their most obvious use would be for disk replacement, eliminating the delays inherent in head movement, and greatly improving upon rotational access time. Because of considerations of cost, CCD's appears to be in a disk cache implementation, providing a statistical improvement in disk performance.

Bubble memories have rather recently made a commercial appearance as buffers for terminal equipment. These devices employ a shift register concept that is similar to CCD's, although the physical principle is magnetic and totally different from semiconductor devices. Magnetic bubble devices are slower than CCD's, but have the important property of memory retention when power is removed. It is generally believed that bubble memory devices will achieve a very high bit capacity, a million bits or more per device. Current products, however, have a tenth of this capacity. For the near term, dp use of bubbles would appear to be limited to substitution for small disks for either economic or environmental reasons.

Behind the scenes in this tentative encroachment of CCD's and bubbles into secondary storage applications, disk technology continues to move apace. Floppy disks are developing toward dual-density, dual-sided recording. IBM's Winchester technology is being emulated by other manufacturers in both small and large hard disks. There is every indication that recording densities and track densities will continue to improve.

PRINTER ADVANCES

In another area of peripheral technology, printers are increasingly becoming more cost-effective. Functionality has been increased in serial printers by virtue of lower cost electronics. Thus, bidirectional printing and line compression are very affordable features. The sheer volume of small computer systems is reflected in production volume, an important aspect of unit printer cost. At the high end, nonimpact printers have been introduced that employ a laser xerographic principle. This appears to be a very exciting development, permitting a variety of type fonts and character sizes, concurrent printing of forms with data, and letter size copy. We can expect to see a renewed interest in hard copy graphics with this new printing capability. As in other peripherals, low cost electronics is an important part of the increased functionality.

Having brushed over some of the leading contributors to the swirl of technology that envelops the computer industry, it is important to backtrack to the question of what it means. It is particularly easy to get such a heady feeling from noting the most rapidly moving part of the technology that other factors which temper its impact are forgotten.

TRENDS AND TRUTHS

There are two statements relating to product development that I have heard expressed on several occasions. These statements derive from rather innocent facts, but it seems that they tend to be taken out of context. At best, they are half-truths.

Statement 1. The cost of hardware is going to zero. Wrong. And even if the cost went to zero, the price wouldn't. Semiconductor components that are subject to high levels of integration *and* volume production are indeed rapidly getting cheaper. But these components do not comprise the entire system. Further, as price reduces, we tend to opt for more function—more processing power, more memory, better peripherals.

The price trend for computer systems is indeed very encouraging, and this will greatly expand the uses to which they will be applied. Word processing systems, distributed processing, higher performance small business systems, and text and image transmission are just a few of the beneficiaries of this trend. The notion of computer-related expenditures being 1% or 2% of total corporate budget will fade away as individual departments begin their automation activities in areas not traditionally viewed as dp.

Statement 2. The cost of software is continually rising with no end in sight. This is a popular misconception arising from the well-known fact that salaries of programmers are going up, as are all pay scales. A part of this picture is programmer productivity, a parameter that has been especially difficult to measure. I am confident that there is improvement now, with more to come. But the most important facet of this statement is that software manufacturing costs are low, and will remain low.

The key to reducing software costs per delivered system is, of course, in manufacturing volume. This is a requirement for the rest of the picture to stay in focus—semiconductor price improvement is heavily dependent on volume, lower hardware prices lead to user demands for reasonably priced software, and it is incumbent on software suppliers to achieve this with greater standardization of product. Fortunately, some of the newer applications, such as word processing, are more amenable to multiuser standardization than are, for example, corporate accounting practices. All of this is not to say that total software efforts will diminish, rather, in the future, much more product will be delivered per unit cost.

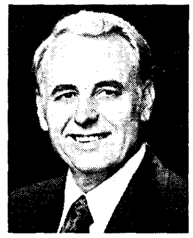
A number of the effects of reducing hardware costs are already well in evidence, for example, micro- and mini-based small business systems. Word processing is still in its infancy, but there is little doubt that packaged hardware and software is emerging that will have substantial impact in this market.

Minicomputers are rapidly moving into the megamini range—at first blush it would appear that this is only a reaction to the pressure from below by microcomputers. This is by no means the whole story; instead the listless medium-sized computer market segment seems to be reawakening as smaller users adjust to larger systems with greater software facilities. And lest we think otherwise, the large mainframes are alive and well—we need only note the backlog for computers in the IBM 3033 class.

One other trend is becoming very apparent, that of distributed data processing. Potentially, DDP will involve a full spectrum of products including intelligent terminals, application subsystems, computer systems of various sizes, and network components.

Much work remains to be done in the hardware and software architecture of such systems. However, it is evident that DDP is perceived, not just as a tool for MIS, but as a vital link in all facets of business operations. ✻

LOWELL AMDAHL



Lowell Amdahl is director of advanced engineering, Data Services Group, Computer Science Corp. He also serves on the governing board of the IEEE Computer Society, and on the NCC board for AFIPS. He has been DATAMATION's technical advisor for 15 years.

Our "smart" microimage terminal pulls its own weight.


Then
Else

We can now tell the computer what we want and let it figure out how.

SOFTWARE

THE CHANGING FACE OF APPLICATIONS PROGRAMMING

by Daniel D. McCracken

The programming of computer applications is about to turn a corner. After 25 years of writing programs in languages like FORTRAN and COBOL, in which we have to tell the computer *how to do* what we want, we are now on the verge of being able to tell the computer only *what we want,* then let *it* figure out *how.* A change in method which will have a profound impact on the computer industry is a long-needed response to the "software crisis" that has plagued us for years.

The change can come none too soon. Although some progress has been made in computer programming, it is in no way comparable to the advancement in computer hardware technology. The ability to write applications software always sets the limit on what can be done with computers. With conventional programming methods that limit is not too far in the future; with newer methods, it is hard to see what the limit might be.

That is my message in a nutshell. Now let's explore—in a nontechnical way—the difference between "conventional" programming and the new methods. Then we can explore the forces that fuel these changes, some of the possible consequences, and an estimate of the timetable.

PROCEDURAL VS. NONPROCEDURAL

The fundamental difference between the old and new methods is best explained through an example. We will not need to study it in any detail but having it in front of us will make it easier to point out the differences.

A common dp application is the preparation of summaries by account groups. Fig. 1 is a simple report illustrating a summarization of sales by account number. Fig. 2 is a COBOL program that produces such a report from input records about individual sales; it is taken from my 1976 book on COBOL programming.

Skipping over the first 25 lines, We see that the bulk of the program is divided into a DATA DIVISION (lines 26–71) and a PROCEDURE DIVISION (lines 72 through the end). The function of the DATA DIVISION is to tell the computer how the input data is organized and stored and to specify the form of the report. The function of the PROCEDURE DIVISION is to specify in complete detail the processing needed to prepare the report from the data. COBOL is an example of a *procedure-oriented language,* which means that to express data processing ideas in COBOL we must give the computer a series of detailed steps—a *procedure*—for it to carry out in a specified order to get the results we want. In other words, using COBOL we have to tell the computer what to *do,* not what we *want.*

When COBOL was designed, over 20 years ago, it represented a dramatic advance over earlier methods. In particular, separating the description of the data from the specification of the procedure significantly improves program flexibility. Also, COBOL reduces the size of programs, since COBOL "verbs" (OPEN, READ, ADD, PERFORM, etc.) are very much more powerful than the individual machine instructions of the computer. A preliminary computer operation called *compilation* translates a COBOL program

ILLUSTRATION BY JOSEPH SMITH

Fig. 1

```
IDENTIFICATION DIVISION.
PROGRAM-ID.
    ONELEVEL.
AUTHOR.
    D. D. MCCRACKEN.
INSTALLATION.
    4 INNINGWOOD ROAD
    OSSINING, NY 10562.
DATE-WRITTEN.
    13 JUNE 1975.
DATE-COMPILED. JUN 19,1975.
SECURITY.
    NON-CLASSIFIED.
REMARKS.
    THIS IS THE CORRECTED VERSION OF THE PROGRAM OF FIG. 6.4

ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SPECIAL-NAMES.
    C01 IS TO-TOP-OF-PAGE.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT INPUT-FILE  ASSIGN TO UT-S-CARDS.
    SELECT REPORT-FILE ASSIGN TO UT-S-PRINTER.

DATA DIVISION.
FILE SECTION.

FD  INPUT-FILE
    LABEL RECORDS ARE OMITTED.
01  INPUT-RECORD.
    05  ACCOUNT-NUMBER          PIC X(5).
    05  ACCOUNT-DOLLARS         PIC 9(5)V99.
    05  FILLER                  PIC X(68).

FD  REPORT-FILE
    LABEL RECORDS ARE OMITTED.
01  REPORT-RECORD               PIC X(133).

WORKING-STORAGE SECTION.

01  FLAGS.
    05  MORE-DATA-REMAINS-FLAG  PIC XXX VALUE 'YES'.
        88  MORE-DATA-REMAINS           VALUE 'YES'.
        88  NO-MORE-DATA-REMAINS        VALUE 'NO'.

01  LINE-AND-PAGE-COUNTERS.
    05  LINE-NUMBER             PIC S99 VALUE +1.
    05  PAGE-NUMBER             PIC S999 VALUE +1.

01  SAVE-ITEM.
    05  PREVIOUS-ACCOUNT-NUMBER PIC X(5).

01  TOTALS.
    05  ACCOUNT-TOTAL           PIC S9(6)V99 VALUE ZERO.
    05  FINAL-TOTAL             PIC S9(6)V99 VALUE ZERO.

01  DETAIL-LINE.
    05  CARRIAGE-CONTROL        PIC X.
    05  ACCOUNT-NUMBER-OUT      PIC ZZZZ9.
    05  FILLER                  PIC XXX.
    05  ACCOUNT-TOTAL-OUT       PIC $$$$,$$9.99.
```

into a sequence of machine instructions.

Although programming in a procedure-oriented language like COBOL represents a major advance over earlier methods, it does not go nearly far enough for today's combination of fast, cheap hardware and tough applications. A few years ago, most applications involved batched transactions processed against a sequential master file; today, we have real-time on-line systems, huge data bases, and incredibly complex computations. To handle these challenges, further big steps are needed in exactly the same areas as COBOL made its earlier contributions:

1. COBOL partitioned the description of the data from the description of the processing—but both are part of a COBOL program. The next step is to remove the description of the data from the program altogether, *and store it with the data.* This is called *data independence* and provides a leap forward in program flexibility and maintainability.

2. As rapidly as we can, we need to move away from writing detailed procedures that tell the computer *how to do* a process and move toward ways of simply telling the computer *what we want.* This cuts down the time and cost of programming and once again provides a great deal of additional flexibility in handling changed or unanticipated requirements.

Programming methods that embody these changes go under the umbrella term of *nonprocedure-oriented languages.* This catchall phrase is difficult to define precisely and covers a considerable range of varying techniques. However, a general idea of the difference between a procedure-oriented language and a nonprocedure-oriented language are easily illustrated. Vendors' proprietary software products such as MARK IV, NOMAD, and RAMIS all exhibit the concepts, in somewhat different ways, as do many research projects. I will use NOMAD as an example because I am more familiar with it.

Fig. 3 is a description how the data in the sales summary application is organized in a form suitable for NOMAD. One of the most important things to realize is that this description does not commit us to the internal representation of data within the computer. NOMAD worries about that. If we later find it necessary to add data or reorganize it, NOMAD can worry about that, too.

This description of the data is called a *schema,* which has functions analogous to the COBOL DATA DIVISION, although it is very much more powerful and flexible.

Now when we want a report derived from the data described by the schema, we enter a command that has the functions of a COBOL PROCEDURE DIVISION, but which is much shorter and simpler. For the report shown in Fig. 1, the command could be as brief as

LIST BY ACCOUNT SUM (SALES AMOUNT) TOTAL

This example is about the simplest data processing application one can imagine. It hardly indicates the complexity of today's applications, the power of NOMAD, or the programming problems that have led to the widely used term "software crisis." Nevertheless, it does dramatically illustrate the differences in programming methods. Even for an experienced COBOL programmer, the program shown in Fig. 2 could easily take a couple of days to write and check out. The complete process in NOMAD takes perhaps ten minutes and is routinely done by people without data processing background. Naturally, most data processing applications are immensely more complex than this one and we should think of comparisons between COBOL programs that run to 100 pages and sometimes much more, versus NOMAD schemas and commands a fraction that size.

The difference between the styles of programming illustrated here is more than just a saving of programmer time, as important as that is. There are also the questions of flexibility and the ability to respond to requirements not anticipated in detail when the application is first programmed. With COBOL, a relatively minor change in the format of a report or the processing logic can require days of work. This kind of maintenance programming is dull, difficult to schedule, and error-prone. With a system like NOMAD, on the other hand, changes as sizable as the addition of data items to records, requiring a complete reorganization of the internal storage, can be a rather simple matter and require no changes in the commands that operate on the data.

It would be misleading to suggest that packages like NOMAD and the others have *no* procedural elements. Furthermore, it is somewhat difficult to give a precise definition of the term "nonprocedural." All such systems are in the

```
           05  FILLER                      PIC X(8).
           05  FINAL-TOTAL-OUT             PIC $$$$,$$9.99.

       01  HEADING-LINE.
           05  CARRIAGE-CONTROL            PIC X.
           05  FILLER                      PIC X(48)
               VALUE 'ACCOUNT    TOTAL             FINAL TOTAL       PAGE'.
           05  PAGE-NUMBER-OUT             PIC Z(6)9.

       PROCEDURE DIVISION.
       PREPARE-SALES-REPORT.
           OPEN INPUT  INPUT-FILE
                OUTPUT REPORT-FILE.
           READ INPUT-FILE
               AT END MOVE 'NO' TO MORE-DATA-REMAINS-FLAG.
           IF MORE-DATA-REMAINS
               MOVE ACCOUNT-NUMBER TO PREVIOUS-ACCOUNT-NUMBER
               PERFORM PROCESS-INPUT-RECORDS
                   UNTIL NO-MORE-DATA-REMAINS
               PERFORM FINAL-TOTAL-PROCESSING.
           CLOSE INPUT-FILE
                 REPORT-FILE.
           STOP RUN.

       PROCESS-INPUT-RECORDS.
           IF ACCOUNT-NUMBER IS NOT EQUAL TO PREVIOUS-ACCOUNT-NUMBER
               PERFORM ACCOUNT-TOTAL-PROCESSING.
           ADD ACCOUNT-DOLLARS TO ACCOUNT-TOTAL
                                  FINAL-TOTAL.
           READ INPUT-FILE
               AT END MOVE 'NO' TO MORE-DATA-REMAINS-FLAG.

       FINAL-TOTAL-PROCESSING.
           PERFORM ACCOUNT-TOTAL-PROCESSING.
           MOVE SPACES TO DETAIL-LINE.
           MOVE FINAL-TOTAL TO FINAL-TOTAL-OUT.
           PERFORM LINE-OUT.

       ACCOUNT-TOTAL-PROCESSING.
           MOVE SPACES TO DETAIL-LINE
           MOVE PREVIOUS-ACCOUNT-NUMBER TO ACCOUNT-NUMBER-OUT
           MOVE ACCOUNT-TOTAL TO ACCOUNT-TOTAL-OUT
           PERFORM LINE-OUT
           MOVE ACCOUNT-NUMBER TO PREVIOUS-ACCOUNT-NUMBER
           MOVE ZERO TO ACCOUNT-TOTAL.

       LINE-OUT.
           IF LINE-NUMBER = 1
               MOVE PAGE-NUMBER TO PAGE-NUMBER-OUT
               WRITE REPORT-RECORD FROM HEADING-LINE
                   AFTER ADVANCING TO-TOP-OF-PAGE
               MOVE SPACES TO REPORT-RECORD
               WRITE REPORT-RECORD AFTER ADVANCING 2 LINES
               MOVE 4 TO LINE-NUMBER
               ADD 1 TO PAGE-NUMBER.
           WRITE REPORT-RECORD FROM DETAIL-LINE AFTER ADVANCING 1 LINES.
           IF LINE-NUMBER = 55
               MOVE 1 TO LINE-NUMBER
           ELSE
               ADD 1 TO LINE-NUMBER.

      ****************** END OF PROGRAM ******************
```

Fig. 2

```
ACCOUNT    TOTAL             FINAL TOTAL       PAGE       1


   20       $17.00
   24       $36.00
   27      $184.00
   27      $184.00
                               $237.00
```

Fig. 3

```
SCHEMA;

MASTER ONELEVEL INSERT = KEYED(ACCOUNT, A, INVOICE, A);
   ITEM ACCOUNT          A5 HEADING = 'ACCOUNT';
   ITEM INVOICE          A5 HEADING = 'INVOICE:NUMBER';
   ITEM SALESAMOUNT      $999,999.99 HEADING = 'TOTAL';

END;
```

process of being improved, and much remains to be done.

SPECIALIZED APPLICATIONS PACKAGES

Systems like MARK IV and NOMAD are general purpose, in that they can be used for a great variety of applications. A quite different sort of nonprocedural software development is embodied in specialized applications packages. There are a great many of these, and it is safe to say there will be many more. They are so diverse that it is a little difficult to catch their essence in an abstract general definition. A few examples may serve to suggest their nature.

A researcher needing statistical calculations need not write a long complex FORTRAN program and then hope it is right. He can instead draw upon elaborate packages with names like BIOMED, MUMPS, or SPSS in which he need only state the statistical processes to be carried out. To anyone knowing the mathematics involved, which is a reasonable assumption under the circumstances, the necessary commands are straightforward.

An electrical engineer studying the response of a complex network can describe the interconnections and electrical characteristics of the network components, together with its input, entirely in the everyday language of electrical engineering, with no knowledge of computer programming whatever.

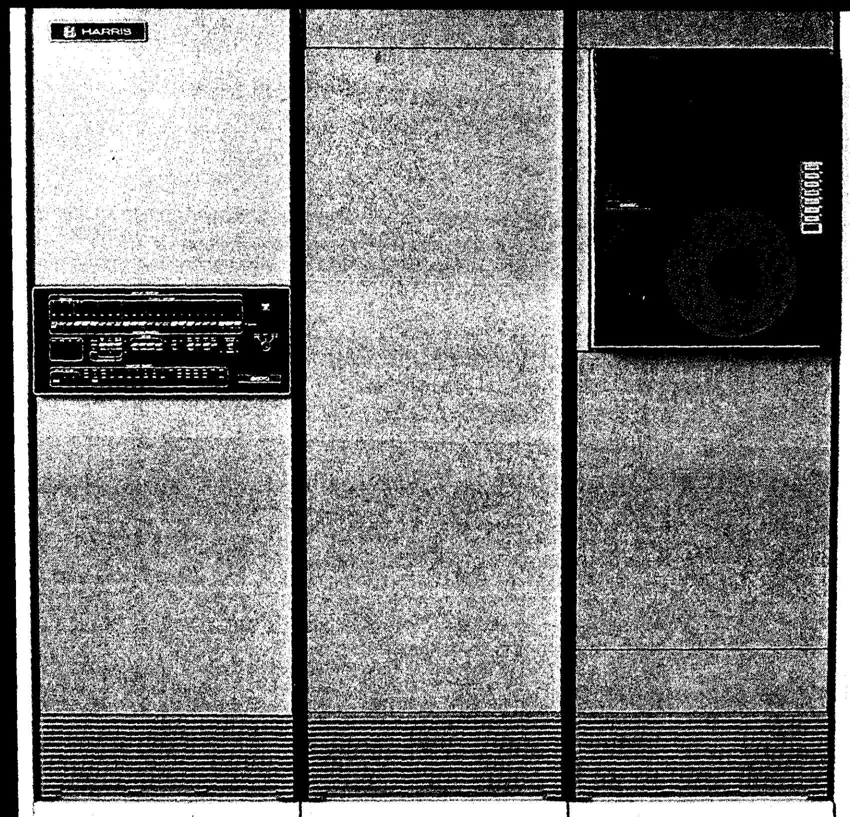
A market researcher can take advantage of a number of software products that permit easy extraction of demographic and geographical data from large data bases containing census and other information. Specification of what the researcher wants is in terms of locations and market characteristics and other such factors; no programming in the FORTRAN or COBOL sense is required.

It is widely predicted that packages of this sort will proliferate in the next few years. A number of them are already very widely used, and there is every reason to think that the trend will accelerate.

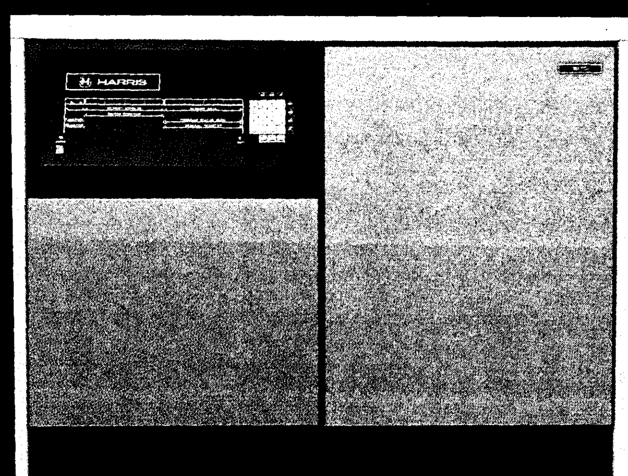
THE FUEL BEHIND THESE CHANGES

As I said at the beginning, the main push toward new programming methods is the cost and difficulty of conventional programming methods. Despite improvements, the productivity of today's programmers is no more than two or three times the productivity of programmers a quarter century ago. In the same period, the price/performance ratio of the computer hardware has im-

Harris 8570



Harris 8170



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For many years, Harris remote batch terminals have led the industry in performance and cost effectiveness. The sophisticated Harris 1600 RBT provides true multiprogramming capability. It can support up to four communications jobs concurrent with other tasks (such as media conversion) and can be upgraded to the next hierarchy of Harris products—the 1600 Distributed Data Processing (DDP) family.

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HARRIS

COMMUNICATIONS AND INFORMATION HANDLING

There will always be programmers...they will be writing software tools.

proved by a factor of perhaps a million. People wanting to use this low cost hardware are frustrated by the handicaps imposed by writing programs in a one-statement-after-the-other form required by FORTRAN, COBOL, PL/1, and other procedural languages.

Further, the tasks are getting harder. As we learn how to solve one class of applications, we tackle harder ones. The software problem is therefore a rolling crisis.

In a word, the rate of improvement in programming productivity using procedure-oriented languages is just too slow to keep up with the demand for new applications. Further, I'm afraid that programmers who are experienced in procedure-oriented programming are no less resistant to change than human beings seem to be in most other regards. Today's methods will have to be superseded, and many of today's programmers will not be willing or able to make the transition.

WHEN WILL IT HAPPEN?

A reasonable question would seem to be, "If nonprocedural methods are as good as you say, why haven't they already taken over?" The answer is threefold:

1. Nonprocedural approaches depend on large software packages, which are themselves programs that somebody has to write. They are large and challenging. Developing them and getting them to successful operation takes years.

2. Nonprocedural approaches can chew up machine time in large chunks. For certain applications they can be prohibitively expensive. But that will change as hardware prices drop, and drop they will. The basic costs are going down at least 20% a year. *Prices* are dropping less than half that fast, I think because the price of computer hardware has so much hidden software development cost bundled in with it. People who sell "naked" hardware (no software supplied with it) are able to sell very much below today's prevailing prices. Perhaps we will see the day when the basic charge is for the software, with a mainframe thrown in "free." Naturally, there is no free lunch, but such a pricing system would be as rational as what we have today, where the basic price is for hardware accompanied by "free" software.

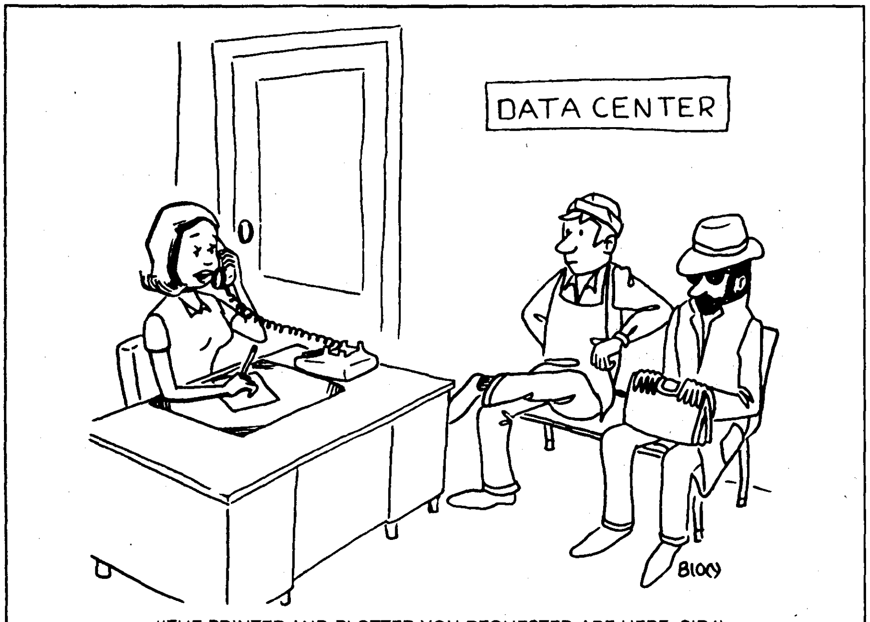
3. The existing programming corps represents a large inertia factor. Most nonprocedural methods are used by people without data processing experience—which is another way of saying that the methods are used directly by the people with problems to solve, without going through the intermediary of a programmer at all.

Taking all the factors together, I will venture a prediction that by the mid-'80s more than half of all computer time will be spent running applications programs constructed with nonprocedural-oriented langauges. As a corollary, I predict that the growth in the number of COBOL programmers will slow down, starting quite soon, as more computer applications are specified directly by the people with the problems. Perhaps, within that time span, data processing managers will also come to understand the true costs of software development, which I believe today usually are drastically underestimated.

An analogy between computer programmers and telephone operators is often made. It is pointed out that in 1920 (or some such date) the telephone people said that if the number of operators continued to grow at the rate it had in recent years, within a few decades every adult in the nation would be a telephone operator.

That didn't happen, of course. Better ways were found, for the most part, to carry out the functions of telephone operators on routine calls. But two lessons should be kept in mind. First, the absolute number of telephone operators *is* greater today than it was in 1920; few operators were ever laid off because of the introduction of automatic dialing equipment. Second, there are still small telephone systems where all calls are handled by operators. The productivity *of those operators* has not increased appreciably since 1920, but the efficiency of the overall system has increased by a very large factor, precisely because most functions were replaced by better methods.

Moral: There will always be programmers, but in the future most of them will be involved in writing the software tools, not actual applications programs. As best it appears now, the productivity of those programmers will not improve by a great deal, but as a result of their work, the overall efficiency of the use of computers will improve markedly over today's status. ❋



"THE PRINTER AND PLOTTER YOU REQUESTED ARE HERE, SIR."

DANIEL D. MCCRACKEN

Daniel D. McCracken, president of the Association for Computing Machinery, is a leading author of textbooks on computer programming. His *Digital Computer Programming* (1957) was the first text on the subject. Among his 15 titles are standard works on FORTRAN (1961, 1965, 1972, and 1974), ALGOL (1962), COBOL (1963, 1970, and 1976), and numerical methods (1964 and 1972). His latest book is *A Guide to PL/M Programming for Microcomputer Applications* (Addison-Wesley, 1978).

HARDWARE IS EASY: IT'S SOFTWARE THAT'S HARD

by M. I. Bernstein

The "software problem" has been with us since the inception of the computer era, for without software, most computer hardware is worthless. During the past five years, however, software has become a major concern of the data processing industry.

What underlies this concern? There appear to be two principal reasons. First, there is the continuing upward shift in the ratio of software costs to hardware costs in dp systems. The cost of hardware is continuing to decline as its performance increases. Software, on the other hand, being a labor-intensive activity, is increasing in cost because the people who develop it cost more. These two factors, working in opposite directions, make the ratio shift more rapid and more obvious.

The second reason for concern is that an increasing fraction of the U.S. labor force depends on dp *systems* (hardware and software) to get its job done. That fraction is already estimated to be greater than one-half and is projected to reach three-fourths by 1990. These are adequate and legitimate reasons for concern.

PRODUCING QUALITY

Both of these concerns embody the concept of productivity; in the first case, the productivity of software developers; in the second, that of the end users whose productivity is dependent on data processing. Therefore, the software problem is more frequently referred to as the software *productivity* problem. According to *Webster's Third International Dictionary (Unabridged)*, productivity is defined as: "—the ability or capacity to produce a) abundance of richness of output, b) the physical output per unit of productive effort, c) the degree of effectiveness of industrial management in utilizing the facilities of production, especially the effectiveness of utilizing labor and equipment." This definition says nothing about efficiency, but it does incorporate the concept of *effectiveness*—what should be done versus how well it's done, according to Peter Drucker. All too often, we tend to lose sight of the distinction.

Software productivity covers three different aspects of the dp environment: (1) the contribution attributable to software that provides a computer system the ability to produce, (2) the contribution attributable to software that permits an end user to be productive, and (3) the effectiveness with which the available resources are utilized to develop or produce and maintain software.

Thus, when we express concern about software productivity without qualification, we encompass practically everyone and everything associated with data processing. The failure to distinguish what or whose productivity is being addressed or attacked is often a source of confusion. Each concerns a different set of people or things and each requires unique understanding. For the operating environment, we need to know how effectively the system processes its load; for the applications systems, we ask how effectively they are using the operating environment and providing function to their users, and how effectively do the end users themselves perform; for software developers, the question is how effectively they produce and maintain the software. The methods and means of determining and evaluating each of these cannot be used interchangeably.

Lately, the productivity of the software developers (programmers and analysts) has been receiving a great deal of attention. The objective of this attention is to both lower, or a least contain, the cost of software and to improve its overall quality as reflected in the other aspects of productivity.

William Thomas, Lord Kelvin, once wrote, "When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of a science."

NOT A SCIENCE

We are still in the unfortunate condition that software development is not science, it is a craft; and our knowledge "is of the meager and unsatisfactory kind." The best we can do, in truth, is "measure" software developer productivity qualitatively.

The following anecdote is illustrative of the present condition. An associate was making a presentation on the ways his company had reorganized its applications development group to take advantage of the new improved programming technologies. He concluded his presentation with remarks about the benefits experienced, such as higher quality software and higher productivity from the developers. When asked how he knew things had improved and what he had measured to substantiate and quantify these improvements, he gave the following answer: "If you don't see me again for six months and during that time I lose fifty pounds (at the time, one could legitimately describe him as portly), you would rightly observe when next you see me that I had lost weight, but you would only be able to guess how much. I know that our applications development group has lost weight."

This is precisely the situation in which we find ourselves today. We have no adequate way of quantifying the state of our software development efforts be-

By what magic are we going to transform a problem into a science?

fore, during, or after we institute changes aimed at improving the process. Some measurements are being made, but they provide information that is "meager and unsatisfactory."

Historically, we have used lines of code or installed instructions or other variations, per unit of work time (man-days, -weeks, -months, -years) as the principal measure for software development productivity. It is certainly meager and particularly unsatisfactory for a number of reasons. Among the many reasons is the observation by Dick Hamming that "the purpose of computing is insight, not numbers." The same holds true for measuring productivity.

Lines of code per man-month has yet to provide any insight into what makes who productive. This stems from the fact that this measure assumes that one line of code is equivalent to any other of code and that one software developer is interchangeable with another. Nothing could be further from the truth.

HOW SHOULD WE MEASURE?

Software developers are supposed to bring imagination, innovation and creativity to their jobs, along with basic programming and design skills and a reasonable amount of self-discipline. They do not stamp out lines of code like bottle caps on a production line. Why should we measure their output as though they did? At best, this is doing them a disservice.

Such a measure has another inherent flaw in that it completely ignores the quality of the product. Errors per thousand lines of code are not a measure of that quality of software that is of primary concern. Of course, minimizing or eliminating errors from software is essential, but it has little to do with the aspects of quality that relate to how efficiently the hardware is utilized, how well the users' requirements are met, or how readily the software can be improved, extended, or modified. We have no *a priori* measures for any of the factors that determine the quality of a software system. At best, we can only qualitatively evaluate them after the fact, but we still have no way to relate cause and effect.

Experiments have shown that initial intent, expressed or implied, affects the resultant software; if the developers believe that time to completion is primary, you get one result; if they believe that minimum storage is desired, you get another, and so on. It's not clear what happens when you want various combinations, either in terms of cost to produce the software or the impact on qualities other than the ones demanded. The conclusion one is forced to reach is that software development is a craft we cannot control and, as a result, can barely manage.

There are those who would assert that this is a tempest in a teapot because the problem is bound to go away. There are those who hold that the high cost and low quality software is a myth because one can buy high quality, low-cost packages to perform almost any application needed. Except, of course, those applications that are too risky and not well enough understood to invest in as a package. The majority of the software developed by most companies are these risky, complex applications, and not the applications for which a software package is available. The not-invented-here syndrome is abating. The industry has matured to that degree.

Others claim that the need for software developers per se will decline to the point where only a few really expert software developers will be needed to support large, central data base systems, and that all other software development will be done as a part of an employee's normal nonsoftware related job because the spread of personal computers will turn everyone into a first-rate programmer. If this is true, why is it then that so many who have chosen software development as a career do so poorly at it and produce such low quality software? If it's so easy to learn to do well at home on a personal computer, why is there such a large disparity in ability as reflected in results between good software developers and poor ones? Why aren't all those capable people flooding into the ranks of software developers and displacing the less capable ones? It certainly pays well enough. How come we have such a hard time finding any kind of software developers these days if all that talent exists? What's going to change ten years from now? What miracle is to be performed, and by whom?

Last, but not least, is the myth that prevailed a few years ago, and still rises from time to time that the software problem and software developers will disappear because of the hardware revolution. All that is now software and that yet to come will be subsumed into the hardware and firmware provided by the vendors.

Who is it that's going to perform that subsumption? By what magic are we going to transform a problem of which we have but the most meager knowledge into one of science and engineering? It is rather foolhardy to project that those wonderful $25 scientific and business calculators will take all of the systems and applications we'll need 20 years hence. The trend points in the opposite direction: the burden of programming the more advanced calculators for the more difficult applications is left in the hands of the owner.

THE PURPOSE

A more legitimate question is, why should we measure the productivity of software developers and the quality of their results? As it says in the Talmud, "If you don't know where you're going, any road will get you there." A corollary to that is, "If you don't know where you've been, it doesn't matter where you're going." Without being able to measure and quantify the software development process, we will never be able to control and manage it, plan for the future, predict and estimate new undertakings, properly evaluate the practitioners or their results, establish norms and targets, or formally teach anyone how to do it properly. The only way we learn to do it today is by apprenticeship and on the job training, which is typical of a craft, and is one of the reasons for the highly variable and uneven results.

We will never turn the software development process into a disciplined engineering process until we can quantitatively measure it and control it. Even when we reach that point, the results will not be totally controllable and predictable, as in most engineering disciplines today, but we will have the necessary tools to analyze and understand the results, avoid the mistakes, incorporate the innovations, and know how to attain reproducible results. But that time is in the indefinite future, for we have far too little knowledge today to predict how and when the state of our collective knowledge will be adequate and the transformation from a craft to an engineering status will be achieved.

That is not to imply we should passively wait for someone else to solve the problem. The problem itself is ill-defined and that requires cooperation and participation on the part of all of us to assure that the proper problem is defined, attacked, and solved.

In the interim, despite that we cannot quantitatively measure the software development process, there are many things that we can do to improve the process. There are many aspects of the total development process that are

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Craftsmen can't be productive if they lack the proper tools and methods.

never likely to become quantitatively measurable and whose impact will only be reflected in the measured results. We can improve these and, at a minimum, observe the qualitative impact while experimentally measuring the development process and its results.

Among those things we must continuously attempt to improve because of their affect on software development productivity are management and supervision, communication, training and education, documentation, tools and methods, and the availability of resources for the developers. Each of these, individually and in combination, can have a marked affect on the productivity of software developers and the quality of their results.

MANAGEMENT AND SUPERVISION

Management and supervision is the single most critical aspect of the development environment in its effects on productivity. Given that one has been able to assemble the best group of developers in existence and provide them the best possible physical environment, the results will be far less than optimal if management and supervision is poor. Software developers, like everyone else, need to know what is expected of them, how they will be evaluated and rewarded, what are their missions and roles within the larger framework, that there will be an orderly progression to the future, and why things change when they do. These are the responsibilities of managers and supervisors. Software developers cannot be expected to correctly define for themselves what is of importance about their present assignment if management doesn't tell them. The same principle applies to the developers' understanding how they are evaluated and rewarded.

Stressing good communication among all parties concerned in a software development effort is like being in favor of motherhood and apple pie, but far too often it is a lack of communication among developers, management, the users, and operations, that leads to what appear to be technological disasters. If the users can't communicate their requirements to the developers and their management, if restrictions aren't properly communicated back to the users, or if the developers don't have sufficient understanding of the operational considerations for a new application, the resultant software is highly unlikely to be satisfactory. Communication is the glue that binds this intense people-process together; without it, the whole is considerably less than the sum of the parts.

In this ever-changing dp environment, it is impossible for anyone to perform his job without knowing the present state of the art in his organization. One can't assume that the developers will, of their own volition and motivation, become aware and acquire sufficient knowledge and understanding of improvements and changes to incorporate them in their work. At a minimum, developers (as well as everyone else) should be encouraged to engage in individual study efforts and professional growth and should be provided encouragement and resources to do so. When major changes in the system or its operation are contemplated, formal training is mandatory. Word-of-mouth communication is, at best, hazardous.

PROPER DOCUMENTATION IS ESSENTIAL

Proper documentation for developers, maintainers, operations, and users is essential, and yet, in most cases, it is done as an after-thought. Documentation, a form of communication, is the link that ties the various elements and workers of a dp environment together. Weak or nonexistent links ensure problems.

Proper documentation is the baseline against which everyone performs. One can't expect the developers to produce working applications software without proper documentation of the system upon which it will be developed and installed. The users can't be expected to understand how to use all of the features if the system isn't documented, and the maintainer can't possibly repair or improve a software package effectively or efficiently without documentation. Documentation must be considered an inherent part of software, not an additional burden.

One can't expect a group of craftsmen to be productive if they lack the proper tools and methods for using them. Yet, far too frequently, an investment in tool purchase or tool building is overlooked or denied. Part of the reason is that no one can quantitatively assess a set of tools, but often it is the case that long-term benefits are heavily discounted in favor of short-term savings, a perfect case of false economy. Heaven only knows what fraction of development resources have been diverted by developers to build ad hoc tools despite their availability (at a cost) from other sources. Given the tools, one must assure that they are used, and used properly. While a full tool kit is not a guarantee to high productivity, the lack of tools will certainly limit productivity.

Everyone suffers from poor productivity. A batch system that can provide nothing better than 24-hour turnaround time for software developers will cripple the best of good planning and intentions. An interactive system that won't support an adequate number of users and developers and gives erratic and lengthy response time will debilitate everyone involved. We attempt to stuff more demand down the throat of an already overloaded system in an attempt at short-term economy. The negative impact on everyone's productivity and the resultant losses are rarely evaluated.

WHAT TO DO TODAY

Even though the problems of software productivity are complex, difficult, and not well understood, there are a great many things that can be done today that will help us lose weight; and lose weight we must as the demands for better software from dependent users increases. Although we may not have a scale to stand on to tell us how much weight we have lost, we will be able to see signs that indicate when we are doing the right things and when we are doing the wrong ones.

But if we are ever to do better than that, we must understand the software development process well enough to be able to invent the scale. As Eisaku Sato, a former Prime Minister of Japan once said, "We are in the same ship, so we must make every effort not to sink together." ✲

MORTON I. BERNSTEIN

Mr. Bernstein is manager of special projects for System Development Corp.'s Research and Development Div. He has been involved in attempting to improve the software development process since the mid-1950s, beginning with research in programming languages and, more recently, managing a variety of software research projects aimed at providing better programming tools and techniques. Active in SHARE since 1957, he was a member of the SILT Committee that produced the 1976 book *Data Processing in 1980-1985*.

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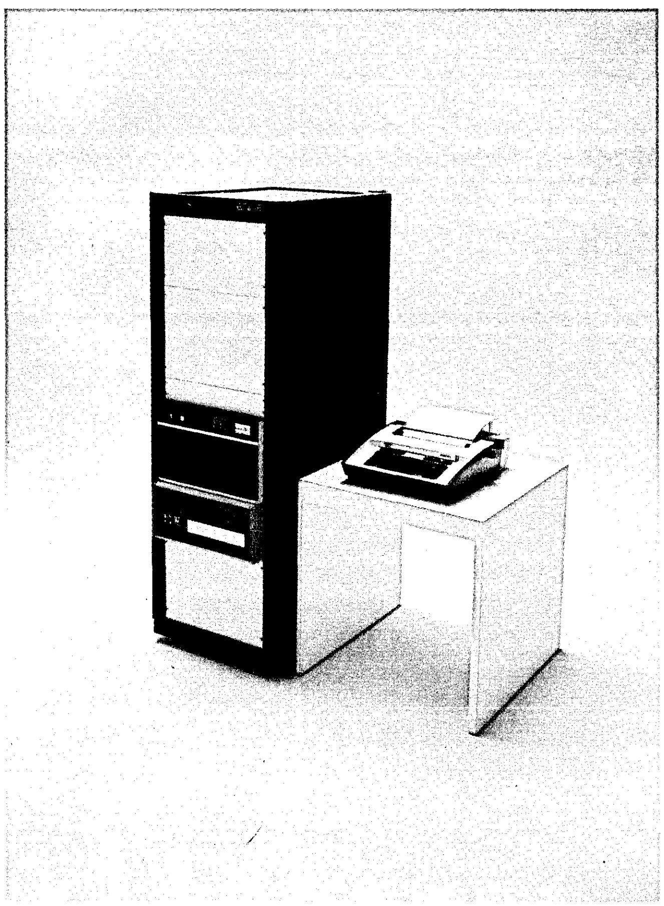

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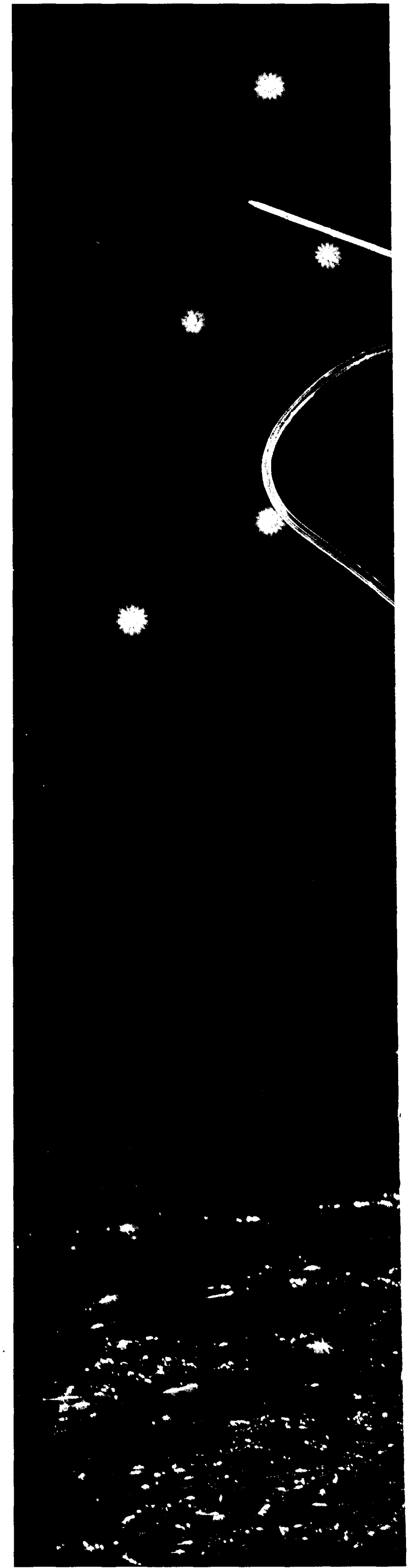
DATA COMMUNICATIONS IN TRANSITION

by Ralph Berglund



Much of the dramatic change in the data processing industry involves data communications, a field itself that is in an exciting state of transition. In technology, in applications, in products and services, and in regulatory issues the rate of development has the industry feeling that future shock has arrived. However, the changes point to more cost-effective systems for business needs, and perhaps even less costly systems.

In the last four years, new digital transmission technology has yielded transmission systems with marked improvements in cost performance, specifically digital transmission and public intelligent data networks. Digital transmission, such as Bell's Dataphone Digital Service (DDS), offers a substantially lower error rate and significantly better response time than the conventional analog transmission (i.e., with modems). The lower error rate (about 100 times lower) means users can transmit large files more reliably. The faster response time means better performance per se, or the ability to handle more terminals or volume within existing response time standards. And, under present tariffs, the improved performance costs no more than the traditional analog approach.

The biggest drawback to DDS has been its limited availability. The FCC had been restraining Bell from expansion of DDS pending Bell's acceptance of a tighter cost accounting system, and provision of related cost data. That having been essentially accommodated, Bell has now begun expansion with a target of 96 cities.

Digital transmission service is important to those users who require and can justify a private line network.The benefits of digital transmission, however, are also extended to those users who choose a public intelligent data network (IDN), since the operators of these networks are using DDS to interconnect their nodes.

The two presently operating public IDN's are Telenet and Tymnet. In addition to digital transmission benefits, these companies are also extending the benefits of economy of scale to their customers. These networks use medium- and high-speed transmission lines which are quite cost effective for those who have the entry level volume or need to justify them.

A principal contribution of the IDN's, then, is to organize this capacity so that it can be assessed by those whose needs cannot justify a private network. Important auxiliary advantages, however, are also provided by these network services which make them attractive to all users, large and small. They include: speed, code, and protocol compatibility between terminals and hosts; error detection and correction; and network management by someone else. The intelligence in the network means that less intelligent (i.e., less costly) terminals can be used. The network management service reduces the need for special staff to plan, design, implement, administer, and troubleshoot the network.

The networks, services, and customers of Tymnet and Telenet are on the increase, indcating users' acceptance and confidence. User awareness and understanding are likely to increase even faster as a result of Bell's efforts in behalf of their planned Advanced Communication System (ACS). This service will provide IDN functions, but will go even further. For example, ACS will support data entry, including the storage and execution of data entry programs and editing logic, and the accumulation of entered data pending batch transmission.

The question of whether, when,

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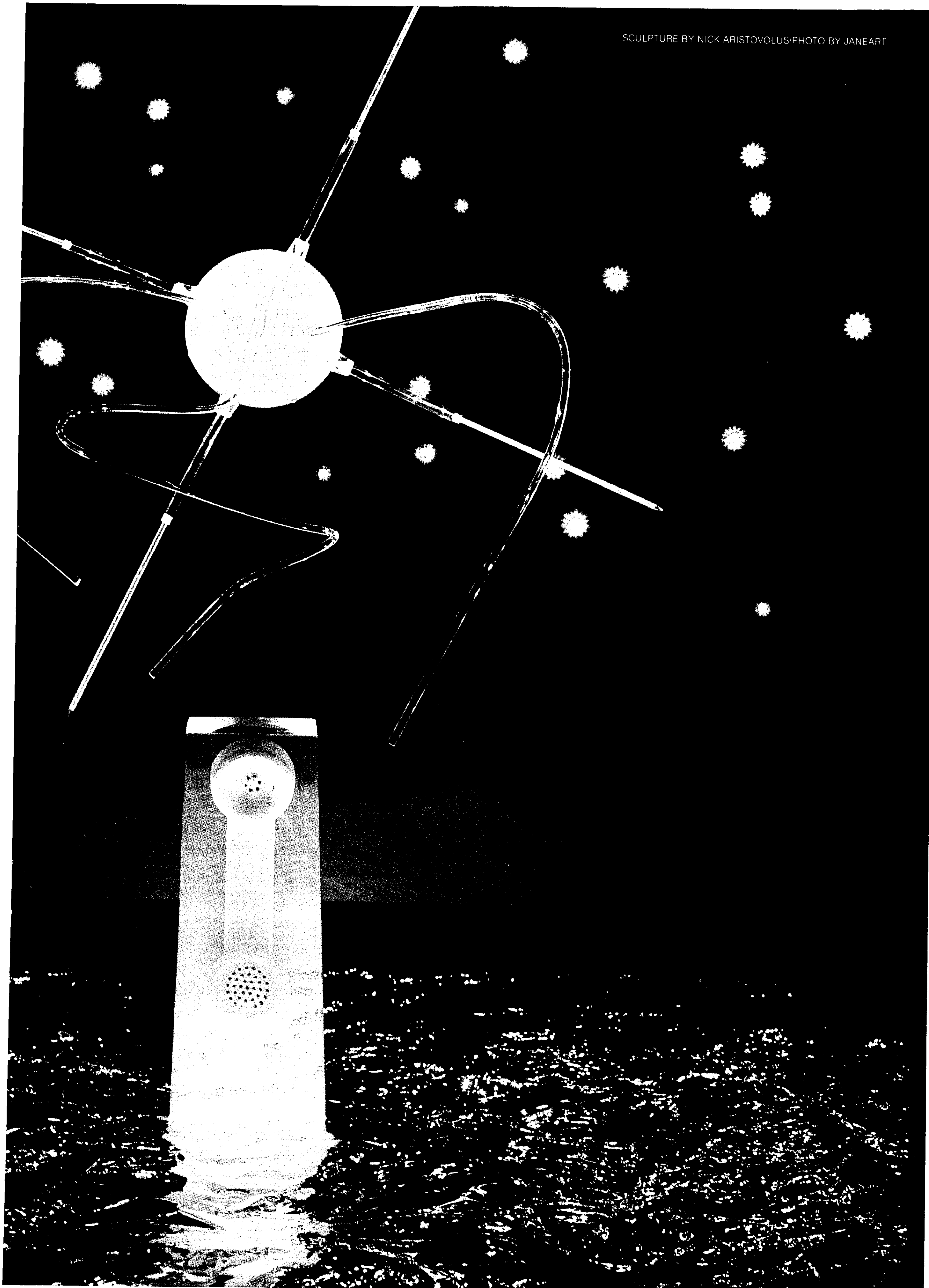


The marketing of ACS is a magnificent brier patch.

and in what form ACS comes to market are all caught up in a magnificent legal brier patch. Even given a prompt resolution of the legal questions, Bell faces a conventional and limiting problem: where or how does one find the capability to establish and support a software-based system. A related comparable problem is the recruiting and training of a marketing and customer support staff. In short, the simple fact of announcing a major salient into data systems doesn't make Bell a credible, substantial supplier. While the power and the glory (financial and image resources) will support it, its maturity in the marketplace will take several years.

PRIVATE IDN's Meanwhile, private IDN's, a fallout of IDN and microcircuit technology, are entering the market. Such private networks seem to be cost-effective, and offer an attractive alternative to the alpha and omega computer network architectures being pushed by the mainframers.

A present major source for these is Telenet, probably to be closely followed by formal announcements of products from Tymnet. Coming from these carriers, the private IDN is an interesting hedge against a loss or deferral of business in favor of Bell's ACS. For many users, it's the best of two worlds: a private system for maximum cost-effectiveness and availability, integrated with a public network for backup and network management. With interfaces developed to public standards, the private IDN would seem more stable, yet more flexible, if change is desired. Public standard interfaces are more likely to be compatible with diverse host and intelligent terminal systems from multiple suppliers, now and in the future.

Whether the networks are to be public or private, and whether they are to be intelligent or passive, their operation is going to be more cost-effective because of another technological development, the data link control. Known by many names—HDLC, SDLC, ADCCP, UDLC, NCR/DLC, BDLC—the significance of data links is in two aspects of performance: (1) they support full duplex operation, and (2) they need interrupt transmission only on occurrence of an error. The full duplex operation means that a host can send to one terminal while receiving from another on the same circuit, or two hosts or intelligent terminal systems can exchange data with each other simultaneously. Interrupt on error means a sender need not pause after each block is sent and await an acknowledgment as an anxious child demonstrating his letters one at a time. Instead, the sender may transmit continuously, secure in the knowledge that he will be advised if something needs to be re-sent because of error. Both of these features mean significant performance improvements, and therefore, more cost-effective systems. It is a shame that they cannot be implemented except as a part of a major move into a much grander, complex, and costly "computer network architecture," somewhat analogous to killing the dog to get rid of the fleas.

SATELLITE CHANNELS The high level data link controls are a means, for example, to realize the maximum effectiveness from satellite channels. With present marketplace packaging (i.e., conventional and passive voice channels), domestic satellite circuits are unimpressive in most data communication applications. An HDLC or ADCCP would dramatically increase their efficiency, and make them much more attractive for domestic data applications. At present, however, their primary role is in one-way information flow or broadcast situation, such as facsimile and news services. In our existing data transmission world of send, pause . . . send, pause . . . their long propagation delays make them relatively unattractive.

Another tack which would make satellite channels more attractive would require more innovative packaging than that of passive "vanilla" voice channels. An example is the Satellite Business Systems' plan—a single high-speed bit stream integrating much, if not all, of a user's intra-company location communications. This approach would be economical, and would include forward acting error correction techniques. The latter would rival HDLC in providing efficient batch transmission.

For transactions processing, the economy of scale would mean that users can afford the many channels (or alternatively, the single high-speed channel) required to get away from multipoint polled circuits. Response times, then, would not suffer as much from propagation delay.

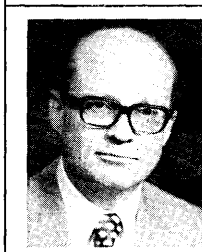
The potential is for more cost-effective communications. Hence, existing systems for traditional applications—batch transmission and transaction processing—can be expanded, improved, or simply cost-reduced.

Beyond traditional applications, improved data communications is also fostering growth in two new application areas, popularly referred to as distributed data processing (DDP) and the automated office. Of these, DDP is the more ill-defined and controversial. But while the semantic and dp policy battles rage within some companies, many users are quietly implementing and enjoying the benefits of at least remote data entry and, to some extent, remote transaction processing. Periodic batch transmissions are involved to forward accumulated data, modified data files, or transaction logs to the central site dp system. In some cases, there may also be an on-line interactive communication link with central dp to enable accessing master data files on an exception basis. The issues of DDP will most likely be resolved on several factors other than data communications. And, while data communication developments clearly encourage DDP, it can also be argued that more effective communications reduces some of the need for DDP. Delightfully, then, data communications is ready to serve either master, centralization or distribution.

The other exciting application area is that of the automated office, a buzz phase covering letter or message word processing, transmission, and storage. Interim systems include local word processing, facsimile transmission, and store and forward message switching. Projected systems will integrate all company locations, integrate dissimilar terminal devices, have a preponderance of communicating typewriters and crt's, and incorporate electronic file cabinets.

Data communications has been in transition since its inception. The past has been fascinating, but compared to the future, the last 20 years will seem like an era of telegraph keys and Morse sounders. *

RALPH G. BERGLUND



Ralph Berglund is a principal in the firm of Berglund & Smith, consultants in data communications and computer networks, Cherry Hill, N.J. In addition to his general client work, Mr. Berglund is the consultant in data communications to DATAMATION and to Datapro Research Corp. Mr. Berglund has an MSE in computers and communications from the Univ. of Pennsylvania Moore School of Electrical Engineering.

MANAGING DATA COMMUNICATIONS

by Ray Sanders

Processing power and memory capacity of data and communication processing equipment are becoming so inexpensive we now face the prospect that management, implementation, and operating costs of these systems will far overshadow equipment costs.

What is not clear is how best to apply this new technology to achieve desirable results at low overall cost. The purpose of this article is to encourage the questioning of many assumptions that have led to current systems. There are important changes which must be made in managing data and communication processing programs if we are to get any substantial benefit from the new technology.

In our industrialized society, we have become used to the process of maturation of an industry. Even though an industry may continue to grow, we expect to see a period of rapid technological advancement followed by a long period of technological refinement. The automobile, the airplane, and, until recently, the communication industries are typical examples. As this maturation process continues, management principles evolve at a slow refining pace in step with the relatively slowly evolving technology.

A few years ago, the dp industry began exhibiting many of the symptoms of these older industries. True, it has been predicted by nearly every industry observer that memory and processing costs would decrease dramatically over a period of 10-20 years, and that applications for computer technology would expand significantly. Even so, few have prepared themselves for the real issues of the revolution now upon us. Few have realized that with the revolution in computer technology we must face a revolution in management's approaches to uses of the technology.

First, we need to examine the fundamental needs which can be satisfied by the new technology; we must not assume that the old implementation approaches are themselves basic or unchanging.

Although all possible future applications cannot be predicted, the following statements can be made with real certainty:

The predominant uses of computer technology in large-scale systems will be in data base-oriented applications.

Large-scale systems will increasingly involve use of communications for data base access by large numbers of users.

HOW TO SATISFY NEEDS

How then do we satisfy these needs with the new technology? There are several choices. The differences in approaches generally center on the questions of where the software resides in a large system and where and how it is developed and supported.

From the point of overall cost, the questions concerning software management are now at a point where we can, at low equipment cost, provide substantial computer and storage capacity for each user at his own work station. However, to encourage each user to develop his own software for his own use is only in rare instances a viable management option.

Developing workable standards for assuring ongoing support and for intercommunication of work stations is a difficult task in itself. Training large numbers of people in the disciplines required is even a more formidable chore. Unless software development systems can be implemented which require users to achieve no greater level of sophistication than what are now thought of as interactive transaction-oriented inputs, we must approach the practice of distributing software development out to a user location with great caution.

At the other extreme, the new technology can be applied on a highly centralized basis where software development and support are under the control of a single organizational entity. This is, in most organizations, an extension of their existing approach to data processing. The problems of this approach have been, and will continue to be, the difficulties of scoping software development efforts to truly satisfy the needs of the user. It is not a simple management problem for users to specify precisely their needs and to allow for upgrading systems to meet changing needs.

The question comes to exploring alternatives between these two extremes.

OBJECTIVES

Is there a generally satisfactory management approach? Let's first list a set of objectives that many managements would like to achieve in their information handling and data processing activities:

1. Accurate, up-to-date information to enable workers to accomplish their tasks in an efficient and professional manner.

2. An information handling and data processing system which will enable management to control the "information explosion" which is taking place in their organization.

3. The organization of the information processing system must be such that management can control the system and not allow the system to control management.

4. The overall system approach must be sufficiently flexible to incorporate the new technology.

To elaborate, the first objective can only be achieved if an information processing system allows users of data bases to have on-line access to information so that all users have available the same up-to-date information at the same time. This requirement places restrictions on the system architecture, since synchronization of distributed data bases has been and will continue to be a problem.

The second and third points are closely related to the first. A large amount of information within organizations is generated to coordinate and check other information. In many cases, on-line access to data which can only be derived from a single well-controlled source of core data will save an enormous number of man-hours, compared to manual and semiautomatic systems where different vintages of the same data can cause enormous confusion. A com-

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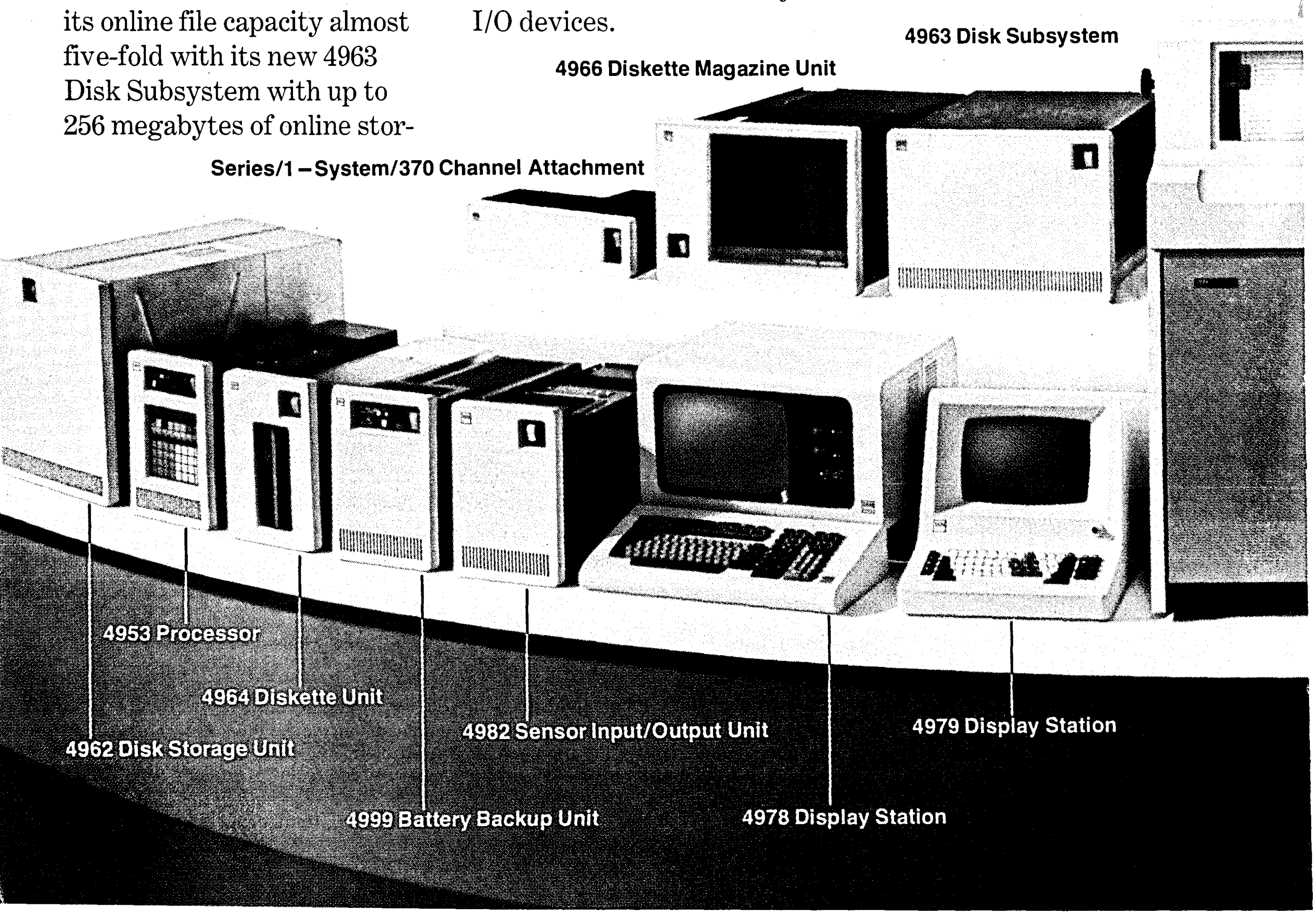

mon example of the process has been seen in many manufacturing organizations which made use of batch dp systems for such functions as order entry or material requirements planning.

In every organization, it has become necessary to generate increasing amounts of information to deal with government regulations, auditing requirements, and the complexities of modern society. That much of this information-generating activity is nonproductive is of great concern to many managements. It is essential that future information processing systems be designed to provide management with tools to control not only the quantity of information generated, but its quality and the numbers of people involved in the process. It is essential for many organizations that they reverse the nonproductive pattern they have established. Proper application of the new technology can achieve this. This emphasizes the need for implementing an information processing system where management sets its objectives and does not allow those objectives to be dictated by the technology or the technologists.

The fourth point emphasizes the need to find ways of implementing information systems which will not restrict the application of future technology. This need for flexibility must be carefully analyzed. First, it is important to be certain at the outset that existing investments in software, procedures, and equipment not be rendered obsolete. Few organizations can endure a revolution in operations over a very short period of time. Second, it is important to ensure that elements of the new technology can be adapted to changes which management will want to make in controlling the organization's productivity. This generally means that system elements should not be so specialized in function that substantial changes in their use is precluded.

STAYING LOOSE

One of the most important aspects of the flexibility is that an organization should make certain that its system architecture does not lock it into always buying the bulk of equipment and software from a single supplier. This is becoming even more important than in the past, since we are in an era of rapidly changing technology; it is important to be able to make use of the best alternative a competitive market has to offer. It is just as important to make certain that maximum flexibility is maintained so that management is not constrained by a single vendor's information processing system architecture in seeking the goals of increased productivity and control of the information generation and distribution processes.

COMING NETWORK STRUCTURES

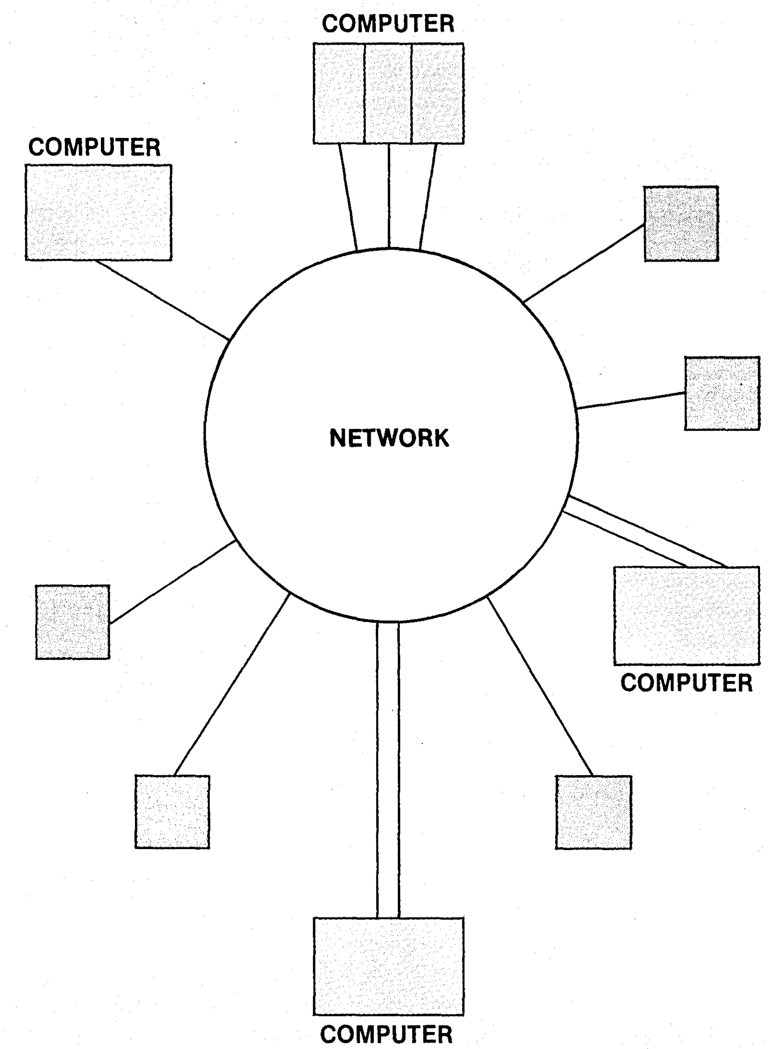

Fig. 1.

We will conclude this discussion with an examination of elements of the new technologies to see if there is at least the hope that a generalized approach exists. We will try to answer two questions. The first is: Is there a generalized information processing architecture which can, with assurance, meet most management objectives? The second question is: What assumptions regarding system implementation should now be subjected to close scrutiny? In other words, are there tacit assumptions inherent in systems architectures today which will insidiously defeat management's goals?

The answer to the first question is simple. Since intercommunication of users is clearly a key requirement in any organization, a communication network which can be used to interconnect users of equipment embodying the new technology is an obvious necessity if information transfer within an organization is to be accomplished without physical handling of documents or storage media. The accompanying figure shows an idealized situation where a network is defined to which both terminals and computers can be attached. The real question is not at this level, but at the next level, which must be answered by looking at some basic aspects of the processes required to implement such systems.

DOUBTFUL AXIOMS

What then should be some of the fundamental requirements of such a network and what tacit assumptions should we avoid? To begin, we should observe that most networking approaches in use today are based on the technology of at least 10 years ago. Some of these which should now be seriously questioned are:

Processing power is expensive, but we should expect that each doubling of computer hardware cost will increase processing capability by a factor of four ("Grosch's Law").

Processing power is expensive and communication handling software consumes large amounts of processor capability; all of these functions should be brought out of a host machine and placed in a "front-end" machine.

Communication line quality is so poor that error control protocols must be used in most telecommunication systems.

Complex communication protocols are warranted to save hardware and line cost and to provide error and flow control.

The results of these and other assumptions now are so ingrained in many people's thinking that they view these concepts as fundamental. Moreover, they embrace the new technology as a way to mechanize the immense complexities which have emerged from the constraints of these assumptions. There can be no way for us to deal with the growth of information processing if we build only on the structural complexities which have emerged from outmoded constraints. We must find ways to simplify the structure of information processing systems if we are to gain the benefits of the new technology.

We are now at a point where we can afford to waste processing power, memory, and even long-haul line cost (which is decreasing with the new technology) if the result is greatly simplified structures. The costs in tomorrow's world of dealing with today's structures will undoubtedly make any savings achieved in hardware look paltry indeed if the new technology is used only to mechanize today's structures.

SIMPLIFY

To prove this conjecture we need only look at the enormous number of man-years which have been expended in developing operating systems for large-scale computers and the application software which operates in that environment. Software development for networking has been another huge consumer of talented software resources. Although we must, of course, make use of that which we have already developed, we should ask if we can conceive fundamentally simpler approaches for future developments. The answer is yes.

Assumptions more suitable to the late 1970s than those of the 1960s are:

Processing power and memory are cheap; we can afford to waste them if it makes the job of developing software simpler.

Processing power is cheap; we can afford to include some of the communications handling functions in host machines and not in "front-ends" if it simplifies the overall system.

Communications line quality is sufficiently good that error control is only required in certain cases.

Simple communication protocols must be implemented to decrease the complexity of highly interconnected systems.

The new technology has largely obscured the distinction between mainframe and minicomputers. Computers with vast processing power and large memory capacities are now available at low cost. We have certainly passed the point where it is cost-effective to design complex software to operate in larger and larger machines to handle more and more tasks. We are at a point where we should seriously consider allocating a single machine to a single application.

This approach reinforces the need for a network of the type shown in Fig. 1. It is possible that inexpensive terminals can access a number of different computers so that there is no constraint in supplying more than a single application in a machine. Moreover, it is now easy to achieve communication between computers so that data fundamental to many parts of an organization's operations need be stored in only a single data base.

PROTOCOLS AND PACKETS

As the trend toward one application per processor increases, the most important system element becomes the communication network and the ways in which terminals and computers can connect to it to achieve manageable simplicity. To enable computers and terminals to communicate across a network boundary, rules (protocols) must be established which allow the network to determine the destinations of messages produced by these devices. Today, communication protocols have been designed to perform many additional functions such as error control, flow control, and functions which are specialized to a particular application. The result of these well-meaning efforts have created layer upon layer of protocols and, as a result, layer upon layer of complexity which must be removed.

Many of these layers can be eliminated by moving to a single application per processor where functions of the layers are folded into end-to-end application software, and where simple network access protocols are implemented *and* the network is designed to be transparent to user protocol.

Packet-switching has become a popular technical subject. Unfortunately, its very structure engenders the layering complexities; it is difficult to implement transparent networks using pure packet switching. Alternative electronic switching technologies such as time division and contention switching are not only available, but provide the basis for achieving the simplified network interfaces. These interfaces are based on existing industry standards which are already supported by nearly all computers; no new standards agreements are necessary.

Certainly, packet switching has a role to play in data communications. However, to become obsessed with this (or any other) technology to the point that the real problems of applying the microcomputer technology are not based on building manageable and nonobsolescent networks is a real risk.

We now have the technology to achieve major simplifications in information handling in organizations and to greatly improve productivity. We can only expect to achieve these results by demanding that the technology be implemented in simple, manageable structures. This will be achieved as soon as managements make certain their productivity objectives are clearly stated and they ensure these objectives are not thwarted by surrendering to nonproductive, technologically complex systems. ❋

RAY W. SANDERS

Mr. Sanders is president of Computer Transmission Corp. (TRAN), an El Segundo, Calif., firm which designs medium and large scale digital communications networks, as well as produces and installs the equipment for them.

Prior to founding TRAN, he was vice president and director of engineering at ITT Gilfillan, and before that a founder of Space Electronics Corp. He also has been a DATAMATION contributing editor.

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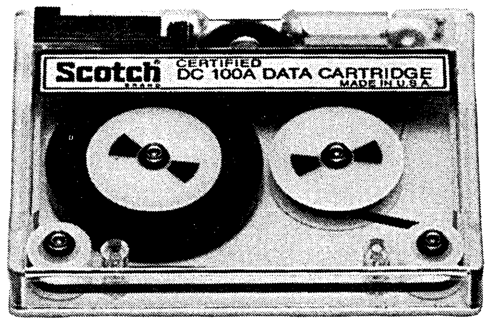

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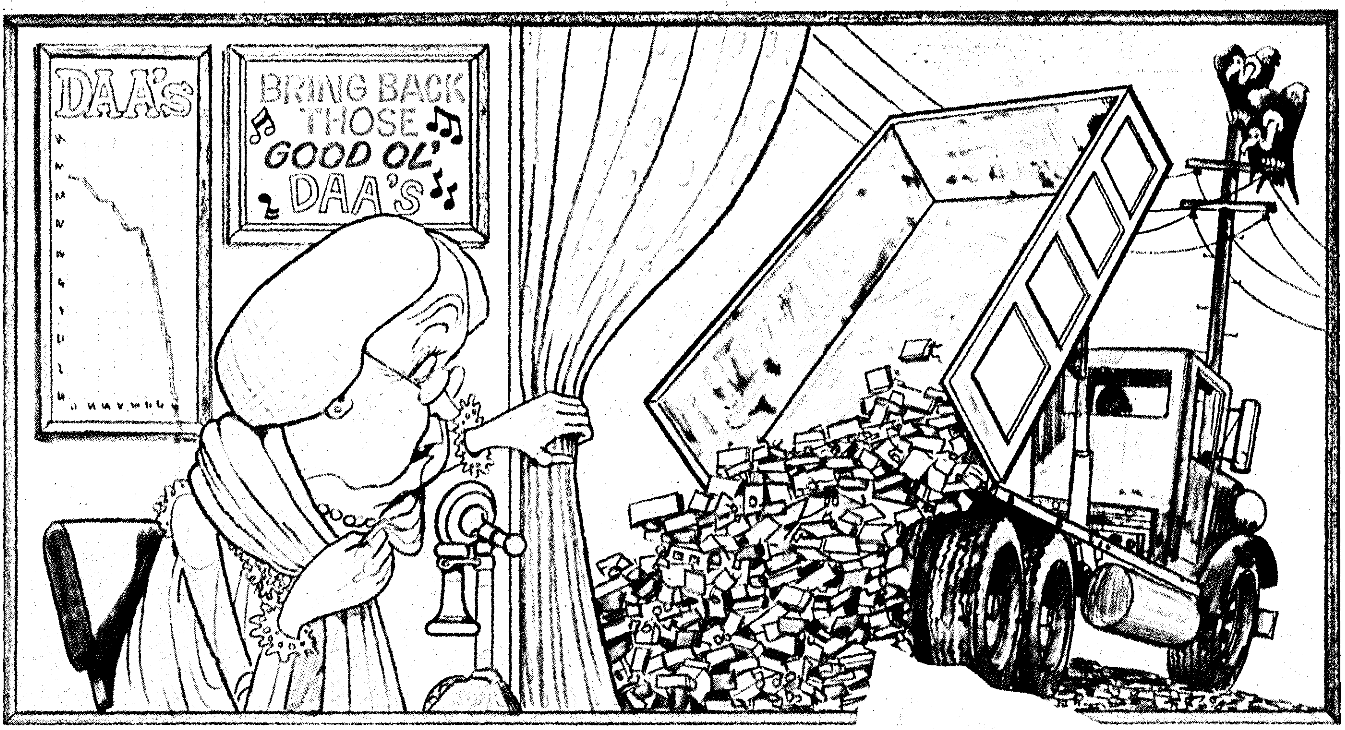

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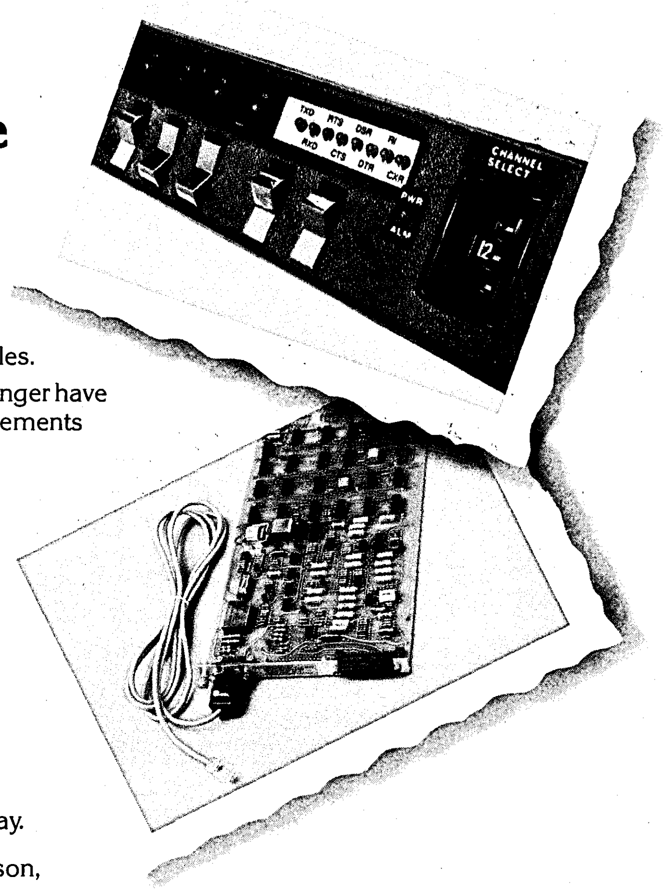

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THE INTERNATIONAL INDUSTRY

TRANSBORDER DATA FLOW

by John Eger

"The liberal vision of a pacific and mutually beneficial international order supported by growing economic interdependence is wearing very thin," Stephen D. Krasner of UCLA commented sadly in a *Wall Street Journal* review of Raymond Vernon's *Storm Over the Multinationals.* "The state will not be worn away by the ebb and flow of economic transactions; if need be, it will build dikes. That reality is going to be difficult for us to deal with."

The dikes, it may be argued, are being built. Ironically, the dikes include laws ostensibly dealing with the privacy, security, and confidentiality of information flowing across national boundaries. Application, interpretation, and enforcement of these laws may actually cut off the flow of information, the central nervous system of transnational communications, which are vital not only to the U.S., but also to the far-flung activities of multinational corporations.

Of equal consequence, the export of "information products," a concept not yet well defined but of increasing importance in the scheme of world trade, may suffer the same crippling effect.

Eighteen nations now have privacy or other so-called "data protection" laws on the books or in the making. Other nations have similar laws in force or under consideration. These laws present an imminent threat to the world economy and to all nations increasingly dependent upon the free flow of information across national borders. In the U.S., where communications are most advanced, the threat looms large indeed.

Every government function from security and national defense to weather prediction and disaster relief is increasingly dependent on computer and telecommunications technology. It is clear, therefore, that taxes, tariffs, laws, regulations, and other barriers to the free flow of information adversely affect not only our multinational corporations, but all others transacting business and exchanging scientific or cultural information across national borders.

Perhaps less clear is what these barriers portend for the future of our so-called "information industry" and our related "information products." While no exact accounting of our "information products" is available from a 1976 study released by the U.S. Department of Commerce, we do know that our service sector (which depends in large part upon the production, use, storage, and transfer of information and is itself better defined by recorded statistics), accounts for two-thirds of our labor force. The same study found that one-fifth of our exports were "services" as opposed to "goods," from either farms or factories. According to a more recent Commerce study, approximately 46% of the American work force is comprised of "information workers"—men and women employed not on farms or in factories but in the information industry. Almost half the GNP is now made up of information services and technology. In the next few years, by other estimates, 70% of our labor income will be from such "information activity."

We are increasingly dependent on this broadly defined "information" for the growth and health of our economy, the smooth functioning of our institutions, and the quality of our individual lives. Information has become a marketable, transferable, exportable commodity. Information, therefore, means national and individual income and well-being.

TRADITIONAL RESTRICTIONS

The U.S. in recent years has seen restrictions on the more traditional forms of information flow. Television, for instance, has become a prime target of restriction. In Canada, commercial messages are sometimes deleted from U.S. programs relayed by Canadian cable tv systems, and a 15% tax on all non-Canadian programming has been proposed. In Brazil, the government has set up policy censors at all post offices to intercept incoming publications which might contain anything "contrary to public order or morality." The Brazilian government has also proposed that 70% of their radio and television programs be domestically produced.

Many of the countries resisting or blocking the export of our information are not concerned with competition in any literal sense. They have no information technology or industry of their own and therefore cannot hope presently to compete with technologically rich nations—and in that fact may lie the reason for their opposition and their fear.

What many fear is cultural inundation or annihilation. They are resisting what they call "electronic colonialization" or "electronic imperialism." They do not want their minds, banks, governments, news, literature, music, or any other aspect of their lives to be Americanized. Neither do they want to be Anglicized, Sovietized, or otherwise victimized by advanced technology and information that freely flows across their

Our information appears as a threat to national status, power, and lifestyle.

borders, thus possibly causing their own identities to become extinct.

It is lamentable but undeniable that while we see ourselves as offering the developing nations of the world information they need to survive, such as medical and other scientific data, they perceive, beyond the images and printouts of data bits, a threat of vast and unwelcome change. More specifically, they see changes in their governments and their leadership groups. Our information, particularly when it is delivered via a computer-satellite link to a battery-operated tv or radio receiver, appears as an imminent threat to national status, power, and lifestyle.

NEW FORMS Among the industrialized nations, the more recent information disputes are taking different forms, and stem from different motives. Long frustrated by our lead in the computer and communications field, Europe, according to some observers, had turned to a new form of protectionism. One need only listen to France's Magistrate of Justice, Louis Joinet, who stated the European concern most directly at a symposium in Vienna in September 1977: "Information is power, and economic information is economic power. Information has an economic value and the ability to store and process certain types of data may well give one country political and technological advantage over other countries. This in turn may lead to a loss of national sovereignty through supranational data flows."

To protect their "national sovereignty" against this perceived threat, many European nations are proposing a variety of data protection laws. Most of these laws are being passed in the name of personal privacy and individual rights. Many countries in Europe have no concern, perhaps, but to protect the privacy of personal data, a concern which neither the American public nor any member of a democratic society can fault. The problem, of course, comes when these new laws are used not to protect just privacy but domestic economic interests.

According to Rep. Barry Goldwater, Jr. (R-Calif.), coauthor of the 1974 Privacy Act and himself a champion of individual privacy, that is precisely what is starting to happen.

All these protectionist steps are leading to some other potentially serious problems. First, there is the very real possibility that in a world where the flow of information is predominantly regulated, "data havens" or "data refuges" will spring up in those countries with either few or no laws restricting the storage, transmission, and use of data. Because computer communications technology is essential not only to business and commerce but to all human activity, laws will not end the information revolution. Instead, data banks in countries where it has become impossible, too expensive or cumbersome to operate, or where privacy of the data cannot be secure, will leave and move to such a "data haven." The loss of revenue, as much as the loss of control over the information, is unthinkable to most nations.

SWEDEN'S DATA ACT The first nation to restrict the flow of information in the name of privacy was Sweden, which passed its Data Act in 1973 as a response to the discovery that material on Swedish citizens was stored or processed in more than 2,000 data systems outside the country. Under Sweden's law, a Data Inspection Board must now approve any export of data files or transmission of personal data outside Sweden.

The impact and interpretation of the new laws being enacted and discussed elsewhere is still uncertain. West Germany's new Federal Data Protection Act requires German data processors to stop the improper input, access, communication, transport, and manipulation of stored data. Belgium and France are making it a criminal offense even to record or transmit some data. In France, violators could pay up to $400,000 in fines and serve prison terms of up to five years for recording or transmitting data defined only as "sensitive." The Swiss, who offer what many consider to be attractive numbered bank accounts, are considering laws to regulate strictly all electronic trade and business data transmission across their borders.

Spain requires money to be deposited in an escrow account before data files can be transmitted electronically or manually out of the country. Canada has warned U.S. industry of its concern over the one-way flow of information to the United States. In addition, certain Canadian provinces have enacted their own regulations blocking data movement at the provincial level. The warnings, nevertheless, have had effect: one medical information bureau owned by U.S. insurance companies has already set up a Toronto subsidiary just for Canadian data. Some also see a potential major threat in Britain, where existing law requires that the British Post Office be able to read any transmitted message—a rule which, if applied to electronic data, would force firms to share their confidential cryptographic codes and data compression formulas with a government body.

The obstacles to building and using global networks with or without minimum restrictions, however, are not limited to national privacy or data protection laws alone.

In the United Nations and the International Telecommunications Union (ITU), the questions of information flow, orbital slots, and frequency allocations have been exploited by the Soviet Union and Third World countries. European Ministries of Posts, Telephones, and Telegraphs (PTT's), the government-controlled telephone postal monopolies, now price their facilities at rates and schedules that are prohibitive for the development of private or user-controlled data networks. In other forums, new proposals have been put forth which threaten elimination of private lines altogether, and protocols (or standards) have been suggested which likewise threaten to wrest the control of international data processing away from the user completely.

OTHER METHODS Louis Pouzin, one of Europe's leading system designers, is skeptical about the use of data (protection) laws as data barriers. Indeed, he argues that there exist much more effective and proven tactics for preventing the exchange of anything (e.g., tariffs). He cites several examples, including the cost-per-mile of a leased telephone line in Europe which is three to five times higher for international links than for domestic ones.

The Italian government last year suggested an end to flat-rate charges for transparent, leased circuits. The Italian proposal that the lines be priced according to the volume of messages sent over them gained support from several European countries and from Japan during the May 1977 CCITT meetings.

Brendan McShane, General Electric's top communications expert, has suggested that the foreign administrations may try a "two-step" move to volume-sensitive pricing for private lines. The first step would be to price lines according to speeds, and then volume. Subsequent steps would involve eliminating the flexibility of use of private lines by gradually making the use more expensive compared with the rates for volume- or speed-sensitive transmis-

National concerns over information have not centered on its value as a commodity.

sions.

Curbing or blocking information flows—directly by laws or taxes, or indirectly by tariffs or nontariff barriers—will vary, depending on the intent or urgency of the nation imposing the restriction.

In the developing world, nationalization of high-technology industries has been considered. National concerns over information have not, as yet, centered on its value as a commodity or source of inherent wealth. As mentioned earlier, their primary concern has been one of cultural inundation, frustration with imbalanced foreign press reporting, and an inability to convince the developed world to share their information products—technology particularly—according to their formula. However, according to Fermin Bernasconi, Director General of the Intergovernmental Bureau of Informatics (IBI), "well over 50 countries have adopted . . . comprehensive national informatics plans."

POLICIES NEEDED Although the U.S. has had the luxury of dealing with these problems as they have arisen, it is becoming apparent that to maintain our relative economic status—not to mention our freedoms—in the global marketplace, the U.S. must have a national communications and information policy to use as a basis from which to bargain for the free flow of information in every international forum, conference, meeting, discussion, or agreement in which we participate. Such a comprehensive national communications and information policy should be founded in our traditional belief in the free flow of information recognized in the Universal Declaration of Human Rights. That commitment, however, must be made by the President and with the express or implied consent of Congress. This will enable the development of a unified approach toward the making and implementation of that national policy, for the effort entails cutting across long-established channels of bureaucratic organizations that refuse to recognize the interrelationships among computers, communications, information, and international telecommunications, and the effect on international economic policies. It is not yet certain that the President will make that commitment, nor is it certain where the task of developing that policy will begin.

The Office of Telecommunications Policy, which existed during the Nixon and Ford Administrations as an outgrowth of the earlier White House Office of Telecommunications Management, was short on both resources and commitment. The OTP was recently abolished in favor of a Department of Commerce agency, the National Telecommunications and Information Administration, which now has additional resources. Despite the title, however, it is still an open question whether the NTIA has the status, authority, or commitment either from its mandate or from the President to deal effectively in the information policy arena.

Authority for international information policy appears to be divided between the State Department's Economic Bureau, where an International Office of Telecommunications Policy reports to a deputy assistant secretary on concerns of the International Telecommunications Union (ITU) and other telecommunications forums and conventions, and the Office of Environmental and Scientific Affairs (OES), where the issues of "transborder data flows" have been placed on the Office's agenda largely because of their responsibility for activities in the OECD. Authority on these matters is also shared with the National Security Council and Departments of State, Commerce, Treasury, and Defense, and the CIA; hence, there is no coordinated approach to these issues. A recent merger of the United States Information Agency and the Cultural and Educational Bureaus of the State Department to create an International Communications Agency also appears to have significant but as yet undefined responsibilities.

RECENT ACTION Nevertheless, these issues are being discussed and steps—however small—have been taken to structure discussion and seek alternative recommendations. The State Department, for example, has broadened its Advisory Committee on Transnational Enterprises to include a subcommittee on "transborder data flows," and has appointed a head of the U.S. delegation to the 1979 World Administration Radio Conference.

The National Security Council has undertaken preparation of several "Presidential Review Memoranda" to address the ongoing concern with privacy laws developing both in the U.S. and (almost as an afterthought) abroad, and the relationship of those laws to other vital concerns of national security.

While certain activity is visible, and evidence of more classified work is highly probable, there must be, before we can be assured of any significant progress, a broader understanding of the impact of these dangers to the flow of information in both the government and among the body politic.

With this understanding will come an awareness of the value of information itself, and a greater commitment by the President and Congress to develop both a national communications and information policy and create a mechanism or focus to implement that policy. Only then can we earnestly begin, *inter alia,* to (1) reexamine and revamp communications and related regulatory practices which inhibit robust, open competition in our domestic marketplaces; (2) review copyright and other property laws and take necessary action to ensure their purpose in protecting and preserving the incentive to invent; (3) clarify the role of the public and private sectors in the development of computerized data bases and other information products and services, thus aiding in the settlement of the related laws of ownership, access, and privacy; and (4) establish standards for the effective interchange of information on all societal levels.

The end result of these efforts, whether legislation or executive action, will not only help to foster and maintain a strong U.S. economy but enable us to use that strength in world markets. ❋

JOHN EGER

Mr. Eger is a Washington, D.C., attorney and a consultant on communications law and regulatory policy who has been a telecommunications advisor to Presidents Richard Nixon and Gerald Ford. He was also head of the White House Office of Telecommunications Policy from August 1974 to July 1976.

While head of OTP, Mr. Eger was chairman of the Interagency Council of Government Telecommunications Users, a member of the President's Ad Hoc Committee on Regulatory Reform, and the President's Cabinet-level Domestic Committee on Privacy. He is presently a consultant to the government on communications, information, and regulatory policies. Mr. Eger is also a contributing editor to DATAMATION and counsel to the Washington law firm of Lamb, Halleck and Keats.

PLANNING FOR INTERNATIONAL DATA PROCESSING

by William Kluckas

The transitional nature of data processing is particularly evident on the international user scene. U.S.-based multinational companies whose dp attentions have been historically devoted to domestic matters are examining the data processing capabilities of their overseas subsidiaries and are finding them to be in various stages of computerization. Some installations may be as advanced, if not more so, than their Stateside counterparts, while others are just now moving from manual or accounting machine systems to their first computer. In short, all stages of growth exist simultaneously, worldwide, and often are operating with no overall plan or direction from corporate headquarters. There is, however, a growing awareness that a well-prepared and administered program will improve the quality and profitability of your international data processing investment.

In this introduction, I will offer points to consider in the planning and management of an international systems and data processing organization. For consistency, I will use the term "international" data processing, or IDP, although the more trendy terms "transnational" or "multinational" would do just as well.

In defining the IDP role, it would be nice to start with a clean slate, draw up an idealized top-down structure of organization, and work from there. Usually, however, this is impossible, as we have to begin with an existing situation. In simplest terms, we'll find overseas data centers to be either standalone (serving one country) or regional (serving more than one country). There are any number of variations, of course, but this is essentially the picture.

The first step, then, is to determine the company's present international data processing status. This is best accomplished by taking a country-by-country survey. The aim is to get a rough measure of operational effectiveness through comprehensive financial, equipment, applications, volume, personnel, and programming statistics. This quantitative data gathering phase can be accomplished in part from reference sources, such as five-year plans and operating budgets, but it will also be necessary to survey the operations directly to acquire the bulk of the information. Then, follow-on visits are advisable to correct any misinterpretations, roundout quantitative data with qualitative assessments, and discuss support requirements with overseas executives.

In the course of the survey, you will discover that several operations have done, are doing, or are planning to do the same things. Perhaps those things are material requirements planning or data base management systems or office-to-plant telecommunications—it really doesn't matter. What does matter is that you've uncovered the underlying missions of IDP: the identification of opportunities and problems which various subsidiaries share in common and the resolution of these issues through the means of systems and data processing. "In common" is the key phrase; even allowing that each country is ultimately responsible for its own management and profit line, dp-related issues from one country to another differ more in degree than in kind. IDP can have the perspective to draw parallels where appropriate, and direct or guide solutions consistent with the company's operating philosophy.

You should, at this point, have a firm foundation upon which to build a plan. Whether your plan calls for managing international dp operations in a tight and decisive manner or in a loose and advisory way is best determined by the way the rest of your business is run. A company with strong, central authority will tend toward a high degree of home office or regional control, while an advisory role would appear more appropriate in a decentralized environment. Decisions for central or regional or single-country data centers will be influenced accordingly. From these considerations will result the IDP structure of organization: its missions, goals, objectives, responsibilities, staffing, and reporting relationships. We're seeking the approach with the greatest probability of success if not the academic ideal.

Specifically, then, in drawing up an IDP charter consider the following activities and define the desired extent of the department's involvement.

Internal Consulting. Conduct overseas performance reviews and support forward operations planning.

IDP should establish and regularly meet with local dp steering committees to review performance and help determine overseas data processing priorities. Based on its broad, international experience, the IDP department can advise on what could be computerized, whether it can be cost-justified, and what effect it should have in improving the bottomline.

IDP can also bring insight and direction to purchase versus lease decisions, hardware installation planning, project and operations management, applications design, security improvements, documentation standards, dp auditing, work measurement studies, and personnel selection. In working to optimize performance, it may take on direct responsibility for some projects while maintaining an advisory role on others.

Common Systems. Encourage and direct the development of common solutions to international business issues.

It is a difficult judgment that a particular dp-related opportunity which exists in several countries can be resolved for all of them in an exact or similar manner. Almost always there are unique circumstances to be taken into account, and certainly the not-invented-here syndrome will have to be resolved. Common systems, though, can result in economies of scale, fewer redundancies, and standard methodologies. They are most feasible where applications requirements do not change much worldwide (e.g., process control, laboratory automation, corporate accounting), and are less so for diversified situations.

The IDP department can provide perspective and leadership in evaluating

Hewlett-Packard Computer Advances

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Thin film technology: The HP2621P printing terminal

Innovations in dot matrix printing

System 35 desktop computer

HP does it with dots

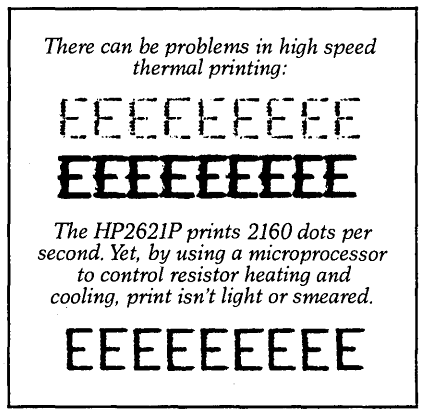
Hewlett-Packard has advanced the technology of dot matrix printing with a line of thermal and impact printing products that are both flexible and reliable, and offer good price/performance ratios.

The flexibility to place dots in any arrangement means that multiple character sets can be developed—and graphics can be printed with high quality and accuracy. A matrix of dots can be used to describe virtually any character set or graphic display including: diagrams, subscripted and super-scripted print, graphs, charts, super-size print, labels (at any angle), and special decorative effects.

Hot dots

In thermal printing, characters in the form of dot matrices are inscribed on heat sensitive paper by energizing the resistors on a printhead. Inherent in this process, however, is the problem of overheating the resistors. When they become too hot, the letters smear.

To print the first dot, a resistor is heated with that amount of energy required to heat a completely cooled resistor. After the dot is printed, the resistor cools, for example, to approximately 75% of the original energy level. To print the next dot, the resistor is fired up again. It is now at 175% of the original energy level and getting hotter by the dot.



There can be problems in high speed thermal printing:

The HP2621P prints 2160 dots per second. Yet, by using a microprocessor to control resistor heating and cooling, print isn't light or smeared.

Uncontrolled, the process can continue and continue until the resistor eventually becomes so hot that the print begins to smear.

Hewlett-Packard's HP2621P thermal printing terminal meets this challenge with two innovations—controlled resistor energizing and efficient printhead cooling.

Controlled dot energizing

The HP2621P's microprocessor enables rigid control of the amount of energy given to a sequence of dots to ensure clear, crisp printing. After a dot is printed and the resistor cools, it is heated to a reduced energy level—just enough to print the next dot, not enough to smear it.

Specifically, we give the first dot of a sequence an extra amount of energy to allow full dot development. Subsequent dots are given only enough energy to maintain high-quality print.

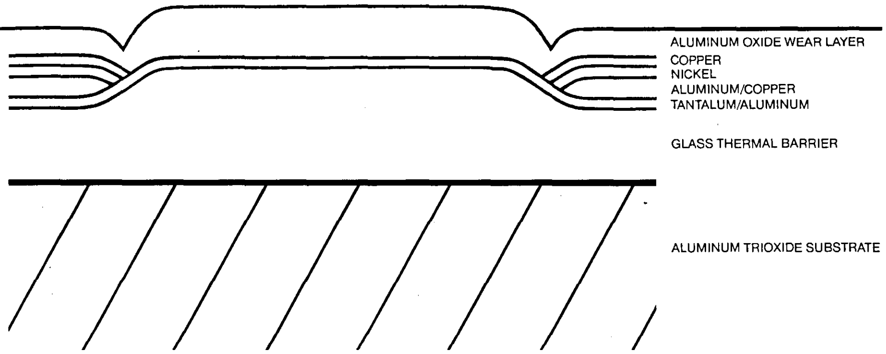
Cooling glass

Many years of experience in thin-film technology have helped us develop a printhead which ensures not only effective resistor heating but cooling as well.

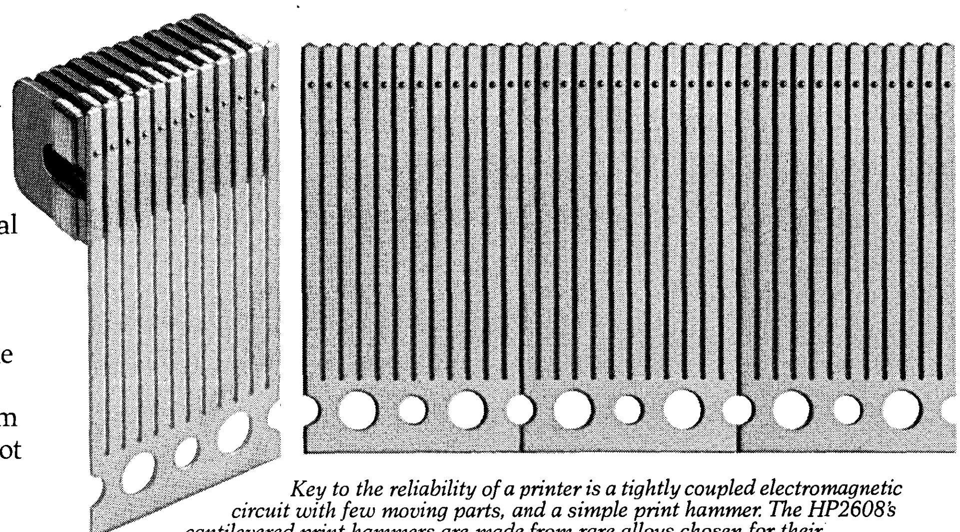
The HP2621P printhead is composed of multiple layers of conductive and resistive materials applied to the printhead surface through an innovative magnetron sputtering system. In addition to these layers, there is a glass thermal barrier. The relationship between the resistive/conductive layers and the thermal barrier's thickness is crucial to heat

◀ Cover

The innovative thin film printhead of the HP2621 is shown greatly magnified on our cover, and here as a diagram (not drawn to scale). We have implemented an exceptionally thin glass thermal barrier to optimize heat transfer and enable clean, clear printing, even at speeds of 120 characters per second.



transfer. Too thick a barrier and the resistors are hard to heat. Too thin a barrier and too much heat escapes. The HP2621P utilizes an exceptionally thin glass barrier to promote the efficient heat transfer so essential for clear, high-speed printing.



Key to the reliability of a printer is a tightly coupled electromagnetic circuit with few moving parts, and a simple print hammer. The HP2608's cantilevered print hammers are made from rare alloys chosen for their magnetic and stress qualities. For increased reliability, the print balls are securely soldered to the hammer using a proprietary HP microwelding technique.

Few moving parts

The HP2608 line printer is the result of a design challenge—to develop a highly reliable, medium speed line printer with precise dot positioning for graphics.

Typically, dot matrix printers have approximately 25% fewer parts than full-font character printers. The fewer moving parts a printer has, the greater its reliability. The high reliability of the HP2608 is achieved by a virtually frictionless print mechanism.

Ordinary printers rest the print bar on ball bearings and move it via stepper motors. The HP2608 has a mechanically balanced print bar on stainless steel springs or flexures. A voice coil linear motor moves the print bar back and forth.

The HP2608 has a virtually frictionless print mechanism.

An innovative concept in printers, this approach is drawn from well established technology in disc drives and audio speakers. The result—no rubbing parts. No ball bearings to wear out.

Precision printing

To ensure high quality graphics, you need precision dot placement. The HP2608 has a cantilever beam print hammer and a drive coil for each of 132 character positions. During printing, each hammer is pulled back and released by an electromagnet. The hammer moves with a velocity defined by its resonant frequency.

To accurately position dots, all hammers must be driven at the same time. We use one drive pulse to guarantee simultaneous striking of all hammers. Printers which drive hammers individually, have varied timing and dot placement.

Often, line printers produce characters and graphics that smear, ghost, or have light and missing areas caused by excessive vibration. We damp our hammers by placing a small, properly tuned spring behind each hammer and by using an electronic damping pulse. As a result, character ghosting and overstrikes are virtually eliminated.

Precision graphics require precision tooling. We maintain exceptionally tight mechanical tolerances on machined parts—tolerances usually found only on higher priced printers.

Specially selected alloys are used in the construction of the HP2608. Chosen for their magnetic and stress qualities, these metals give additional durability and reliability to the printer parts. Tungsten carbide, an extremely hard element often used for high speed cutting tools, is used for the head or ball of the hammer. The cantilevered print hammer beam itself is made from an alloy selected for its magnetic traits. HP uses an innovative microwelding technique to bond these alloys together to form the hammer.

For more data on the HP2621 and HP2608, check A and B on the reply card.

The one-stop shop for terminals, printers, systems

HP2621

All too frequently low-cost character mode terminals mean a disappointing lack of capability. Not so with Hewlett-Packard's new interactive HP2621 terminals. These teleprinter-compatible terminals are designed for interactive computer applications such as data inquiry, computer-aided instruction, program preparation and development, data access and update, and general time-sharing.

The HP2621 terminals have many of the features found on the successful HP2640 terminal family. All offer refreshed raster scan technology, high resolution CRTs, the full 128 ASCII character set, off-screen storage, and built-in editing functions.

Instant hardcopy

Until now, getting a permanent record of your terminal activity was often expensive and inconvenient. Printers sometimes cost more than the terminals to which they are connected. In addition, if several terminals shared a printer, you may have had to wait for access to the printer and then walk to another area to pick up your print-out. Not any more. Since the HP2621P terminal has an integral, compact thermal printer, hardcopy is available where and when you want it.

There are advantages to integrating a printer and terminal. Both can share the same power source and the same housing. This reduces our costs—which keeps your price low. And thermal printers are quiet—suitable for a variety of work environments.

120 char/sec

The HP2621P prints fast—120 characters per second. It can print twenty-four full 80-character lines bi-directionally in less than 18 seconds. To do this, HP uses a smart carriage return—a known technique for increasing printer speed. In addition to printing from left-to-right or right-to-left, a microprocessor automatically computes the length and last character position of the next line of text, and then prints that line in the fastest, most efficient direction. A typical page of text prints in 10-12 seconds.

Reliability and high resolution

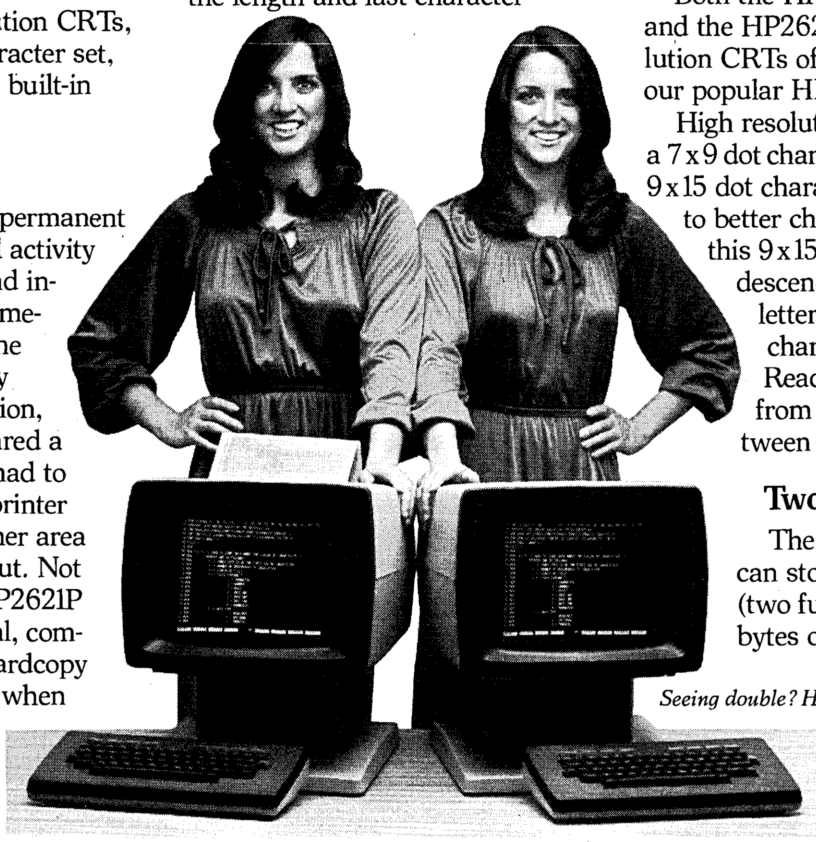
A potential cause of printer failure is the printhead/flex-circuit cable connection. Typically, printheads are attached to cables by wire bonds or metal clamps that tend to open up. Solder forms a more dependable, solid bond. On the HP2621P, the long-life printhead is soldered firmly to the cable and typically can withstand three pounds of 90 degrees vertical pull as well as a 10 pound tensile lift.

Both the HP2621A (no printer) and the HP2621P use high resolution CRTs of the same quality as our popular HP2640 family.

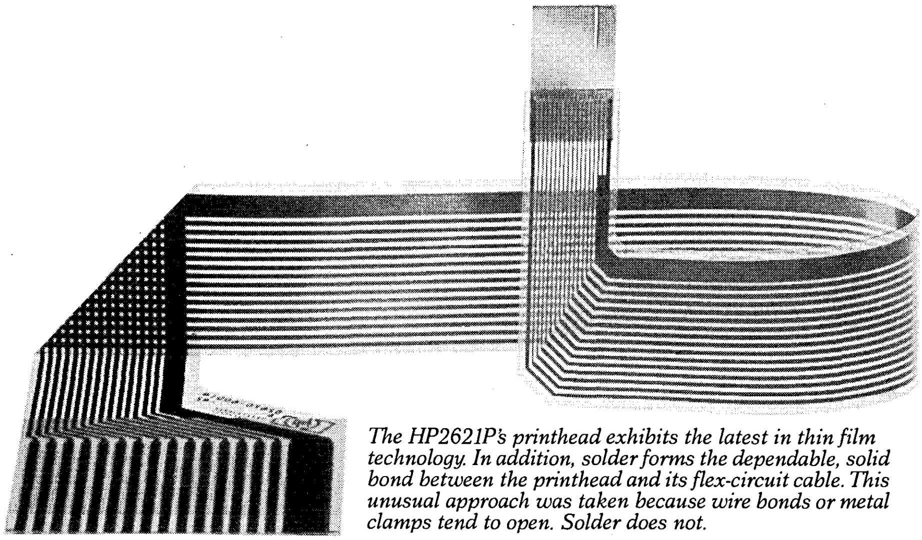
High resolution results from a 7x9 dot character matrix within a 9x15 dot character cell. In addition to better character definition, this 9x15 cell size provides for descenders on lower case letters and a character-by-character underline. Readability improves from wider spacing between characters and rows.

Two-page memory

The HP2621 terminals can store up to 48 lines (two full pages) in its 4K bytes of display memory. In



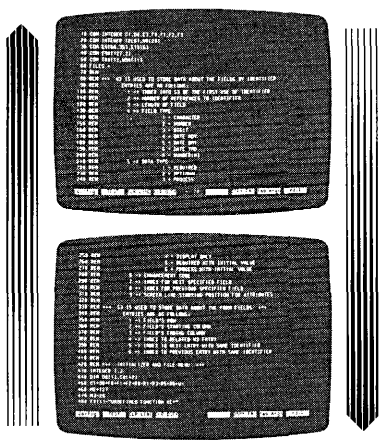
Seeing double? HP's low cost, character mode terminals, the HP2621A and the HP2621P, are nearly identical. The difference? The HP2621P has instant hardcopy.



The HP2621P's printhead exhibits the latest in thin film technology. In addition, solder forms the dependable, solid bond between the printhead and its flex-circuit cable. This unusual approach was taken because wire bonds or metal clamps tend to open. Solder does not.

text generation and program development, the ability to conveniently view 24 lines, either page-by-page, or by scrolling, line-by-line, can save time and reduce errors.

The HP2621 terminals add local editing to interactive applications.



Scroll up and down through a full two pages of memory with the new HP2621 terminals. This convenience saves programming time and reduces the potential for errors.

Neither requires software development or modification on most systems.

With line mode, each line of data from the keyboard is buffered for editing until the return key is pressed. Because these terminals can distinguish between data sent by the computer and keyboard entered data, operators can locally edit replies to computer generated questions. Only desired data is entered. In modify mode, any line in the terminal's 48-line memory can be edited and then retransmitted without retyping the entire line.

Interested in a low-cost data inquiry terminal for interactive applications? The HP2621A sells for $1450* while the HP2621P sells for $2550.* **For more details on the entire family of data terminals, check C on the reply card. Check A for the HP2621.**

Impact Printing

Hewlett-Packard recently introduced three new dot-matrix, impact printing peripherals: the HP2608 line printer, the HP2631G serial printer, and the HP2639 serial printing terminal. Because they use dot matrices, there is virtually no limit to the number of character sets that can be defined for the printers now or in the future. Among current offerings are character sets for most European languages, Arabic, Cyrillic, Katakana, and line drawing.

Reliable and convenient

The use of microprocessors in these new products means fewer electronic components and fewer high-priced mechanical parts. And that means greater reliability.

Plus, we put our impact printing products through rigid environmental and reliability verification tests (RVT). Randomly selected units from inventory are operated 24 hours a day, five days a week for the equivalent of one full year's average usage each. Results are documented in our RVT brochure. **If you want to see what punishment these products can take, check D and we'll send you a copy.**

Our new printing peripherals use a long-life, mobius loop ribbon cartridge. To change ribbons, just pop out the used cartridge and drop in a new one. No mess. No inky fingers.

HP2608

Designed as a medium speed line printer, the HP2608 is capable of printing over two million lines per month at a rate of 400 lines per minute. And, the HP2608 has graphics capability.

Precisely positioned dots are printed in a matrix form with a density of 5040 dots per square inch. Dots can be placed anywhere on a page within 0.03 mm accuracy. A 10 by 13 inch page can be printed in less than 20 seconds.

System flexibility

HP2608 line printers can be placed almost anywhere they are

Continued from page 5.
needed—up to 1000 feet from a connected CPU. For applications with extremely large output requirements, several HP2608s can be used in a multiple printer approach.

Rugged, yet quiet

Rugged enough for EDP applications, yet quiet enough for most office environments, the HP2608 provides noise reduction and ease-of-use features usually found only on more expensive printers.

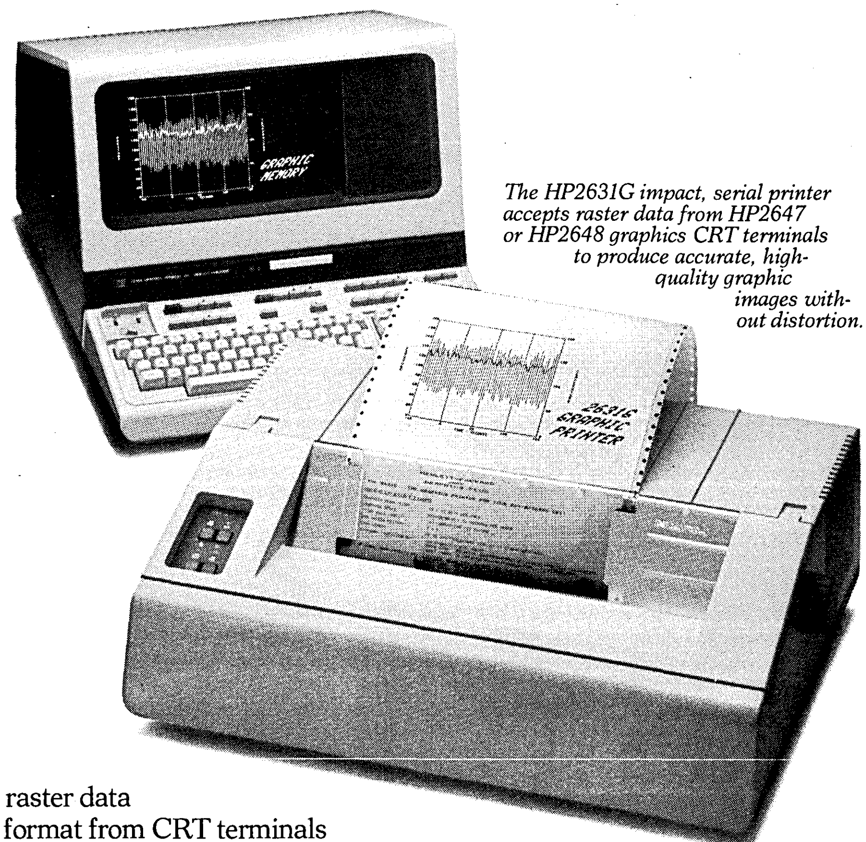
The HP2608's stand is completely lined with sound absorbent foam with special deep recesses around the access cover to keep the noise sealed inside. An optional sound cover is also available.

The stand holds printer paper and has storage space for extra ribbon cartridges. A paper tray is positioned on the back of the stand to hold printer output.

Paper alignment is easy. You can move the paper up and down electronically with one dot row accuracy, using either the guide on top of the printer cover or the precision forms alignment guide inside the stand.

The HP2608 sells for $9250.* **For more information select B on the reply card.**

HP2631G



The HP2631G impact, serial printer accepts raster data from HP2647 or HP2648 graphics CRT terminals to produce accurate, high-quality graphic images without distortion.

The new 180 characters per second HP2631G serial printer has all the features of the popular HP2631A—plus graphics.

The HP2631G accepts HP's raster data format from CRT terminals to produce exact graphic images without distortion. In less than 50 seconds, a typical 10 by 5 inch graph can be printed from the screen of an HP2647 or HP2648 graphics terminal. There's even an optional high density character set which nearly doubles the horizontal dot density—providing greater character clarity with only 50 percent loss in print speed. You can programmatically select four print sizes, line spacing, and page/text lengths. Also, an automatic perforation skip mode can direct the printer to advance automatically to the top of the next page when the printing reaches the bottom of the specified text length. Forms up to 255 lines can be handled.

Interested in a high quality serial printer with raster dump graphics? The HP2631G sells for $4250.* **For details, check E on the reply card.**

HP2639

The HP2639 interactive printing terminal can be used with a broad range of systems in a variety of applications, and is specifically manufactured for OEMs and end users of non-HP systems.

The HP2639 provides all the features of the HP2635 printing terminal as well as a flexible, asynchronous, serial interface. It sells for $4205* complete with keyboard. OEM discounts are available. **For more information, select F on the reply card.**

*U.S. prices only.

Minicomputer power; desktop convenience

Don't be deceived by appearances. Under the guise of a desktop computer, the System 35 gives you all the power of a minicomputer. Its high performance, 16-bit parallel CPU has typical instruction times of less than two microseconds. Yet, processor, keyboard, memory, mass storage, CRT and printer are integrated so compactly that they fit neatly on the top of your desk.

Large internal memory

The System 35 features a surprisingly large internal memory. Up to 256K bytes can manage an array of 30,000 numbers with 12-digit precision. A wide range of interface capabilities make the system ideal for data acquisition and controller applications. It is fully HP-IB compatible* and supports a wide range of peripherals.

Language power

The System 35's major contribution to desktop computing is a combination of complementary programming languages—BASIC and Assembly language.

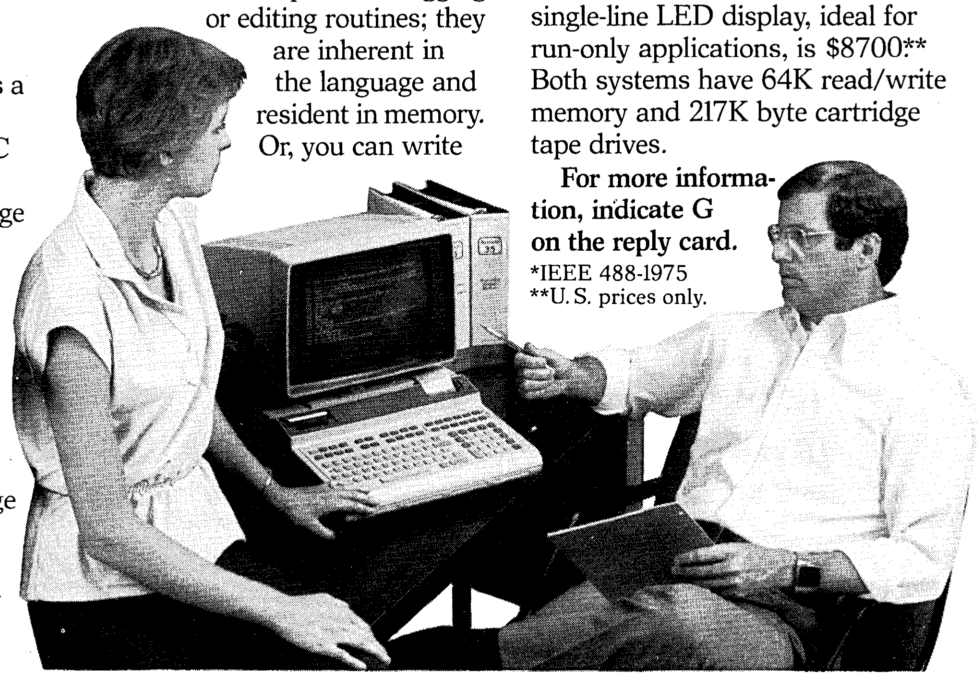
BASIC is an interactive language that is both simple to learn and easy to use. The System 35 runs standard ANSI BASIC and is enhanced with sub-programs, numeric array instructions, and multicharacter identifiers—features normally associated with FORTRAN and APL.

An optional Assembly language capability optimizes program efficiency in terms of I/O and computation speeds. You can significantly decrease application program run times by isolating those segments of a BASIC program that are potential bottlenecks and coding them instead as an Assembly language sub-program. Certain specialized computations and I/O operations may actually be executed as much as 100 times faster in Assembly language.

Rapid Assembly

You can enter Assembly language source code through the keyboard as part of a BASIC program. Each line is checked syntactically the instant it is stored in memory. The ROM-based assembler performs at the rate of 1000 lines per second: turnaround is practically instantaneous.

The System 35 provides automatic editing capabilities which enable you to enter and edit your applications interactively. There is no need to call in special debugging or editing routines; they are inherent in the language and resident in memory. Or, you can write your own special function debugging programs.



Once your application is entered and edited, it can be reassembled in a matter of seconds.

You can also interactively modify by single stepping through your Assembly programs. Each line of the original source code can be displayed for review. Variables can be examined and modified by name.

Compatible systems

The System 35 protects the software investment of HP9825 OEMs and end users who wish to add it to their existing systems. A translator is provided to convert HPL software to System 35 BASIC. In addition, BASIC is fully compatible with both the System 35 and 45.

The System 35A with CRT costs $9900.** The System 35B with single-line LED display, ideal for run-only applications, is $8700.** Both systems have 64K read/write memory and 217K byte cartridge tape drives.

For more information, indicate G on the reply card.

*IEEE 488-1975
**U. S. prices only.

New & Noteworthy

On-line transaction processing system helps reduce inventories.

A manufacturer's on-hand inventory often represents substantial capital and carrying costs. But when material requirements are planned and controlled, inventory often can be reduced. Even a slight improvement in controlling inventory can have a major effect on profits.

Hewlett-Packard's materials planning and control system, MFG/3000, is ideal for manufacturers who produce multi-piece products in lots or batches. Utilizing the speed and power of an HP3000 Series II or III computer, MFG/3000 software can help to significantly reduce your manufacturing inventory.

MFG/3000 is three interrelated materials planning and control products. One stores bills of material, standard routings, and descriptive part data. Another keeps track of stockroom inventory as well as manufacturing and purchase orders; while the third suggests inventory procurements based on a customer's master production schedule.

With MFG/3000 you can avoid under or over-stocked conditions, recognize upcoming line stoppages due to material shortages, and meet your customer commitments with more certainty.

Proven results

Vydec, Inc., a user of MFG/3000 since January 1978, manufactures and markets floppy-disc-based word processing systems. While increasing sales and production by 100 per cent, Vydec has reduced its months-of-supply inventory by 30 per cent.

With MFG/3000, terminals are strategically situated so that as inventories change, data is immediately entered into and validated by the HP3000. Each department captures an up-to-the-minute snapshot of inventory status. And, as is necessary in many transaction processing environments, user interactions are designed to accommodate people with little or no computer or programming experience.

Vydec's materials manager, Marty Connolly, states, "Because MFG/3000 is an on-line system, we are able to reduce the time between receiving a market forecast and preparing its MRP to one or two days—versus about 14 days under the old system."

Quick implementation

MFG/3000 is a fully-developed, performance-tested package—complete with data base and flexible forms capabilities. No user programming is required for MFG/3000 implementation. And Hewlett-Packard provides the same high level of support commitment as for our HP3000 operating system.

Cutting implementation time and maintenance costs lets you direct your programming resources towards other needs within your company.

Know before you buy

Even before installation of an MFG/3000 system, we consult with customers to discuss their specific needs and the terminal throughput and response time they can expect based upon our documented transaction performance studies. Plus, customer training courses and implementation schedules are suggested.

John Doyle, plant manager for Vetter Corporation (a manufacturer of motorcycle fairings, and another MFG/3000 user), states "We knew what we were getting before we purchased. We felt confident we'd get full support from HP. We were right."

Each element of MFG/3000 sells for $5,000* with a monthly maintenance cost of $150.*

Interested in the cost savings of materials planning and control? **Check H for more information.**

*U.S. prices only.

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HEWLETT hp PACKARD

Central control over hardware and software acquisition is desirable.

and selecting common systems projects. It may then take direct project responsibility through its own staff of systems designers and programmers. Or it could direct project teams made up of personnel selected from headquarters, regional, and local country operations.

Hardware and Software Selection. Review and approve acquisitions of computers and marketed software packages.

Central control over international hardware and software acquisitions is desirable as these items carry high price tags and have a significant impact on a company's long-range dp direction and performance. IDP may approve and control purchase/lease decisions for all computers, terminals, key data entry units, etc., or only certain items, or only items over a certain value. It will be necessary to define exactly what is considered to be a computer or a computer-related device and clearly specify channels of and ceilings on approval authority.

VENDOR POLICIES

It is advisable to decide early on whether all future hardware is to be acquired from one vendor or if it is in the company's interest to follow a multiple-vendor policy. In general, the desirability of a single, worldwide vendor (or for that matter a single family of computers) is most apparent in a common systems environment. As you move away from that position, the benefits tend to diminish. When it goes beyond two vendors, however, hardware choice gets progressively more difficult to manage.

Since one software vendor usually cannot answer all marketed software needs, there is little reason to limit software acquisitions to one or even two suppliers. It is advisable, however, to purchase a major package, such as a data base management system, from a single vendor under a worldwide contract with multiple-site discounts.

Vendor Liaison. Promote the company's interest in dealing with international suppliers of hardware, software, expendables and services.

Vendor relationships involve a spectrum of activities from negotiating contracts to encouraging preannouncements on new products, from arranging technical education seminars to detailing requirements for multiple-site proposals. Establishing good international vendor liaison is an important responsibility.

Computer manufacturers will appoint international account managers to work with the IDP department. Essentially marketing representatives, they do, however, carry clout in resolving specific vendor-related problems overseas and can complement your planning activities. If you're a major or exclusive user, the international account manager may even have his own budget for international travel on your (and his) behalf.

Most U.S. software companies are not well established overseas and those that are quite often do business through agents. The major ones, though, offer multiple-site international contracts at discount and a single representative to contact in case of trouble.

Education. Sponsor coordi nate education programs and conferences.

Bringing dp and other managers together in periodic regional or worldwide meetings promotes the cross-pollination of ideas and builds interpersonal relationships across national boundaries. For a first conference, the agenda may be varied since its main purpose is to stimulate an exploration of common interest and problems. Subsequently, theme workshops, limited in scope and attendance, would be more appropriate.

BRIEFINGS AND STANDARDS

Specialized education programs should be prepared to meet unique situations. Overseas dp managers may be invited to home office for individual briefings. In-house training programs will have to be developed for common systems users. Extensive training may be needed for personnel assigned to geographically remote areas. IDP personnel may require foreign language training.

Your computer supplier is usually well equipped and quite willing to support in-house education programs. He won't dominate the proceedings but will work with you to the extent desired. If there are several users of like or similar hardware, he may host a technical conference for your company alone. Education service organizations and IDP newsletters can supplement these activities.

Standards and Guidelines. Prepare and maintain a manual of international standards and guideline procedures.

An IDP reference manual should address documentation standards, hardware and software evaluations, applications profiles, installation planning, project management, security appraisals, library services, and survey results—in short, items which will help the local dp manager to work and plan more efficiently. The manual should be updated several times a year and should be the result of overseas, as well as headquarters thinking.

International Awareness. Maintain a continuing awareness of matters of international concern, particularly as it applies to your business.

Privacy legislation and transborder data flow restrictions already are having a profound effect on planning for the international movement of information. Volume-sensitive pricing on international telecommunications networks could change the whole cost/benefit picture, as could PTT (post/telephone/telegraph) rate changes within a country. Some governments pose particular hardships due to restrictive, expensive and time-consuming importation policies. Some countries have long histories of poor vendor support.

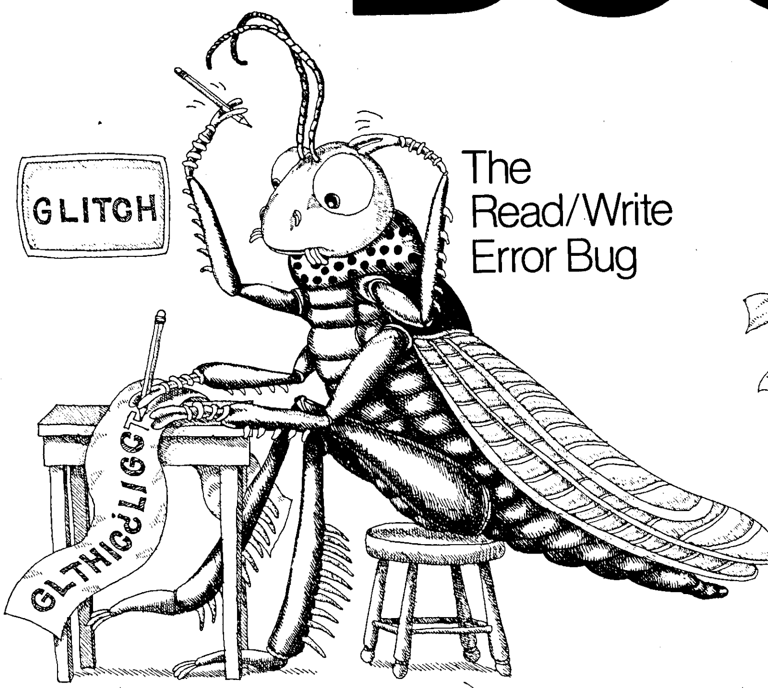
It is the IDP executive's responsibility to seek out and maintain those contacts which can help him keep current on such issues. The European dp press and DATAMATION's international supplement are of particular value. The World Trade Institute and the American Management Association's International Division are two organizations which at times sponsor helpful seminars. The International Data Processing Associates, an organization of IDP executives from various industries, may be of more direct and specific benefits.

In conclusion, international data processing management does indeed differ from its domestic counterpart. Although many issues are similar, there are differences in degree which call for special and devoted attention. A well defined and well managed IDP program can improve the quality of, and return on, your international dp investment. ✲

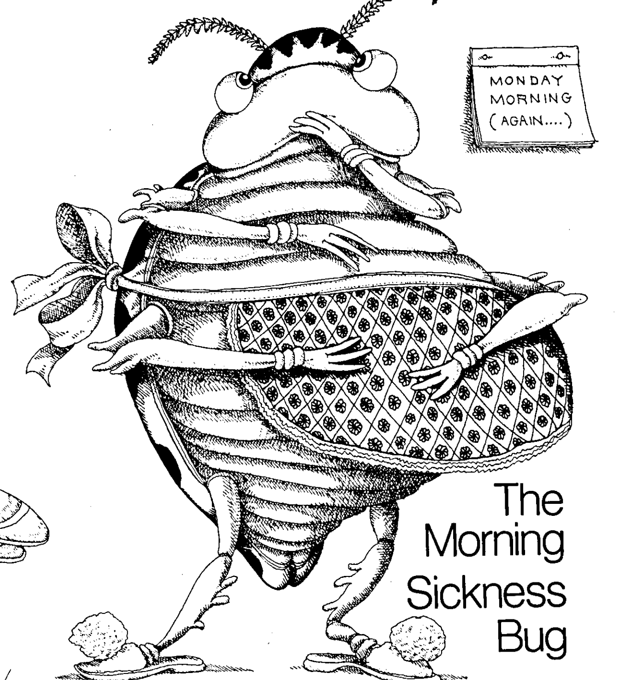
WILLIAM F. KLUCKAS

Mr. Kluckas is manager of worldwide information systems for E. R. Squibb & Sons, Inc., Princeton, New Jersey, where he is responsible for headquarters support of systems and data processing activities outside the United States. He joined Squibb in 1965, headed several marketing systems assignments, and was manager of distribution systems prior to entering the international field in 1971. Mr. Kluckas is chairman of the International Data Processing Association, and has served as project chairman and division manager for COMMON.

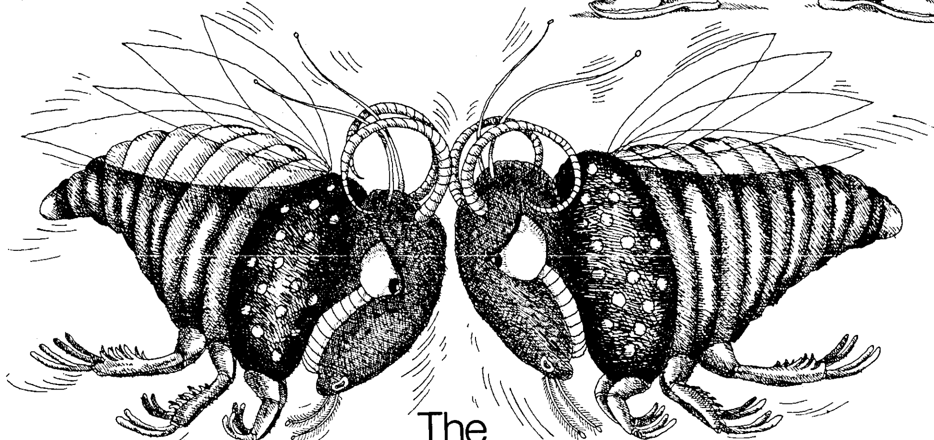
BUG!



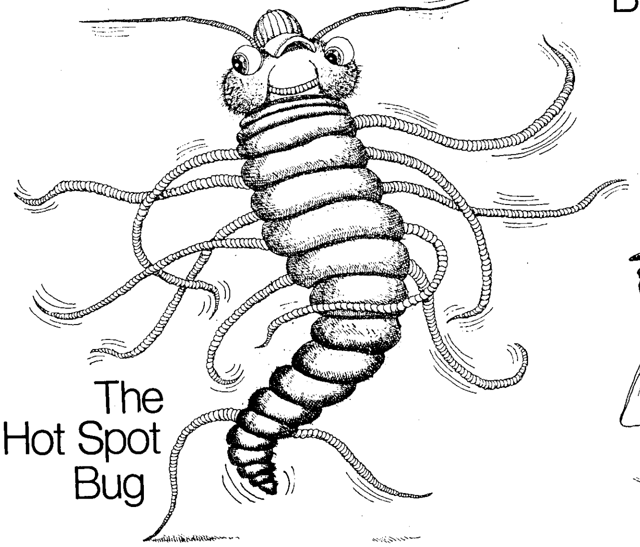
The Read/Write Error Bug



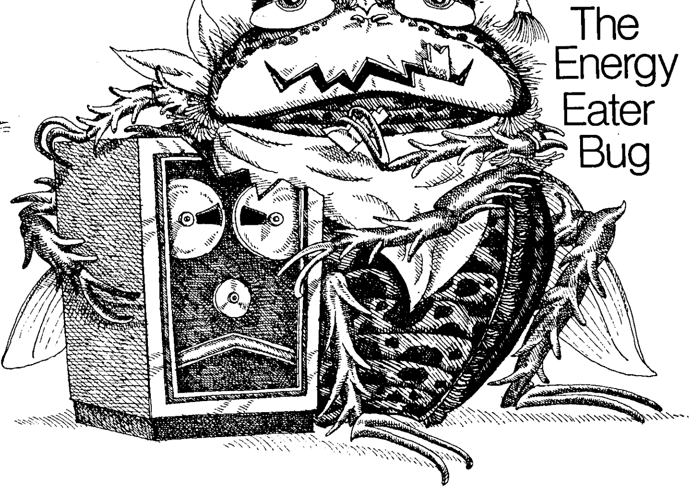
The Morning Sickness Bug



The Head Crash Bug



The Hot Spot Bug



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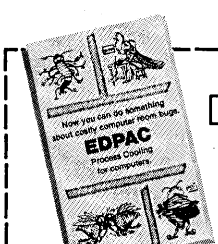

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CIRCLE 10 ON READER CARD

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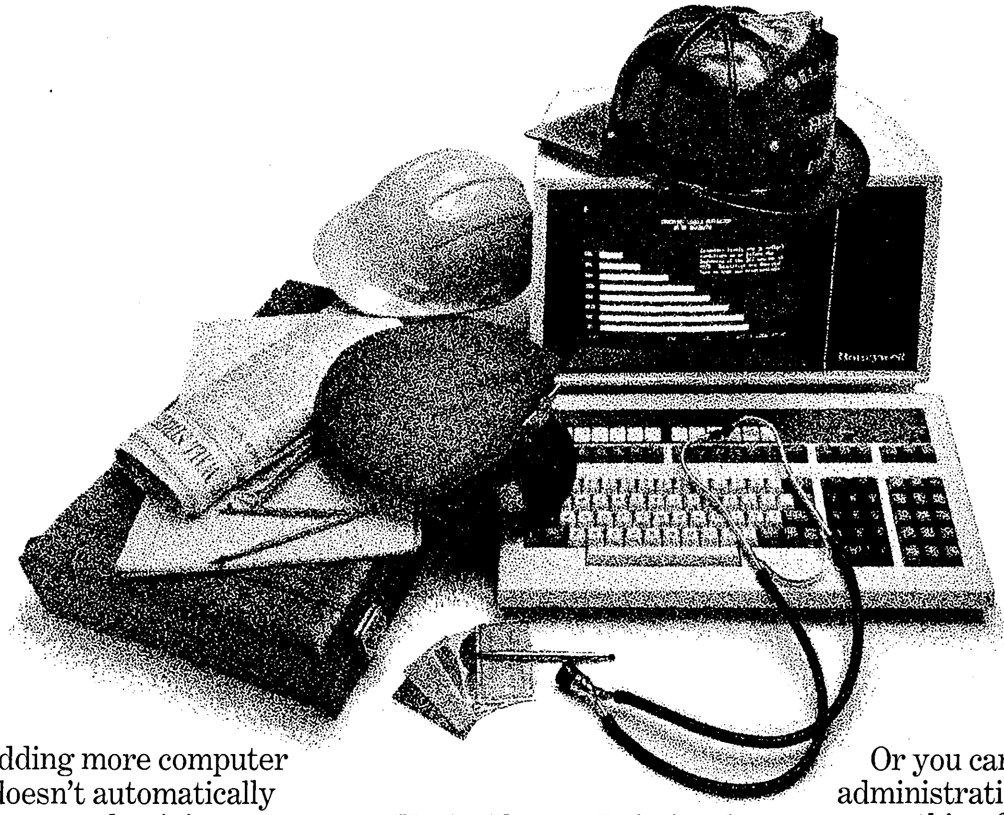

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CIRCLE 41 ON READER CARD

JAPANESE INVESTMENTS IN THE U.S. COMPUTER INDUSTRY

by Edward K. Yasaki

By the end of this year, there should be a half-dozen installations in southern California of small business computer systems made in Japan by Mitsubishi Electric Corp. They will be showcase sites of the so-called Melcom 80 series being sold in the U.S. by the newly established Melcom Business Systems Inc. And they represent the first major thrust by a Japanese company in the U.S. computer market. But that's only the beginning.

Along about the time Melcom is making its initial installations in the Los Angeles area, the announcement of a similar sales effort with small business systems is expected from Nippon Electric Co. through its Boston-area subsidiary, NEC Information Systems Inc. NEC will be selling a family of three machines that has already gained wide acceptance in the domestic market. Indeed, spokesmen for each company claim to have the largest share of the Japanese small systems market.

Increasingly during the 1980s the computer user community in the U.S. can expect to find a larger selection of equipment from Japan. Until now those vendors have been testing the waters only in the original equipment (oem) marketplace. NEC Information Systems, for example, has been selling a printer called the Spinwriter. Other peripherals, mainly small disk drives, are being offered by Hitachi Ltd. and Fujitsu Ltd.

One of the oldest of Japanese ventures here is Okidata Corp., Mount Laurel, N.J., which manufactures and sells peripherals. It was formed in April 1973 as a joint venture owned equally by Oki Electric Industry Co. Ltd. of Tokyo and David L. Nettleton, the president. Since that time, majority ownership has shifted to Oki, which buys card readers from Okidata for resale in Japan. But, with the exception of some components that Okidata buys from Oki, most of the things the American firm sells are made in the U.S. This includes printers, card readers, and disk drives with both moving and fixed heads.

About a year before Okidata, a company called Omron Systems that was making electronic calculators expanded into the peripherals equipment business, producing small disk files in northern California for marketing in Japan. The operation has since been reorganized and now produces intelligent terminals as the Information Products Div. of Omron Electronics Inc., a subsidiary of Kyoto-based Omron Tateisi Electronics Co.

But since the formation of Okidata in '73 and until this year, the Japanese have been slow to plunge into the U.S. marketplace. Ironically, the one international event that seems to have triggered the recent surge in sales activity by foreign vendors is the Mideastern nations' oil embargo of 1973. It created a severe economic recession in Japan, as elsewhere, and is frequently blamed for the depressed value of the dollar against other currencies.

This has led to a recent rash of foreign investments, particularly in the American semiconductor industry. One close observer sees it as the result of two conditions that exist simultaneously. "One is that the recipient country or industry has to have a perceivable technology lead" in something that attracts the investor, says Thomas A. Skornia, vice president and general counsel of Advanced Micro Devices Inc., a semiconductor manufacturer in Sunnyvale, Calif. He says the U.S. clearly has that lead in semiconductors.

"The second condition appears to be a precipitous shift in exchange rates." He explains that even though the investor pays a high dollar price—above the market price, say—he's still paying with dollars purchased at a lower rate, whether purchased with deutsche marks or yens. Thus, a 20% position in AMD was recently acquired by the West German firm of Siemens for some $22.5 million—at $45 a share when the market price was in the low- and mid-20s.

Investments from abroad, of course, are neither new nor startling. Foreign interests own a majority share of many companies that are household names. In food products there's Nestlé, Stouffer Foods, and Libby, McNeill & Libby, all owned by the Swiss Nestlé firm. Thomas J. Lipton and Lever Brothers are owned by the British Unilever company, and the Baskin-Robbins ice cream chain by Lyons. The Travelodge motel chain, Grand Union supermarkets, and Ohrbach's department stores are wholly or almost entirely owned by foreign companies, and that's true as well of Bantam Books, Moore Business Forms, and Brown & Williamson tobacco.

Indeed, while foreign direct investments in the U.S. at the start of 1978 came to an estimated $33.5 billion, investments abroad by Americans reached almost $150 billion. The leading investors here are the Dutch, Canadians, and the British, which among them account for more than half. They're followed by the Swiss, West Germans, French, and the Japanese.

Despite the small share (about 3%) accounted for by the Japanese, interest in their activities rises with each new wave of investment activity. In the early '70s they invested heavily in real estate, hotels, and golf courses along the West Coast and in Hawaii. This flurry subsided, however, when OPEC went into its act. But now the Japanese are back again, armed with dollars they can buy at half the rate paid in 1970.

And in the midst of charges that Japanese firms were resorting to nefarious methods in an effort to learn the secrets of America's semiconductor technology, what did they do but buy outright an American semiconductor company. The announcement by Electronics Arrays shocked and dismayed a large segment of the American electronics industry, people who would have you believe that the only thing worse for the U.S. would have been to sell 51% of NASA to the Russians. Never mind that in earlier transactions foreign interests from Europe had acquired all or portions of larger semiconductor houses possessing even more advanced technologies and manufacturing capabilities than Electronic Arrays.

As semiconductor manufacturers go, Electronic Arrays Inc. is a small com-

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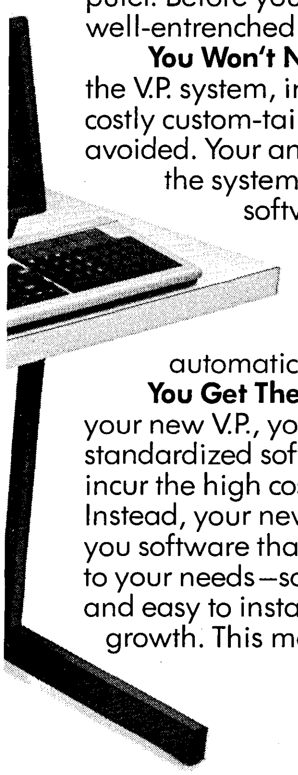

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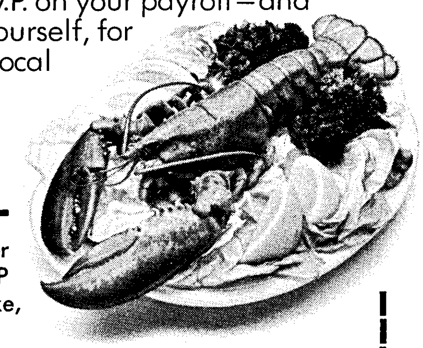

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The Japanese are back, armed with dollars they can buy at half the 1970 rate.

pany. The 10-year-old firm, which went public in 1973, never grossed more than $18 million, and in more recent years expanded its product line to include more than calculator chips. But in fiscal 1977, ended March 31, the Mountain View, Calif., company had a loss of $3.4 million, and last year lost an additional $2 million. There was some discussion internally about selling the company, but newly elected president Charles L. Wood said you can't do that with a company losing $300,000 a month.

"There were a lot of sentimental reasons for wanting to stay a public company," he now says, although that would be a risky thing to try. Perhaps Arrays could have continued as an independent company for two years. "But when you backed away from it and looked at the funding you'd need for the next three to five years, even conservatively I could identify $10 million right now to spend. And if I wanted to lay the base for doing the things we really should be doing, it's another ten. That's $20 million."

No bank would advance them that kind of money. They couldn't go back to the stock market, lest they dilute the stock of their current holders. So they began looking for an acquisition partner. Earlier this year, that company was announced as being Nippon Electric Co., Ltd. of Toyko, the leader among Japanese semiconductor makers.

For some $9 million, then, Japan's NEC stands to acquire a company with 300 employees and manufacturing capacity to produce $30 million of products in a year's time. In the agreement, which should become final late this fall, the Japanese stand to acquire little in the way of technology. "Most people have it categorized as a reverse technology flow," admits Wood, although he explains that EA has some technology of value to both companies. "I don't think there's a technology transfer in either direction. But if there is one, it is more inclined for us to gain more . . ." He says the Japanese are very strong in manufacturing technology, while U.S. companies tend to be strong in innovative new processes and design.

SELLING TO THE U.S.

Wood sees this acquisition as a first step by NEC to serve the large U.S. marketplace, noting that the acquirer in all likelihood will have to add to its investment and expand Electronic Arrays' capacity. He adds that it's just like what the Americans did in the European marketplace about 10 years ago. Initially they sent semiconductor products made in the U.S. to Europe, and then found that to service the market properly they had to open plants there. "So it's really a natural evolution for NEC to come here," he explains.

And this change is likely in the computer business as well. Equipment manufacturers in Japan, West Germany, and the U.K. are faced with a small domestic market that they perceive as reaching saturation. They feel they must look to markets beyond their own borders, and in doing so cannot afford to overlook the world's largest consumer of just about everything manufactured, grown, or extracted from the ground—the United States.

Marvin R. Fisch, vice president of marketing and sales for Melcom Business Systems in Compton, Calif., observes that in the small business systems market Olivetti is here from Italy, Nixdorf from West Germany, and Philips from the Netherlands. And Melcom "is probably the first significant Japanese entry." He notes that Mitsubishi Electric, Melcom's parent organization, is already here with color tv sets, stereo components, and microwave ovens. "So this is just a logical extension to try to get into the business environment. We're already involved in the consumer environment, and doing a super job at it."

Melcom will be importing all its hardware, adding American-made applications programs, and selling turnkey systems. As such, it will be dependent upon American marketers like Fisch, who formerly was affiliated with Datapoint and with General Dynamics' DatagraphiX. It will need the skill of American programmers who know business methods in the U.S. and of American sales personnel who know the territory. But evident in the company's business plans is the strong central direction from the home office.

Typical of the Japanese, MBS is starting more with a whimper than a bang, restricting its marketing to Los Angeles and adjacent Orange counties for the initial six months. From there it will expand north to San Francisco and south to San Diego. "We may venture out and try Texas," says Fisch, not certain yet whether those sales will be handled directly or by appointed dealers. In midsummer he wasn't even sure whether he would have to get help from a local software house for his applications program development. If he did, he said, it would be to speed up development, for the plan is to have an in-house programming staff.

Prominent by their absence Stateside are Japanese software companies, the result of a technology gap, a language barrier, and a significant disparity in the way business is conducted in the two countries; it is the latter factor, of course, that makes it difficult for them to develop applications programs for use here. By contrast, a number of software houses from Europe and the U.K. have opened sales offices here, albeit more to sell language processors and system software.

Nor are Japanese mainframes a significant factor in the U.S. installation base. A decreasing portion of all Amdahl computers are made by Fujitsu, and the revenues from that activity bring Fujitsu's income from sales abroad up near the 10% level, highest among the majors in Japan. Hitachi, which is paired with Fujitsu in the manufacture and sales of M-series computers, is the supplier of the AS-6 computers being marketed by Itel Corp. Itel's AS-4 and AS-5, of course, are made in San Diego, California, by National Semiconductor. Hitachi, which has already delivered an M 160 and two M 160-II's, to the Central Meteorological Agency of the Peoples Republic of China, developed the AS-6 under Itel's direction to be software-compatible with IBM's 370s. But installation of the AS-6s by Itel began only early this year.

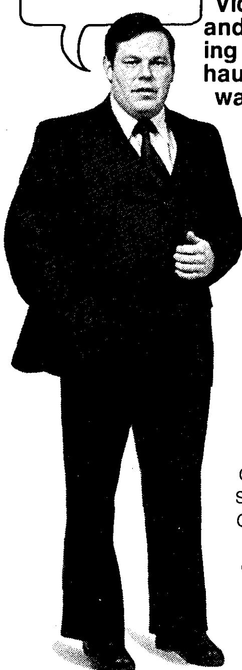
Do the Japanese expect to find resistance to a Japanese product? "On the contrary," says Marv Fisch. "I really think the Japanese have done a superb job of establishing themselves in technological areas, electronics especially." He cites products in the tv market, in stereos, photographic equipment, and automobiles. "I don't think a Japanese product carries any stigma whatsoever. I think it's well established as a quality product that Americans have come to appreciate."

He says large corporations are prejudiced more against American companies, still favoring IBM against all others. But small businessmen are interested in price-performance, and not at all concerned that a product comes from Japan.

CARVING A NICHE

If this holds true and if the Japanese penchant for manufacturing high reliability into their products continues, then the pattern for the '80s will be the carving of market niches by them—perhaps in small business sytems, possibly in peripheral equipment, and maybe in other small devices and systems such as personal computers and home video games. Success in any of these markets can then lead to their establishment of manufacturing plants in the U.S.

EDP professionals have a word for the new Wang VS computer.



Richard Berger, Vice President and Data Processing Manager, Bughaus, Inc., a Volkswagen service center network headquartered in Hartford, Conn.

"Because we had been using a computer—the Burroughs B1700—with card input sequential files and no video displays, we suffered long delays and storage constraints.

"Now, with our Wang VS system, storage is virtually unlimited, and we simply recall a screen load of information on the CRT to make a change in seconds—all of this without interrupting our normal flow of work.

"We've put everything in our business onto our VS system, including payroll, accounting, sales and wholesale and retail inventory control. And we did it in 90 days without changing languages and with only minor modifications in almost 90 COBOL programs."

"We are absolutely amazed at the throughput rate we've achieved with our Wang VS. On our very first job for one of the country's largest student insurance agencies, the VS arrived in Pittsburgh on December 23 and was completely installed and operational on-site on February 15, with 61 programs written, debugged and tested—all by only two people—and not a single line of code had been written until the machine came in the door.

"The VS really fulfills all of our requirements, particularly in areas where other systems are weak: cost/performance, language-availability, user-utility software.

"I think the real key for the DP manager is the utilities available with the VS, its speed and its interactive COBOL compiler. These three things combined make for a very powerful tool."

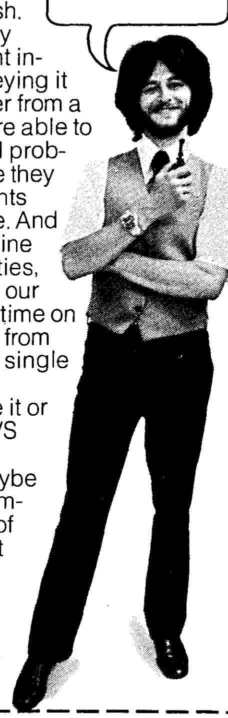
J.P. Scott, Data Processing Manager, Aptech Computer Systems, Inc., Pittsburgh, Pa.

Kenneth W. Cakebread, Manager of Data Processing, Trans-Air Forwarding and Brokerage, Inc., Inglewood, Calif.

"I had 30 days to convert about 220 programs from our old batch-oriented Honeywell 62 system to our new Wang VS system. Not only did I do it: Thanks to the programming power of the VS, I actually came up with more.

"Before we converted to the VS, the biggest problem we had in the accounts receivable area was misapplying cash. No more. Now, by capturing current information and keying it into the computer from a workstation, we're able to sort out potential problems long before they get to the accounts receivable stage. And with Wang's on-line editing capabilities, I'd say we've cut our average editing time on a per-item basis from 30 seconds to a single second.

"And believe it or not, while the VS gives us faster access and maybe triple the programming efficiency of our old system, it was only half the cost."



EDP professionals in more than 100 companies are singing the praises of the Wang VS. And for good reason.

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We also think you'll appreciate how simple the VS is to operate. In fact, because of its level of sophistication, it can be operated by people with little or no computer-related training or experience.

One more thing: the entry level price of the VS is under $50,000. Which is perhaps the most remarkable thing of all about this computer.

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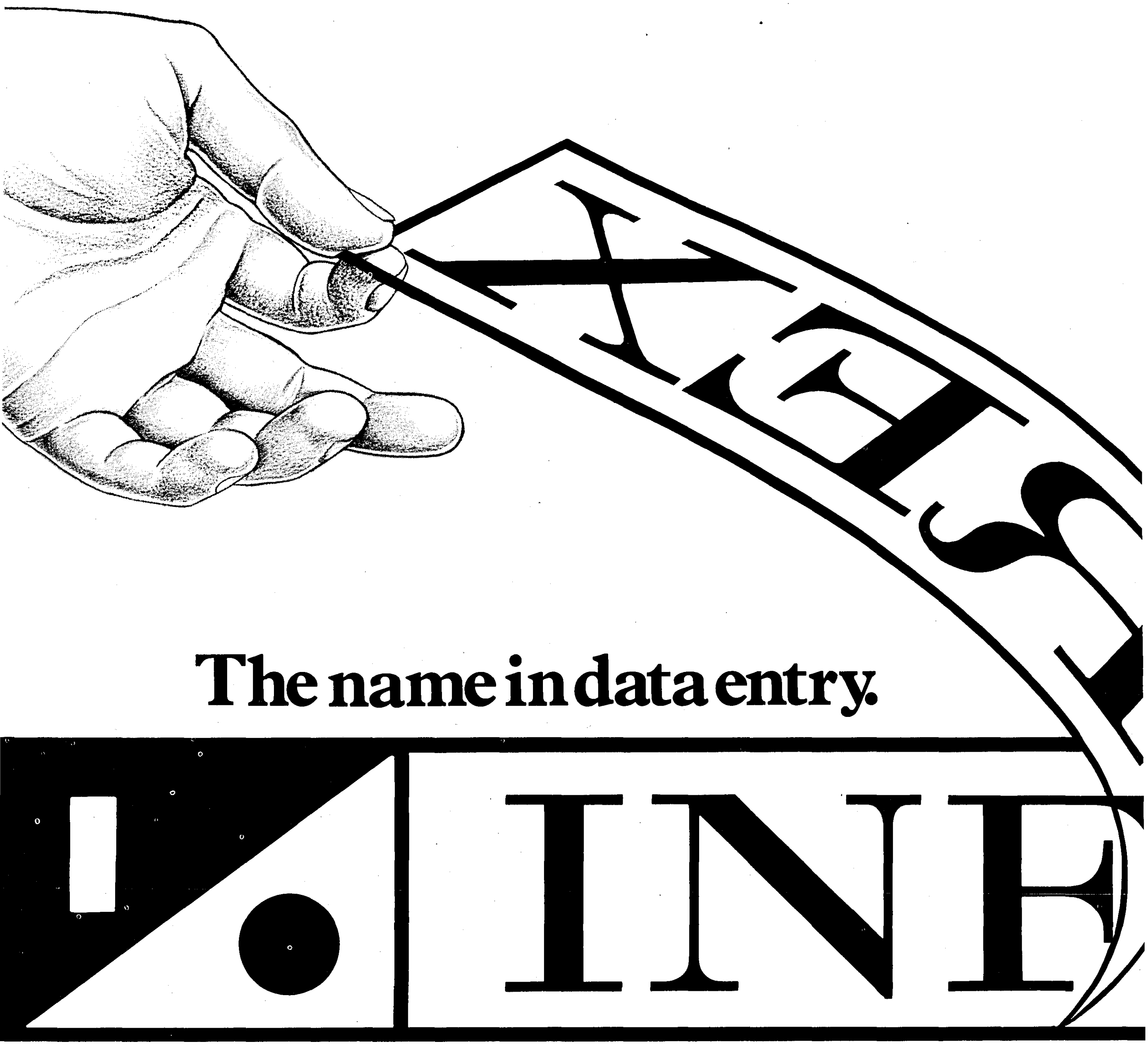
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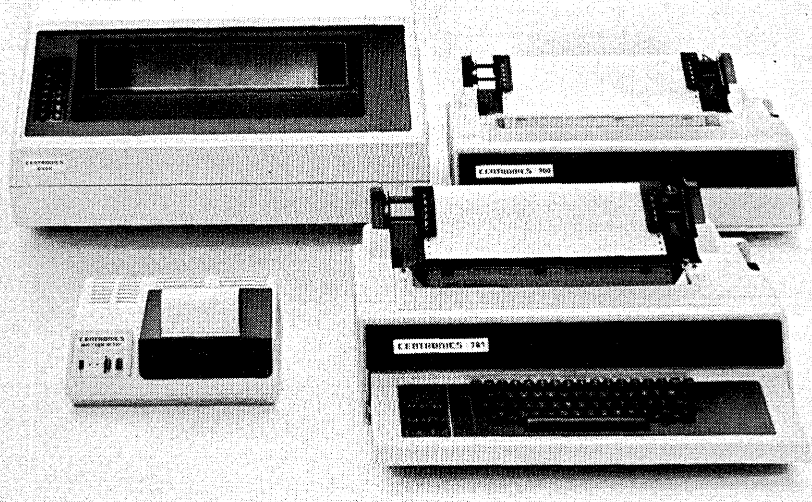

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CIRCLE 5 ON READER CARD

Virtually all the major Japanese color television producers, for example, are now building in the States.

The interest in establishing manufacturing facilities in the U.S. stems from a number of factors. Prime among them is the wish to hedge against the possible enactment of import barriers against their products, as has been done with Japanese textiles, steel, tv sets, and automobiles. But making the products in the U.S. also improves their position to exploit this market, enables them to study U.S. marketing and management techniques at close hand, and makes it possible for them to cultivate favorable public opinion here by contributing to the American economy.

Adding to the appeal is a gradual narrowing of wage differences between U.S. and Japanese workers. Indeed, there are some who argue there no longer is a wage difference when one takes into consideration the fringe benefits and other employee-related costs provided by Japanese employers. Additionally, the prices of electronic parts are sometimes lower here than in Japan.

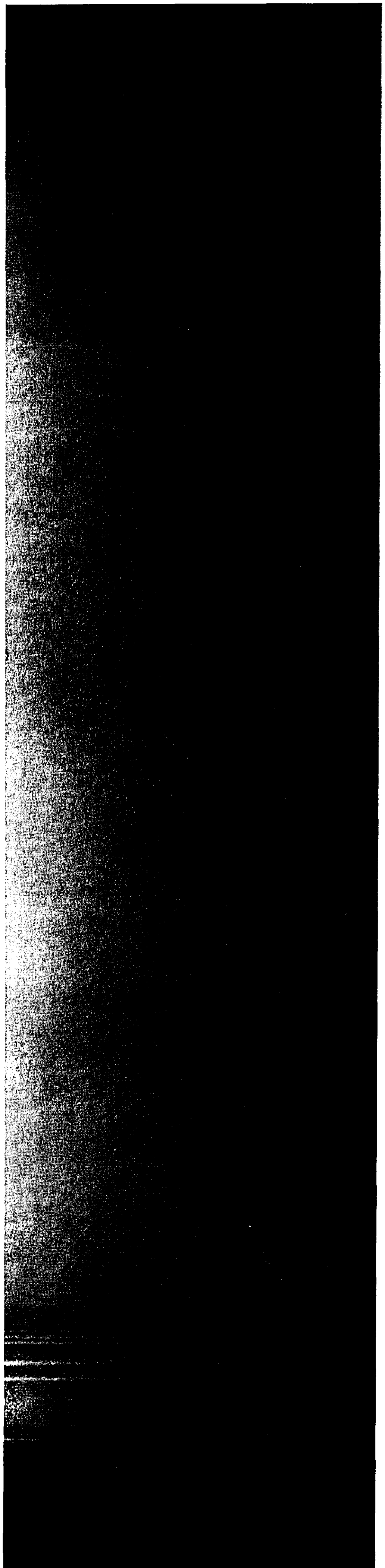
Not to be minimized is the effect of the exchange rate. In a recent 18-month period, the value of the Japanese yen rose by 30% relative to the dollar, which means the price in the U.S. of goods made in Japan must go up. Anyone who has been following the prices of automobiles lately can appreciate the dilemma being faced by Japanese manufacturers, some of whom have had to put through six price increases in a year's time. That's enough to put any computer vendor's price-performance curve into a downspin.

The vendors looking at this market from the other side of an expansive ocean do not take their marketing task lightly. Rather, they show a keen awareness of the market, the players in the game, and strategies being employed. They seem determined to position themselves for a role in this market in the 1980s.✲

EDWARD K. YASAKI

Western editor for DATAMATION, and manager of the magazine's San Francisco bureau, Mr. Yasaki has also spent several years covering the development and growth of the Japanese computer industry.

ILLUSTRATION BY DICKRAN PALULIAN



The proliferation of minis and micros is changing the nature of all business transactions.

THE SMALL SYSTEMS MARKET

WHATEVER HAPPENED TO THE MINIS?

by Carl Reynolds

A little while ago, everyone said minicomputers would revolutionize data processing—that the dp organization of the past was dead.

Others said t'aint so . . . there are too many software problems. They'll never get those things to do anything—there aren't enough programmers in the world. Besides, IBM still says bigger and centralized is the only way to go.

Have the dreams all fizzled? Is the "mini revolution" just another hula hoop—a temporarily exciting toy which burst like a nova on the scene, and now dims into just another star in the heavens of dp?

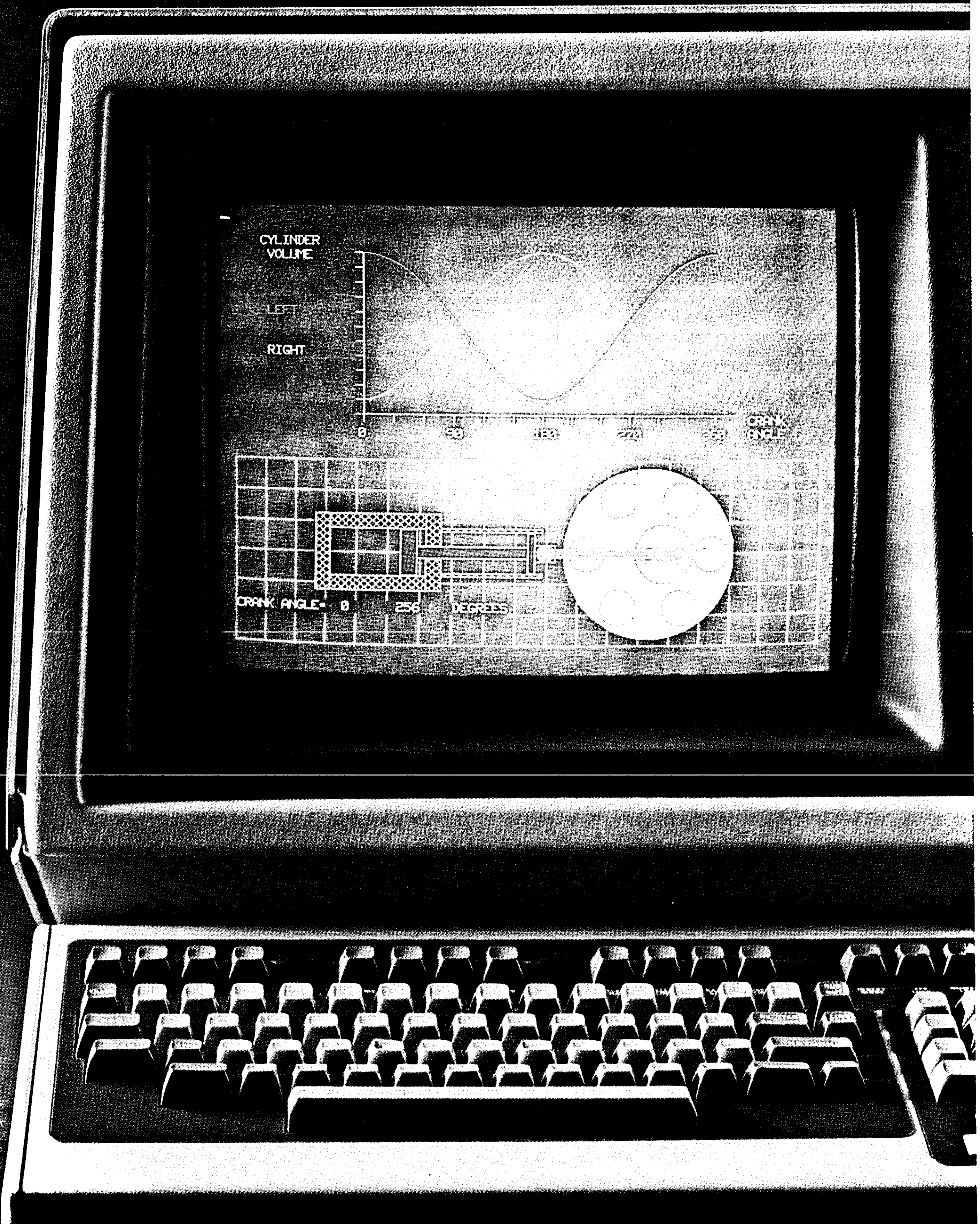
In California, we thrive on big splashes that dissolve into tiny ripples. Proposition 13, for example, was going to be the end of the world as we knew it. Now that it has been passed, most of us find little evidence of real change. In a way, the same thing seems to have happened to the minis. Claimed to be a major force for change, they seem to be causing few waves in the great dp centers of the West. Could it be that the big dp centers will be forever secure with their bigger and faster 303Xs? For those of us who have to provide a dp plan that somehow meshes with our company's long range strategy, it is a vexing question.

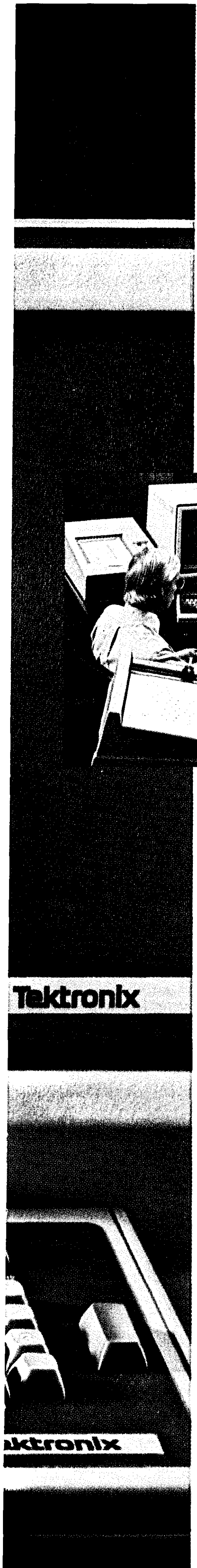
On the one hand, it is inconceivable that the changes LSI has produced in computers in the last ten years can be considered only as changes of degree, not of kind—and yet, that is what most of the dp establishment seems to think is the case. The Amdahl-forced price/performance gains in the maxi computers have convinced everyone that Grosch's Law (the power of a machine is proportional to the square of its price) has not been repealed. Minis are, after all, just small machines to do small jobs in small businesses, and aren't as good as big machines on our big problems.

In planning for the future, I think that there are some reasons that minis have not penetrated traditional dp organizations as fast as might have been expected.

OVERSHADOWED For one thing, the impact of minis is overshadowed in the large dp organization by a couple of factors. One is that dp business is good; in fact, it has never been better. Computers are understood by all—or at least most—of our co-workers to be a necessary, even desirable, part of business. Even though the stock market drags along, computer budgets continue their steady growth. We haven't had a budget cut, or even a serious threat of a cut, in three or four years. We're so busy, and so fat, we really

From the Graphics Leader




Tektronix

haven't had many face-to-face mini vs. maxi confrontations. There seems to be enough money for everyone.

The second factor is that maxi dp has a renewed lease on life with the price/performance standard set by Amdahl for big machines. As an example, two to three years ago, we developed a mini-based system to offload work from our IBM 165s at Hughes, both to cut the cost of TSO, and to provide better performance. The resulting system, called MISER, was completed about the time we installed our Amdahl V/6. The result has been that the performance/price improvements of the V/6 completely overshadowed the impact of MISER. Even though MISER is still half as expensive (for some work) as TSO/V-6, our users have been happy enough not to look for more—at least not right now.

In the dp shop, we've been busy, and we've been providing better, cheaper services. So who needs the minis?

THE UNDERGROUND That question still nags at me. A revolution I can't see, and yet I know it's here. Perhaps the war has gone underground? Are the mini vendors really selling guns and ammunition to the natives? Are they sneaking in supplies to subvert the big dp organizations?

The answer is yes. And at full force, but we shouldn't worry. We all know these guerrillas are poorly trained, have little knowledge of programming, and have no standards or operating procedures. How can they mount a full-scale assault on a real dp activity?

The users are buying small machines with ever-increasing hardware and software power, and chipping away at problems we in maxi dp don't have time to work on. It is beginning to look like the two major ingredients of a good dp organization are an on-line editor and a BASIC-like language—and now we can get those, with communications, for as little as $40,000 to $50,000. Every word processing/shared logic system is a potential dp center. I see proposals for "word processing" equipment that include FORTRAN and COBOL compilers.

So, dp activity and the small size of the users' individual activities are hiding the status of the mini-revolution. But there are also other forces at work slowing down the impact of the minis.

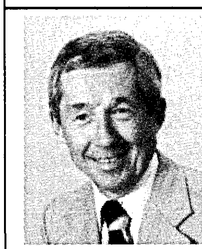
SLOWING DOWN First, there's just plain history. Almost all of our systems work is done by people who have been trained to centralize a problem in order to solve it. One example of this thinking arises in designing personnel systems. Most designers assume that corporate level data is the most reliable, and any decentralization of data will be from corporate to the performing organization. Yet over 80% of all such data is originated and initially recorded at the local organization. The corporate data base is *never* absolutely correct since it is batch updated.

The final problem is that, after all, dp was not the only or even the main bastion of centralization. Any organization with a large centralized dp organization has other centralized staff functions as well. They are every bit as conservative in their position as dp people. In general, the cry is: "Decentralize the other guy, not me." At best, it's "Decentralize to my area of responsibility, I'll take care of the users." Finance and accounting and personnel departments have no more desire to give up hard earned control and technical functions than dp people, and they have good reasons.

Gene Amdahl was right. Momentum/inertia will preserve the big dp operation for some time.

Yet, the mini/micros are a revolution, and when the next recession comes, we will have the first of the mini-maxi shootoffs. Some user will challenge the dp establishment that he can do it cheaper on a set of minis than the dp organization can on its 3033—and if that recession is two years from now, the mini will be twice as good as it is today. I wonder what the price/performance of the 3033 will be? Incrementally better, I'm sure, but twice as good? I doubt it. Oh, the joys of long range planning! ✲

CARL H. REYNOLDS



Mr. Reynolds joined IBM in Boston in 1954 and held various positions in sales, engineering, and development programming, including manager of systems programming for the Systems Development Div. In 1971, he was appointed corporate staff director of computing and data processing for Hughes Aircraft Co., the position he currently holds. In addition, he is a member of the board of directors of Boole and Babbage, and on the advisory board of DATAMATION.

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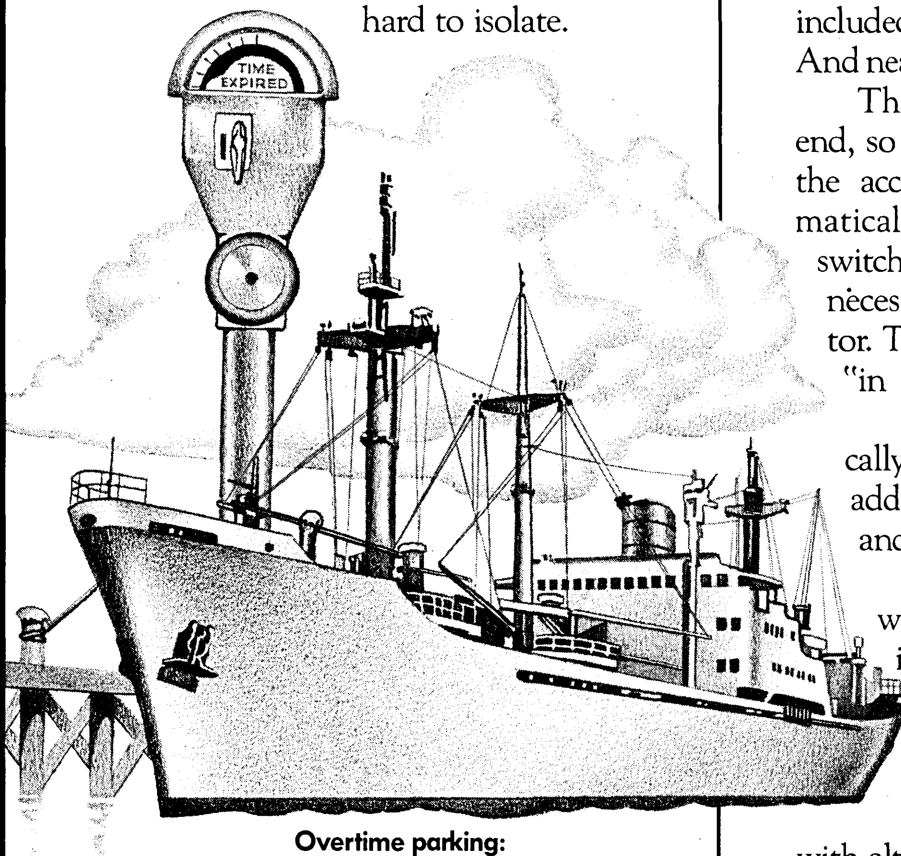

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THE CONSEQUENCE OF MINICOMPUTERS

by Howard Bromberg

In the last few years, profound utterances have emanated from within the data processing community. They have taken forms such as "a computer in every home," "a minicomputer within the reach of every business," and "minis today, micros tomorrow."

While the words are simple and clear there is a deep, serious meaning to these statements. Such a meaning may have a significant impact upon the future direction of the dp industry and certainly upon how the waves of small machines are being accepted by the new users of these products.

When the concept of electronic computing was first introduced to the business community, it was heralded as a giant step toward the harnessing of technological power for business use. It was advertised as an absolute, fundamental requirement for the success of all businesses. Its promise included speedy answers, accurate results, and reduction of manpower, to recall a few.

While the statements and promises of the early '50s sound remarkably similar to those of the late '70s, there are, however, significant differences. In the first place, the promises of the '50s fell upon the ears of large corporations. These were organizations with sufficient funds and staff to be able to cope with problems that could arise from technical difficulties including those that might create business interruptions.

In the second place, the novelty of computer utilization was sufficient to carry the inertia for computerization by itself without regard to effectiveness and economy.

And, finally, the most important difference was with respect to the role played by the hardware vendor company and the hardware salesman. In the early days, when there was little pre-established work supplied by the manufacturer, it was an accepted fact that the end user was responsible for the majority of the efforts required to produce a successful data processing installation. Furthermore, the salesman operated on a different level. Not only was his commission based on the success of the operation, but his major preoccupation was with the hardware. Little consideration was given to operating systems, data conversions, and applications software. It was this early hardware hand-holding that accounted for a large portion of early installation successes.

DEFINITIONS

What really is a minicomputer? If we evaluate the current minicomputer offerings in terms of 20 or 25 years ago, we would find that today's minicomputers could really be classified as giant mainframes of the past. The size of the first and second generation general-purpose computers barely approached the size of today's minicomputers. So, in a sense, size is really not a meaningful measure.

An average minicomputer has a core memory size that ranges from 10K to 128K bytes. Physically, the size of these minicomputer cpu's range from a table-top to one approximating a large four-drawer file cabinet.

In addition to the central processing unit, a minicomputer system includes peripheral units such as disk or tape devices and high-speed printers. There will also be from one to a dozen or so terminals, through which the human interface with the computer is accomplished. Each minicomputer system has some limitation on the number of such units that can be attached to it; operational trade-offs are consequently made based on the mix of the various attached units.

For the most part, the applications to be processed and the various file sizes associated with these applications dictate the particular configuration that will constitute the system.

A more manageable definition of a minicomputer is that it is *a machine developed primarily for the processing of a single application or the processing of a number of small applications.* For example, in a distributed processing network, a minicomputer could perform a specific operation and send the volume processing through communication lines to a large mainframe. Conversely, in a small business environment, the minicomputer could perform all of the accounting functions for a firm whose manual accounting procedures require a bookkeeper and one or two clerks.

Probably the single distinguishing feature of a minicomputer is its price. Today, minicomputers can be purchased from $10,000 to $200,000 depending upon capacity and peripheral requirements. An interesting fact: built into this mini price and mini size is a major amount of sophistication. This sophistication has significant influence on the user personnel and the user environment.

INFLUENCES AND DDP

The relatively low cost and early availability of minicomputer systems has influenced, if not altered, the practices of a large segment of the business community. Minicomputer systems are appearing in a wide range of locations, both expected and unexpected, and for an even wider range of application purposes. It wasn't until the recent advent of communications networks and, more precisely, distributed data processing, that the minicomputer has come into its own as a standalone or connected communications device.

The concept of distributed data processing is both interesting and profound. What it says is that we would like to be able to put computing capability out where the data exists; in other words, to distribute low-cost computing to the physical processing location.

The implication, of course, is cost-effectiveness. Once we were given low-cost minicomputers and a reasonably priced communications capability, this opportunity became a reality. In fact, however, what actually happened was that the potential benefits from distributed data processing became great enough without communications that standalone minicomputers became fashionable. Thus, user departments in large corporations not very far away from their own central data processing facility, as well as small businesses, found themselves installing dedicated, standalone minicomputer systems. In such a way, minicomputers have come out of the closet and have taken their place as an important tool for business in general.

NEOPHYTE USERS

An interesting effect of this move to mini automation is the creation of a new breed of users. These users actually come from two separate sources. On the one hand, they are actu-

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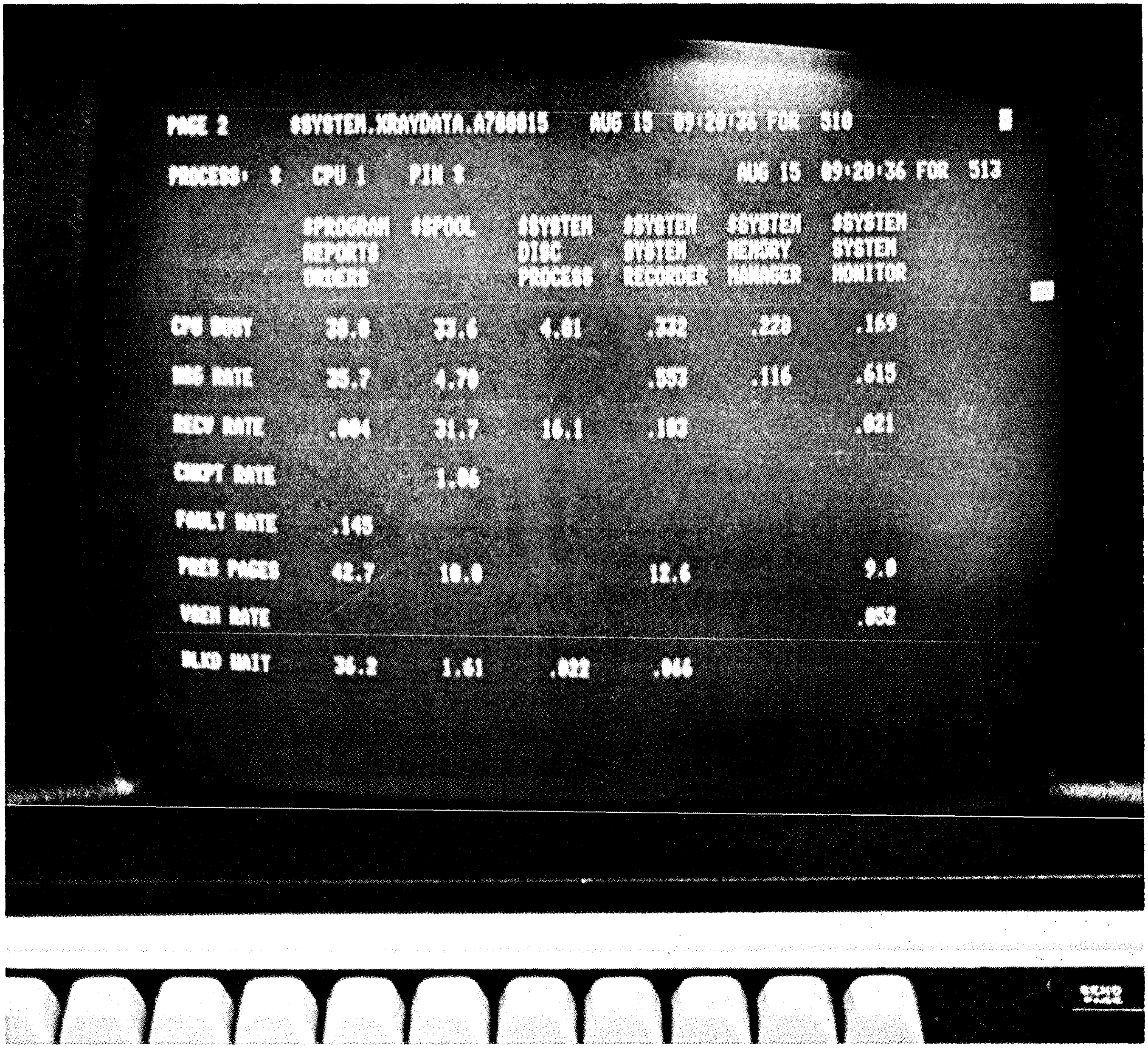

XRAY lets you see what's up throughout the system, software and hardware, in enormous detail at remarkably low overhead.

The one and only multiprocessor hardware and software monitor. Tandem introduces XRAY, the first performance monitor in the computer industry to permit the balancing of all software and hardware components throughout a multiprocessor system. With measurements controlled and analyzed from any terminal in the system. Tandem designed this monitor especially for the data base/transaction environment to detect bottlenecks and permit orderly system growth, all within the lowest overhead burden on the market—less than 1%—and featuring some incredible capabilities. Among them—our exclusive graphic XRAYSCAN™ outputs. You can set your XRAY on automatic browse, keyed for instant and in-depth analysis of trouble spots as they occur. You can program for continuous and/or exception reporting, and data is stored correlative to actual system operation in all phases of program, file, processor, controller or terminal. No one can tell you more about what you're doing. Or make it as simple to modify system set-up and operation for optimum throughput. You'll be able to spot overload situations immediately and fine-tune your system at a fraction of the previously required efforts. Powerful, efficient and flexible to begin with, Tandem NonStop Systems are brought to their full potential by XRAY.

on-line bottlenecks fine-tuned applications.

Measured and reported in depth. Tandem XRAY lets you see exactly what's going on in processors, data communications lines, tapes and printers, terminals, disks, disk file opens, processes, and file opens. The depth of reporting in all categories is typified by those for processors: i.e., percent of elapsed time CPU is in use; virtual memory pages input and output per second; disk I/O transfers per second; number of disk cache hits per second; average length of CPU queue; total number of interprocessor messages sent per second; number of times per second CPU was set up to execute some process; number of terminal interactions per second; and average wait during a terminal transaction. All are available for the total system, by individual CPUs. And similar levels of reporting are available in each category. On CRT or hard-copy at your immediate option.

We never stop. We not only designed and built the Tandem NonStop Computer; we've never stopped perfecting it. First we added ANSI Standard COBOL and FORTRAN. And our new Remote Diagnostic Capability provides interactive analysis of what's happening right now—anywhere in the system, in both hardware and software—from any terminal as long as proper security clearances are provided. Through a modem connection, we can diagnose problems on your system straight from any Tandem service center; no lost time and no wasted efforts. And now, we've used our own XRAY to enhance system microcode in the Guardian Operating System software so that Tandem can now do with two processors what used to require three in many applications. It's not across the board, but it is typical and it is extraordinary.

The better and the best. The Tandem NonStop System is unique to begin with; it's the only computer built to keep right on operating even if a failure occurs in any part of the system. An on-line multiple processor system with a level of data base protection unparalleled in the industry. And that is coupled with the capability of preventing loss or duplication of any transaction even if a processor, I/O channel, disk controller or disk should fail during processing.

With a capacity of up to four *billion* bytes per file, comprehensive alternative capabilities in file structure, and up to 255 keys per file, the Tandem System is amazingly powerful and flexible. Perhaps the best part is that it's expandable without penalty, without reprogramming, without one cent of loss on the original investment. And now with XRAY, it can be precision-tuned in load factors throughout both hardware and software. See for yourself. It's worth looking into. Tandem Computers, Inc., 19333 Vallco Parkway, Cupertino, California 95014.

Toll Free 800-538-9360 or (408) 996-6000 in California.

TANDEM

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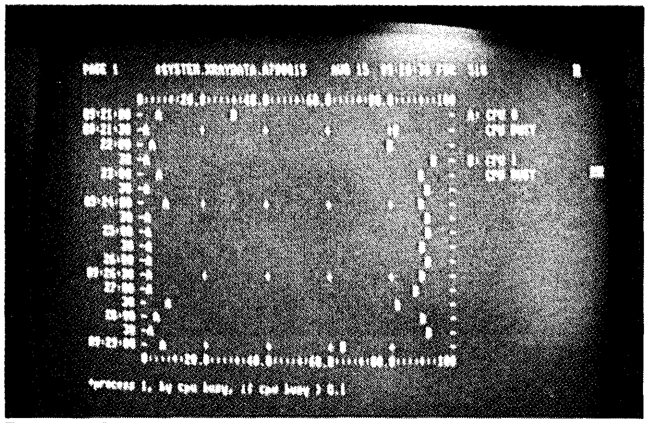
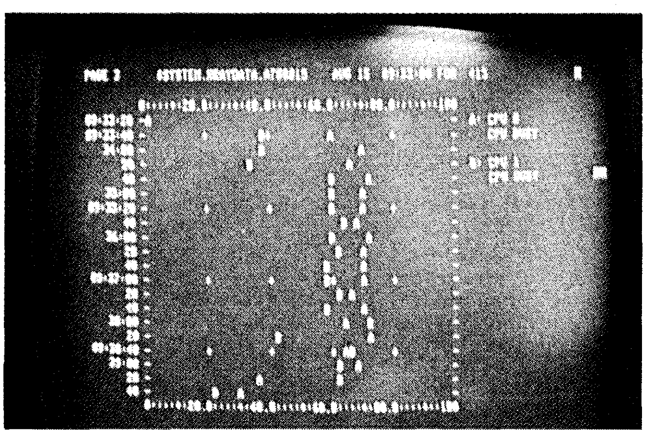
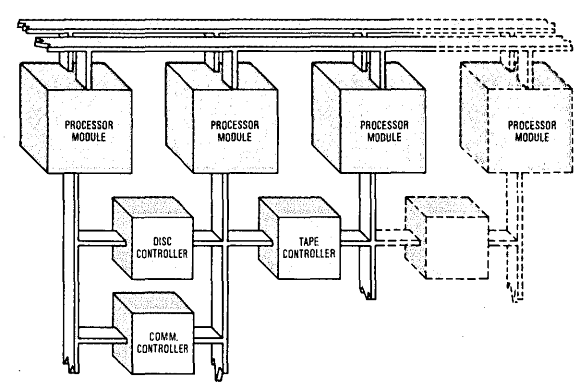


Bottlenecks are immediately visible, whether in programs and files or processors, controllers and terminals.



Systems can be balanced for optimum performance, exclusive in multiple processor systems with the Tandem NonStop Computer.



With anywhere from 2 to 16 multiple, independent processors and dual communications paths between all system modules, the Tandem NonStop Computer provides not only continuous operation, but throughput unmatched by any other system of comparable cost.

The intelligent and farsighted business executive will be asking for more modeling capabilities.

ally former users of computing services. These are people who had been using corporate data processing from a central source or who had been subscribers to a utility service such as a service bureau. In these cases, this user had the use of data processing but not the responsibility for it. And this, probably, is the major difference between those being serviced with data processing and those running their own data processing facility on a minicomputer. In the long run the difference will not be cost, or timeliness, or accuracy; it will be responsibility.

Large-scale data processing facilities, whether private or commercial, have difficulty in providing balanced services to all of its customers. Some customers feel that they receive less than equal treatment. An alternative that appears to be gaining popularity for these customers is for them to acquire and run their own minicomputer shop. This dedicates the machine to their specific application requirements and places the responsibility for the success or failure of the operation directly on themselves. Thus, minicomputers are slowly but surely eroding the total concept of large-scale centralized data processing by distributing responsibility to a multitude of small installations.

The other new user of minicomputers is the true neophyte, typified by the organization that has never before been involved in any type of computer service. This new user differs significantly from his counterpart who has had some previous experience in that the virgin user is totally dependent upon his various vendors for the success of his minicomputer installation.

This situation has some aspects of *déjà vu,* as if the clock had been turned back 20 years. The only major difference, of course, is the price. All the other premises are still the same.

Perhaps the most extraordinary effect of the minicomputer revolution is the influence these machines are having on small businesses and small businessmen. To establish a common point of view, I categorize small businesses as those organizations with annual revenues of between $500K and $10 million. By far, the major impact of these minicomputers will be experienced by those small businesses which are new to the concept of dp. It is a great leap forward.

GAINS FOR SMALL BUSINESS

Today's minicomputer provides a small business with features not yet available to many larger commercial organizations. These features include a totally interactive system with data available through terminals 24 hours a day. All functions, moreover, are completely interrelated so that one is able, for example, to process a total accounting package within the complete system.

Unlike many major organizations, where tremendous data volumes preclude them from having such a complete on-line capability, today's small businesses are able to implement this capability relatively quickly and certainly much less expensively than if mainframes were their only alternative.

The influence that this capability will have on small businesses will be monumental. It will provide these organizations with access to all of their business records on a timely, if not immediate, basis. The interface that small businesses maintain with their customers, with their suppliers, and with their own personnel will change considerably. Furthermore, the intelligent and farsighted business executive, recognizing the additional potential of simple minicomputer systems, will be able to use them for other than simple recaps of his business operation; he will be asking for forecasts and projections coupled with information concerning influences particular decisions have on various parts of his business. In other words, he will be asking for more modeling capabilities.

Finally, the interaction between small businesses and the government agencies with which they do business will change and will certainly improve when they are able to communicate on a machine-to-machine basis. Similarly, the relationships between the small business institutions and major corporations, such as banks, will also change. In short, the age of minicomputers will provide the small businessman the same efficiencies and cost savings that up to now were available only to much larger organizations.

ENTER THE MICROS

While all of this is underway, we see peering at us around the corner the beginning of yet another movement. This is a continuation of the same trend toward micro-miniaturization. It is the appearance of the microcomputer. In a way, very similar to what has occurred with the minicomputer activity, micros are starting to come out of their "machine control" environment and are being made available as standalone devices. Initially, they were offered only as personal computers, primarily to serve the hobby market. But now the hobby market is being overshadowed by purchases from small companies, individual entrepreneurs, and user departments of large corporations. What is happening is that microcomputers are opening up yet another whole segment of the marketplace—the lower end of the user population who find it difficult to cost-justify a mini, but who can easily afford a micro.

SOFTWARE PROBLEMS

The major problem in the successful use of both mini and microcomputer systems is the software. In the case of minicomputers, the problem exists primarily in the lack of application software. While systems software is supplied to a sufficient extent—language compilers, operating systems, and text editors—there is a dearth of complementary tools to aid in the production of application programs.

The greatest misunderstanding, of course, is that the vast majority of minicomputer users will have no programming staff. This means that these users must either create a programming staff, rent a programming staff, or depend upon the so-called free help that they receive from the hardware vendor.

An interesting phenomenon is that while the same lack of application software and, to a great extent, systems software also exists in the microcomputer area, it is not as severe a problem as it is with minis. This is because the microcomputer appeals to an individual who is challenged by the lack of support and is eager to provide all of his application requirements himself. This will change, no doubt, as more and more very small businesses start acquiring micro systems.

A great boost is being given to the application package business by the movement to minicomputers. Not only can new application development not be sustained by the new minicomputer user, but it is also increasingly difficult for him to cost-justify building application programs where the dollar outlay may be twice as much as the cost of the hardware. So packages are being produced, and packages are being purchased, and both the manufacturer and the buyer of software packages are learning a great deal about their respective needs.

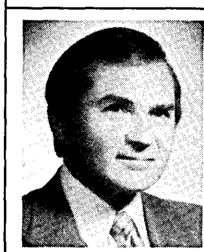
Users are finding that packages do not reflect all the specific requirements of their businesses. And package builders are finding that small businesses aren't as simple as they had thought. The situation is similar to that experienced by mainframe users in the modification of software packages to fit their requirements. The difference, however, is that the cost of these modifications, which are billed at an identical hourly rate, is much less palatable for the minicomputer user.

MATCHING THE NEED Yet another problem of this mini automation activity is being able to match the application requirement to the particular computer hardware system. For example, we must be able to determine whether a 150,000-item inventory can fit on a 10 megabyte disk, or whether an array processing technique can be used on a machine that is built primarily as a transaction processing device. These and other considerations will ultimately enable us to fit the proper configuration to the existing requirement with a minimum amount of trauma and without great extra cost. By utilizing the experiences we have had over the past 20 years in the large computer installation activities, we will be able to ease the transition for the users of the smaller machines.

It is interesting to note that no matter what specific business any one organization is in, the second business that all organizations are in is data processing. Yet, when one considers the amount of time that the chief executives of these organizations apply to their second business, the success ratios of computer installations become understandable.

In the case of minicomputer installations, it is most critical that the chief executive play an integral and continuing role. Because of the special constraints imposed on a minicomputer installation, such as the lack of technical capability, the absence of software tools, and the requirement for application building, participation by top management is imperative. Once this level of participation is coupled with price reductions and capacity expansions, minicomputers will help create a community of small businesses that are enlightened, technically aware, and are galloping down the road to become big businesses. ❊

HOWARD BROMBERG



Mr. Bromberg is founder and president of International Computer Technology Corp., a San Francisco-based consulting and systems house. He has long been active in the computer industry; his participation includes being one of the original authors of COBOL; head of the U.S. participation in international language standardization of COBOL, ALGOL, and FORTRAN; and a contributing editor of DATAMATION.

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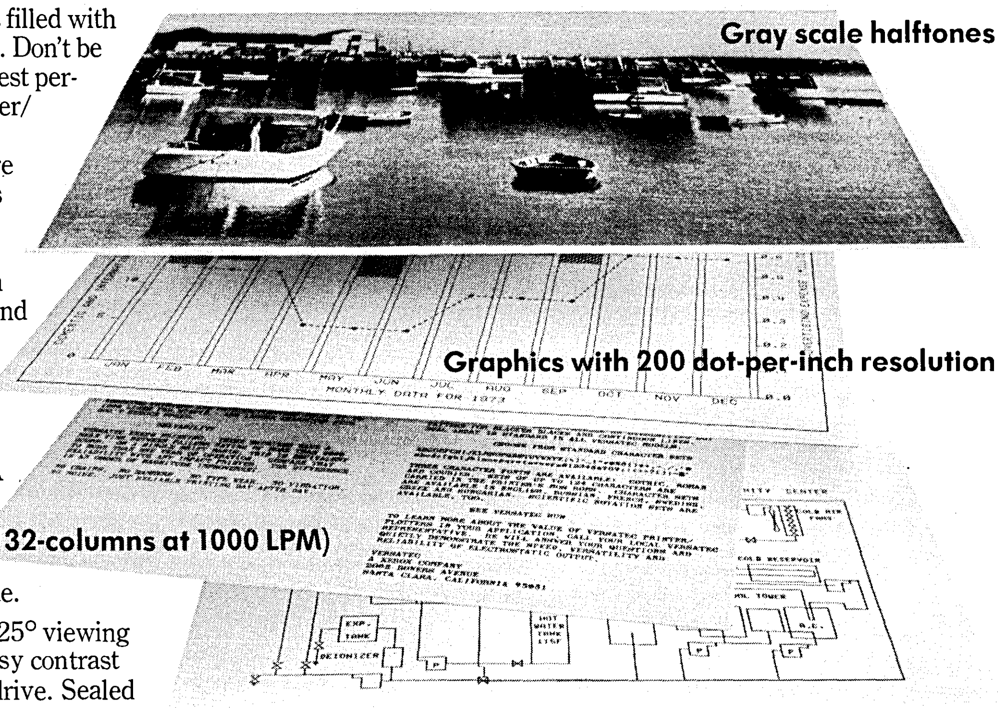
The Versatec 1200A is more than a line printer with graphics pretensions. It gives you true plotting and gray scale quality. And it delivers that quality with more than twice the reliability and one-tenth the noise of impact devices. No wonder the 1200A is the world's most popular printer/plotter.



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Graphics with 200 dot-per-inch resolution

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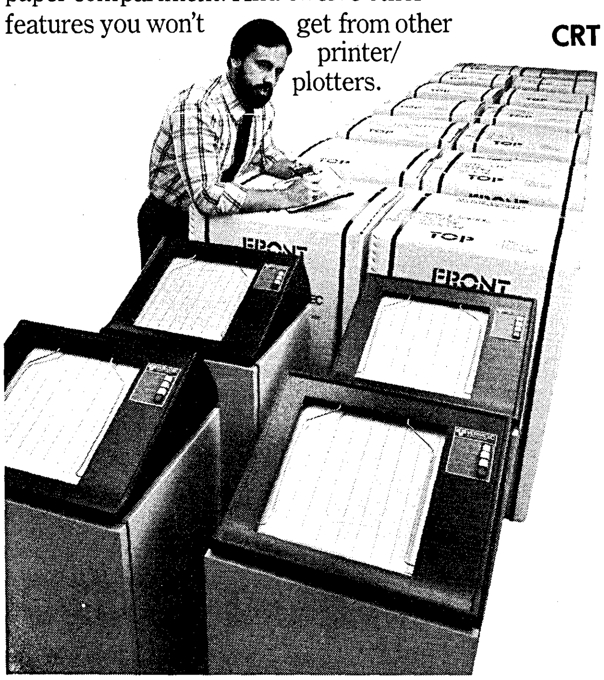

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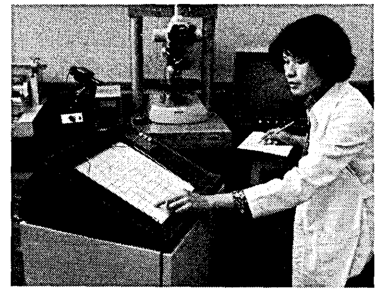

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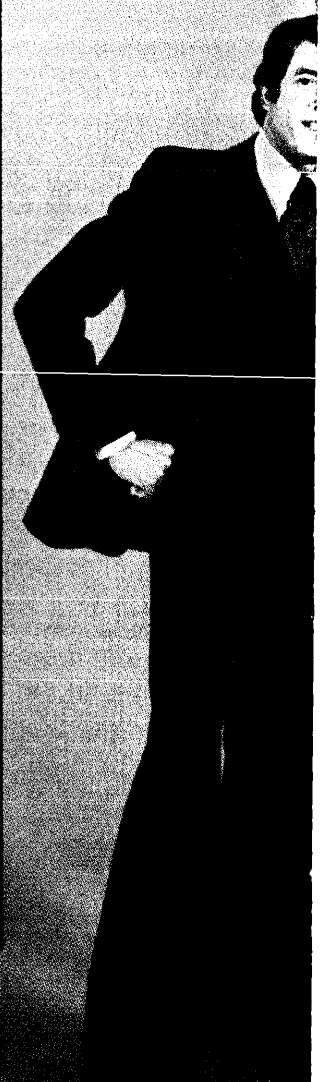
Perkin-Elmer proudly presents the end of high-cost FORTRAN number-crunching.

Perkin-Elmer proudly presents the FORTRAN VII System. $89,900.*

		INTERDATA FORTRAN VII 8/32 System	DEC FORTRAN IV-Plus VAX 11/780	IBM FORTRAN H 370/158
Table Handling Binary Search (40KB Array)		26 secs	119 secs	126 secs
Matrix Manipulation (Gauss-Jordan Reduction)	100 x 100	45 secs	42.5 secs	33 secs
	200 x 200	322 secs	376 secs	263 secs
	400 x 400†	2555 secs	3774 secs	1840 secs
Sharable Development Software	editor	Yes	No	Yes
	linker	Yes	No	No
	assembler	Yes	No	No
	compiler	Yes	No	No
Small (under 40 KB) Development Modules	editor	Yes	Yes	Yes
	linker	Yes	Yes	Yes
	assembler	Yes	No	No
	compiler	Yes	No	No
Fast Compiler	(over 1500 LPM)	Yes	Yes	Yes
Optimizing Computer Technology		Global	Block	Global
Custom Microcoding Development Software		Yes	No	No
Price		$89,900	[illegible]	[illegible]

* Domestic U.S. price includes Interdata Model 8/32 [illegible]
800 BPI tape, Carousel console, Operating System [illegible]

† Requires larger memory.



The new Interdata FORTRAN Systems – starting at $89,900 – outperform the industry.

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Start with our development compiler with its fast execution time and comprehensive error analysis. Program compilation couldn't be faster or simpler. And because we've designed to the ANSI FORTRAN 77 standards, your existing programs will run with minimal changes.

Add our proven 32-bit architecture and you've got mainframe precision and convenience.

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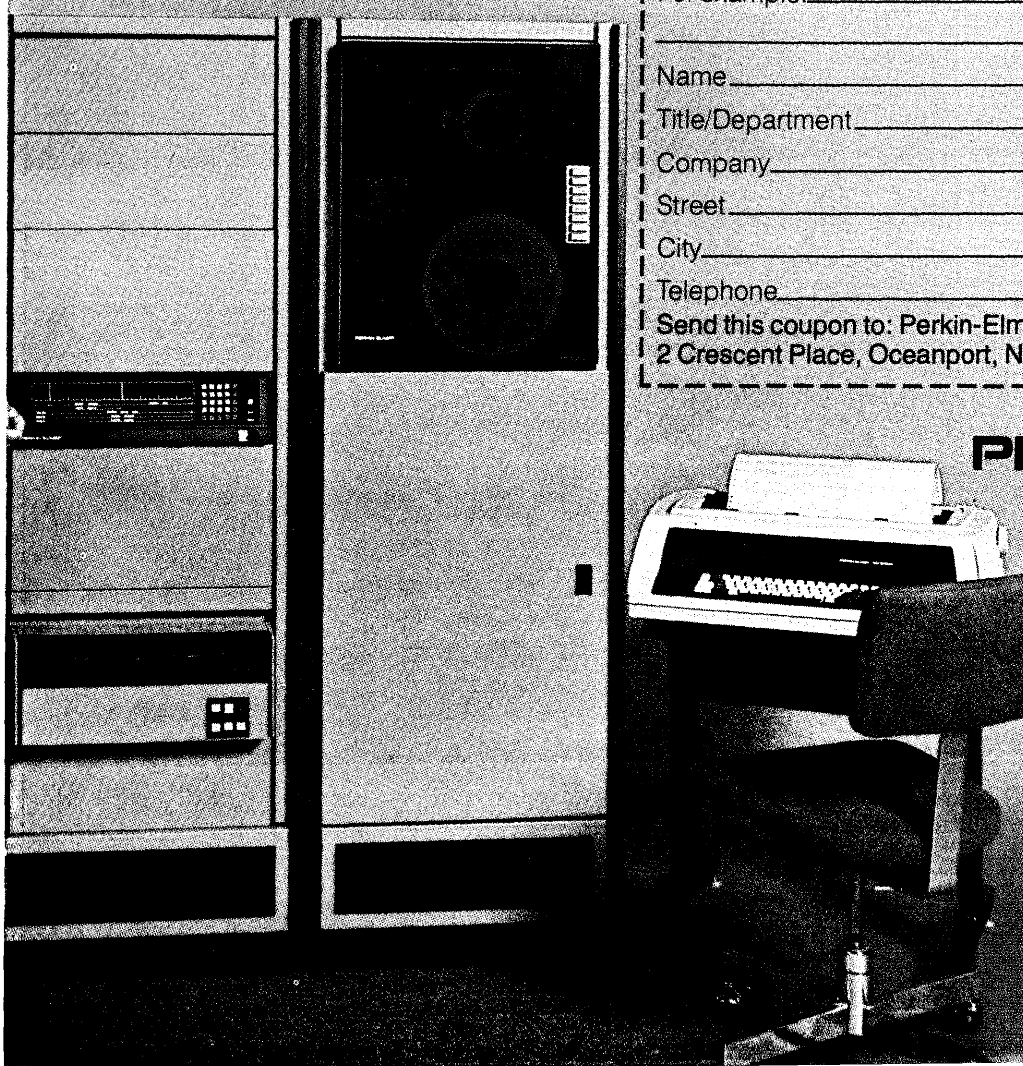


PERKIN-ELMER

Data Systems

THE SMALL SYSTEMS MARKET

A SURVEY

- ☐ A leveling in purchase of minicomputers suggests a more sober marketplace than a year ago
- ☐ Price of system not most important purchasing factor for small business user
- ☐ Users tend to stay loyal to current vendor; dissatisfaction with software support most common reason for switching vendors
- ☐ Use of network software at mini sites is rising sharply
- ☐ Average system prices continue upward trend
- ☐ Greatest growth in peripherals seen in serial printers, floppy disks, and disk drives

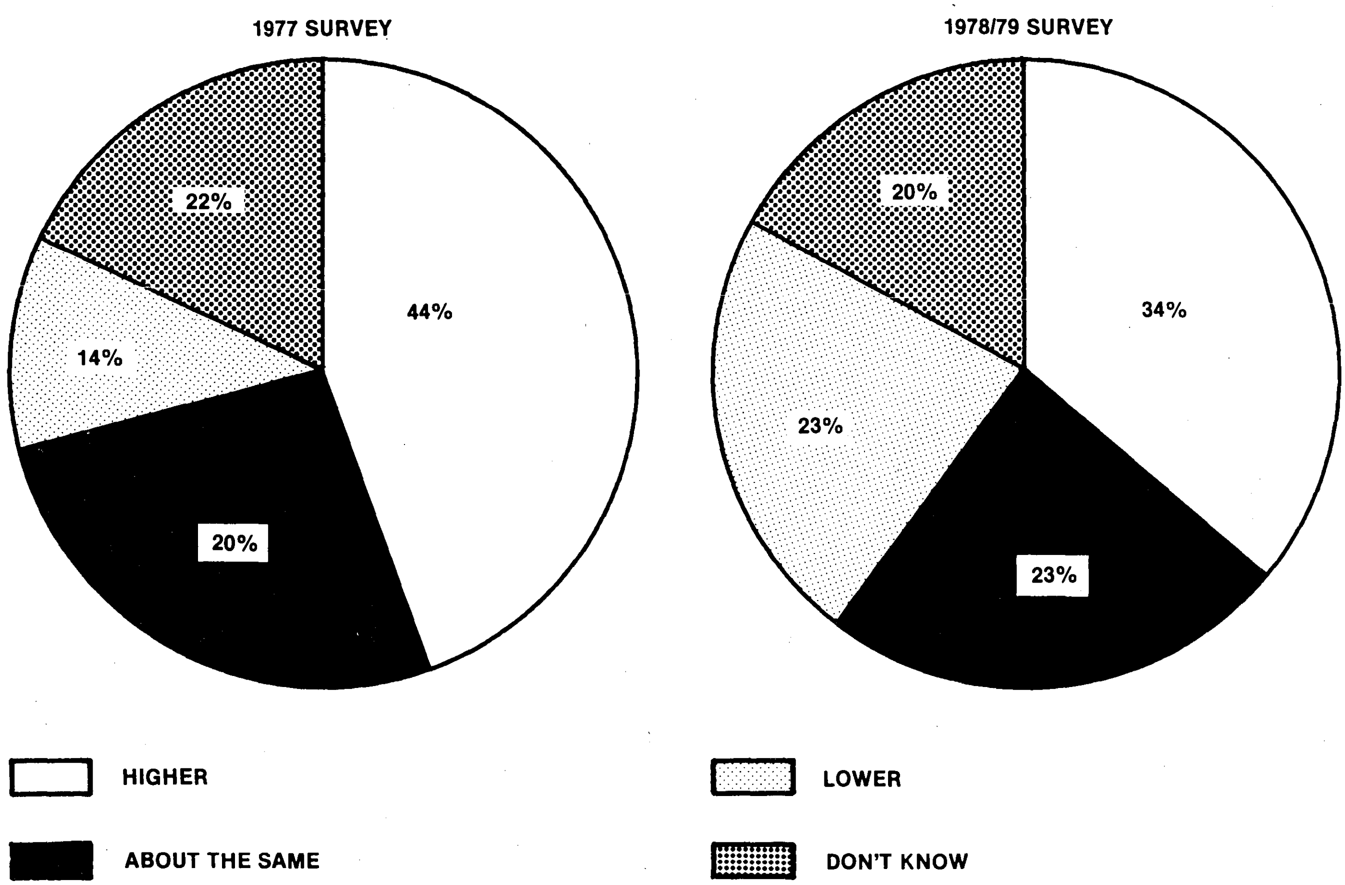
These are a few highlights from the 1978/79 survey of the mini-microcomputer market research by G.S. Grumman/Cowen & Co. in conjunction with DATAMATION.

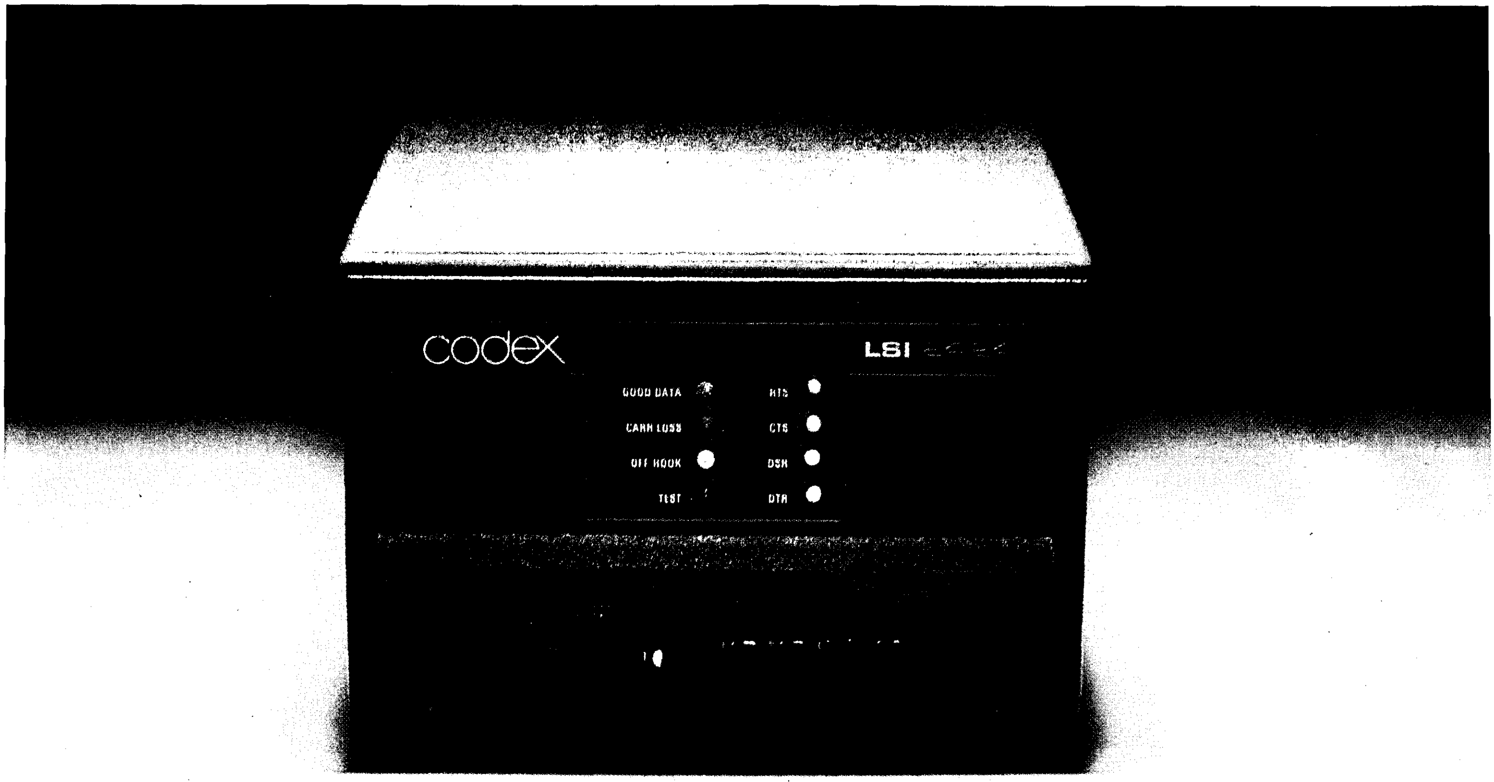
The 1978/79 survey is based on responses from 5,581 user/buyer sites reporting approximately 36,000 minicomputers in place as of July 1978. The survey also included a small European sampling.

"The minicomputer market continues to expand at a fast rate," the report states. "Fully 19% of all the respondents were first-time users in 1977, and the percentage remains nearly that high in the current year. Over the last eight years, user base expansion averaged 24% annually in

USER YEAR-AHEAD OUTLOOK LESS EBULLIENT THAN WHEN SURVEYED IN 1977

QUERY: Asked to envision their organization's needs a year from now, users said they would expect their minicomputer purchases during the ensuing 12 months to compare as follows with the prior 12 months (7/77-6/78):




codex
LSI
GOOD DATA
CARR LOSS
OFF HOOK
TEST
CTS
DSR
DTR

the U.S. . . .

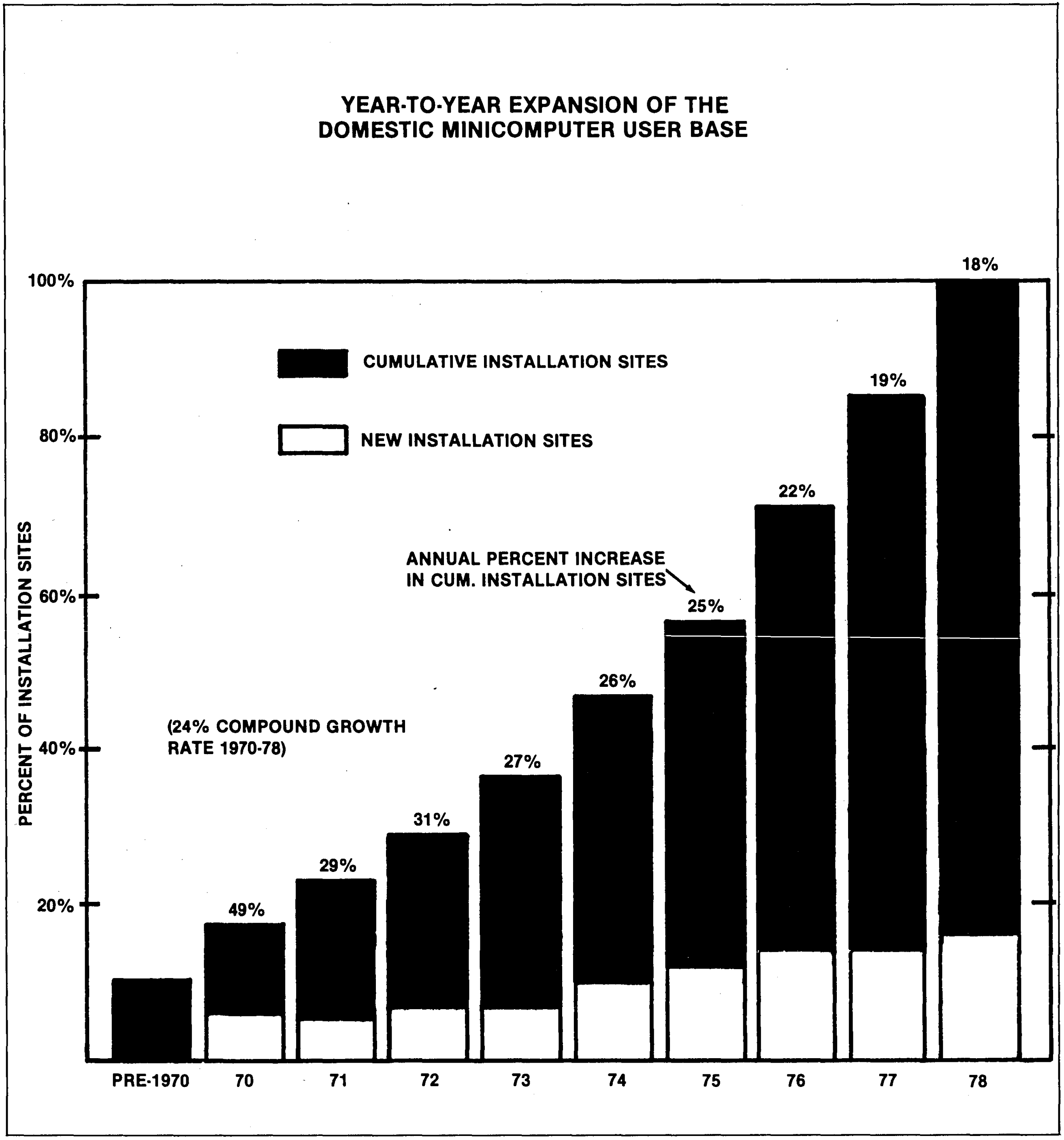
"In terms of applications, the survey data show the most rapidly growing area of small computer usage in 1978-79 to be business data processing, both here and abroad, continuing the trend evidenced consistently in these annual surveys.

"Roughly 60% of the respondents reported purchasing minicomputer hardware during the past year, and 55% expected to do so during the year ending June 1979."

End-user respondents expressing minicomputer buying intentions planned to spend 36% more on an average per-site basis than was spent by end-users during the prior 12 months; on this same basis, oem/systems house respondents envisioned a hefty 45% step-up in minicomputer-related expenditures year-to-year.

"After adjusting these data for factors such as first-time user expansion of the marketplace, worldwide minicomputer unit purchases are projected in average unit price indicated by the survey, to $41,300; this translates to a projected increase in dollar shipments of 30% year-over-year," the report added.

Many users continue to express concern over the support received from their minicomputer manufacturers and, indeed, the principal reason cited by survey respondents for plans to switch mini vendors was dissatisfaction with software support. Firms that ranked poorly in the software support department included



IDMS 5.0...The Only High Performance DBMS.

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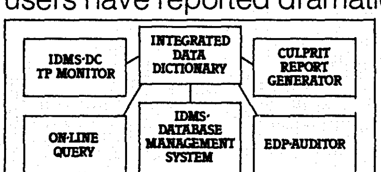

A complete data management system with single vendor support.

Throughout a rigorous testing period in over 100 user environments, IDMS 5.0 outperformed expectations:

- terminal response time reduced up to 80%.
- job execution time decreased up to 50%.
- data processing department savings in time and resources.

The completely new IDMS 5.0 architecture accounts for these benefits. Here are some of its features:

- fully reentrant and multi-threaded
- automatic recovery facility with automatic rollback.
- improved journaling and archiving.
- increased integrity through concurrent update prevention.

Learn why our users are saying, "exceptional," "impressive," "fantastic" after using IDMS 5.0 and its new features. For further information call or write Cullinane Corporation, 20 William Street, Wellesley, Mass. 02181. (617) 237-6600.

Cullinane Corporation

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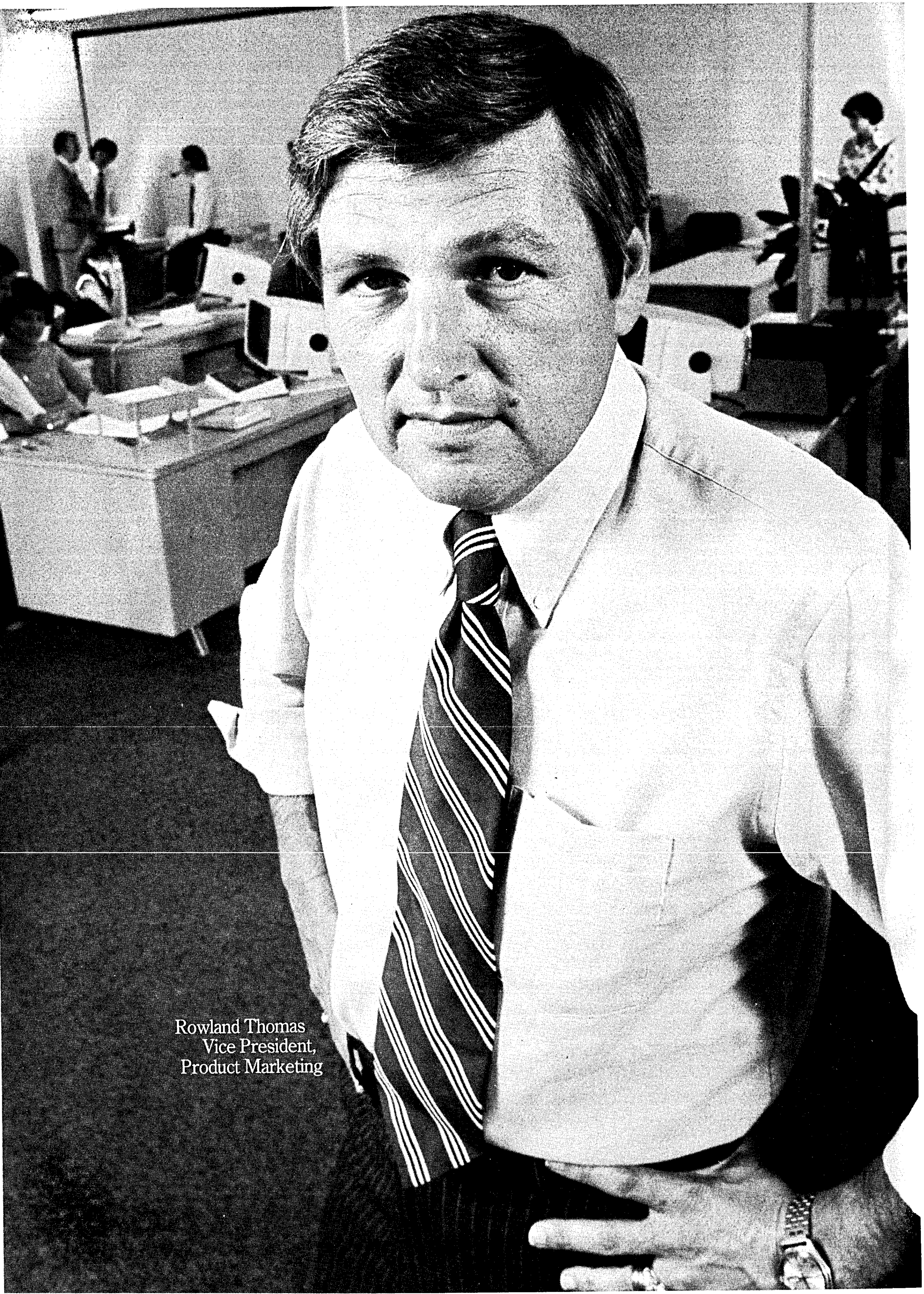
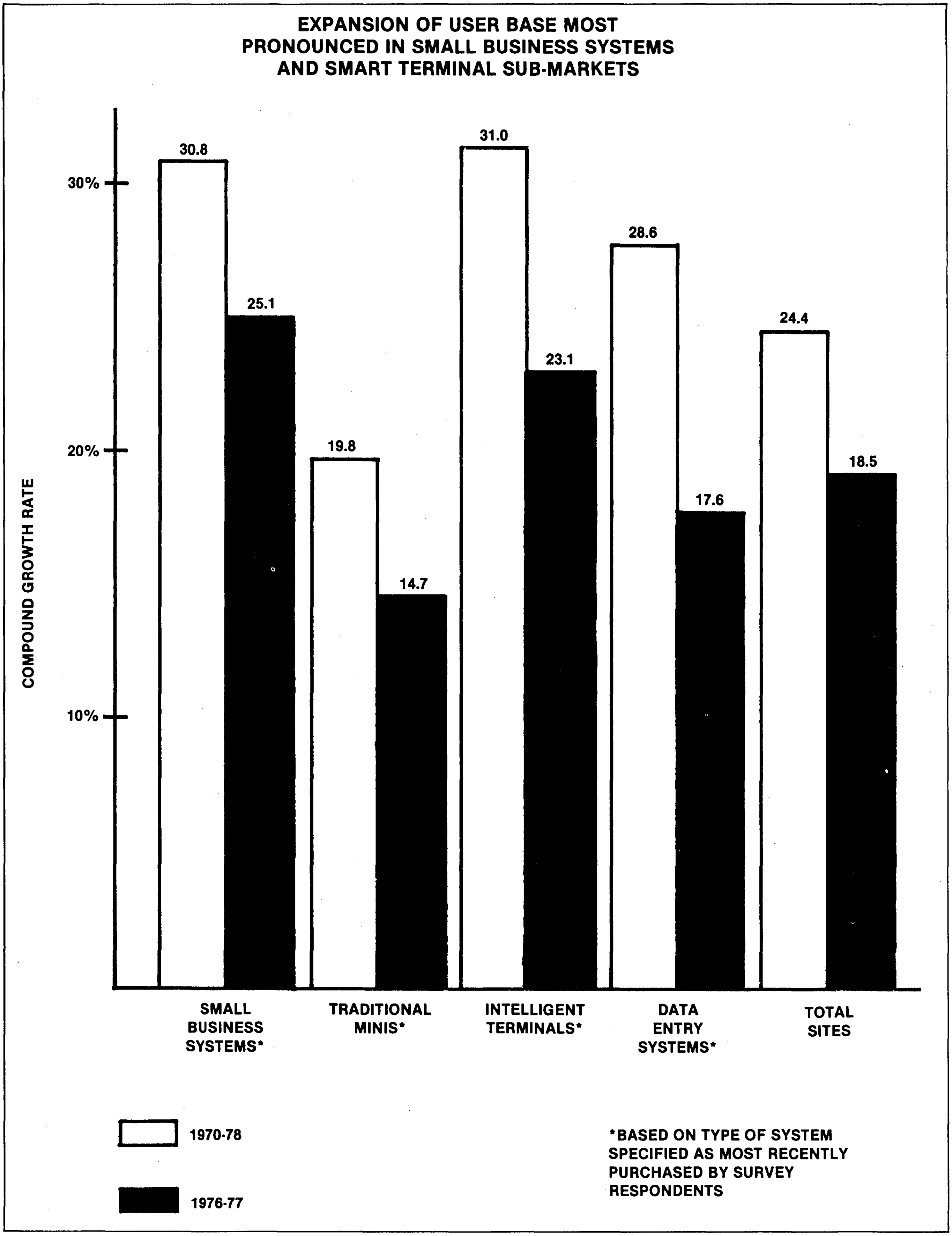
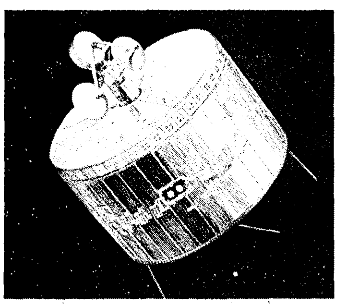
CIRCLE 18 ON READER CARD



Rowland Thomas
Vice President,
Product Marketing


EXPANSION OF USER BASE MOST PRONOUNCED IN SMALL BUSINESS SYSTEMS AND SMART TERMINAL SUB-MARKETS
COMPOUND GROWTH RATE
30%
20%
10%
30.8
25.1
19.8
14.7
31.0
23.1
28.6
17.6
24.4
18.5
SMALL BUSINESS SYSTEMS*
TRADITIONAL MINIS*
INTELLIGENT TERMINALS*
DATA ENTRY SYSTEMS*
TOTAL SITES
1970-78
1976-77
*BASED ON TYPE OF SYSTEM SPECIFIED AS MOST RECENTLY PURCHASED BY SURVEY RESPONDENTS

FACOM computers are made by Fujitsu, a company which puts the emphasis on systems.

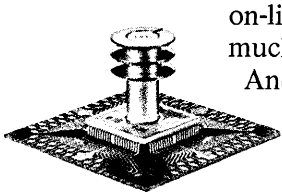


A computer is above all a system, a comprehensive processing tool integrating hardware, software and application technology. Computers are of course sold by many different companies. But few of these companies can offer you a full range of data processing tools — each not only specifically designed for optimal performance but also open-ended for integration into bigger systems.

Fujitsu is one company which can offer this. Fujitsu, Japan's leading computer maker, produces everything from one-LSI-chip microcomputers to the world's most powerful all-LSI computers, as well as a wide range of peripheral and terminal equipment.

FACOM computers are doing big jobs in business and government in many countries throughout the world. And in Japan, the world's second largest computer market, more FACOM computers are installed than any other brand. These powerful, reliable FACOM computers do just about anything. They put satellites into orbit, produce real-time color graphic displays of meteorological conditions, handle funds transfers in on-line systems tying in over 7,000 bank branches, and much, much more.

And all FACOM computers are totally integrated systems, systems in which state-of-the-art technology, powerful software and proven application programs are combined to give you a performance and reliability that can't be beat.



LSI with cooling fins

FUJITSU

CIRCLE 180 ON READER CARD

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Look again.


Take this quick quiz:
Look closely.
Very closely at our new Model 85 remote information system.
How many functions do you see?
There are more than meet the eye.
Batch communications and volume data entry should be easy to spot.
And on-line file management and stand alone processing should be apparent to those who've kept up with Data 100's continuous progress in distributed processing.
But your needs keep growing.
And so does our commitment to fulfill those needs.
Our Model 85 remote information system introduces the functions of remote file management and high level language processing at your remote sites efficiently and economically.
Model 85 is a display based system featuring up to 100MB disk storage, 15 interactive work stations, a multi-tasking operating system and concurrent communications.
For ease of use, two disk based high level languages are available: RPGII and COBOL. With COBOL, a local compiler lets you compile programs on your Model 85. And a cross compiler allows stronger central site control by permitting you to compile and debug COBOL programs on the mainframe for execution on your Model 85.
The Model 85 gives your network the best of both worlds. The degree of central site control you need and remote processing capabilities to reduce communications costs and mainframe processing time.
And the Model 85 can communicate with our other proven Data 100 multifunction data processing products.
Now look closely at your growing needs for multifunction data processing.
Then call your nearest Data 100 sales office or one of the numbers listed below.
DATA 100
CORPORATION
multifunction data processing
DATA 100

Is our expanded Model 85 system in your future?

(WARNING: there may be more than one right answer to each question)

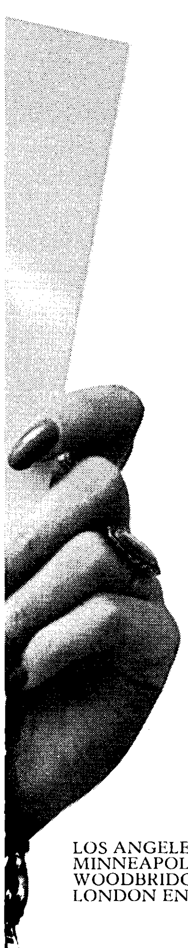
1. Model 85 is:
(a) a remote information system we first introduced in 1978.
(b) a distributed data processing product.
(c) a multifunction data processing product.

2. Its features include:
(a) multitasking for up to four applications.
(b) large disk capacity.
(c) modular configuration.
(d) more than these.

3. New improvements are:
(a) increased processor memory to 256K bytes.
(b) the addition of remote workstations and printers.
(c) increased disk storage to 100 MB.

4. Model 85 functions are:
(a) remote file management and high level language processing.
(b) on-line file management and stand-alone processing.
(c) batch communications and volume data entry.

5. Available languages are:
(a) RPG II.
(b) COBOL.
(c) ESPERANTO.



6. Model 85 saves users money as an alternative to:
(a) enlarging mainframes overburdened by network interactive applications.
(b) adding communications lines with greater capacities.
(c) maintaining a mainframe configuration only fully used at peak time periods.
(d) losing time and money due to mainframe downtime.

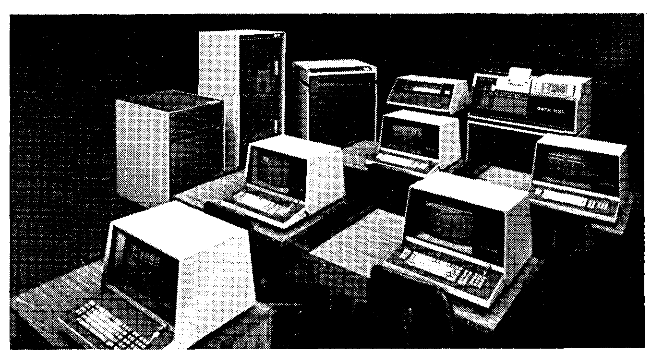
7. For more details on Model 85, you should:
(a) phone your nearest Data 100 sales office or one of the numbers we've listed.

Now check your answers.

All answers but these three are correct.

2a: Model 85 offers multitasking for up to *eight* applications.
3c: 100 MB is old figure; Model 85 is now *245.6 MB* disk storage.
5c: No, Model 85 doesn't speak it. Yet.

DATA 100 CORPORATION
multifunction data processing



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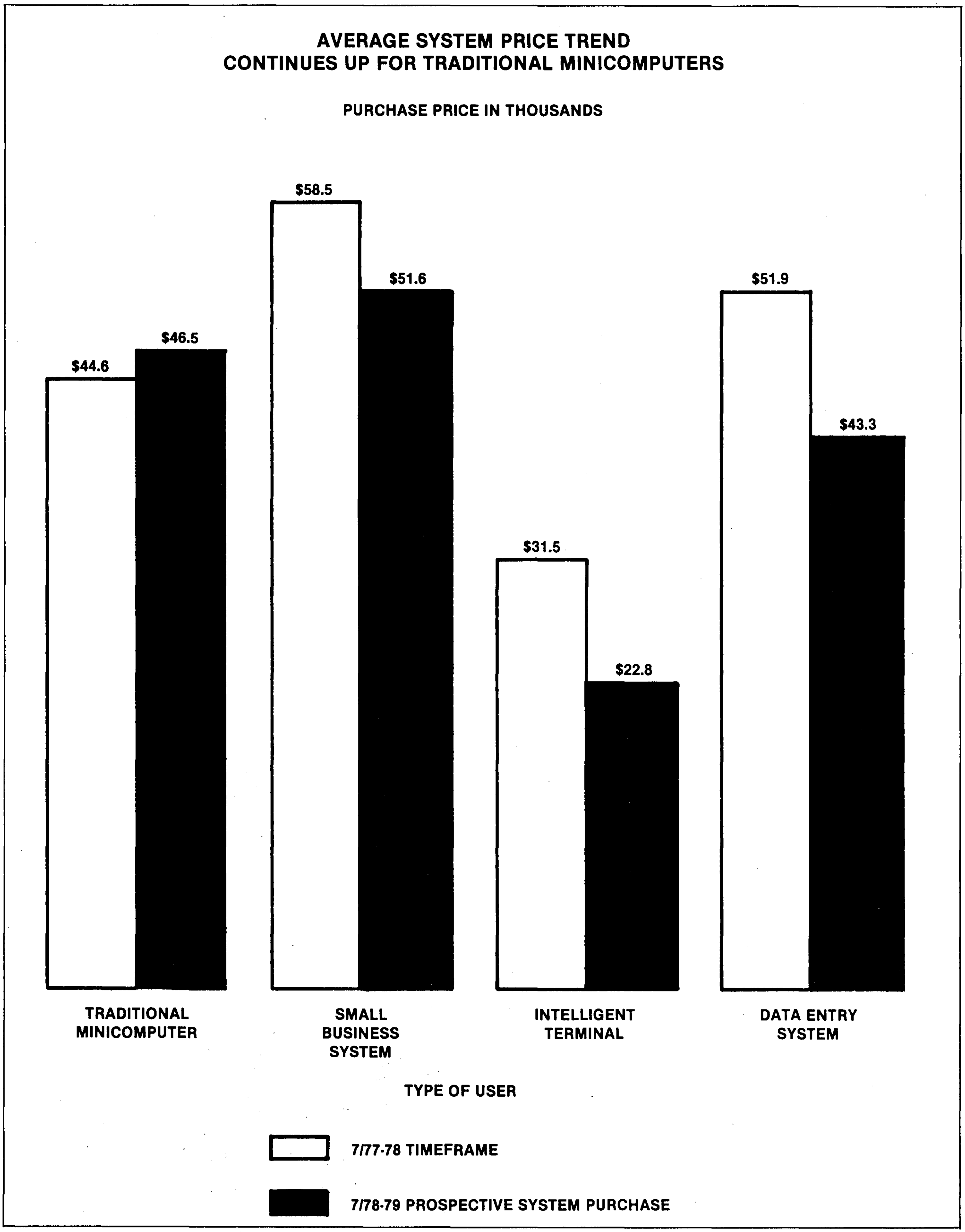
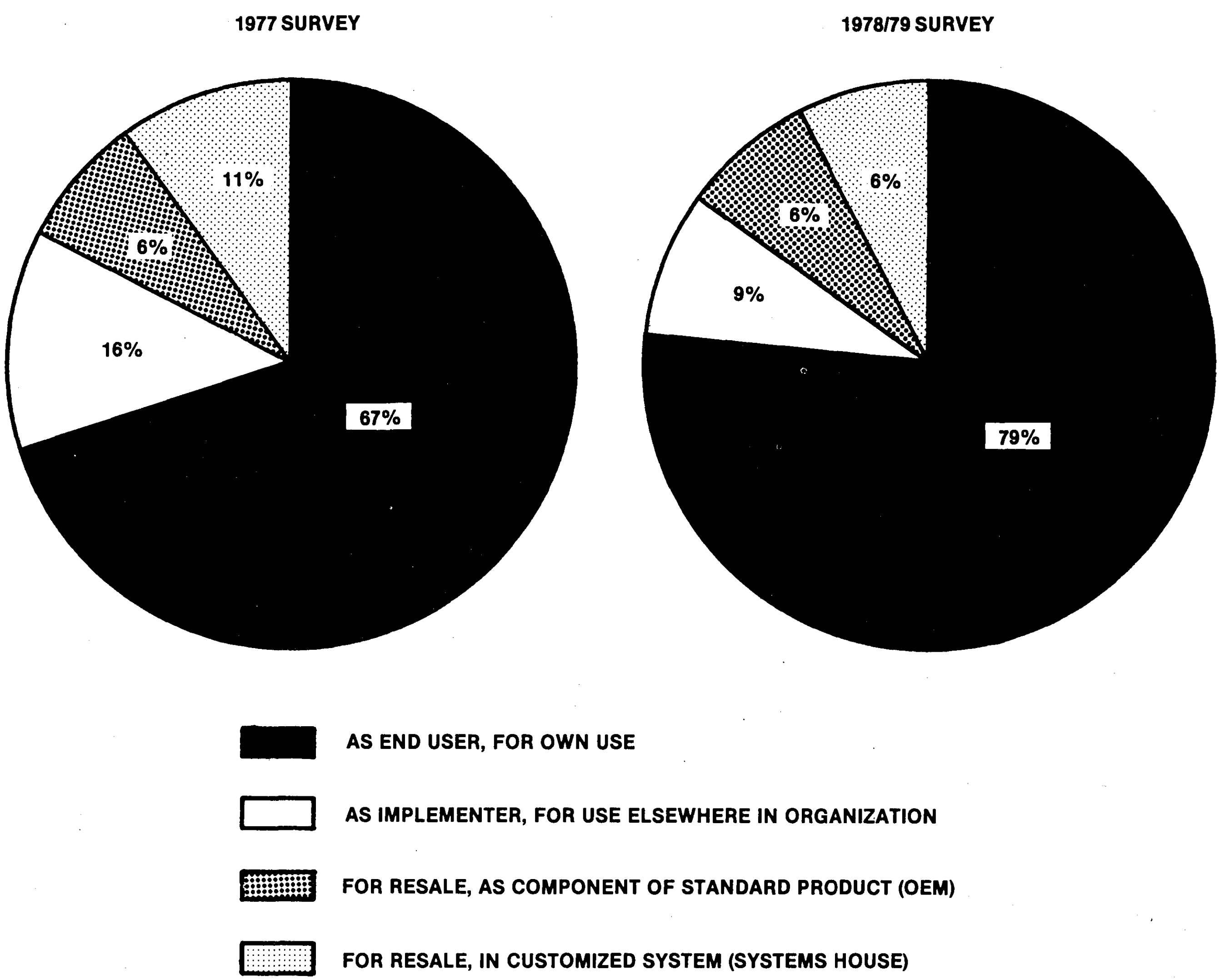

AVERAGE SYSTEM PRICE TREND
CONTINUES UP FOR TRADITIONAL MINICOMPUTERS
PURCHASE PRICE IN THOUSANDS
$44.6
$46.5
$58.5
$51.6
$31.5
$22.8
$51.9
$43.3
TRADITIONAL MINICOMPUTER
SMALL BUSINESS SYSTEM
INTELLIGENT TERMINAL
DATA ENTRY SYSTEM
TYPE OF USER
7/77-78 TIMEFRAME
7/78-79 PROSPECTIVE SYSTEM PURCHASE

Sycor and Interdata. A full 40% of Sycor's customers responding said they were dissatisfied with the software support they were receiving; for Interdata, the figure was 38.7%. However, even IBM, with its huge support forces, was cited by more than 25% of its respondent customers who said they were dissatisfied with IBM's customer support in the mini area. The firm that came out with the best record from its customers on the software support issue was Honeywell—only 17% of its customers responding to the survey complained.

IBM's Series/1 small computer—generally thought to be doing poorly in the marketplace—appears to be gathering a quiet and growing momentum as IBM intensifies its drive into the booming minicomputer market. An extensive survey of some 5,600 user-buyer sites indicates that about one-quarter of the sites evaluated the Series/1 and 18% of those planned to buy the IBM small computer.

SURVEY POPULATION MORE HEAVILY SKEWED TOWARD END-USER THAN IN 1977

Asked in what capacity their organization primarily purchases minicomputer equipment, the survey respondents answered as follows:



• Shift in mix reflects inclusion for first time in latest survey of small business systems and end users.

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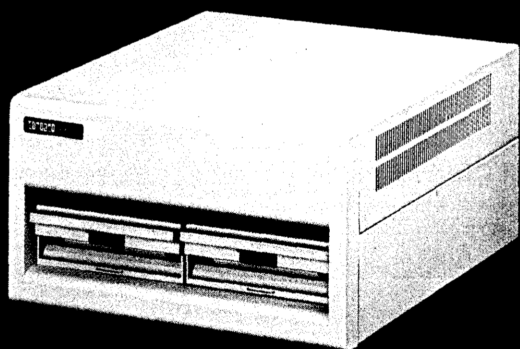
PRICE GENERALLY DEEMED MOST IMPORTANT FACTOR IN CHOICE OF VENDOR, BUT NOT BY SMALL BUSINESS SYSTEM USERS

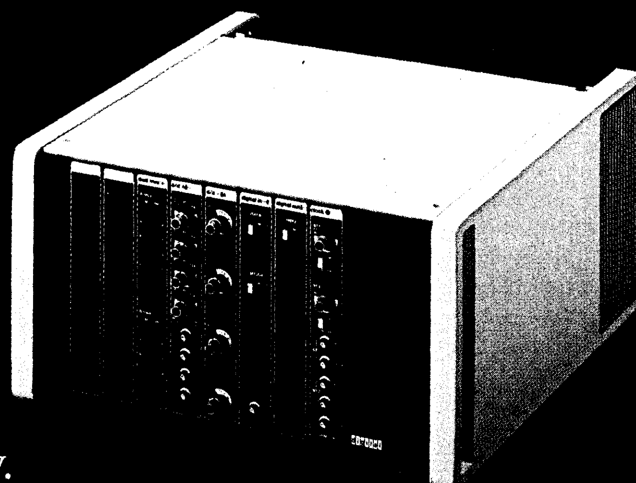
	TYPE OF SYSTEM LAST PURCHASED			
FACTOR	SMALL BUSINESS SYSTEM	TRADITIONAL MINICOMPUTER	INTELLIGENT TERMINAL	DATA ENTRY SYSTEM
Vendor Support	7	9	7	8
Vendor Reputation	1	2	4	4
CPU Performance	9	3	8	7
Hardware Reliability	5	3	3	2
Field Maintenance	3	7	2	5
Operating Systems	4	3	6	3
Programming Languages	6	8	9	9
Delivery	10	10	10	10
Price	2	1	1	1
Prior System Compatibility	8	6	5	6

COMPATIBILITY OUTRANKS PRICE FOR OEM RESPONDENTS AS FACTOR IN CHOICE OF MINI VENDOR

FACTOR	END USER	END USER/ IMPLEMENTER	OEM	SYSTEMS HOUSE
Vendor Support	8	9	9	9
Vendor Reputation	2	4	4	3
CPU Performance	6	8	6	4
Hardware Reliability	3	3	3	5
Field Maintenance	5	2	7	7
Operating Systems	4	5	4	2
Programming Languages	9	5	8	7
Delivery	10	7	10	10
Price	1	1	2	1
Prior System Compatibility	7	10	1	6

MINC





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digital

CIRCLE 127 ON READER CARD

A similar survey last year indicated that about one-fifth of last year's respondees had evaluated the Series/1, but that less than 6% had planned to purchase the Series/1.

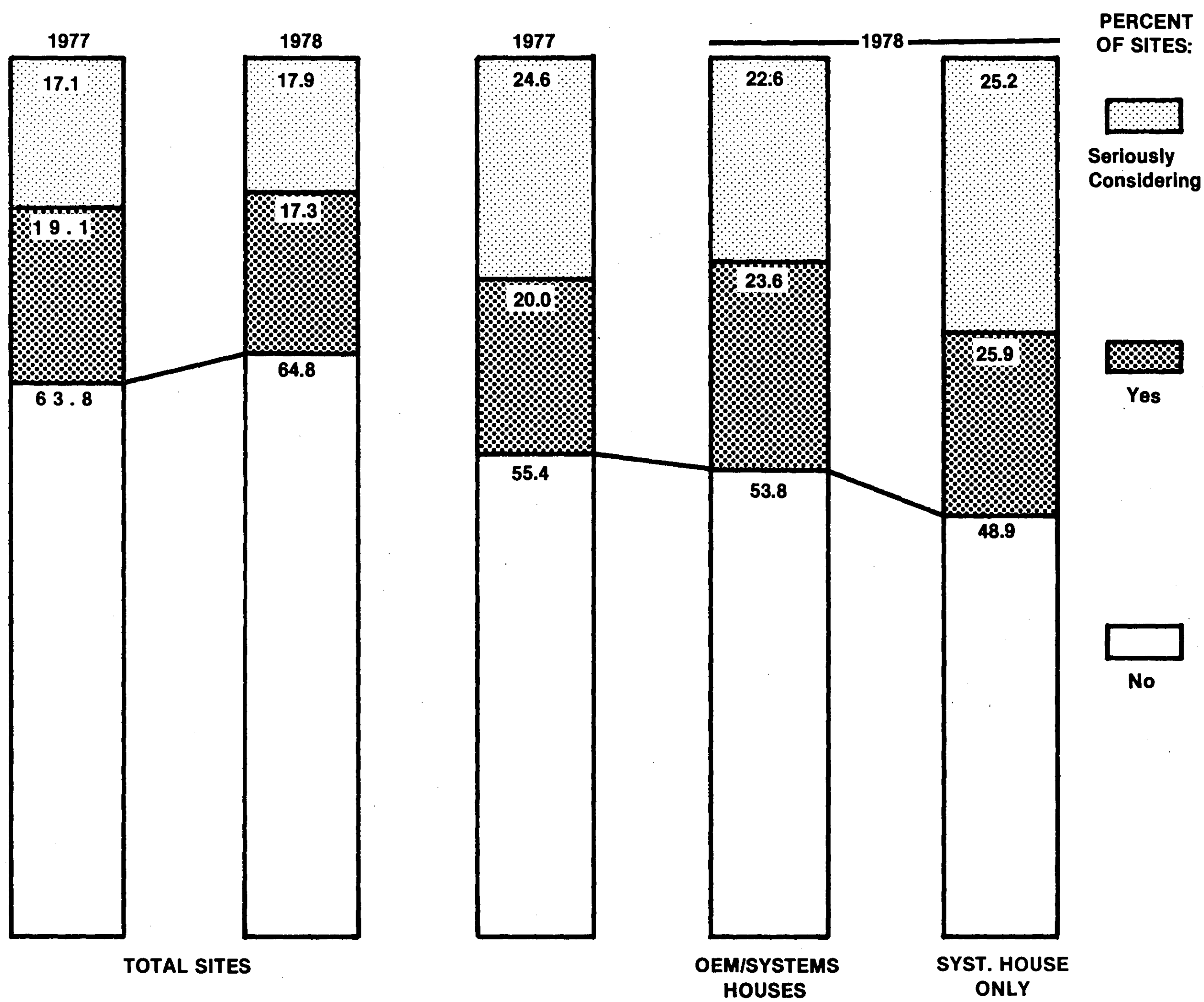
"Many of the factors that bothered users about the Series/1 last year have been removed," said Barry Rosenberg, the Grumman/Cowen vice president who prepared the survey. "Last year, for instance, 56% cited the lack of high level languages as a problem with the Series/1. IBM has taken care of that in the interim simply by announcing PL/1, FORTRAN, and COBOL for the machine."

The chief positive factor in favor of the Series/1 that surfaced in the survey was "IBM's extensive field maintenance coverage." The survey also revealed that users who had a "past relationship" with IBM were more likely to be favorably disposed toward the machine.

Users appeared to find some difficulty with the Series/1, however. The major hurdle for them was that the machine is not compatible with other minicomputers, like the machines they are using currently, manufactured by Digital Equipment Corp., Data General, and Hewlett-Packard.

FOR THE MOST PART RESPONDENTS REMAIN LOYAL TO CURRENT SUPPLIER(S)

Asked if users expected to purchase minicomputers in 1978/79 from firms other than those they had done business with in the past, they responded as follows:



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- network accessing and interactive software design?
- compiler design?
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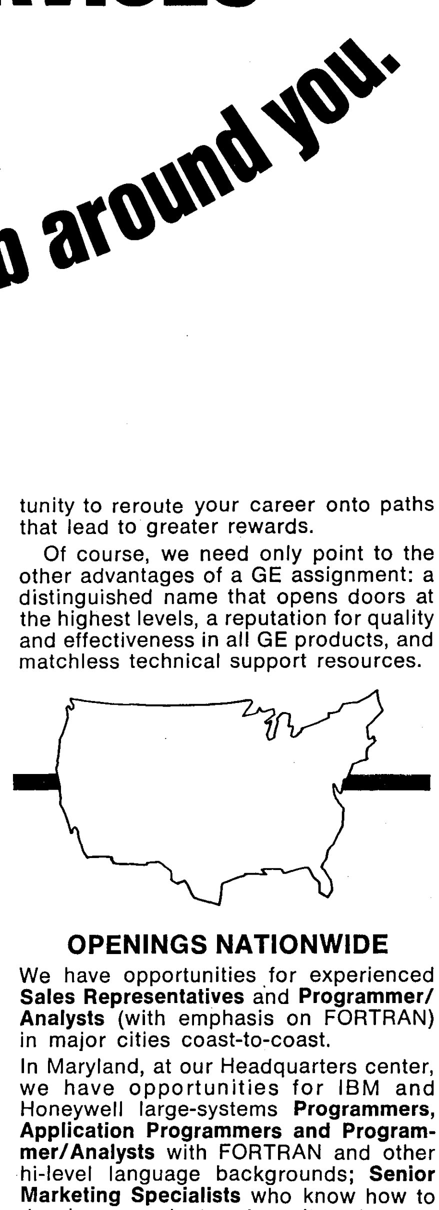

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CIRCLE 183 ON READER CARD

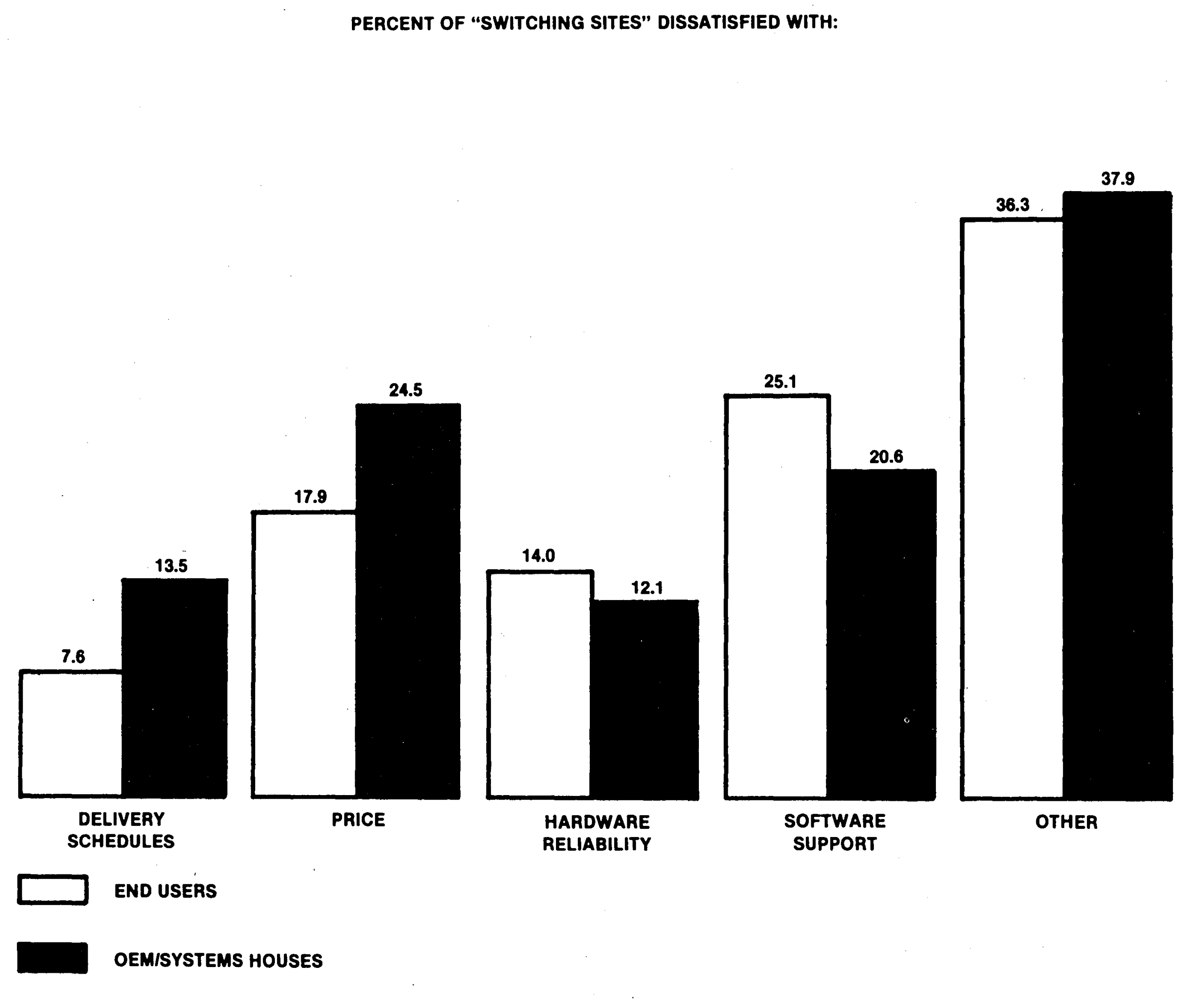
Users also indicated they were unhappy that the Series/1 system expandability is limited. However, since the survey was launched in late June, IBM has announced increased memory for the Series/1—an indication that IBM is moving to increase the machine's attractiveness in the marketplace.

The survey produced indications that IBM's fabled "missionary selling" may be at work in the Series/1 market. Of the respondents who were planning to buy Series/1 equipment, the Grumman/Cowen-DATAMATION survey found that 81% already had IBM mainframes.

"I think IBM may be creating market here," said Rosenberg. "IBM appears to be expanding the market. The growth of IBM with the Series/1 is not so much at the expense of the other mini manufacturers. It is coming from the IBM base."

Digital Equipment Corp.'s VAX 11/780 has also begun to show up in users responses, although there were still few large quantity orders for the DEC supermini. The survey found that the VAC machine has attracted much of its initial interest from users who seek increased throughput and who are seeking a higher-powered machine that offers compatibility with DEC's PDP-11. The survey also picked up answers from oem's and system houses that indicated the machine may sell—initially, at least—better among those segments rather than among end users.

RESPONDENT REASONS FOR PLANNING/CONSIDERING VENDOR SWITCH



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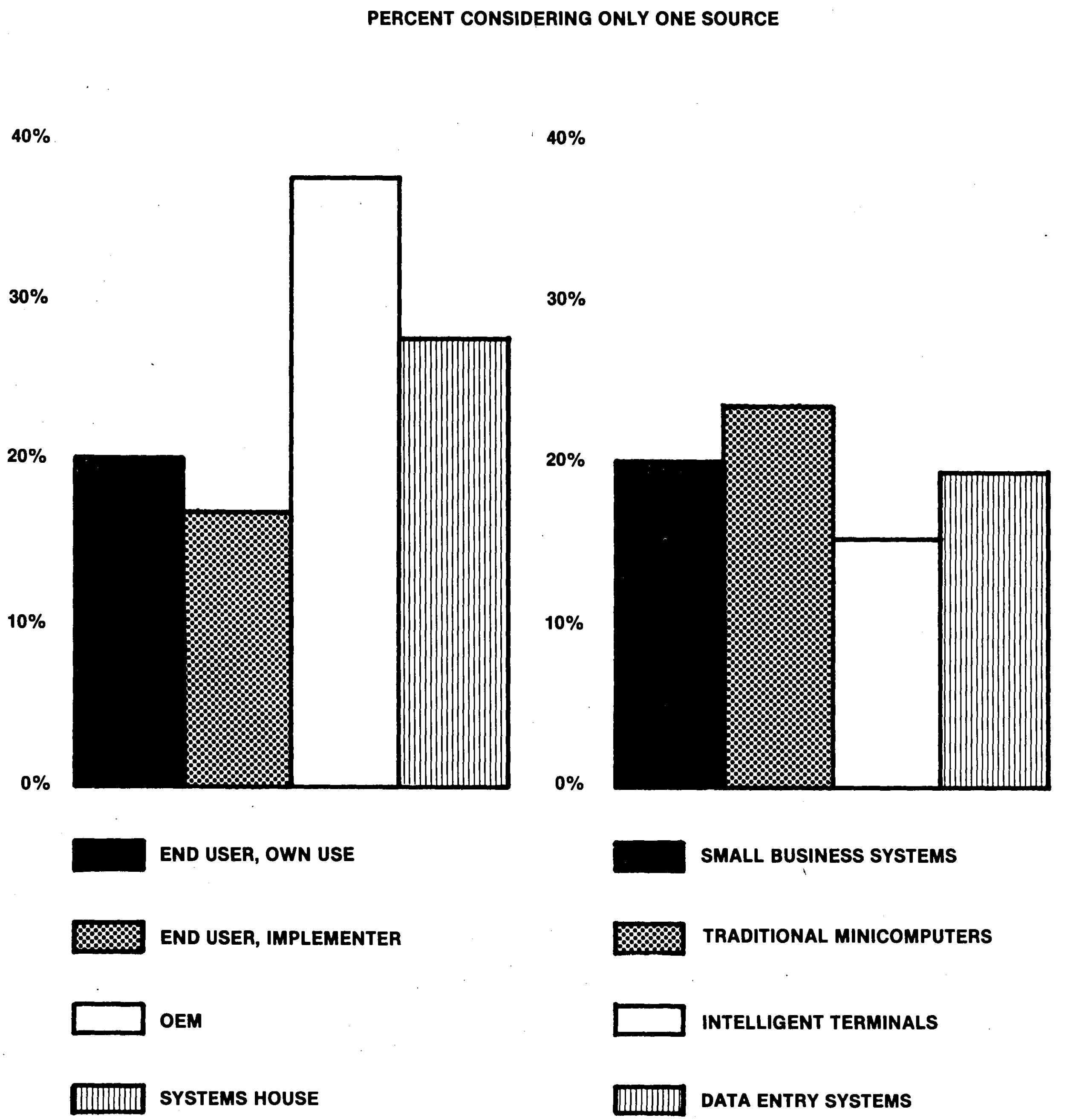
INTELLIGENT TERMINAL AND END USER SEGMENTS APPEAR THE MOST COMPETITIVE OF MINICOMPUTER MARKETPLACE

Query: How many separate suppliers did you consider before making your most recent minicomputer purchase decision?



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The survey pinpointed a failing with the VAX, though. Many in the survey looked upon the machine's lack of COBOL as a weakness. The report, however, indicated that: "Eventual availability of COBOL should help open up the commercial side of the marketplace for VAX downstream."

In the area of minicomputer software support, the Grumman/Cowen-DATAMATION survey indicated that there is a swing toward applications utilizing more programming languages in commercial applications, particularly COBOL and RPG.

In networking, the survey found there was a pronounced growth of network software among users of certain manufacturers, particularly DEC, Hewlett-Packard, IBM, and Prime Computer.

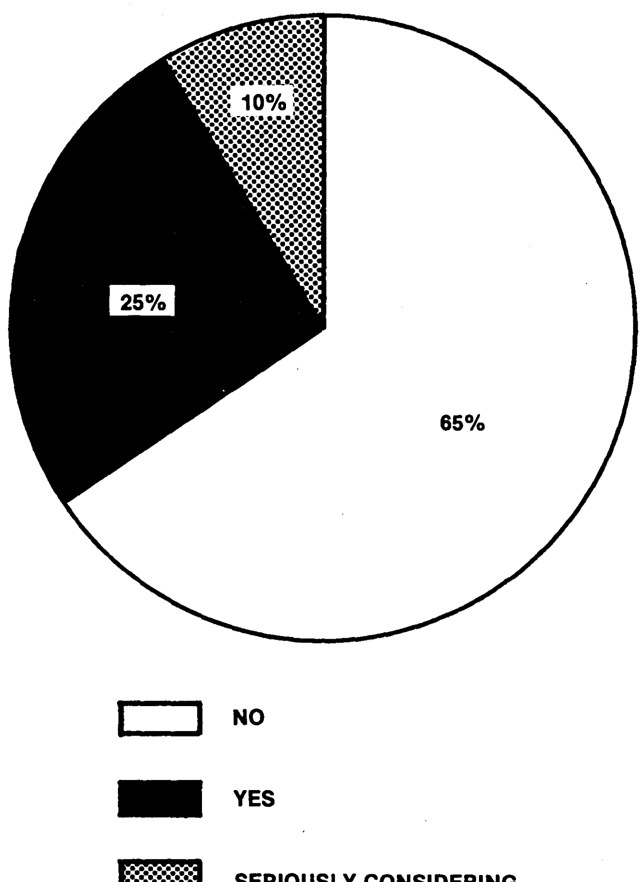
The survey also developed data that indicated DEC's customer problems attached to the equipment delivery stretch-outs of 1976–77 were improving, but still continued in evidence. In the 1977 survey, nearly 42% of DEC users surveyed were "unhappy" with Digital Equipment Corp.'s slow delivery schedules while the 1978 survey indicated that the "unhappy" number had dropped to 25%—an improvement, but an indication that users are still not universally pleased with DEC's delivery schedules.

Nevertheless, there was no evidence of "any undue customer loss for DEC" as a result of the delivery problems. As the number one supplier of minicomputers, DEC found that its delivery schedules were pressed as users in 1976 and 1977, in the wake of caution during a recession, ordered in a state of pent-up demand. Some users, particularly oem customers, compounded problems by double ordering. ✲

CONSIDERABLE BUYING INTEREST IN PERSONAL COMPUTERS EVIDENCED BY SURVEY DATA

Queried if they or their organization had purchased or considered the purchase of microcomputer(s) available through retail outlets, users responded as follows:

PERCENT OF SITES ANSWERING THIS QUESTION (52%)



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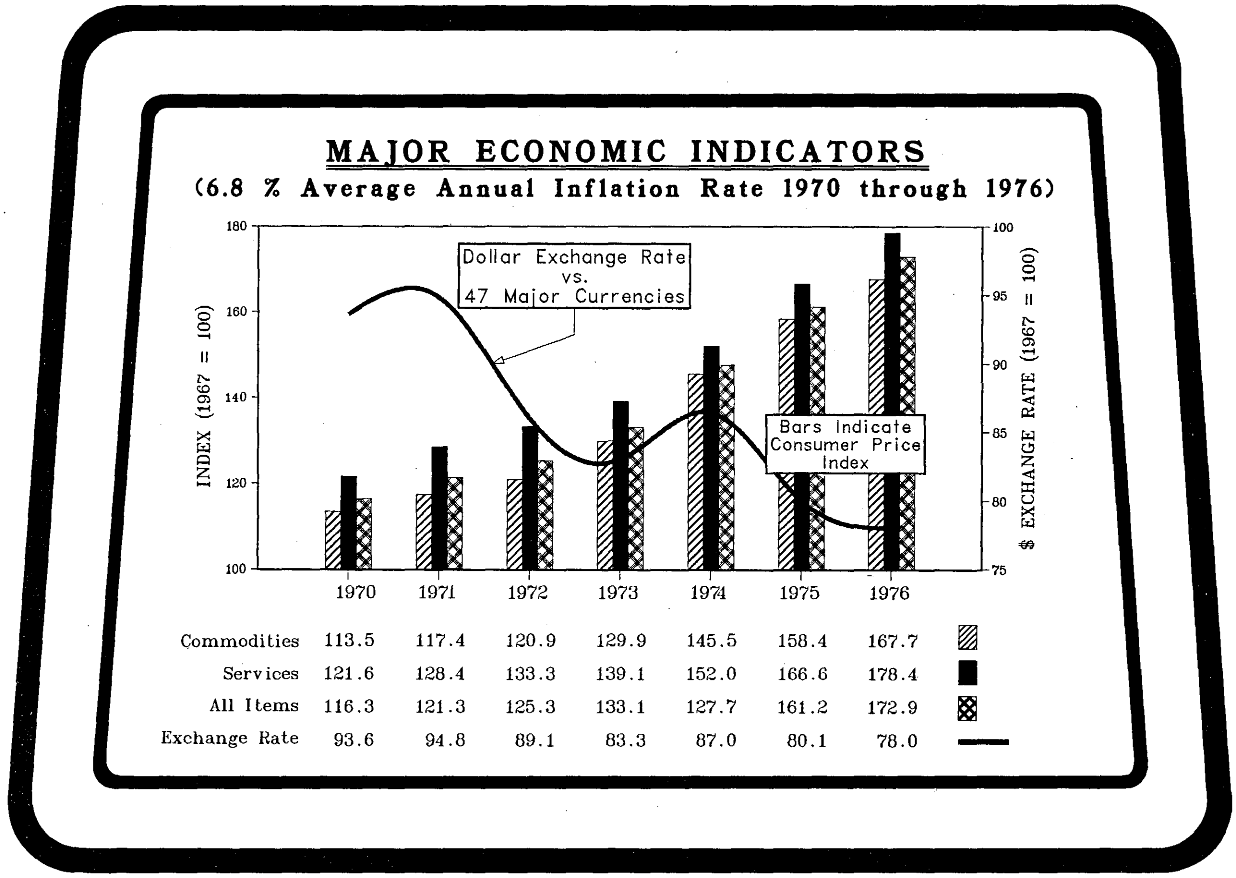

	1970	1971	1972	1973	1974	1975	1976
Commodities	113.5	117.4	120.9	129.9	145.5	158.4	167.7
Services	121.6	128.4	133.3	139.1	152.0	166.6	178.4
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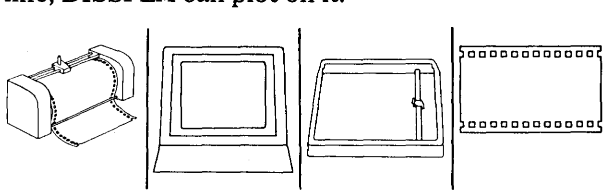

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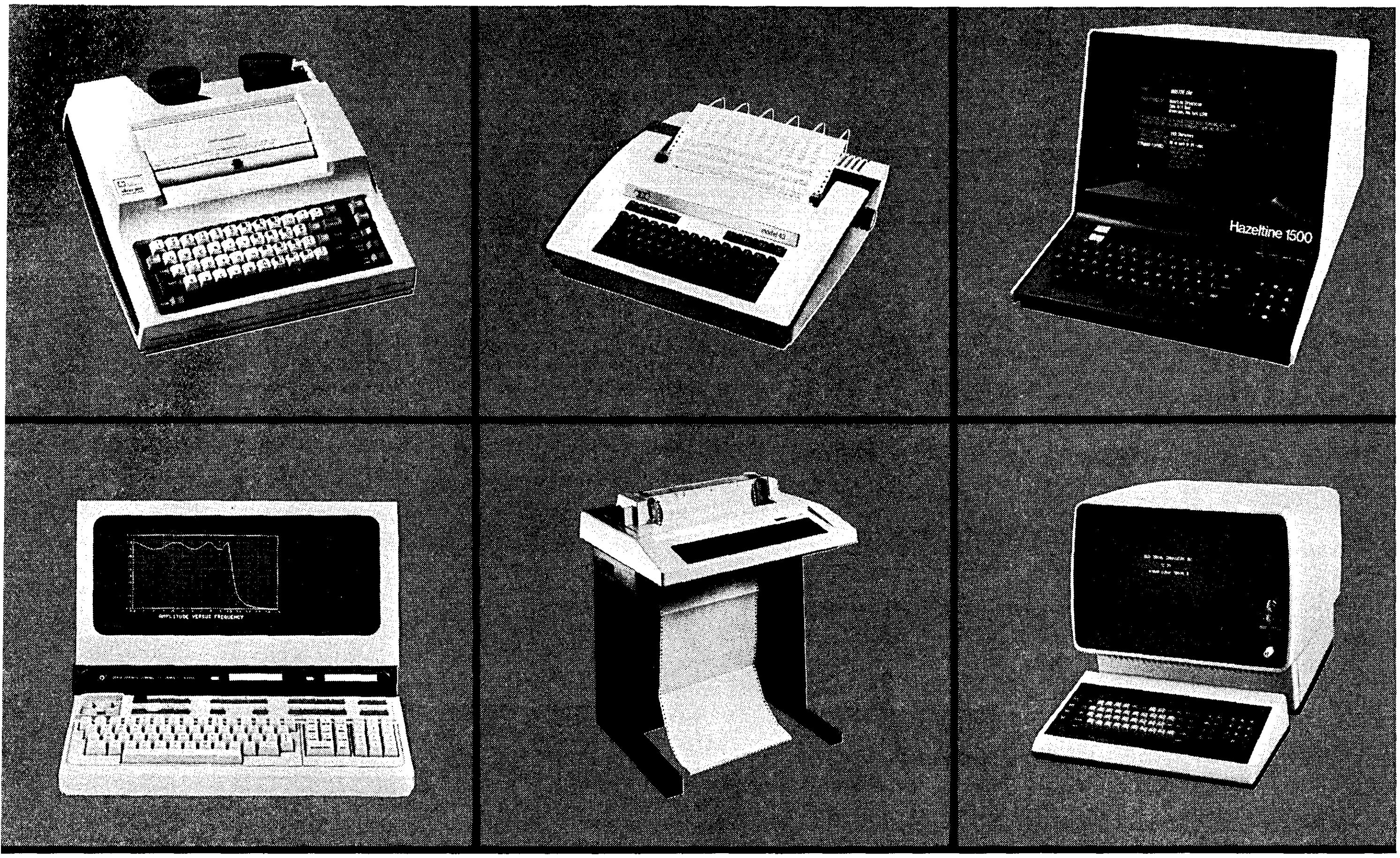
CIRCLE 59 ON READER CARD



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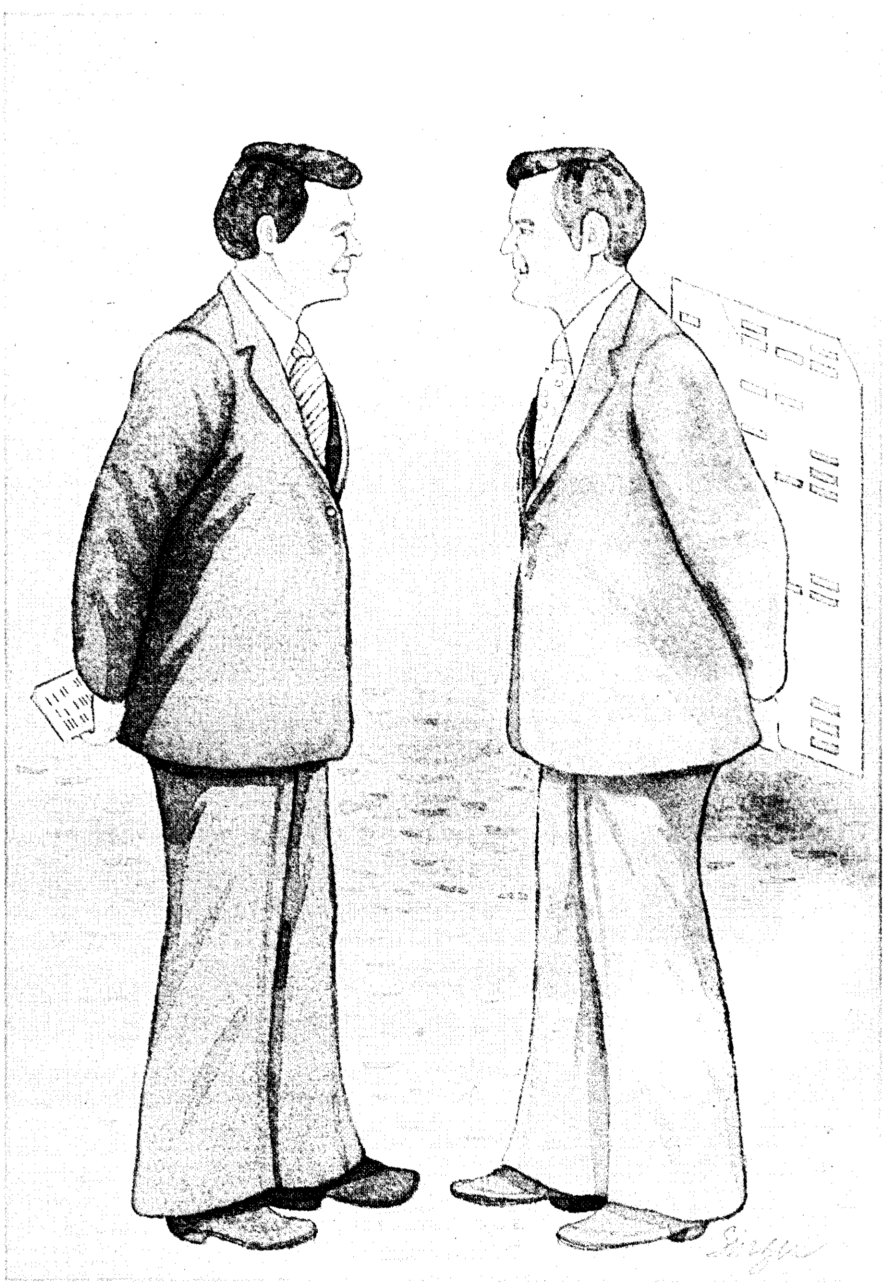
CIRCLE 49 ON READER CARD

The lack of industry standards is beginning to reflect on our sanity.

ISSUES

FRUITCAKES, NUTTIER THAN



by Fred Gruenberger

> "We are in the most exciting, the most rewarding, the most eye-popping part of American technology. We influence, around the world, the social development, the business development, and the technical development of almost every nation. We have a tremendous role to play, and a tremendous tool to use. The fact that most of us seem to act as though we were as nutty as fruitcakes makes it all the more challenging."
>
> —H.R.J. Grosch, March 26, 1969

Three times or so each year I face a new roomful of eager young students who know nothing about computing. Actually, if you were to ask them, they would say that they know a great deal about computing from their avid reading of the *Reader's Digest* and *Popular Mechanics,* plus having seen *2001: A Space Odyssey* twice. They are a bit weak on some of the points of the trade (like how a computer works, how to program, how to analyze a problem, how to validate a debugged program—little things like that), but they are strong and sure on one topic: namely, that computer people are a super breed, close to perfect in their logical reasoning ability, and rational in all things. All semester I have to look at their shocked faces as they discover that computer people are
a) Human
b) Irrational
c) Superstitious
d) Illogical
—in short, nuttier than fruitcakes. Nothing they have read or been told has prepared them for this news, and for some reason they feel hurt at having been misled.

Consider, for example, the list of

It would be funny if it weren't so tragic.

things that we have managed to standardize in the three decades of the computer age:

1) the dimensions of the punched card,
2) the width of magnetic tape,
3) the use of a diamond for a decision box on a flowchart (this one took *22 years* to become standardized, and it is still not universally used),
4) FORTRAN and COBOL, and
5) the positions of the English letters on a keyboard.

A rather short list but all I can think of at the moment.

Not that we are short on standards; we have, in fact, hundreds of them and even some good ones, except that no one seems to observe them. We have, for example, *two* standard keyboard layouts, neither of which are to be found on any keyboard. We have *two* information interchange codes, and while there are probably excellent reasons for having two of them, and simple ways of converting from one to the other, it is difficult to explain to those beginners just why this is all tolerated by supposedly intelligent people. "Couldn't we," they ask, "agree on just one such code?"

Another missing standard is much more serious, but difficult to explain to beginners: the lack of a standard collating sequence. This is not earthshaking, except that there is no reason why we couldn't have agreed on a standard collating sequence years ago.

AGREEING ON TERMS

We haven't, in fact, agreed on our most basic terminology. Most manufacturers are content to use terms like "storage" and "accumulator," but they balk at using terms like "instruction counter" or "multiplier quotient unit." So every machine has its own parochial names for its parts. Is this worth worrying about? Well, give it some thought. You couldn't write a legal contract to procure a computer that is to have three index registers.

We have no official (or even semi-official) glossary, and the term "index register" (which is undoubtedly perfectly clear to you) can mean anything anyone wants it to mean. Any semi-intelligent vendor who wants to unload a machine that has only one of what *you* think an index register is (and he damn well knows what an index register is) can blithely claim that his machine has a dozen of them, and you can't argue with him. What's more important, you can't take him to court for failure to deliver. Wouldn't it be nice to have a legal glossary of the terms we use? Couldn't we even manage to agree among ourselves what our technical terms mean? Can you and your friends agree on the meaning of things like system analysis, data base, and structured programs?

Part of this problem rests with writers and editors. How far should you go in explaining things? It would be silly to keep repeating the meaning of standard acronyms like cpu, JCL, EAM, ACM, RJE, DBMS, COM, ANS, APL, LED, oem, CPS, and NRZI. But our industry has acronymphomania and is jargon-happy. Our journals use expressions like "SNA-compatible" and "beta test" as though we all know what such things mean, and the newcomers continue to give us that look.

Do you suppose you could write an intelligent RFP to procure a data base management system for your company? Could you compose a contract with a software house for a program that you want to have "structured"? Could you tell, when they deliver a program to you, if it is indeed "structured"? If you and the software firm should disagree on this point, how would you settle the matter?

It would be funny if it weren't so tragic. Some people have devoted most of their professional lives to promoting standards, and no one seems to care. A standard for almost anything that has settled down should benefit everyone, but most of us have to be hit in the pocketbook before we'll even listen. The resistance to change among computer people is vast and completely puzzling. Isn't this the industry based on change?

Well, yes it is, but we'll start with him, not me.

We also have no performance standards in our software industry for either the short term or the long term. There are no measures of productivity for programmers. There seems to be no way to apply a performance metric or set of metrics to a machine—which is sad when you look at the minicomputer market where some 40 machines appear to differ primarily in their nameplates. In every group of programmers, the productivity and quality pecking orders are well known and acknowledged—everyone in the shop knows who the aces are—but for some reason we can't find a way to quantify that information. The world can assign four-significant-digit rankings to chess players, but we can't rate programmers on a scale from one to ten. We can assign multiple rating schemes to cameras, automobiles, and municipal credit, but we seem unable to rate two computers in any way but by their cycle times. Not that people don't try: some really magnificent rating scales have been proposed, not one of which has ever won any advocate besides its author.

Many years ago, Francis V. Wagner and I wrote an article in which we listed the 19 canonical reasons why anyone buys a specific computer. The 19th reason was that the particular machine was the best suited for the anticipated work load. We wrote tongue-in-cheek, but we were seriously concerned that computers were being selected for such quaint reasons as that Brand B was painted the same color as corporate HQ. I suspect that that article could be reprinted unchanged today and it would have exactly the same meaning and impact. In other words, despite that fact that we were pointing out an area of irrational behavior, you could not detect any improvement in 20 years.

For that matter, great gobs of material from the DATAMATION of 20 years ago could be rerun today with little or no change. All the references to milliseconds could be switched to microseconds, perhaps, and there you are. The glowing descriptions of every magic language—from the A-O "compiler" right up through structured PL/I—could be rerun every year and no one would notice. It's much like video tapes of football games; if they ran last year's tape, only the most devoted fans could tell the difference.

'Way back in the olden days there was a machine called the 701 which had a 5-bit operation code and 32 valid op-codes. Maybe it isn't immediately obvious, but that's a blunder in design. It means that any word in storage is a valid instruction, so that if your program takes you to some area in storage where you shouldn't be (say, in the middle of someone else's leftover data), which is quite easy to do, your chances of stopping within a mile of your trouble spot are nil.

All right, we had to learn that lesson the hard way. Then along came the GE-225 which repeated the blunder but with an added twist: the zero op-code bit configuration was assigned to "Load Accumulator." Ho, ho, very funny for the old-timers who had to suffer such primitive equipment. In our modern world we do things much better, we do. Sure: all the 8-bit microprocessors are doing the same thing all over again, and no doubt the 16-bit micros will try it, too.

The point is, we don't seem to learn much from our mistakes. There seems to be a law among computer designers; to wit, never *ever* talk to anyone else who has designed a machine.

For each new breed of machine, the manufacturer graciously furnishes two simulation programs: one to run on the old machine to make it act like the new one, so that new programs can get checked out, and one to run on the new machine to make it act like the old one, so that old programs that didn't get converted can still be run. In the IBM world, that means that some 360/370 users are running some programs under 1401 simulation. But of course, anyone who would be doing that (over a decade after the 1401s have vanished) is probably really running a 650 program that was in turn simulated on the 1401. It could even be that the program was originally written for the 604, and is now being run weekly under three levels of simulation.

That situation probably isn't so stupid when you consider the alternative, which is to have someone deduce what the program does and rewrite it. What is nutty and tragic is that in all likelihood the installation manager doesn't even know what is going on. A specific program may run for 15 minutes, and that seems normal since it runs for 15 minutes every week. But if it could be reprogrammed for the new machine, it might run in 15 seconds. Students just don't believe that computer people can be that ill-informed. But then, where do they get the notion that computer people are so all-fired bright? Why, from computer people, of course.

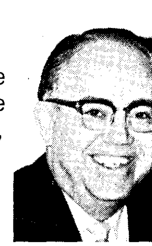
I get the feeling, while I'm teaching beginners each semester, that everywhere I turn I have to apologize or explain some evidence of nuttiness in our industry. When my students get their first printouts from our operating system, I hasten to point out things like:

a) *We* don't know what some of those things mean, either.
b) And we can't seem to get rid of them.
c) So we have learned to ignore them.
d) *You* try to ignore them, too, and learn not to be a chronic complainer.

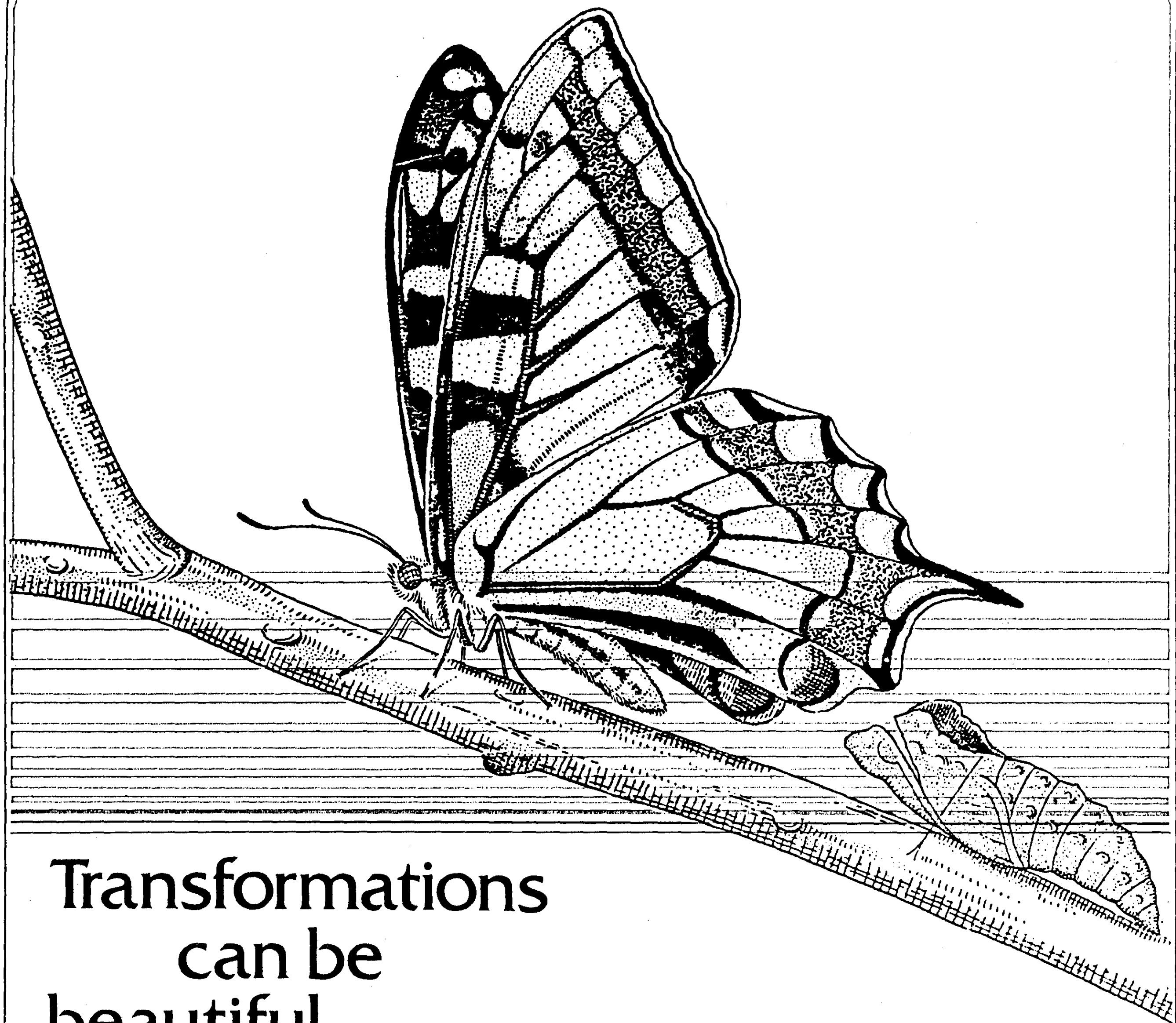
Somehow I wish that my industry could do better than that.

Maybe all this nuttiness is part of what keeps computing so fascinating. Any good controversy we've ever had (perhaps excepting open vs. closed shop) is still just as controversial as ever. We got COBOL by government edict, so maybe our good government could issue a few more edicts—to eliminate zero-slashing, settle on GAUSS as *the* high-level programming language, and decide, once and for all, on some collating sequence. While they're at it, maybe they could whip up an official glossary. ✲

FRED GRUENBERGER



Mr. Gruenberger is a professor of computer science at California State Univ., Northridge, and is the publisher of *Popular Computing*. He is the most prolific author in the computer field, with 26 books and more than 100 journal articles to his credit in the last 25 years.



CIRCLE 60 ON READER CARD

Auditors and dp'ers need to start talking the same language.

ISSUES

AUDITING AND DP: REDRESSING THE RELATIONSHIP

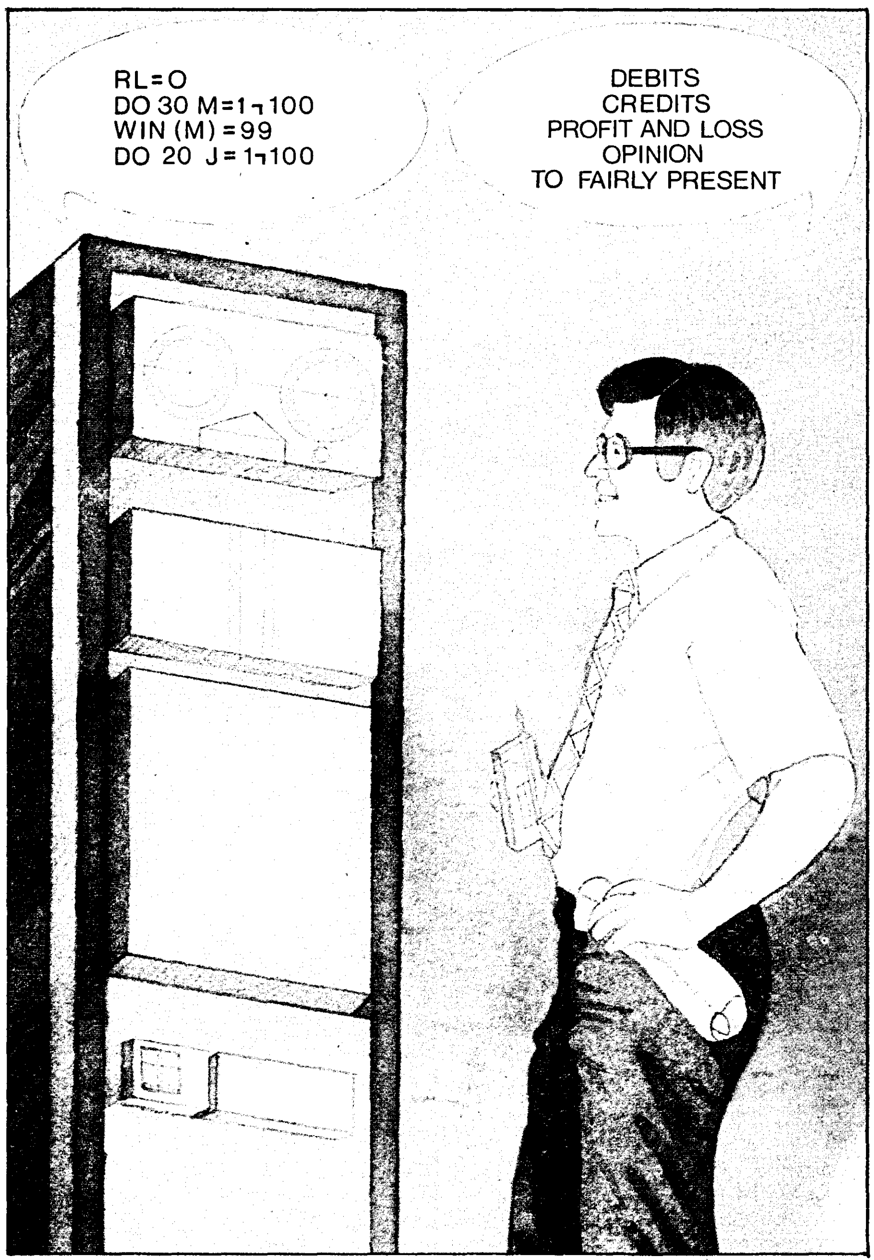


ILLUSTRATION BY GLORIA SINGER

by Robert L. Patrick

The senior executive seldom thinks about auditing. Being concerned about profitability, product offerings, and divisional realignments does not leave much time for auditing—or for data processing, for that matter. Besides, he does have a financial vice president to worry about all things involving finance and to handle relationships with the external accounting firms. Somewhere in the vp of finance's purview, moreover, lies auditing, record-keeping and, by extension, computer bookkeeping. However, that tranquil surface may hide trouble.

For the last 10 years, studies of computer abuse have reported that the potential for abuse is high, the number of reported cases is low, and there is no incentive for victims to admit abuses. Even so, there is a steady trickle of computer abuse reported by both the public and private sectors. From time to time, Congress takes up the issue and bills are introduced to strengthen the laws governing computer theft, fraud, and other forms of electronic abuse. Occasionally, stockholder suits are filed charging company executives with mismanagement because they failed to adhere to prudent management practice.

A few years ago, in a fit of enlightened self-interest, IBM granted $500,000 to the Institute of Internal Auditors. The money was spent by Stanford Research Institute and a series of thought-provoking reports were produced[1]. The reports chart current internal audit practices, enumerate some problems, and make some recommendations. While the recommendations address worthy goals, one or two key elements fail to fall into place. The purpose of this article is to offer a practical solution for one of the missing elements.

The SRI reports match my per-

Dp has made monumental strides and the auditors have failed to keep up.

sonal observations and the observations of my colleagues; that is, computer technology has advanced so rapidly that it has all but run off and left the audit profession. At lunch the other day, a computer executive for a major aerospace firm told an anecdote on his external auditing firm. Some audit executive had noted that they hadn't had a recent computer audit, so they spoke to the aerospace firm's vp of finance. Since an external audit was "overdue," an audit was approved. A 26-year-old MBA with some computer programming experience was sent to find the computer center and spend three days reviewing its operation.

Now, the executive telling the story was director of computer operations with a staff of 600 and five separate computer centers, the largest of which contained two IBM 370/168s. The 168s were coupled, and the resulting system supported 200 personal terminals and 20 remote job entry stations, and operated around the clock seven days a week with its own private air conditioning system. Its own bank of batteries provided an uninterrupted power supply.

The auditor who came in to review the computer operations found the system has 68 spindles of disk, 3,000 regularly scheduled production jobs, and 5,000 names on the reports distribution list. In three days all he could do was to inventory the physical equipment installed.

In a related incident, on a recent client assignment for a large New York bank, I had occasion to contact the deputy director of internal audit responsible for computer affairs. As he and I discussed the handling of privileged bank information and the augmented procedures which were necessary to handle microfiche records, it was clear that he knew some computer words and a few computer concepts, but was not at ease with the computer system once it got much beyond the cash accounting system. Considering that a major bank deals in loans, securities, personnel, and real estate, a mind set which views the world as one big cash bookkeeping system is much too narrow.

COMMON PRACTICE

The aforementioned SRI studies found these two instances not unusual at all. Further, they surveyed 1,500 organizations and found many "common" practices were far from common and, in some cases, were almost unknown from organization to organization. Digging further, the studies found training programs for internal auditors that neglected to emphasize computer techniques even though 90% of the record-keeping in the U.S. private sector may be in some way computerized.

Understanding how the auditors fell behind the technology will help in devising a solution. The auditing profession is, in many ways, a closed culture springing from a closed culture. Auditors usually grow up as CPA's and follow the CPA continuing education program. Certification exams are devised by current practitioners; review courses and college curricula are predicated on the exams. After formal training and certification, and maybe a sojourn with a national accounting firm, on-the-job training is provided by many large corporations so the aspiring auditor gains company knowledge, gets to apply his formal audit training, and continues to grow under the tutelage of a seasoned auditor. While any generalization is risky and perhaps unfair, there is a lot of "what was good for my father is good enough for me" in these internal training programs.

About 18 years ago, the auditing profession was split by a debate which addressed the question, "Shall we audit *through* or *around* the computer?" In the early '60s when the small accounting machine gained popularity with the advent of the IBM 1401 computer, the auditors saw it merely as a replacement for punched card accounting equipment and, as such, many of them chose to ignore what the computer was doing inside and satisfy themselves with reviewing the data put into the computer and the reports that emanated from it. They were comfortable in a mature profession and failed to see how these whippersnappers in computing could change the status quo; they were also wrong.

In 1964, IBM announced a graded family of computers called the System/360 and the data processing field exploded. The time for patient learning was past; the time for doing was upon us. For those of us working in data processing, we had management support beyond our wildest dreams, and we were limited only by our talent.

Today data processing is still suffering from the rapid growth of the middle '60s. While we failed to live up to our own expectations (and, oh yes, the optimistic promises we made to management), we have made monumental strides in the last 15 years and the auditors have failed to keep up.

About 10 years ago, the more enlightened auditors decided they couldn't audit *around* the computer, but had to know what went on inside the data processing system. Just about the time they decided to audit *through* the computer, we invented data base management systems. Suddenly, individual files lost their identity, the simple transaction counts that had sufficed during the punched card years lost much of their meaning, and management information systems were born. As usual, we failed to deliver all we had promised with management information systems, but many systems now share common data so changes are entered but once, and all the users of that data benefit from time-current files.

Almost coincident with the data base technology came telecommunications. While man-machine dialog involving an operator, a terminal, a communication line and a computer developed somewhat more slowly, there are tens of thousands of systems that capture data near the point of transaction and send that data to the computer data base without the paper leaving the point of origination (and, in some cases, without any paper being created at all). These systems almost sounded the death knell of the traditional auditor who believed in counting things and checking that the paper in the archives matched the entries in the ledger: a whole new control technology was required. Today, those controls are still evolving in an attempt to catch up with computer technology that puts processing power in the hands of the worker who holds the data.

For 10 years, the computer profession has been trying to alert its users to the hazards of processing precious data without adequate security controls. The process is still going on, but a recent review of auditors' checklists still shows a certain wariness about the computer and a reluctance to dig deeply into computer operation and programming.

To be sure, performing an operational audit on a large computer shop is a formidable undertaking (auditing an annual budget of $35 to $40 million, a headcount of a thousand people, and a $100 million worth of assets is a difficult undertaking regardless of the background or skill brought to bear). All of us set priorities during operational audits because only so much can be done within the time and funding available. But the facts clearly indicate that current audit techniques are not as advanced as the technology being audited.

Furthermore, the computer profession shows no signs of waiting while the auditors catch up. In the last few years, the minicomputer has crept into

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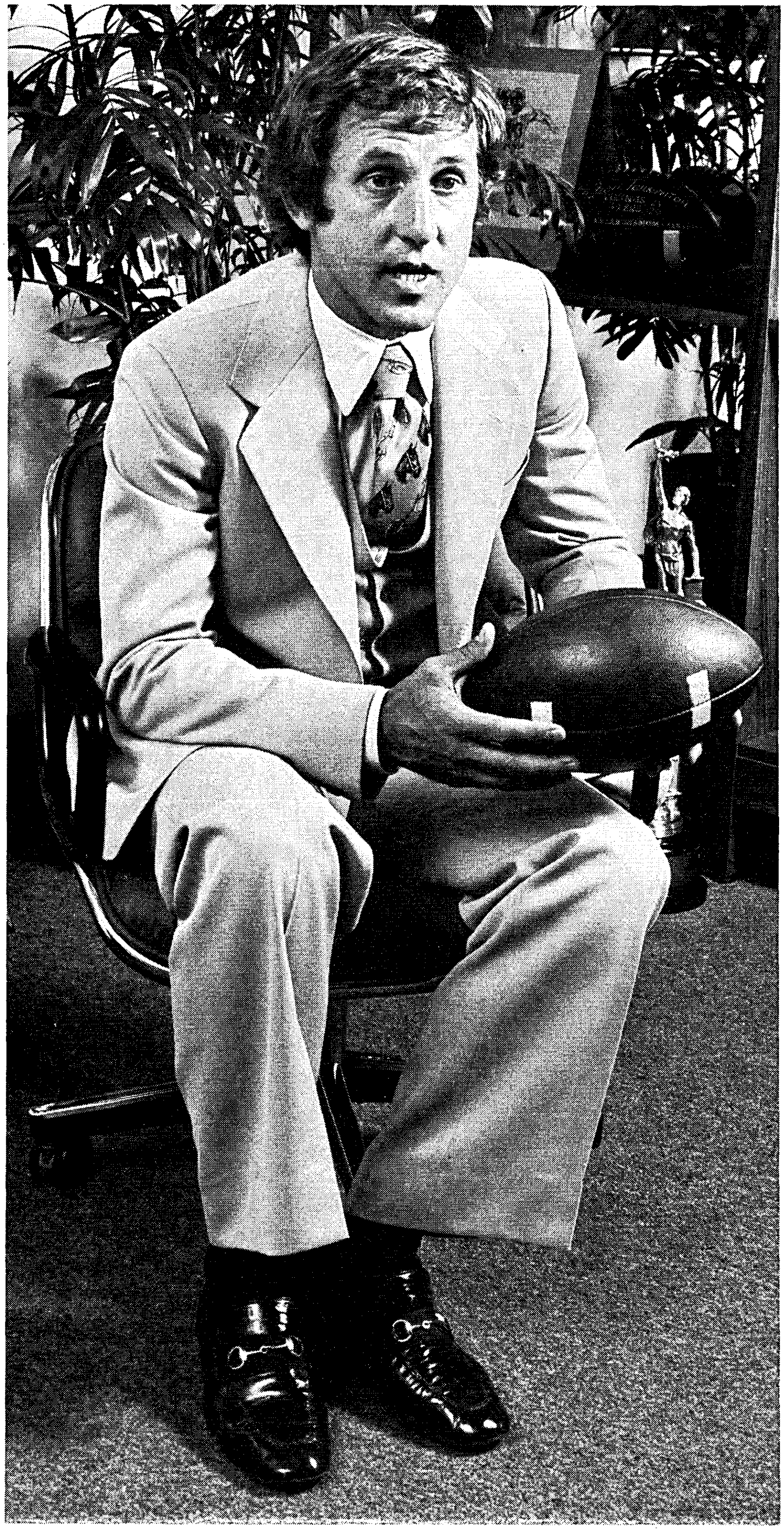
Fran Tarkenton, Minnesota Vikings' Quarterback



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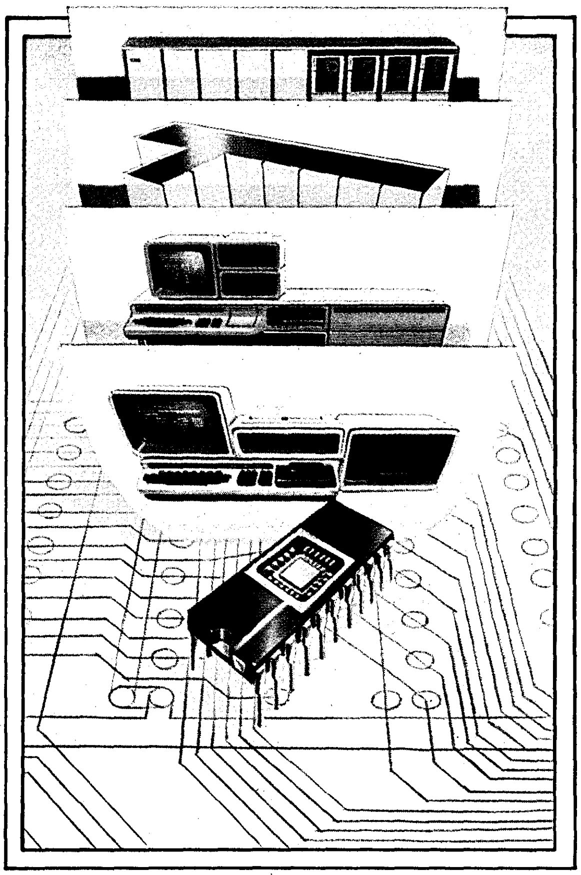
System/400 is another case in point. It gives users the very real advantage of being able to run existing industry standard 370 software on a



minicomputer. So mainframe computing power is possible at a fraction of the cost.

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We've been doing a lot of talking lately about a new wave computer technology. Actually, this is simply the latest manifestation of National placing more and more functions in less and less space. The ultimate result is that we can offer users complete systems for less money than many traditional computer companies — a fact that should make the next decade a period of substantial growth and profitability.

If there's more I can tell you about National Semiconductor, and the directions we'll be taking in the next ten years, I'd be glad to fill you in. Write me personally: Pierre Lamond, Technical Director, National Semiconductor Corporation, Drawer 18, 2900 Semiconductor Drive, Santa Clara, California 95051."

Computer Products Group
National Semiconductor Corporation

Participation of the auditor in the system design process does not constitute consorting with the enemy.

American business like a puppy into bed. The price of computer electronics is now well within the signature authority of middle managers, and so instead of dealing with the central computer facility and its "intractible" management, many middle managers have their own computers; thus, they have avoided the standards, the controls, and the audit trails that are so vital to stable business.

And as if that weren't enough, just breaking on the horizon is a new set of software offerings from several manufacturers which will allow minicomputers to be configured into distributed data processing systems so not only data capture can be handled outboard (as was done 10 years ago), but the processing and the data files can also be distributed to the source of need.

The audit professionals must be frustrated—every time they are almost comfortable with the existing technology, data processing takes another great leap forward.

However, there is an opportunity for catchup. With the support of senior management, the auditor can once more play his proper role in the organization. About five years ago, dp managers and computing researchers became concerned about the economics of programming and the gradual erosion of programmer productivity (which was none too good in the first place). Some new systems analysis techniques were invented, and a new look was taken at the programming development process. A flurry of activity by a few pathfinding organizations (loudly trumpeted in the trade press) added some additional discipline to the programming process. Various components of this groundswell have various names—software engineering, structured programming, and design inspections. Together they form an emerging body of methodology which will help programmer productivity and reduce the cost of maintenance across a system's life cycle.

For some years, professional reference books have been charting the program development process. It is usually divided into several definite phases, beginning with requirements analysis and ending with an installed computer system which performs the functions enumerated by the requirements specification. If each of these development phases is defined more precisely, lists of deliverable items will appear so line management can determine that a development phase has been completed by inventorying the deliverable items produced in the phase.

The design inspection process[2] is an attempt to review these development products at milestones and certify the quality of each one against a predetermined standard. These inspections consist of formal review meetings attended by the computer programmers and designers on the development team, and by a review team consisting of knowledgeable peers. The review team distills the specifications to determine what should be done, studies the documentation to see what has been done, and interrogates the development team to determine what needs to be changed.

If your company conducts milestone reviews and design inspections during the systems development process, you have an ideal opportunity to train your audit staff *and* to build proper audit controls into emerging systems of computer programs.

Generally computer programmers are worried about function, performance, and cost (in that order). Unless motivated by some exterior force, they are not much concerned with controls and audit trails (among other things). However, if your auditors can become knowledgeable so they can sit as peers on an inspection team, they can assure that an emerging design contains adequate controls to prevent mistakes, mischief, or malicious activity. Further, during the entire design-development-installation process, knowledgeable auditors can sit in on milestone reviews to assure the controls being implemented will carry out their intended purpose.

THREE STEPS Three things will be required to establish a union between the technicians performing design inspections and the internal auditors pursuing their professional interests:

1. The senior financial executive must gently but firmly lay to rest the auditor's theological belief that any participation by auditors in the development process constitutes consorting with the enemy and would impugn the auditor's objectivity.

2. Work priorities for the internal audit workforce must be reviewed and adjusted. If necessary, additional personnel must be provided so the internal auditors can participate in milestone reviews in addition to conducting their traditional schedule of operational and financial audits.

3. Since design reviews are conducted amid the heat and pressure of an on-going development schedule, the interpersonal reactions are such that an ignorant auditor will not be tolerated. Therefore, it may be necessary to provide some special training or to bring in some special temporary help to augment your audit workforce until knowledge can replace ignorance and peer relationships can develop.

Although computing technology is highly complex, the problem can be distilled to its simplest form. We have one profession rushing way ahead and another profession lagging way behind. Extra time, talent, and money will be temporarily required to equalize the skills. Once a balance between skill and expertise is established, computer systems will be naturally more robust because they will have been developed with built-in protections against computer abuse. ✲

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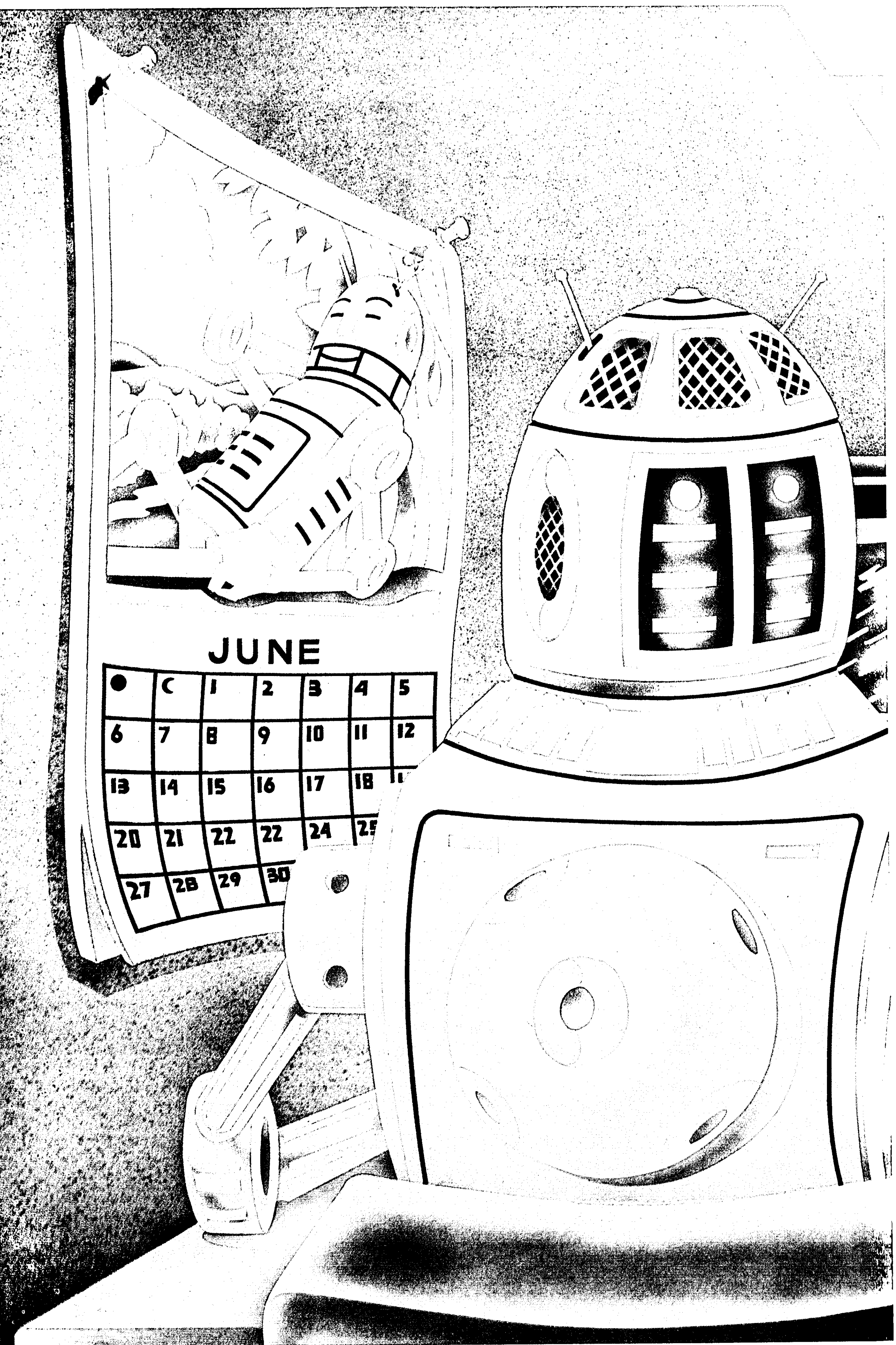
ROBERT L. PATRICK

Mr. Patrick is a free-lance computer specialist based in Southern California. He has spent 27 years in computing, including 19 years in his own consulting business. His client list contains several *Fortune 500* companies with products in aerospace, computing, finance, and manufacturing. He has performed 28 operational audits of computer centers, and is the author of the 1974 AFIPS Security Manual. He is also the author of many books and reports including a 1978 NBS study on data integrity practices.



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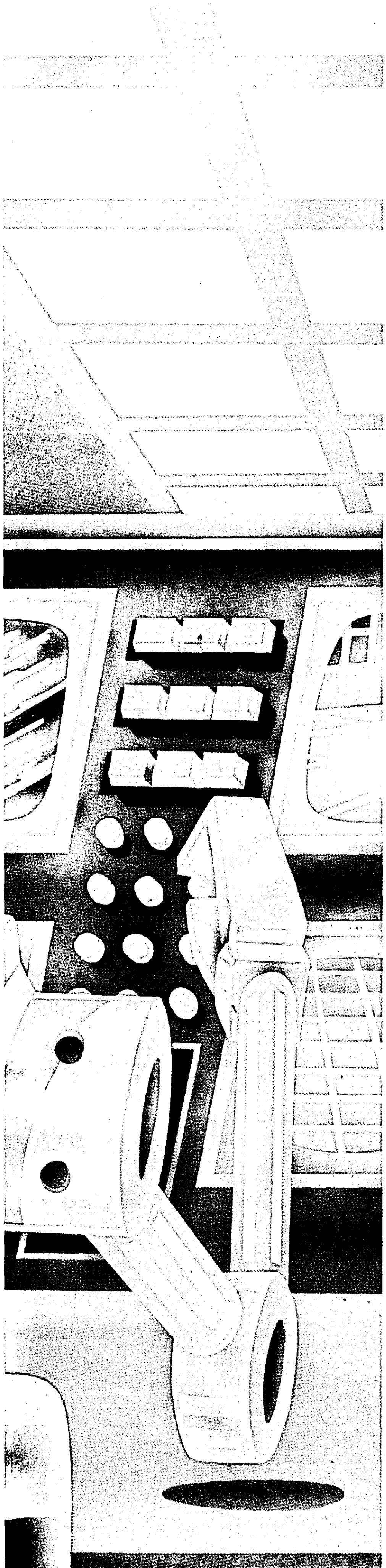

Robotic programmers would never violate dress codes.

THE ROBOTS ARE COMING!

by Marvin Grosswirth

When a machine can do something that would earn our respect if done by a fellow human being, we can react in one of several ways. We can immediately downgrade our estimation of the achievement . . . or we can become alarmed and resentful. ("If a machine can do *this* already, how much longer will it be before machines take over *every* job?")

—Lane Jennings in *The Futurist* (publication of the World Future Society) June 1978

A robot device is an instrumented mechanism used in science or industry to take the place of a human being. It may or may not physically resemble a human or perform its tasks in a human way, and the line separating robot devices from merely automated machinery is not always easy to define. In general, the more sophisticated and individualized the machine is, the more likely it is to be classed as a robot device.

—*Encyclopaedia Britannica,* 15th edition (1978)

To you, perhaps, a computer is a computer and a robot is a robot. As far as I'm concerned, however, any piece of "automated machinery" that is "sophisticated and individualized" enough to send denigrating notes, or compliment a customer for paying his bills on time, is a robot, regardless of whatever other euphemism the perpetrators of such devices choose to call it by.

The *Britannica* definition could be describing a typical computer; clearly robots and computers are members of the same family, and even more clearly, they are slowly beginning to get the upper hand.

Typically, we—that is, mankind—have no one but ourselves to blame for letting the robot situation get out of control. Had we recognized, from the outset, what we were letting ourselves in for, we might have retained control, but now it is too late.

It was not as though we had no warning. The word *robot* was coined by a Czech playwright named Karel Capek who, in 1921, wrote a melodrama called *R.U.R.* (for Rossum's Universal Robots; I have no idea who or what Rossum is or was). He based the word on *robata,* which is Czech for "forced labor." In Capek's play, robots that were supposed to serve as labor-saving devices turned on their creators and ultimately destroyed humanity.

Now at first glance that may seem somewhat distant from reality but, in our real world, how far is it from writing a nasty note to punching someone in the nose? If you do not think that a punch in the nose is a major leap forward toward the destruction of humanity, then you have never been punched in

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the nose by a robot.

THREE LAWS Isaac Asimov, the writer-scientist who is as kindly as he is brilliant, must have seen where things were heading when he devised his Three Laws of Robotics: First, according to Asimov's laws, a robot may do no injury to a human being or allow a human being to be harmed by its failure to take action; second, a robot must obey the orders it receives from humans, except in instances where such an order contradicts the First Law; and third, a robot must protect and take care of itself, except when such protection and care are contrary to either of the first two Laws.

That is all well and good, but Dr. Asimov, in formulating those laws, failed to take into account two possibilities: first, his Laws, just like any other set of sensible laws, are likely to be ignored. And second, inasmuch as a robot is supposed to serve people, what will it do when people are in conflict?

Sooner or later a robot is going to learn how to oil and check itself. For the present, however, robots need people, especially technological types, to develop the self-perpetuating robotic systems that will make those same technological types obsolete. But the technologists seem to think they can control things. They want the rest of us to believe they know best and, as part of a massive propaganda effort, are working hard to make robots lovable. Thus, those mechanical marvels, C-3P0 and R2-D2, emerge as the endearing heroes of "Star Wars." Robotic mail carriers, in increasing use in large companies, are given human names. One major insurance company calls its automated mail cart "Harvey," and a press release extolling these self-propelling, self-stopping, and self-charging mail carriers suggests: "call them 'Robby,' 'Igor', or"—in what can only be described as an attack of excessive cuteness . . . " 'Norman the Mailer.' "

There is a paradox in the evolution of robotics. To allay our fears about robots taking over from humans, robotologists (a word I just coined) constantly reassure us that robots can never be as clever as humans. At the same time, however, they continue to make the insidious devices as human-like as possible. What is electronic voice simulation if not a form of highly sophisticated robotry?

The condescendingly delivered assurance that robots will never replace people because robots are incapable of thought is nothing less than an insult to human intelligence. It presupposes that thought is necessary in the performance of human occupations. Anyone who believes that has never been exposed to assembly lines, the Motor Vehicle Bureau, or the U.S. Congress.

In his book, *Robot* (Harvest Books, 1978), Robert Malone paints a scenario of the factory of the future. He envisions robots being programmed with all the instructions required to produce a product. Controlled by a "supervisory computer," robots will be scuttling about all over the place, plugging themselves in where needed and maintaining a steady flow of production, uninterrupted by shifts, coffee breaks, and meetings called by the shop steward.

It is an easy transition from the factory to the office. All that is needed is one person to program one robot. That robot could then, in turn, program other robots. I can see a whole data processing department inhabited by robotic programmers that never violate corporate dress codes, refrain from smoking questionable substances, do not decorate their walls with inciteful posters, and do not take up collections every time one of them is transferred to another department. At the end of this line of robots is the Ultimate Robot, which gradually has been programmed to program the first robot in the cycle, eventually rendering the lone human programmer obsolete. Should that human seek redress by appealing to the Vice President in Charge, he is likely to find an Executive Robot behind the mahogany desk.

If the concept of an Executive Robot seems far-fetched, consider this from the *Britannica:* "A human worker . . . has certain physical limitations. He cannot work continuously in a hostile environment. He works at a relatively slow speed and possesses little physical strength. At best, he can work continuously at peak efficiency only for relatively short periods. Most significantly from the economic point of view, he is . . . often expensive to hire."

CRUMMY JOBS The implications are plain enough. If "a human worker . . . cannot work continuously in a hostile environment," a robot apparently can. Consider the possibilities of robots in such hostile environments as staff meetings and budget conferences. We inefficient humans may work "at a relatively slow speed," but a robot could produce a sales projection faster than you could say "stagflation." And as for being "expensive to hire," I have yet to hear of a robot carrying a second mortgage, supporting a teenager in college, or paying astronomical orthodontia bills.

Ironically, there may be a built-in reciprocating factor that may yet save us from robotic domination. According to author Robert Malone, as robots become more complicated, the ways in which they break down will resemble the ways in which people break down.

Deep in the recesses of the Accounts Receivable department there could be a robot afflicted with a duodenal ulcer and migraines . . . ✲

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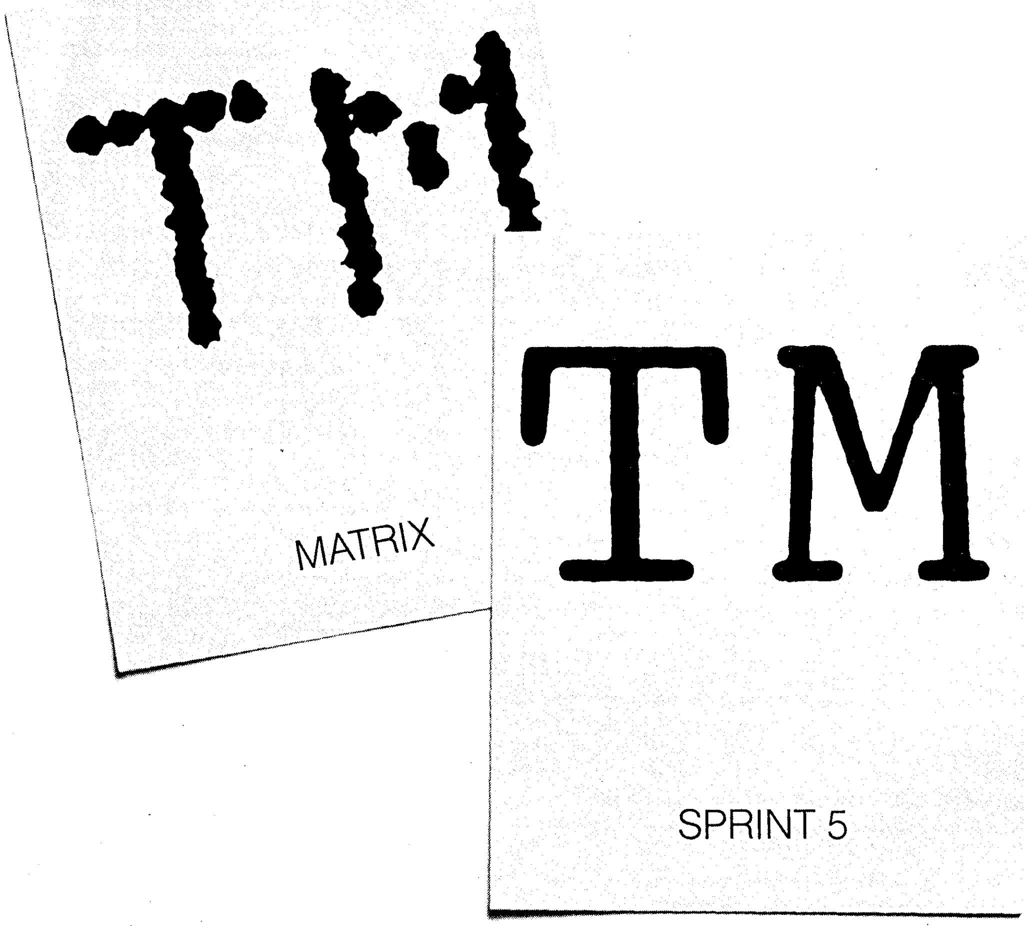

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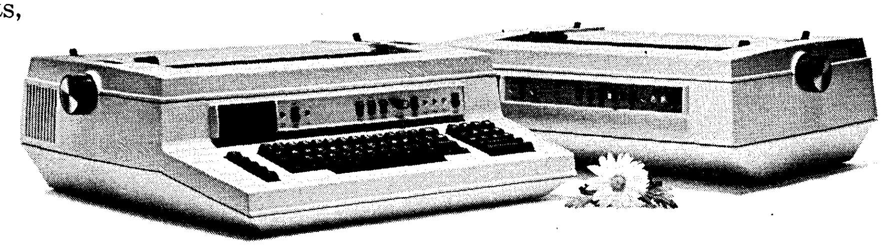

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THE AUTOMATED OFFICE

THE ROAD TO DISASTER?

by Philip H. Dorn

The craftsmen and cottage industries of the 18th century evolved to the now familiar industrial society. After just over 100 years, the world faces another iteration in an endless social transformation process. Will a post-industrial society, an information age, replace the product-based economic system? If the transition is to occur, when will it happen? What will be the effect on working populations when, inevitably, the mills stop and the furnaces cool? What are the consequences for individuals, nations, and societies of a system where fewer and fewer people produce more and more goods and services?

The questions, to paraphrase the oft-quoted remark, are too serious to be left to the technocrats. Matters of national economic policy and employment slash deeply into the fabric of society. These become issues for the political system with decisions to be made in the white glare of public watchfulness.

Addressing complex problems in an abbreviated fashion risks simplistic solutions based on missing facts and half-understood ideas. Even a brief discussion, however, is better than none at all when key issues have not been previously raised in the U.S. electronics and data processing community. If any solutions exist, these should be found in the trained body whose basic mission is to deal with these new forces.

The aptly named microelectronics revolution has barely begun. In hardly five years the ubiquitous chips spawned in northern California have jumped out to blanket the industrial world. Costs have dropped and dropped again: 1977's fair price is expensive in 1978 and prohibitively high by 1979. The movement is bidimensional. One vector doubles speed while leaving the price unchanged. In the other direction, power remains constant while price falls. The net effect is the same. An automatically produced, miniature, low-cost device is replacing—effectively, efficiently, and economically—all the complex mechanical, electrical, and pneumatic controls formerly built by thousands of workers.

From microelectronics spring the tripartite pillars of the information age: communications, computers, and office automation. While all have existed historically, inherent price/speed/reliability equations have served as effective braking constraints on system development. The brakes are now off.

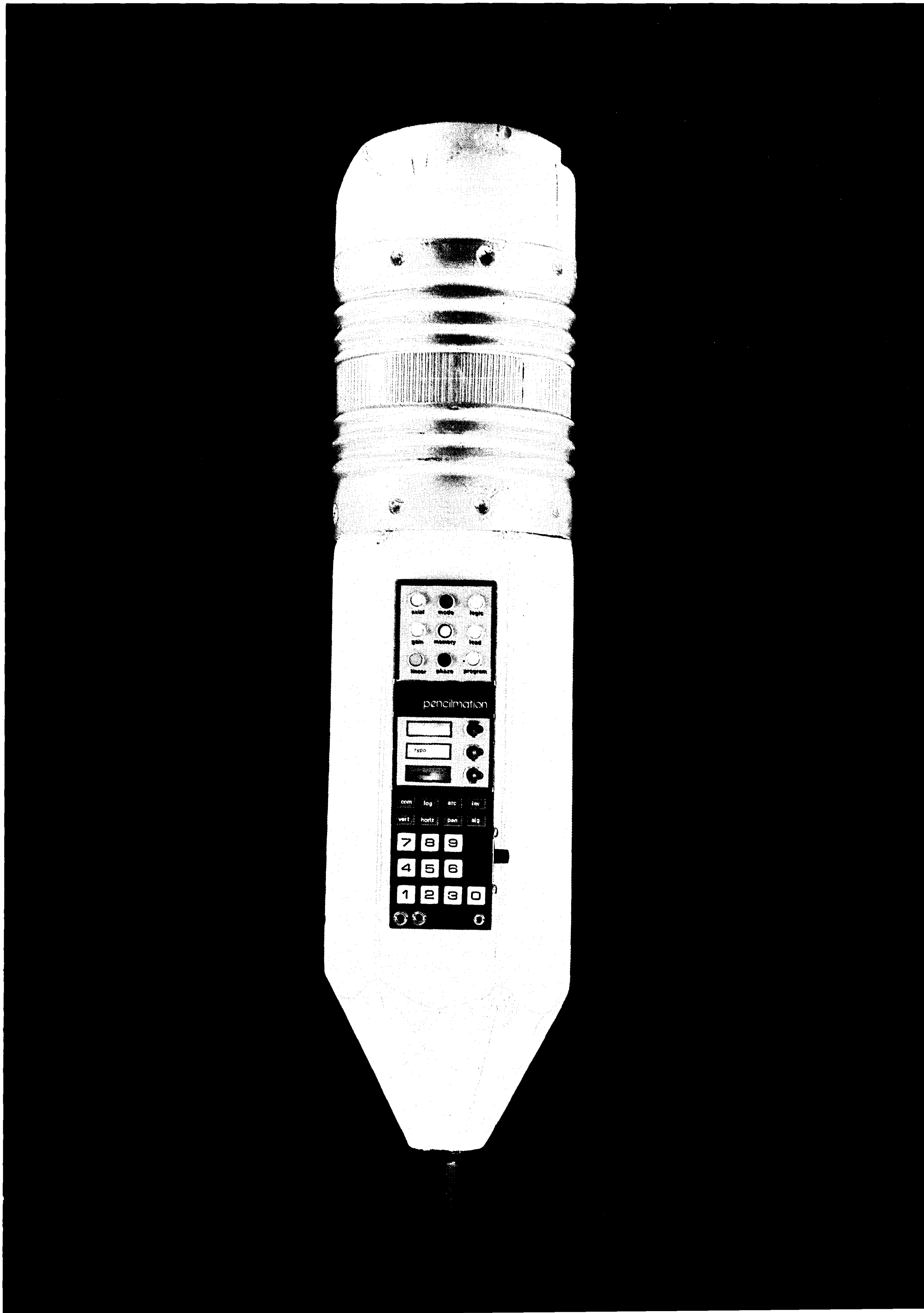
Two central facts about microelectronics technology are either poorly recognized or widely ignored. Microelectronics are: (1) relatively cheap, and (2) universally available. Everybody can afford chips; there are no monopolies in using them. They are not confined to cash-rich nations or those with high-technology infrastructures. Because microelectronics is a revolutionary concept, 100 years of traditional skills in manufacturing capital goods have gone by the boards. The thick file of game plans for manipulating raw materials into finished goods is meaningless. The players haven't changed but the game board has been suddenly and rudely yanked away.

The infant information industry already makes a sizable dent in the economy. Among the top 50 of the *Fortune 500*, information industry companies account for 17% of the total revenue and a surprising 31% of the total employment. The numbers are biased by the communications giants; remove them and the figures drop to a more predictable 9% of revenues and 18% of employment. However, numbers alone are deceptive. Although small in worldwide terms, such information industry companies as Intel, Zilog, and National Semiconductor create impacts many times their size.

WHAT IS AN OFFICE?

Corporations have multiple functional components. There is a set of operations identifiable as production, another clearly delineated as marketing. Research and development, accounting, distribution, and assorted staff functions all can be tagged, classified, and marked on a budget. When all the pieces have been assembled there is still a large chunk left over. Called, for lack of a better name, "administration," this function pervades the corporate society, touches every operation, and is almost never thought of as an isolated entity. But even though it is neither seen nor recognizable, there is very definitely an "administration industry."

How big is the administrative size of corporations? Pundits do not agree; the estimates range from $100 billion to as high as $600 billion. In numbers of this magnitude, accuracy is apt to give way to casual comparison. Administration is by any standard "large"; that seems sufficient.



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Every time a corporation spends capital on machinery, less money is available for individuals.

Supporting the administrative worker would seem to require vast capital. Robert Potter, former president, Xerox Office Systems, tells us that the typical office worker is backed by a capital investment of less than $2,000 while a factory worker has the benefit of $25,000 worth of machinery. The contrast is startling.

However, capital investment in office automation is growing. The electric typewriter started it, and now a flood of products is aimed at the office: copiers, high-speed duplicators, dictation units, automated text handlers, facsimile transmission systems, microfilm/microfiche readers, and small office computers. The glue that should hold it all in place is communications—not the simple voice systems of the past, but an advanced, digitally based, high-speed, general purpose, on-demand network. It isn't all in place yet, but it is coming.

Every time a corporation spends capital on machinery, less money is available for individuals. Capital is finite; it can only be stretched so far. By using office machines to eliminate the drudgery of rote administration, the real danger is at last brought to the surface. The basic employment pattern that defines the social structure is under increasing pressure by the steady reallocation of capital. A simple example: word processors electronically connected reduces the need for letter sorting machinery which reduces the need for post office construction. The ripple effect is obvious.

WORK PATTERNS

The individual skills of craftsmen have historically given way to automated methods and mass employment. Skills have a way of becoming technologically obsolete. In the long past, the worker, who might have been highly trained, nevertheless put down private tools and joined the factory force. It wasn't enjoyable but at least a living wage was assured.

The pattern has had a secondary effect. Large corporations have generic bureaucracy. This always leaves some openings for the creation of service industries to fill the gaps created by overhead. Talented individuals took refuge in services.

Enter now microelectronics. Corporate employment levels fall off. Although not widely observed, it is already happening. British writer Colin Hines in *The Chips Are Down* (Earth Resources, London) notes that in five years Western Electric had been able to cut its assembly work force by 50%. Another case: between 1971 and 1977, NCR increased its revenues by 67% while reducing its work force by 33%. Numerous additional cases can be found.

The traditional pattern would call for the former Western Electric or NCR employee (substitute Hitachi, Siemens, L.M. Ericsson or Thomas-CSF, based on national preference) to join the service sector. But the opportunities are not as available as 50 or even 10 years ago. In the office, the same effects are being felt as labor is displaced by machine. The opportunities may evaporate before being recognized.

THE UNIONS

The traditional craft-based trade union is confronting head-on a basic sociological phenomenon. More and more people (i.e., union members) are leaving the factory. Fewer and fewer people are finding service employment as office personnel counts stagnate.

Unions exist by supporting people, and unions are financed by membership dues. Machines neither join unions nor pay dues. It is not surprising, therefore, that professional trade unionists have sensed this flow toward the post-industrial society far in advance of their management counterparts. Nothing triggers a union response faster than declining membership.

It is curious that these changes have gone nearly without comment in the United States. In Europe, however, the closer relationship between trade unions and the international socialist movement(s) seem to have generated a greater sensitivity to the fundamental changes that are coming. Perhaps the only noticeable domestic exception has been in the printing trades where the potential dangers of automation have long been recognized. What has occasionally been an ugly confrontation seems now to have simmered down to an uneasy truce.

All over Europe, however, the impact of microelectronics is being viewed with deepening concern. It is as true with respect to management and government as with worker councils and union circles.

Cees Commandeur, secretary of the board of the Confederation of Netherlands Trade Unions (FNV) said: "FNV does not oppose automation but employees must be involved. We are against enforced dismissal."

Germany is the home of the most efficient and highly paid work force in Europe. Siemens has stated that by 1990 about 40% of today's office work can be carried out by automated equipment and this translates to between two and five million jobs.

In France, a report written by Simon Nora, senior advisor to the Finance Ministry, predicts that in banking and insurance possibly some 30% of all employees will lose their jobs in the next 10 years due to automation.

In the U.K., the public consciousness has been aroused on several levels. Labor MP Max Madden: "There is a terrifying employment crisis which is facing not only this country but the entire Western World. We are creating less and less demand for labor while increasing output." Dr. Duncan Davies, chief scientist and engineer at the Department of Industry: " . . . the likelihood of social upheaval depends, more than anything else, on the rate of the computer revolution." Ray Curnow, Science Policy Research Unit, Univ. of Sussex: "Labor displacement is taking place in retail distribution networks, banking, insurance and, with the coming of the word processor, in large or specialized offices also. Since more people are engaged in office work than anything else, the impact here may be very large."

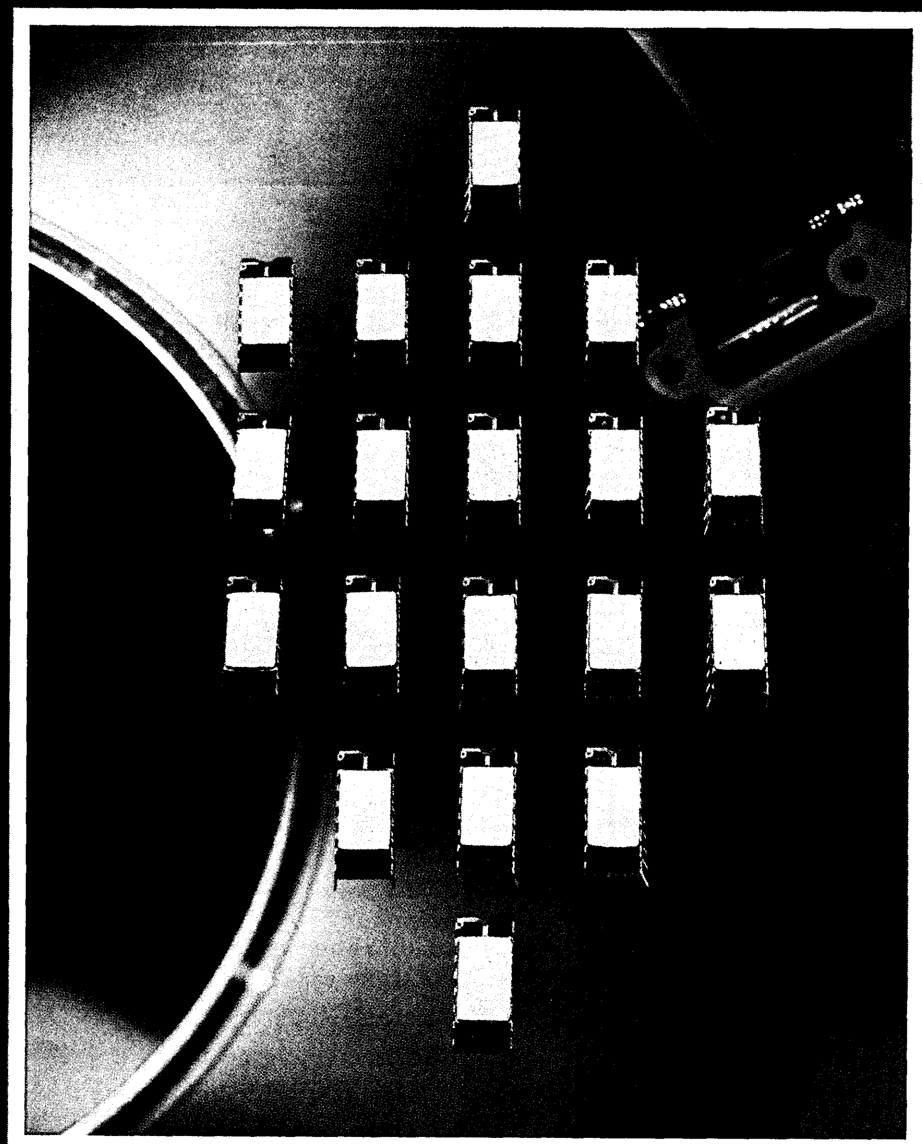
A CLASSIC RESPONSE

The classic American data processing industry response has always been that if these dislocations were to have taken place, we would already have seen the effects because automation has been an ongoing process for 100 years. This view, based largely on the notion that wider availability of information will lead directly to some new, brightly glowing individualistic form of society, seems simplistic in the extreme. U.K. Professor of Social Science, Albert Cherns, Loughbourough Univ. of Technology, has written widely and critically on this view, noting especially that even now, available information far exceeds the motivation to use it. Nor in the view of Cherns can there be much optimism about a return to cottage industries: union managements and governments are all allied against such a movement.

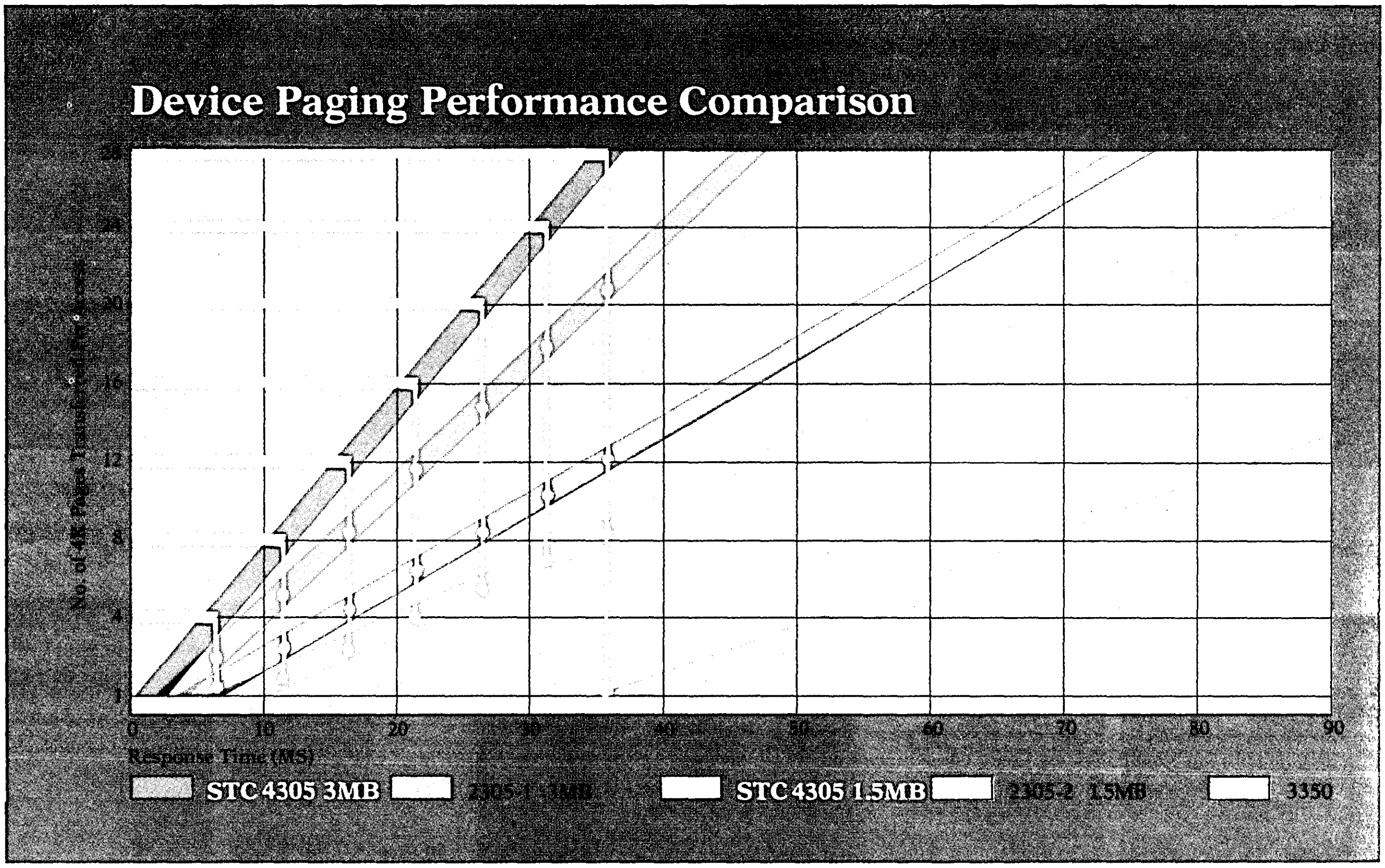
Microelectronics is leading a revolutionary movement. The lash has already been felt in the factory. Impact on the office is just beginning. Previously a snug harbor for those displaced from heavy industry by technological unemployment, the office is rapidly losing favor as an attractive long term situation. The higher the level of automation, the fewer the jobs.

The 1978 implications of microelectronics in the office are comparatively minimal. Stand out five years and the

Storage Technology's new disk system: Doesn't spin. Doesn't seek. Doesn't fly.



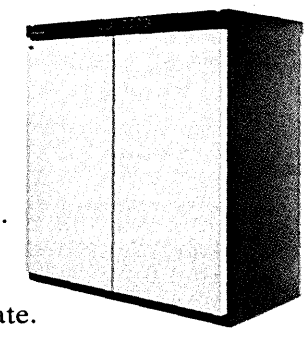
STC introduces the Solid State Disk: It gives you faster virtual storage paging for a fraction the price of the fastest drum.



Until now, you've had three options to improve virtual machine performance, all of which were expensive: upgrade the CPU, add memory, or add drum storage.

Today, there's a better answer: The STC 4305 Solid State Disk. In a basic configuration, it gives you 134% of the virtual paging rate for 50% of the cost of IBM's 2305 Fixed Head File. Better still, Solid State Disk's capability grows faster than its price. You can add options to increase its performance more than five times that of the 2305, yet still pay 20% less.

The best of both worlds: plug compatibility with superior performance. Your CPU will think Solid State Disk is an IBM 2305 in every respect but performance. It runs with no software modifications under all releases of OS, VS1, VM and MVS operating systems. An STC field engineer simply plugs Solid State Disk into the block multiplexor channel of your 370 (135 or above), 303X or PCM equivalent CPU. They lead you through a straightforward conversion procedure. And you're ready to reap the performance benefits of the Solid State Disk's unique semiconductor, charge-coupled device (CCD) architecture.



For instance, with Solid State Disk, you get 0.7 millisecond access time vs. 5 milliseconds for the 2305. Storage capacities up to 45 Megabytes vs. 22.5 Mbytes. And selectable channel rates of 1.0, 1.5 and 3.0* Mbytes per second vs. a fixed 1.5 Mbyte rate.

This latter feature, when combined with dual channel option, lets you share your Solid State Disk among processors with different channel characteristics. Add the

* 3.0 Mbyte/second and 6.0 Mbyte/second (aggregate) transfer rates are options and require two byte wide interface from IBM.

powerful dual port capability, and you can attach to more processors, or gain concurrent access for a 2.0, 3.0, or 6.0* Mbyte/second aggregate transfer rate.

Lowest cost of ownership. When it comes to cost, Solid State Disk is a real penny-pincher. It costs less to buy, because it's easier to build. There are no critical mechanical parts to precision machine and assemble, just straightforward IC and PC board fabrication. In your data processing center, a typical Solid State Disk Configuration saves you 65% of the space required by the 2305, cuts power consumption by 60%, and reduces heat dissipation by a healthy 66%.

Extensive FE controls, coupled with a built-in microprocessor, enable STC field engineers to service your Solid State Disk in-line, off-line, or on-line. And because all components are modular and field replaceable to the module, board or chip level, you get the fastest time-to-repair at the lowest possible cost.

Solid State Disk: Just one of the ways STC helps you get more for less.

The Solid State Disk is just one of many STC products and services designed to help you get more productivity, and more useful life out of your IBM computer. And do it with significant cost savings in both purchase price and operating expenses.

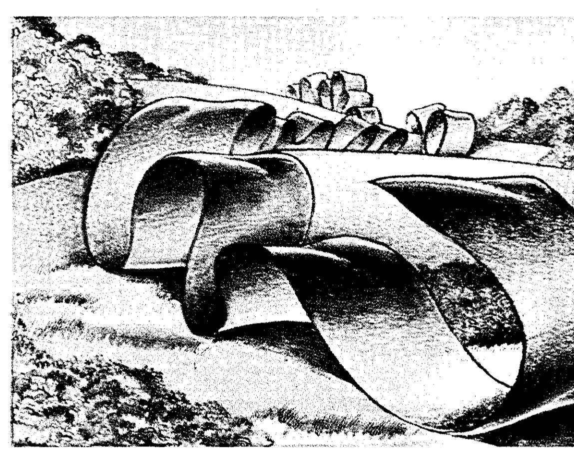
If you have the impression that one of every three tape drives is ours, it's more than an impression. If it's ever seemed to you that everywhere you see medium and large-scale computers, you see our name, it's not just an impression.

Over the past nine years we've installed 22,000 tape drives—or about 30% of all tape drives installed during that period of time. In fact, today STC makes more tape drives for medium and large scale systems than anyone else, including you know who.

The secret behind this success isn't any secret at all. STC tape drives deliver superior performance at a very attractive price.

For instance, only STC drives incorporate SPAR, a unique, built-in diagnostics system that took 16 man-years to develop, and that allows our field engineers to perform all diagnostics and maintenance off-line, on-line, or in-line. Which is just one reason why national reliability studies show STC drives outperform IBM equivalents. So when you choose Storage Technology, you get more than performance. You get availability, serviceability, and reliability.

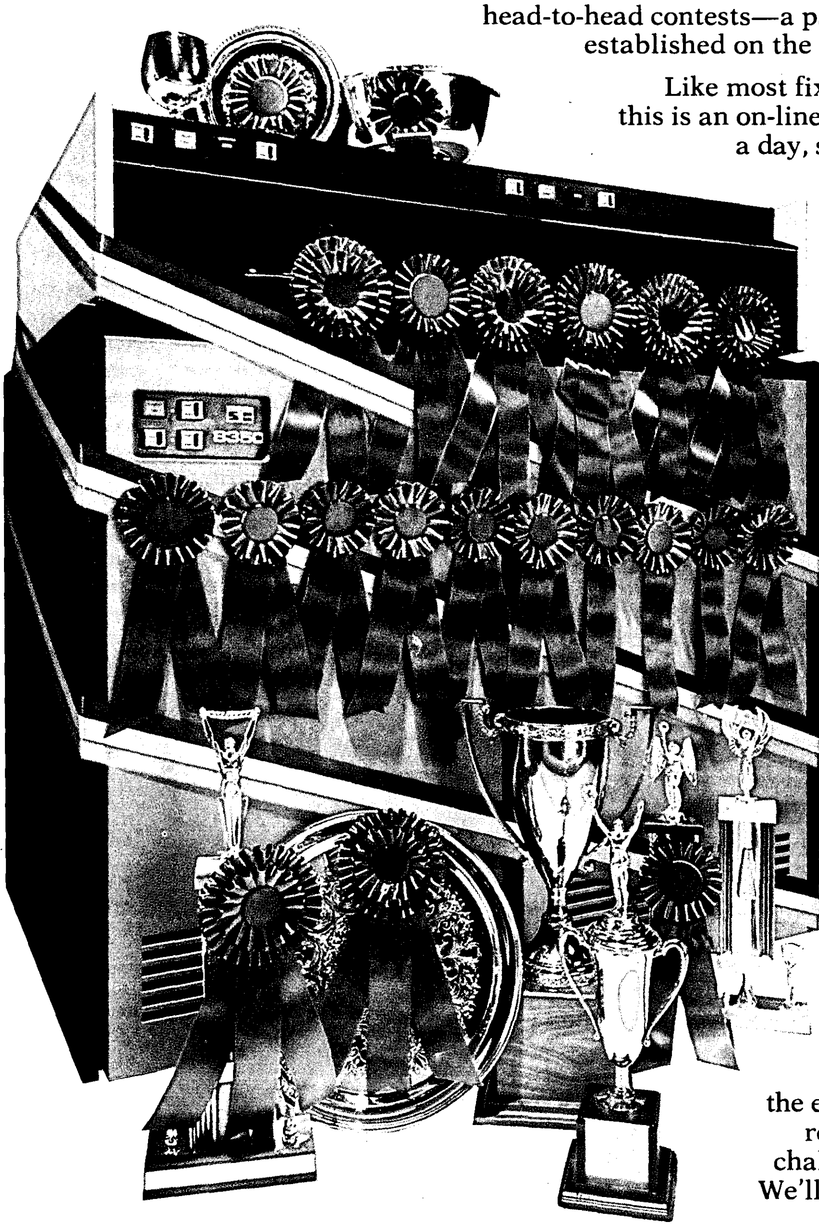
Now, to our customer (and you know who you are) who is still using STC tape drive 001: Come on. Give us a break. How long will a STC tape drive last? After 9 years, we still don't know. You see, the first engineering prototype we built back in 1969 is still being used by a California-based electronics firm. It hasn't had a service call in over two years. And our first production model, serial number 001, was field-converted from a 2450 to a 3470 (IBM 3420-7 equivalent) two years ago, and is also still being used heavily by one of America's largest retailers. So we're beginning to wonder if they'll ever buy a replacement. In the meantime, we'll keep giving them the same great service that's made our field engineers a legend in their own time.



Help, police! Creativity can sometimes make the difference between good service and great service. For example, can you imagine yourself asking the police to pick you up? That's what a couple of our field engineers did during Boston's driving moratorium last winter. An STC customer had a significant problem, and since the only legal way to drive was with a police escort, our people had to call for police assistance to reach the site.

Now, we obviously don't relish the image problems that might result from our FEs riding around in squad cars. So we're thankful that this was a rare event during the 3-day, 12-state storm. But it does underline why STC field engineers are popular enough with our customers to top the June **Datapro** report with a 3.6 rating.

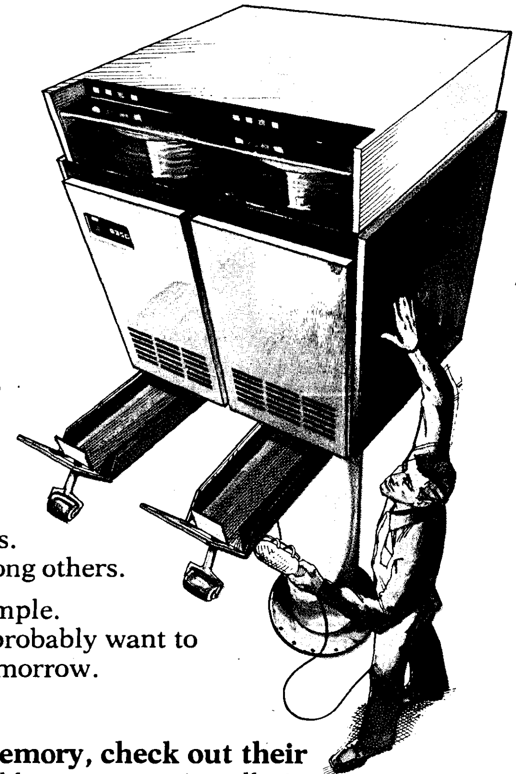
Why the 8350 has never lost a contest. Fixed media disk users are a very picky lot. Many of them demand vigorous benchmarks before buying a winchester drive. The STC 8350 is used to winning these head-to-head contests—a pattern of success established on the very first installation.



Like most fixed media disk applications this is an on-line system running 24 hours a day, seven days a week. Anticipating typical new product problems, we arranged for this customer to provide computer time for engineering work. As it turned out, we didn't need even a fraction of a CPU second. During the 90 day test period, there wasn't a single hardware failure.

That performance was designed into the 8350 from the outset with such features as fully redundant electronics and power supplies. Elimination of discrete components in favor of easily serviced PC boards. And MIDAR, STC's proprietary diagnostic package designed to quickly direct the field engineer to a problem component for fast repair.

How would the 8350 measure up in your environment? Why not put us to the test? As the leading independent supplier of high-performance fixed media disk drives, we can provide you with the product, the experience and the service resources to satisfy your most challenging requirements. We'll even guarantee it. In writing.



Tips and tools to tune up your storage subsystem performance. How many channel tries before you get a start I/O? Are catalog requests idling in the queue? What's the distribution of your data sets by size? By frequency of access?

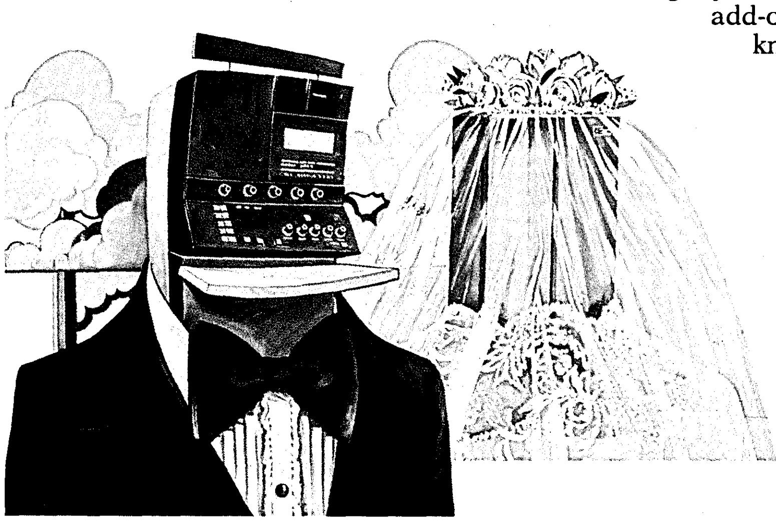
STC Systems Engineers can help with answers to questions like these to squeeze more mileage out of your existing storage equipment, and help you plan for more efficient system growth. They've helped our customers solve a wide range of storage problems under virtually every conceivable combination of CPU, operating system, and job mix. Their experience is now at your disposal in the form of free software packages.

Some of the tools you can put to work today include Configuration Planning Software with programs for evaluating tape and disk data set characteristics. High Speed Dump/Restore. And Performance Maximization, among others.

Our philosophy in providing these tools is simple. If we help you get more from what you have today, you'll probably want to do business with us when you're ready to grow tomorrow.

Before you wed your CPU to an add-on memory, check out their hand holding. You know that when it comes to add-on memory, installation and service are as important as hardware.

So you should know that our STC field engineers have over 250 Mbytes of large system memory experience (including more 168 add-on than any independent). So they know how to get you up and running fast. STC's new family of 158, 168 and 303X add-on memory uses the latest MOS technologies. They have fewer components for fewer failures, reduced power consumption and less heat dissipation. Their modular design makes for an easy growth path, too. All our people have to do to give you additional capability is plug in additional cards. This typically takes less than a shift, including the diagnostics. And if that's not enough to convince you, price and availability should be. Because STC add-on memory costs 30% to 50% less than IBM's. And it's available today.



For more details on STC data storage products and services, call your local STC sales office. Or clip and mail the coupon below to: Storage Technology Corporation, Mail Drop 3M, 2270 South 88th Street, Louisville, Colorado, 80027. Phone (303) 497-6262.

Yes. I'd like to know more about the following STC products:

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CIRCLE 68 ON READER CARD

effects are apt to be increased tenfold. All the storm signals are present, but in the U.S. they are largely ignored.

Corporate efforts to automate, proper in the eyes of management, shareholders, and the financial community, have deep-rooted and potentially catastrophic impacts on the socio-economic-political tissue of Western society. Europe is starting to be aware of these possibilities. Nations with closely integrated industrial-governmental infrastructures have greater awareness of these problems than those more loosely structured. Even so, solutions are not known.

Short-term unemployment trends are likely. But far more critical are the long-term dangers of drastic population bipolarization. This would appear to generate a small minority of technologically oriented elitists against a vast majority of unskilled, nearly unemployable workers. This event, predicted by some and doubted by others, would probably represent the end of the road for contemporary Western civilization as now understood.

Whether it wants to be involved or not, the information industry is going to be forced to deal with these historic political issues. The industry may, as in the U.K., elect to assist in the decision making through formal structures and societies. Or, as in the United States, the industry may elect to withdraw as much as possible and leave the matter to politicians and self-appointed experts. Hopes that a Jovian bolt will resolve everything and put it right is wishful thinking. The pathing choice is growing more apparent. The office automation changes that are occurring represent only a tiny and highly localized segment of a vast, global problem. ✲

PHILIP H. DORN

Mr. Dorn, an international data processing consultant since 1973, has been in the industry since its formative years. His assignments usually involve system evaluation and selection, audits of computer center operations, and advising management on major future trends. His clients are in such diverse businesses as publishing, agriculture, apparel, insurance, and heavy industry.

THE AUTOMATED OFFICE

THE CHALLENGE

by John J. Connell

The greatest challenge facing people in the computer field today is not the implementation of data base technology, or distributed data processing, or standalone minicomputers, or telecommunications. Over time, as the political machinations subside, computer executives will learn to use whatever mixture of centralized data processing, distributed data processing and standalone minicomputers is most responsive to perceived information processing needs.

The greatest challenge facing people in the computer field is to define their roles in the emerging world of the office of the future. It is not a technological challenge, for advanced office technologies are often an outgrowth of machinery and techniques with which computer people are long familiar. It is a people challenge—a need to introduce and manage new technologies in an intensely people-oriented world and maximize the potential of both.

Certain characteristics define the office of the future.

It is a concept in which a number of new technologies are being introduced to facilitate management communications, to improve office productivity, and to provide a more stimulating and intellectually rewarding work experience for office employees.

Implementation of the concept requires a level of coordinated planning never before encountered in office operations. Computer-based information processing systems are only one of the many elements which must be considered in the plan. The key factor for successful implementation is not so much the capabilities of the technologies as it is the ability to make the technologies acceptable to office personnel.

THE LAST HOLDOUT

Statistics identify the office as the most labor-intensive activity in American life. Further, since office salaries continue to rise with inflation, and since the demand for office-oriented services is increasing in response to internal requirements and external stimuli, there is a growing management interest in new approaches, technological and otherwise, to improve office productivity.

However, each innovation developed to address this productivity problem must cope with the human factors which dominate office operations. The statement that the office is the last corporate holdout to the tide of automation is true. Office personnel, especially at the middle management level, resist technology, believing that it is rigid, structured, unforgiving of errors, and a constraint on personal creativity.

Computer people claim to have automated many office functions. In fact, the functions automated—payroll, billing, inventory, etc.—had already been organized into a processing system of some type which was then converted to a computer-based processing system. The general office has not been affected to any great degree by computers and, as for management, to this day technology stops at the manager's door.

People, then, are the key ingredient in the office, and any attempt to introduce technological innovations must recognize this fact. Furthermore, office personnel are seeking greater job satisfaction. They are no longer willing to put up with routine, monotonous jobs. They want intellectual stimulation and a feeling of participating in the essentials of the enterprise. Technology must recognize and respond to this need.

There have been many technological innovations introduced into the office over the years, specific products designed to solve productivity problems in specific areas of the business. Word processing is a good example—a typewriter with a memory and playback capability, supplemented recently with microprocessor-based text editing and video terminal capabilities and other features. An entire industry with over a hundred suppliers is aimed at reorganizing the secretarial function and improving productivity in correspondence preparation.

Micrographics is enjoying similar growth—again, a specific function aimed at improving productivity in a specific

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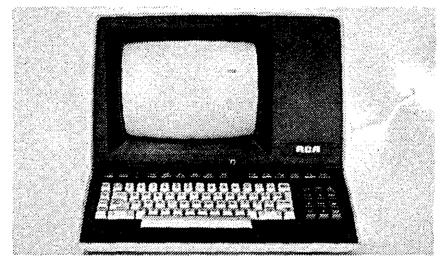

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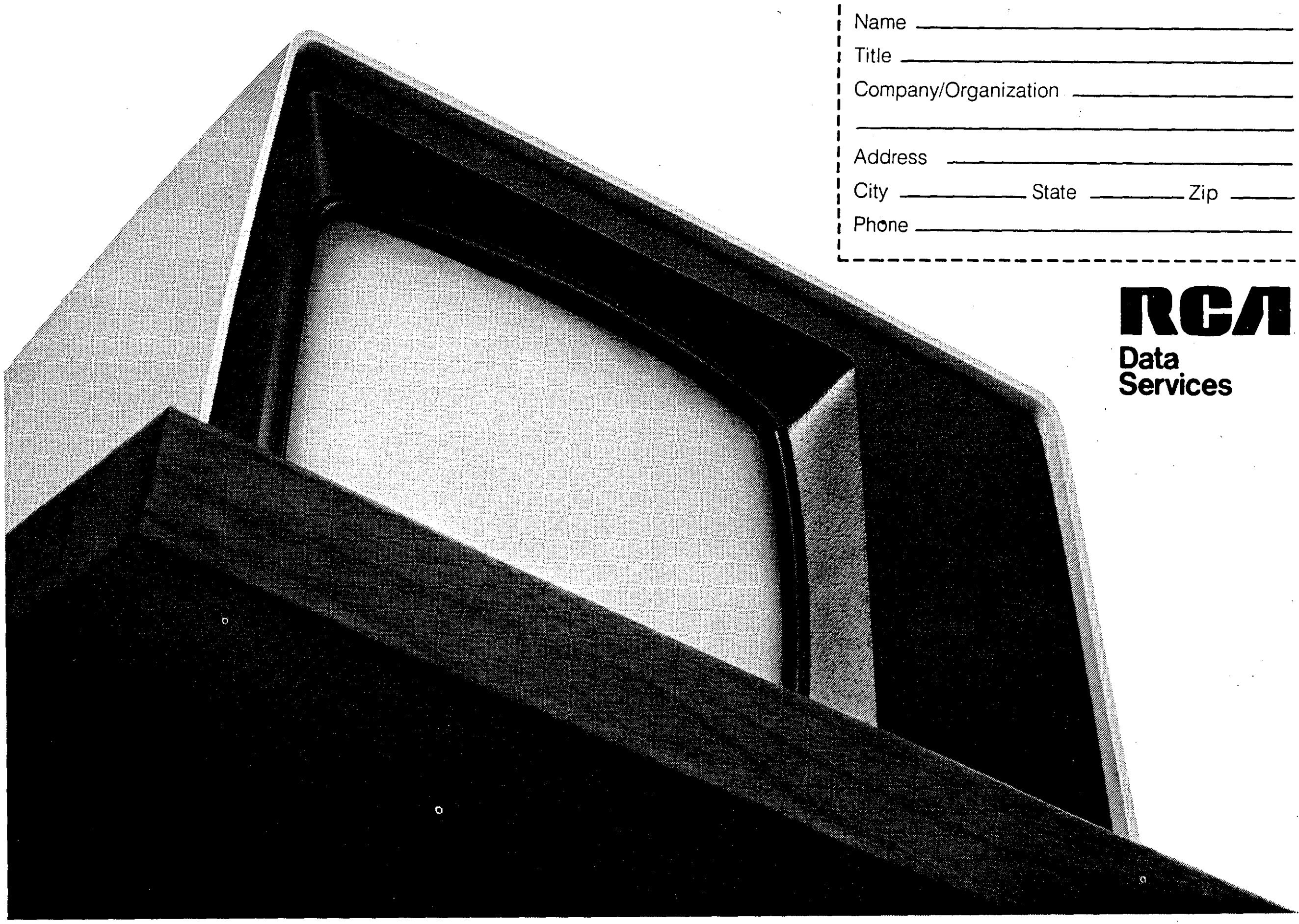

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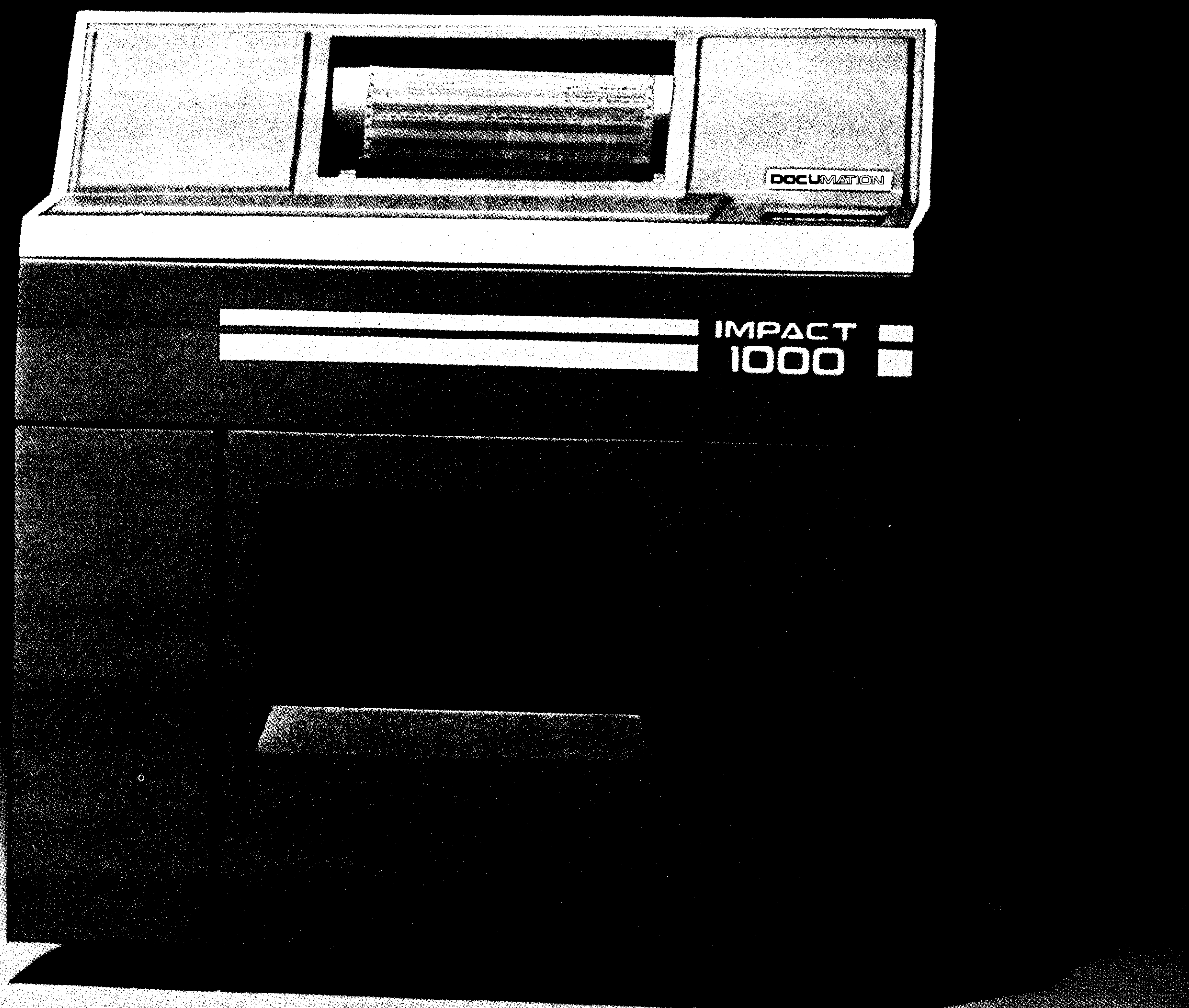

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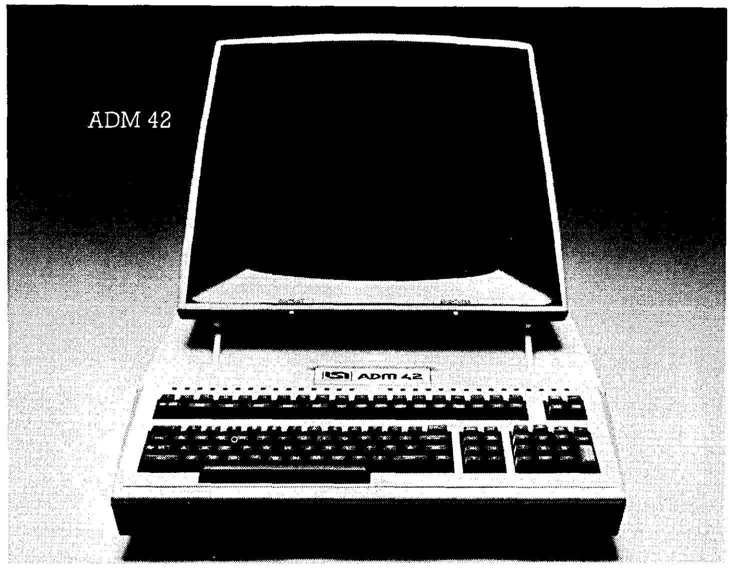
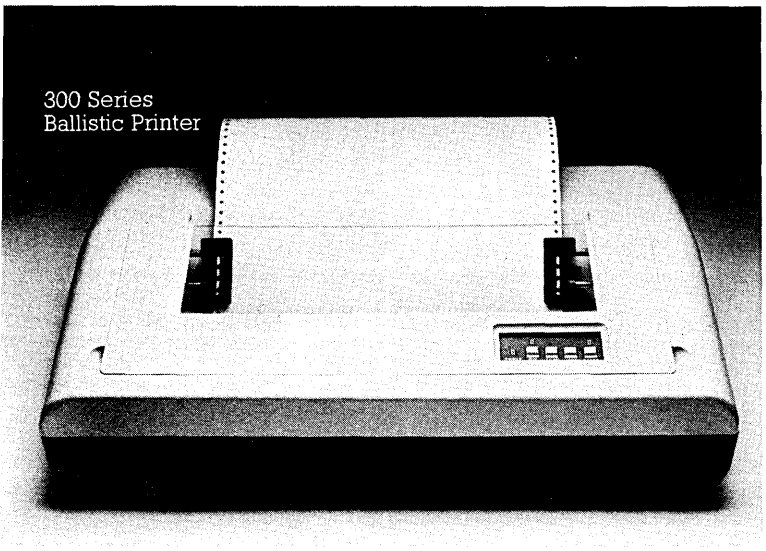
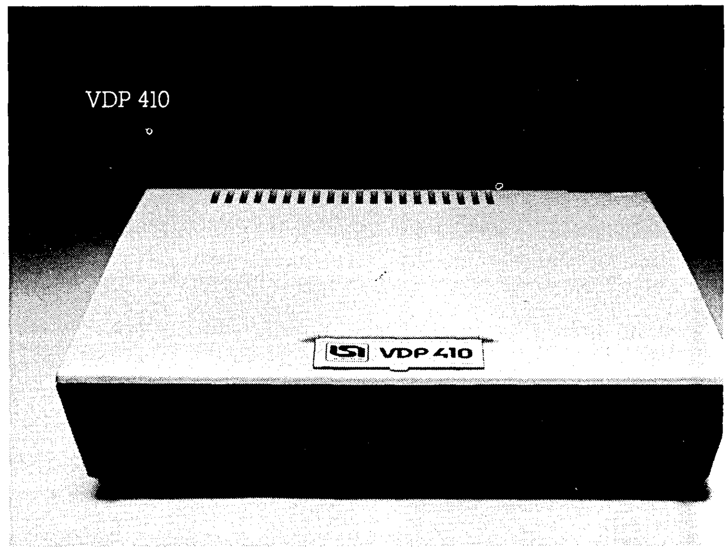
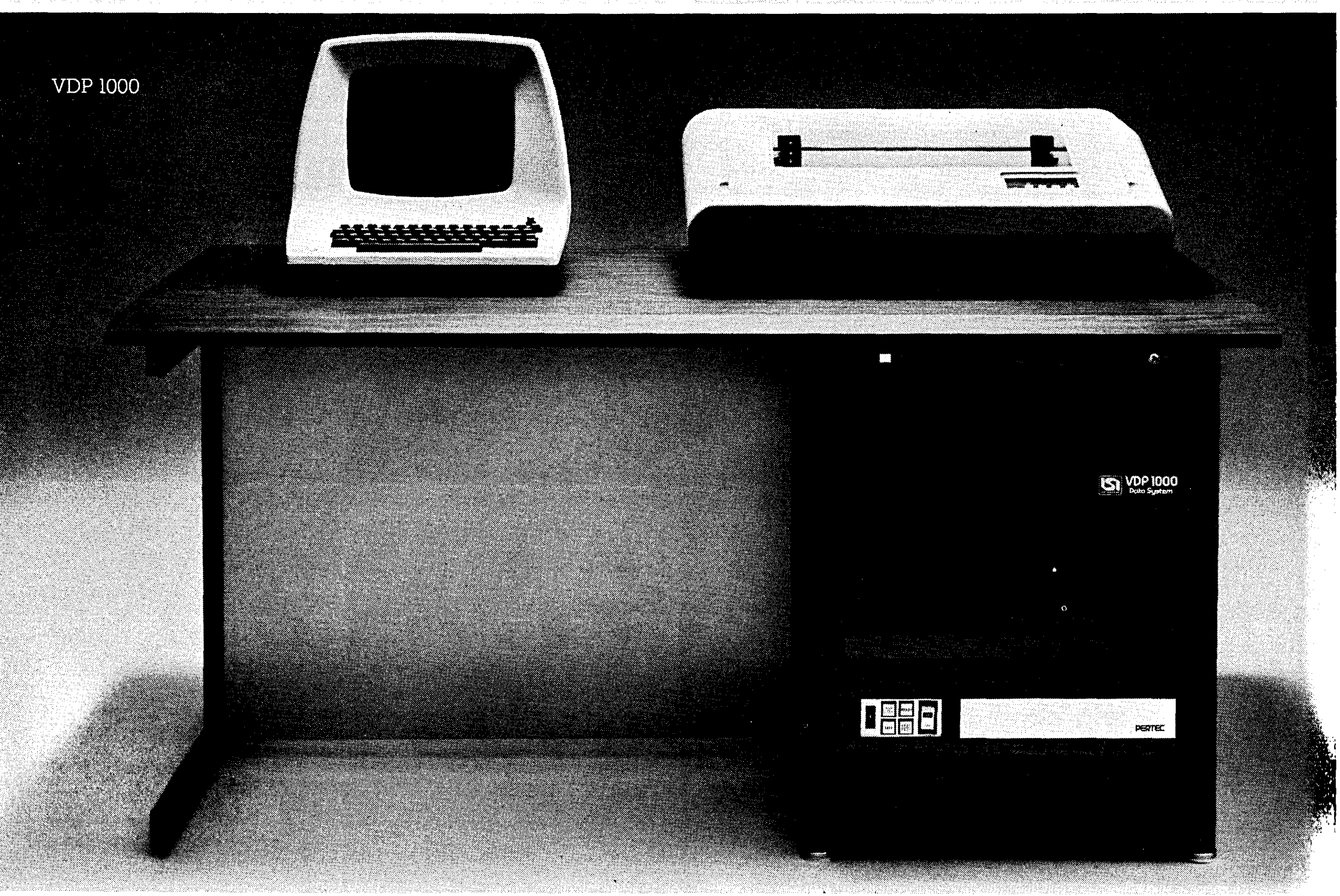


ADM 42


300 Series
Ballistic Printer



VDP 410



VDP 1000

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As a result, we build all our products from your point of view. So you get what you want, and we get what we want.

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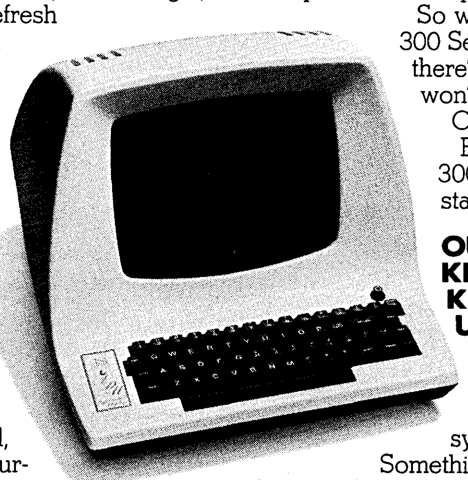

If this sounds like just the thing you need, it should come as no surprise. After all, you were the one who told us what you wanted.

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Our customers told us they wanted a semi-intelligent terminal.

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THE 300 BALLISTIC™ PRINTER COMES WITH BELLS & WHISTLES STANDARD.

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A lot of OEMs said they needed a building block for system development. Something that would give them the flexibility to configure a variety of systems.

So we built the VDP-410. The intelligent controller in the plain brown box.

It's a low-cost, 16-bit CPU with enough speed and ports to support a variety of peripherals. And it lets OEMs build a multitude of systems. From communications controllers without external storage capabilities, to sophisticated timesharing systems with a string of terminals, printers, and disks.

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CIRCLE 53 ON READER CARD

Dp managements must discard their technical mantles and become businessmen.

area of the business—in this case, document storage. Microfilm, long looked on as an archival storage medium and justified based on space savings, has now become an operating medium in roll, aperture card, or fiche form.

Interest in better conferencing techniques is rising, spurred by the trend toward participative management and an increase in management meetings. New developments in audiovisual facilities, and tele-, video-, and computer-conferencing are all intended to make meetings more effective.

Electronic mail, reprographics—the list goes on. But this is not new. What *is* new, and what is important to management, is that technicians, heretofore separate and independent, will soon communicate directly with one another, closely interrelating all office disciplines via telecommunications. This imposes a requirement for planning of office operations on a scale never before contemplated. The management concern is that most office personnel are not organized, trained, or prepared for such major planning efforts.

As an example, communicating word processors are now available with the ability to create correspondence in magnetic form in one location, transmit it electronically, and reproduce it in hard copy form in another location. Planning requires coordination among the sending unit, the telecommunicating unit, and the receiving unit. It sounds simple; the computer people are accustomed to such coordinated planning in developing computer-based systems—however, office personnel are not. The three parties involved probably report to different department heads, in different locations, and with different motivations and priorities, who have never been called upon in the past to coordinate their office operations.

Multiply this by the ability of word processing equipment to communicate with reprographics equipment and reprographics equipment with micrographics equipment, with advances in electronic mail and the potential of electronic office systems, and it becomes apparent that the need for coordinated planning of future office operations is a paramount consideration. Add to this the extraordinary advances being made in the field of telecommunications—customized satellite networks, packet switching, electronic PBX's, fiber optics—and the planning need becomes a major management problem.

Going one step further, development of coordinated plans for future office operations requires that one determine what the function of the office is, and how various office technologies help carry out that function.

NEW LEADERS, IDEAS

All of the new technologies have one characteristic in common: they help management communicate.

The way in which management organizes an enterprise, the hierarchical structure, the span of control ground rules, etc., is based upon perceived business requirements and a given communications capability. Introduce a technology which improves that capability substantially and new approaches can be taken to the basic organization of the enterprise. Hierarchical levels can be eliminated, spans of control extended, middle management personnel utilized more effectively, better coordination introduced in responding to changing business conditions, etc. Thus, the office of the future is not limited to the concept of the automated or the electronic office; rather, it is one in which senior management can consider entirely new approaches to organize, manage, and control the enterprise.

Once senior managers learn of this potential, they will participate personally in deciding who will be assigned leadership roles in office of the future efforts. They will certainly consider computer personnel; but they will also consider word processing personnel, who have been on the firing line in introducing an improved management communications capability into the world of the manager and the secretary; general administrative personnel whose knowledge of office disciplines and the associated human factors is of vital importance; and telecommunications personnel, who are responsible for the key underlying technology.

In some cases, management may decide that the office of the future could have such a profound effect on the management process that it warrants senior leadership from the ranks of general management.

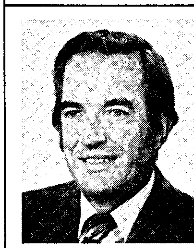
ROLE OF DP'ERS

How can computer people compete for leadership roles in this new field? Certainly, they should play an important role, for they have mastered the technology, applied it successfully to many business operations, and are experienced in developing coordinated plans within their own operations. They have carved out an important niche in business organizations—but that niche may turn out to be a deterrent; in many cases, it is based not so much on management's perception of the importance of the information processing function as it is on management's lack of understanding of the function. To successfully participate in the management planning for the automated office, data processing management must do several things. First, they must discard their technological mantles and become businessmen, interested in results rather than processes. Second, dp management must recognize and respond to the fact that technology in the office, to be successful, must be adapted to office workers, not vice-versa. The power of chip must be used to make machinery easier to use, more flexible and adaptable, more forgiving of errors, and less threatening.

Third, computer people should recognize that general office personnel, though less knowledgeable than they about technology, are far more knowledgeable about how an office operates, and that knowledge is vital in planning for the office of the future. Fourth, they should participate in joint efforts to pool the knowledge and experience gained in introducing computer-based systems with the practical day-to-day experience of other office personnel.

With computer technology becoming increasingly more effective in providing management with information about the business, with a variety of new office technologies helping management communicate better, and with telecommunications tying it all together, the office of the future promises to be an enriching and intellectually stimulating environment. Planning for and managing the move into the office of the future will without doubt be one of the most challenging assignments of the next decade. ❋

JOHN J. CONNELL



Mr. Connell is Executive Director of the Office Technology Research Group, Pasadena, California. The group is an association of executives from major corporations who are concerned with staying abreast of office of the future developments and influencing the direction which those developments take.

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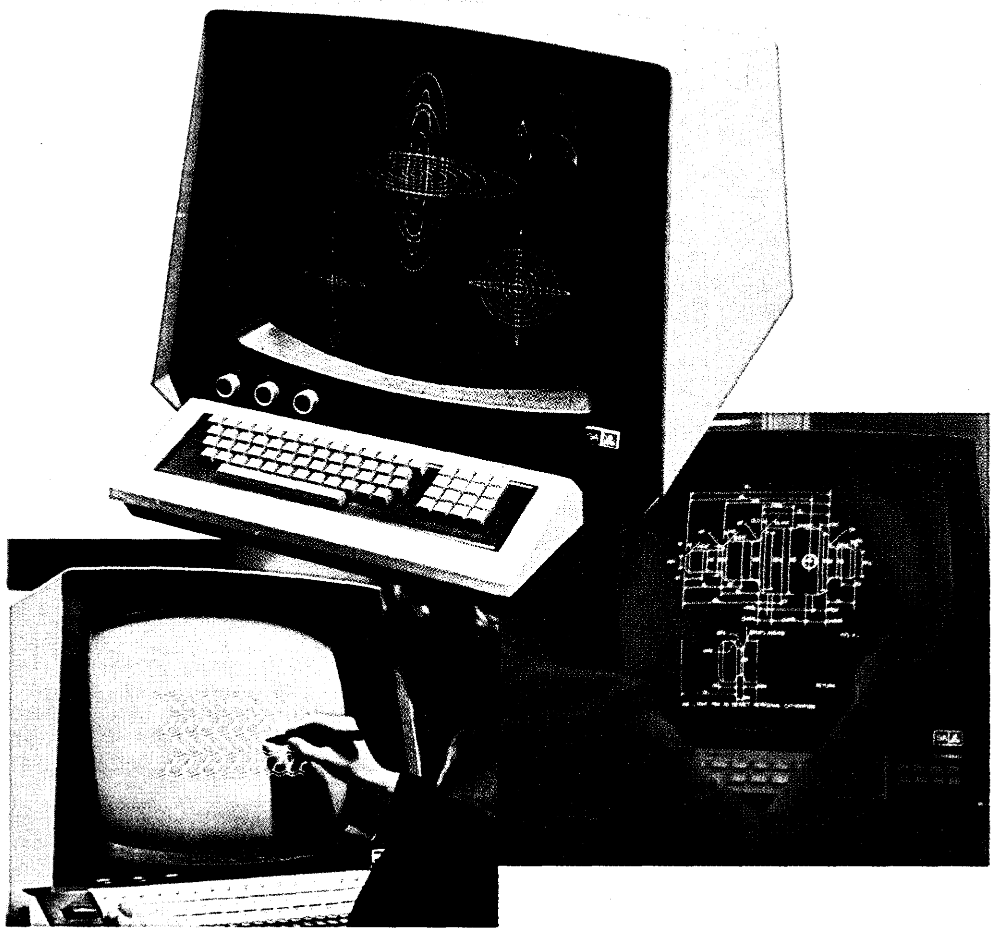

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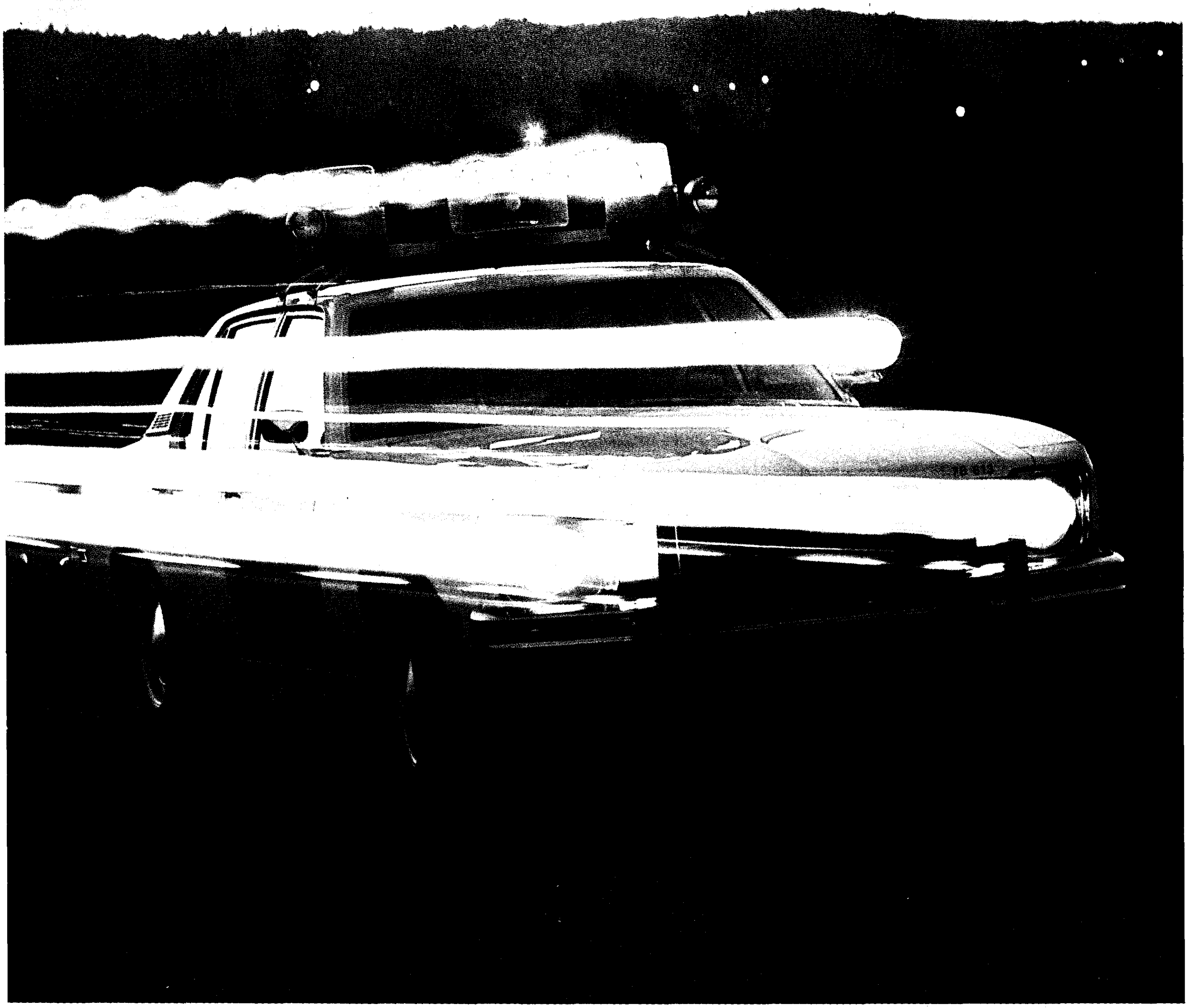

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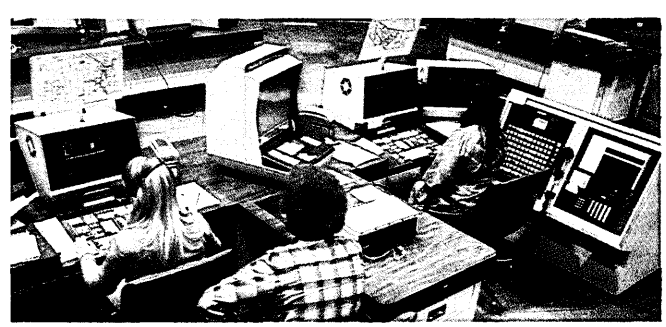

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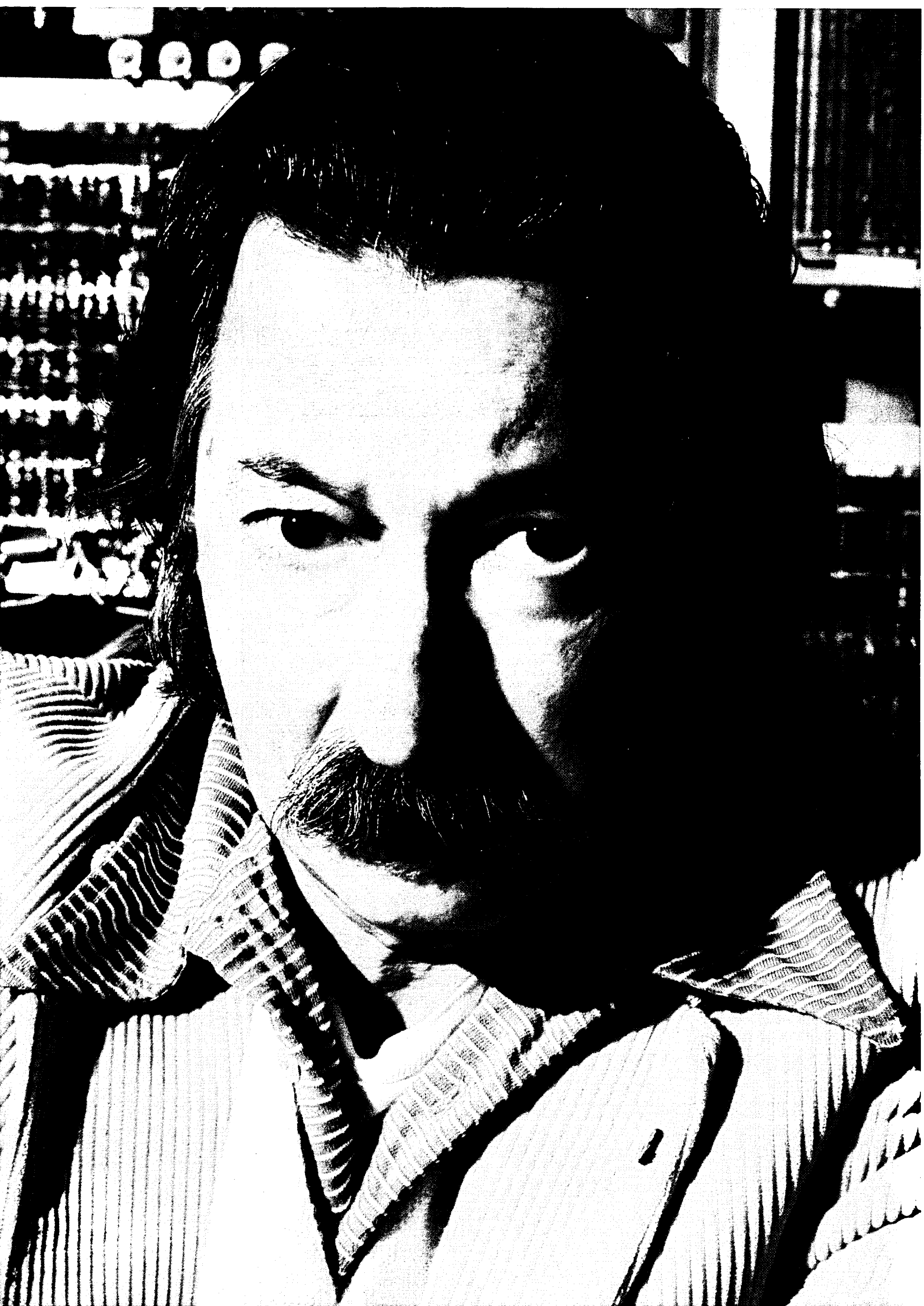


Now is the time for critical assessment.

A SCIENTIST'S VIEW

CONTROVERSIES AND RESPONSIBILITIES

by Joe Weizenbaum

It is, in a way, surprising that the computer field is as nearly free of controversies as it appears to be.

There are, of course, disagreements, and some of them occasionally do rise to the level of controversy. Years ago, for example, there were people who thought that floating-point arithmetic was an evil because it would encourage people to apply computers to problems before they understood enough of what they were doing to be able to predict the scaling of their variables throughout the whole course of computation.

Today there are disagreements over programming styles, computer architectures, ways of realizing computer system security, and so on. But, on the whole, such differences of opinion are just that—differences of opinion, not controversies. Observers from another field would, I think, be most impressed by an apparent unanimity of views in a field so large as the computer community. Where else are so many scientific and technical workers so much of one mind?

OPTIMISM AND CRITICISM

The unifying thread is, I believe, fervent optimism. And that optimism appears justified. Never before in the history of technology has there been a development whose every measure of technical progress grew exponentially from the beginning and which has sustained that growth without interruption. Indeed, this explosive growth has created a momentum which has conferred on the field another characteristic perhaps unique to it among scientific endeavors: an orientation to the future so pervasive that it swamps all attempts to look back—especially to look back critically, or even to examine itself critically at all.

But the field's immunity from critical thinking, hence from criticism, hence from controversy, is not total. What critical assessment there is, is born of the optimism that also very nearly drowns every critical voice. This critical assessment seldom surfaces explicitly and, when it does, it is greeted either by cries that it is "philosophical" and therefore, by a curious logic, irrelevant, or it is met by a stony silence. There are, to be sure, occasional debates on university campuses, but it is rare to see a journal article by a technological optimist which attempts to state "the problem" and to answer the critics.

"The problem" is, of course, the one raised by the slogan "artificial intelligence" and by the images that slogan creates in the minds of workers in the computer field, and in those of the general public.

As a sometime critical commentator on the sayings and doings of the artificial intelligence community, I was happy to see no less an authority than Dr. Herbert A. Simon, surely a ranking leader of the AI field, write an article in which he at least alludes to a debate which I consider to be of the utmost importance.

Dr. Simon writes that the most important question with respect to what the computer means for man and society is "what (the computer) has done and will do to man's view of himself and his place in the universe."[1] I agree with him. I must, however, quarrel with his precise formulation of that question and with his assertion that "attacks on the computer" are focused on the claim that it, the computer, "causes people to be viewed, and to view themselves, as 'machines.' "

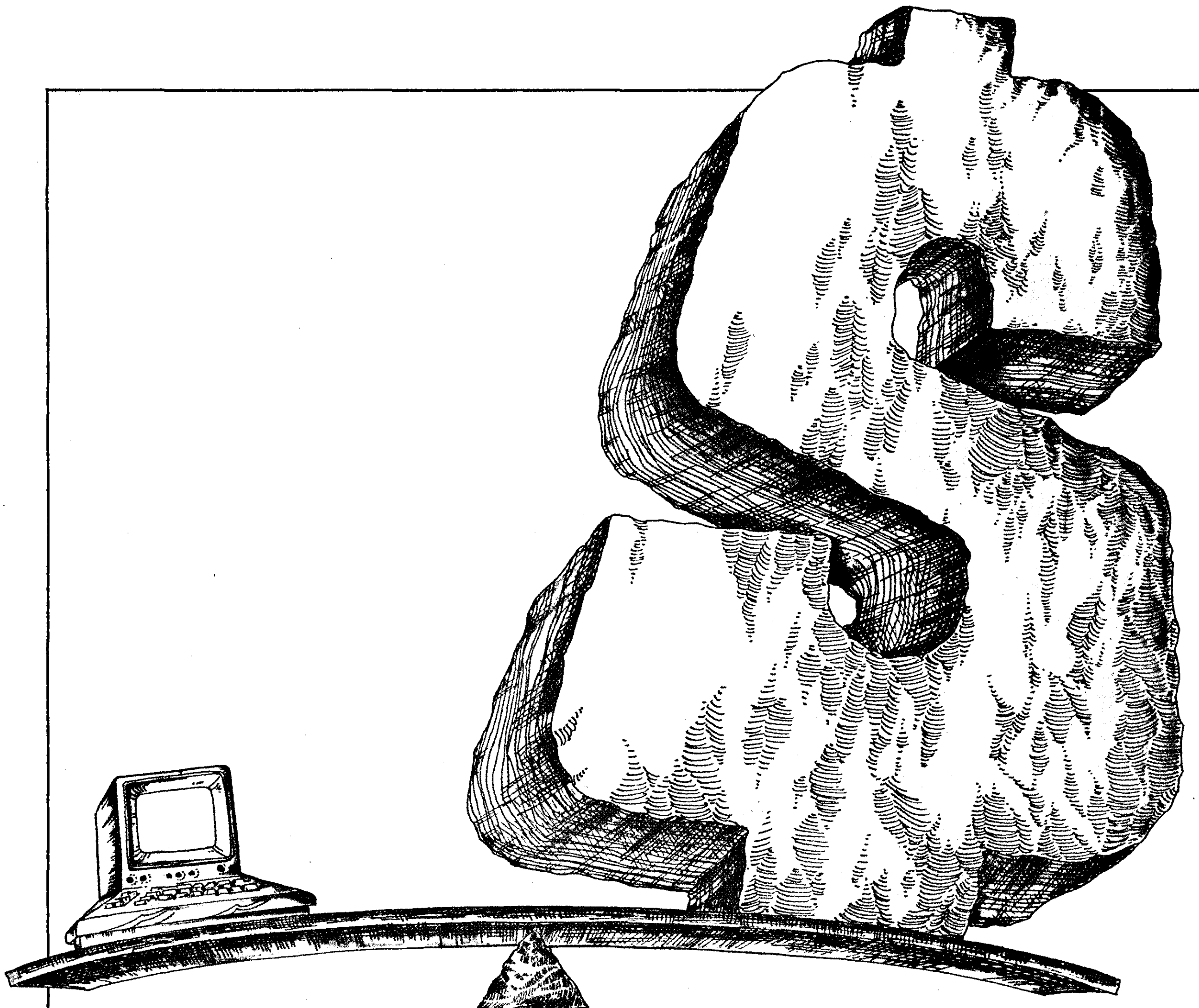
There are, to be sure, people who are critical of some of the ways the computer as an instrument and computation as a metaphor are being used in society. I am one of them. But, at least to my knowledge, no responsible critic attacks the computer as such or believes computers "cause" anything. This point may well be perceived as trivial. But it is not.

The habit of speech, and it surely reflects a habit of thought, that makes instruments reponsible for events, leads directly to speaking and thinking of science and technology as autonomous forces and to the idea of technological inevitability. It leads finally to the proposition that man is, after all, impotent to struggle with powerful impersonal agencies of his own making over which he has lost control, and that he is therefore justified in abdicating his responsibility for the consequences of his acts.

Dr. Simon goes on to say: "What the computer and progress in artificial intelligence challenge is an ethic that rests on man's apartness from the rest of nature. An alternative ethic, of course, views man as a part of nature, governed by natural law, subject to the forces of gravity, and the demands of his body. The debate about artificial intelligence and the simulation of man's thinking is, in considerable part, a confrontation of these two views of man's place in the universe. It is a new chapter in the vitalism-mechanism controversy."

At left...**Dr. Weizenbaum is professor of computer science at M.I.T. and a member of M.I.T.'s Laboratory for Computer Science. He is also the author of *Computer Power and Human Reason*, published by Freeman, Inc.**

PHOTOGRAPH BY JEFF BOXER

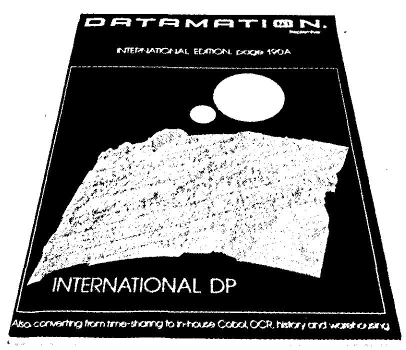


AS COMPUTERS GET SMALLER THE MARKET GETS BIGGER.

Remember yesterday's huge centralized computers? Because of their high price, users were forced to put all their eggs in one basket. An industry pioneer once said that a business that did all its work on a huge centralized computer was like a business where the president opened every piece of mail that came to the company.

Today's huge computers are sharing the limelight with the smaller ones. It makes sense.

Because as computers and their prices have gotten smaller, they've found their way into remote places and are doing jobs unheard of a generation ago. Jobs in medicine, education, transportation, communications, banking, insurance . . . they're even sneaking into the home.



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CIRCLE 71 ON READER CARD

"I am encouraged by the recognition that artificial intelligence has something to do with ethics...that it raises the deepest possible philosophical questions."

ETHICS AND INTELLIGENCE

I am encouraged by this recognition of the fact that artificial intelligence has something to do with ethics and that it raises the deepest possible philosophical questions; questions, that is, about the place of human beings in the universe, even though this characterization of what divides the artificial intelligence enthusiasts from their critics is upside-down.

Artifacts are not part of nature; else everything to be found in the universe is part of nature and then to so label some particular thing or being would be to say nothing. The critics to whom Dr. Simon alludes insist on distinguishing between human beings, whom they do consider part of nature, and artifacts, such as computers, that are not part of nature. Human beings are to be treated with respect and contemplated with awe. Computers, too, may inspire respect and awe—but really, save for idolatry, only as reflections on their human architects. Of course, human beings are part of nature; of course, they are governed by natural law, etc.

George A. Miller once lamented in an unpublished manuscript that: "Many psychologists have come to take for granted . . . that men and computers are merely two different species of a more abstract genus called 'information processing systems.' The concepts that describe abstract information processing systems must, perforce, describe any particular examples of such systems."

Psychologists were encouraged to take such a view of human beings by the repeated assertions of such leaders of the artificial intelligence movement as Dr. Simon that, from an information processing point of view, "the whole man" is "quite simple"[2] and that the ability of computers to think, learn, and create will "increase rapidly until—in the visible future—the range of problems they can handle will be coextensive with the range to which the human mind has been applied."[3]

ABSTRACTIONS

The really deep controversy has nothing whatever to do with vitalism. It is about the extent to which science, or indeed any other single perspective, can lead to an understanding of man or, for that matter, of any other part of nature. My own view is that human beings, as parts of nature, are to be understood by whatever means we have for understanding nature. Science provides certain of those means. But science must necessarily proceed by simplifying reality, and the first step in its process of simplification is abstraction. The information processing metaphor leads to particularly powerful and hitherto unattained abstract characterizations of certain aspects of man's mental functions. But they are *abstract* characterizations and they are simplifications of the reality they mirror. Dr. Simon appeals to the way computers process information as a model for human cognition, for example, when he writes: "The elementary information processes underlying human thinking are *essentially* the same as the computer's elementary information processes" (my emphasis). He says, as of course he must, that the two processes he is discussing are "essentially" the same. None of us can avoid having to make value judgments about what aspects of whatever we are studying are "essential" to *our* purposes and what aspects to leave out of our consideration. But leave out some we must. Neither the computer metaphor nor any other drawn from the armamentarium of science alone yield a complete understanding of any natural phenomena, let alone of the whole man. The computer's information processes may serve as a model of more or less heuristic utility for human information processes. But every model has limitations.

Another belief that Dr. Simon wrongly attributes to critics is that: ". . . knowledge can be dangerous . . . (and that) the attempt to arrive at a full explanation of man's ability to think might be especially dangerous."

Partial knowledge is dangerous when the knower believes it to be complete. It is, in my view, certainly one task of scientists (and of others as well) to humbly strive for ever more nearly complete explanations of the phenomena of the world. I say "humbly" because only humility can guard against the arrogance of believing we understand completely when, in fact, we can understand only partially. Systems of thought—one might well say "ideologies"—that have in the past arrogantly promised "full" explanations, have usually proved catastrophic to both their adherents and to innocent bystanders.

Dr. Simon also bravely writes that "knowledge is better than ignorance." By asserting that, in the context of distinguishing his position from that of critics, he invites the inference that critics prefer ignorance to knowledge. I reject it, of course. Suggestions of this kind lead in the not-so-very-long run to the absurd charge that all critics of any aspect of science and technology are fundamentally anti-intellectual. Again, it seems to me, this turns the issue upside-down: It is not those of us who seek to understand

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the world from a number of different perspectives, including the scientific one, who prefer ignorance to knowledge. It is those who, blinded by their faith that science can yield "full" explanations, prefer to remain ignorant of whatever knowledge other ways of knowing the world have to offer.

THE SCOPE OF SCIENCE The questions which define the controversy between unrestrained computer enthusiasts and their critics revolve about concerns over the scope of science and of scientific rationality. They are really questions about the power *and of the limitations* of a variety of ways of knowing the world.

It is, in my view, unfortunate that there is not more debate on such important points in the computer community—and by debate here I mean specifically exchanges of views in the computer community's professional literature. We have seen the computer begin as a mere instrument for generating ballistic tables and grow to a force that now pervades almost every aspect of modern society. In an important sense, it has already transcended its status as a mere tool to be applied to specific tasks. It has become a symbol, indeed a source, of questions that were in earlier times asked only by theologians and philosophers but which have now, in part because of the role computers and computation play in the world, attained immediacy and urgency.

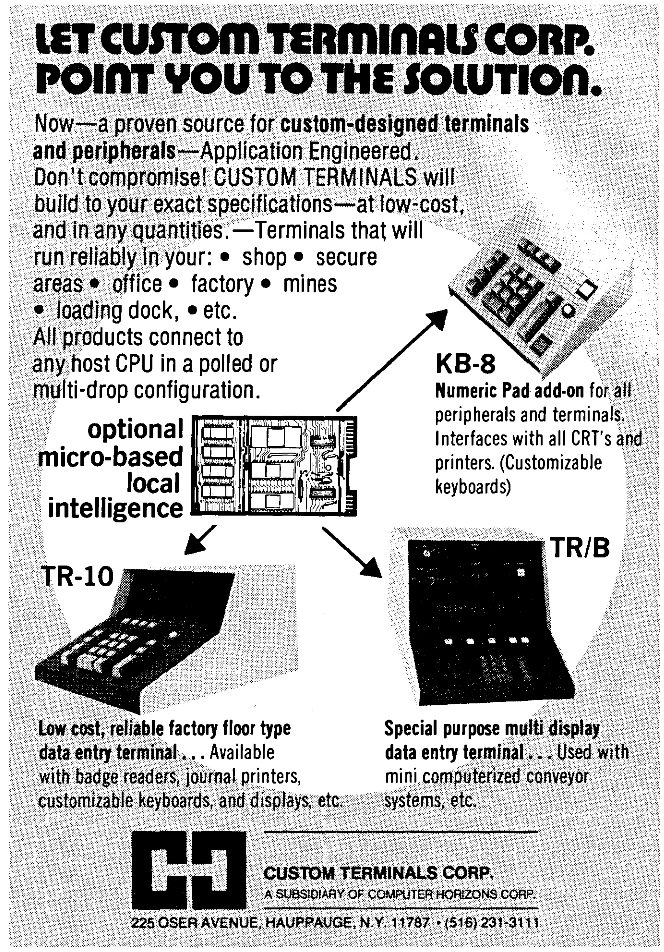
The history of science and technology of the post-war era is filled with examples of reckless and unreflective "progress" which, while beneficial or at least profitable to some in the short run, may yet devastate much life on this planet. Perhaps it is too much to hope, but I hope nonetheless that as our discipline matures our practitioners will mature also, that all of us will begin to think about what we are actually doing and ponder whether, whatever it is, it is what those who follow us would want us to have done. ❄

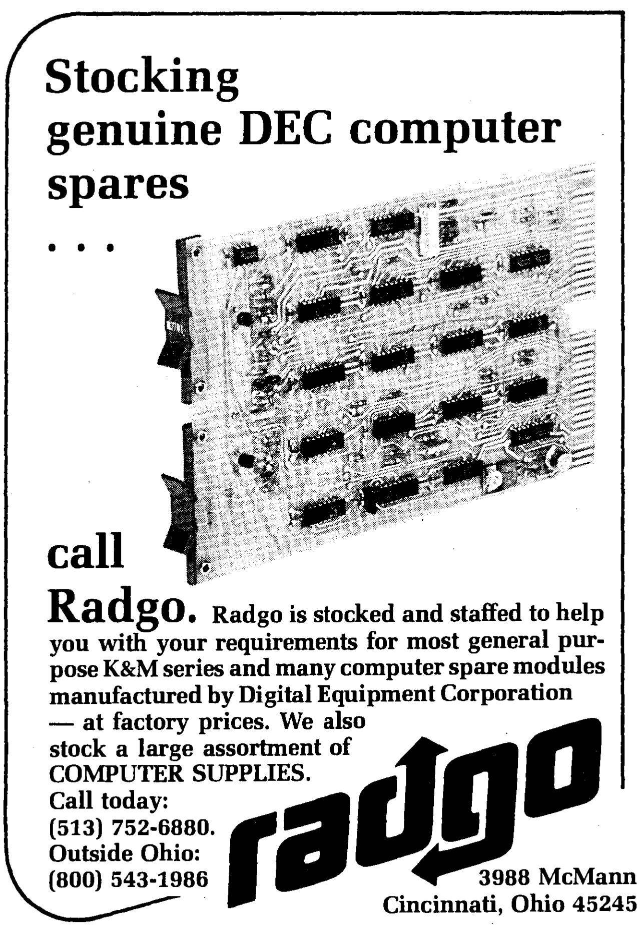
REFERENCES

1. H.A. Simon, "What Computers Mean For Man and Society" (*Science*, vol. 195, 18 March, 1977).

2. H.A. Simon *The Science of the Artificial* (MIT Press, Cambridge, Mass., 1969).

3. H.A. Simon and A. Newell, "Heuristic Problem Solving: The Next Advance in Operations Research" (*Operations Research*," vol. 6, Jan-Feb 1958).





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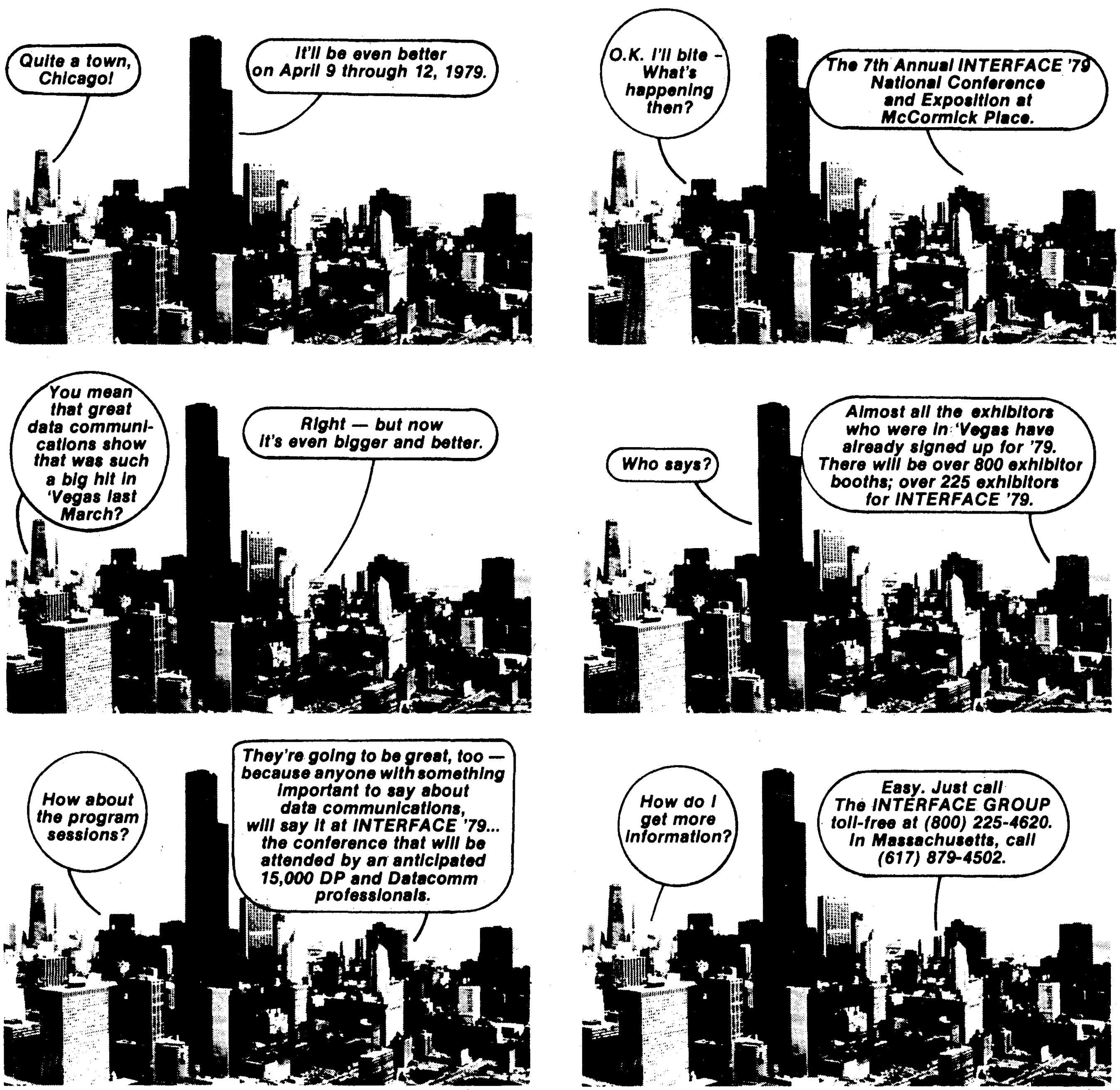

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Hospital Information Systems Sharing Group Meeting & Exhibition, January 15-17, Newport Beach, California.
Implications of the changing health care industry on information system requirements. Contact: Clair Naylor, Advanced Health Systems, 54E South Temple, Salt Lake City, UT 84111 (801) 531-1213.

U.S./Africa Telecommunications Conference & Exhibit, January 17-19, Nairobi, Kenya.
Contact: Mark V. Rosenker, Electronic Industries Assoc., 2001 Eye St. N.W., Washington, DC 20006 (202) 457-4990.

OCR Users Assoc. Meeting, January 21-24, Denver.
Contact: OCR Users Assoc., 10 Banta Place, Hackensack, NJ 07601 (201) 343-4935.

MARCH

Midatlantic Computer Expo, March 13-15, New York City.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

Numerical Control Society Annual Meeting and Technical Conference, March 25-28, Los Angeles.
Contact: Carl Wangman, The Breeden Co., 1800 Pickwick Ave., Glenview, IL 60025 (312) 724-7700.

Midwestern Computer Expo, March 27-29, Chicago.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

APRIL

5th Annual Conference of the American National Metric Council, April 1-4, Washington, D.C.
Contact: American National Metric Council, 1625 Massachusetts Ave., N.W., Washington, DC 20036 (202) 232-4545.

9th Conference on Computer Audit, Control and Security, April 2-5, Chicago.
Contact: Institute of Internal Auditors, 249 Maitland Ave., Altamonte Springs, FL 32701 (305) 830-7600.

Twin City Computer Expo, April 3-5, St. Paul.
Contact: Leo Bowser, The Conference Co., 60 Austin St., Newton, MA 02158 (617) 964-4550.

Independent Computer Consultants Assn. Annual Meeting, April 6-7, Lake of the Ozarks, Missouri.
Contact: Steve Epner, P.O. Box 27412, St. Louis, MO 63141 (314) 567-9708.

COMMON Spring Conference, April 8-12, Philadelphia.
Contact: David Lister, COMMON, 435 N. Michigan Ave., Chicago, IL 60611 (312) 644-0828.

Northwestern Computer Expo, April 17-19, San Francisco.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

Hannover Faire, April 18-26, Hannover Messe, West Germany.
Contact: Enno Stoltenberg, 2221 Rosecrans, El Segundo, CA 90245 (213) 973-8700.

Electro '79, April 24-26, New York.
Contact: Robert Myers, Communication Counsel, Electrons Conventions Inc. (213) 475-4571.

Southern California Computer Expo, April 24-26, Los Angeles.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

Assn. for Systems Management Annual Conference, April 25-28, St. Louis.
Contact: ASM, 24587 Bagley Road, Cleveland, OH 44138 (216) 243-6900.

Tenth Annual Pittsburgh Conference on Modeling and Simulation, April 25-27, Pittsburgh.
Contact: William G. Vogt, Modeling and Simulation Conference, 348 Benedum Engineering Hall, Univ. of Pittsburgh, Pittsburgh, PA 15261 (412) 624-4141.

National Information Conference and Exposition, April 29-May 2, Washington, D.C.
Contact: Information Industry Assn., 4720 Montgomery Lane #904, Bethesda, MD 20014 (301) 654-4150.

MAY

5th Illinois Conference on Medical Information Systems, May 2-5, Champaign, Illinois.
Contact: Julie Garrett, Regional Health Resources Center, 1408 University Ave., Urbana, IL 61801 (217) 337-2324.

PRIDE Users Assn., May 6-9, Williamsburg, Virginia.
Contact: Alcide Goboriault, Director Management Services, Sperry Univac, P.O. Box 500, Blue Bell, PA 19424 (215) 542-2240.

Business Forms Management Assn. May 7-9, Ottawa, Canada.
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continued on page 188

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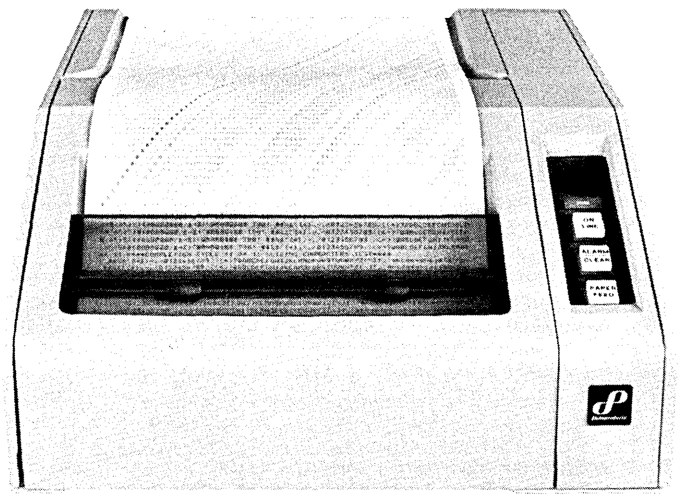

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CALENDAR *continued from page 182*

Americas Univac Users Assn. Spring Conference, May 7-10, Minneapolis.
Contact: Barbara Gattus, Federal Yeast Corp., Highlandtown Post Office, Baltimore, MD 21224 (301) 633-8000, ext. 29.

Southwestern Computer Expo, May 8-10, Houston.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

Micrographics '79, May 8-11, Atlanta.
Contact: Conference Dept. National Micrographics Assn., 8728 Coleville Road, Silver Springs, MD 20910 (301) 587-8444.

West Coast Computer Fair, May 11-13, San Francisco.
Contact: Jim Warren, P.O. Box 1579, Palo Alto, CA 94302 (415) 851-7075.

Canadian Assn. for Information Science, May 12-15, Banff, Alberta Canada.
Contact: Oldrich Standara or Patricia Schick, Box 158, Terminal A, Ottawa, Ontario, Canada KIN 8 Va.

Southeastern Computer Expo, May 15-17, Charlotte, North Carolina.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

Assn. for Educational Data Systems Conference, May 15-18, Detroit.
Contact: Art Daniels Jr., Director of the RAMS Cooperative, 31201 Dorchester, Madison Heights, MI 48071 (313) 585-7530.

ADAPSO Management Conference, May 16-18, Washington, D.C.
Contact: 1925 Lynn Street, Rosslyn, VA 22209 (703) 522-5055.

Hospital Information Systems Sharing Group Meeting, May 16-18, Atlanta.
Contact: Clair Naylor, Advanced Health Systems, 54E South Temple, Salt Lake City, UT 84111 (801) 531-1213.

8th ASIS Mid-Year Meeting, May 16-20, Alberta, Canada.
Contact: ASIS Headquarters, 1155 16th Street, N.W., Washington, DC 20036 (202) 659-3644.

Northeastern Computer Expo, May 22-24, Pittsburgh.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

New England Computer Expo, May 29-31, Boston.
Contact: Leo Bowser, The Conference Co., 60 Austin Street, Newton, MA 02158 (617) 964-4550.

JUNE

National Computer Conference (NCC), June 4-7, New York City.
Contact: AFIPS, 210 Summit Ave., Montvale, NJ 07645 (201) 391-9810.

Edp '79, June 12-15, Milan, Italy.
Contact: Mrs. Marcia Griffin, U.S. Dept. of Commerce, Room 1014, Washington, DC 20230 (202) 377-4508 or 377-4377.

Syntopicon VII, June 26-28, Chicago.
Contact: IWP Assn., Lorriane Lear, AMS Bldg., Maryland Road, Willow Grove, PA 19090 (215) 657-3220.

JULY

OCR Users Assoc. Meeting and Equipment Expo, July 15-18, Boston.
Contact: OCR Users Assoc., 10 Banta Place, Hackensack, NJ 07601 (201) 343-4935.

Summer Computer Simulation Conference, July 16-18, Toronto, Canada.
Contact: Chip Stockton, The Society for Computer Simulation, P.O. Box 2228, La Jolla, CA 82038 (714) 459-3888.

AUGUST

SIGGRAPH '79, August 6-10, Chicago.
Conference on Computer Graphics and Interactive Techniques. Contact: Bruce H. McCormick, Dept. of Information Engineering, Univ. of Illinois, P.O. Box 4348, Chicago Circle, Chicago, IL 60680 (312) 996-2315.

International Conference on Parallel Processing, August 21-24, Bellaire, Mich.
Contact: Dr. Charles Elliott, College of Engineering, Wayne State Univ., Detroit, MI 48202 (313) 577-2812.

SEPTEMBER

WESCON, September 18-20, San Francisco.
Contact: Robert Myers, Communication Counsel, Electrons Conventions Inc. (213) 475-4571.

COMMON Fall Conference, September 23-27, New Orleans.
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Data Entry Management Assn. Annual Meeting, September 24-28, New Orleans.
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1979 Mini/Micro Conference and Exposition, September 25-27, Anaheim, California.
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OCTOBER

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ADAPSO Management Conference, October 22-24, Colorado Springs, Colorado.
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NOVEMBER

MIDCON, November 6-8, Chicago.
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COMPEC, December 3-5, London, England.
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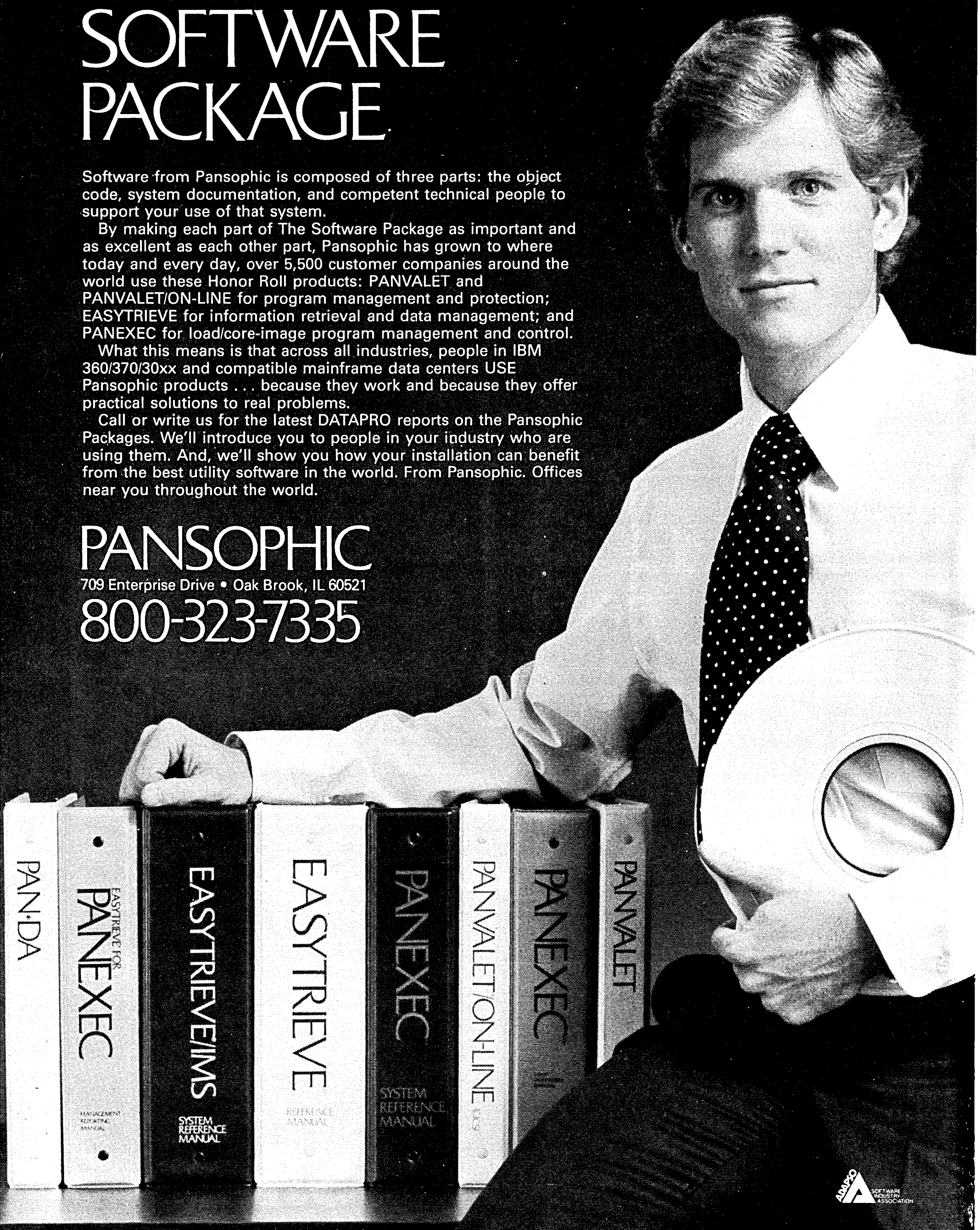

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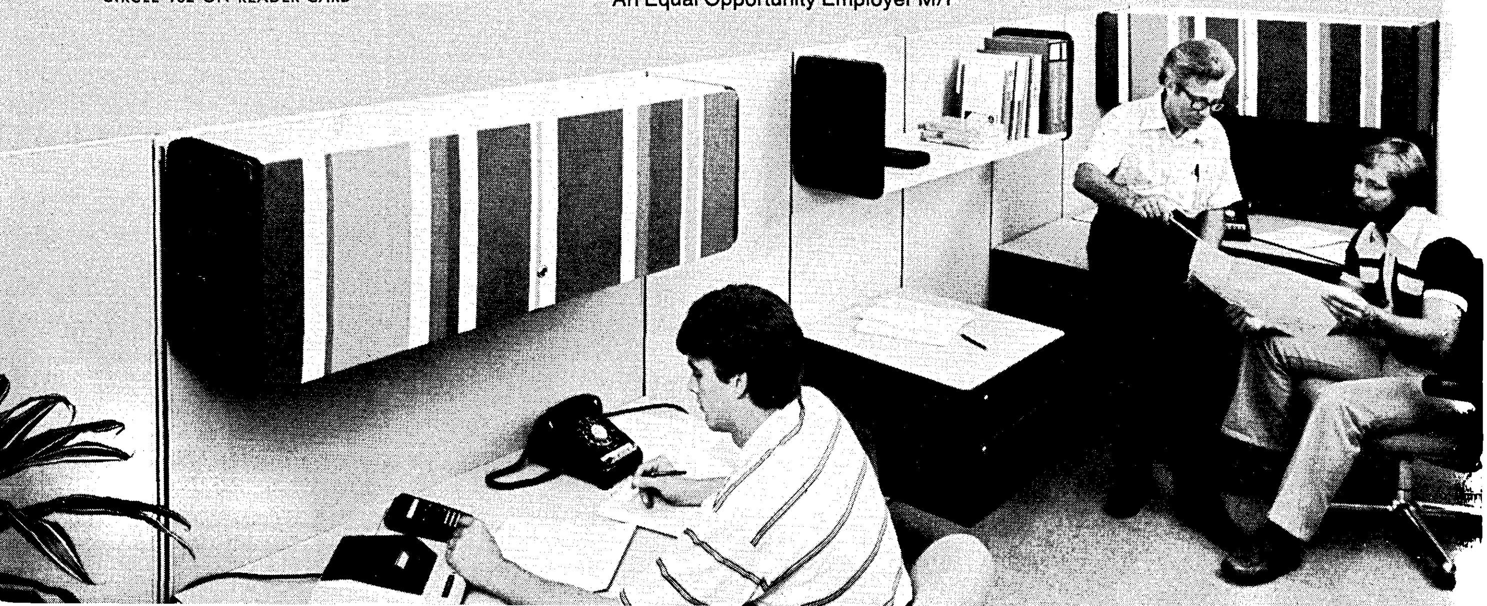

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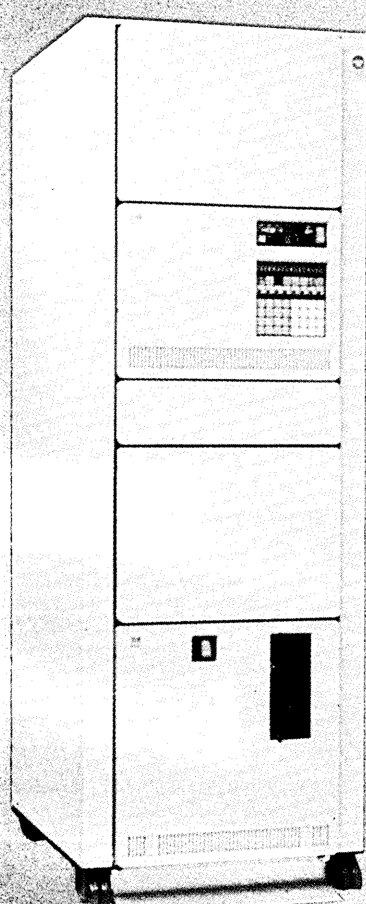

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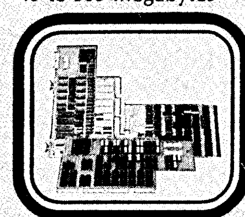

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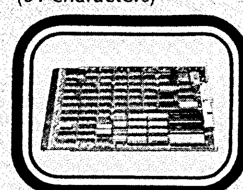

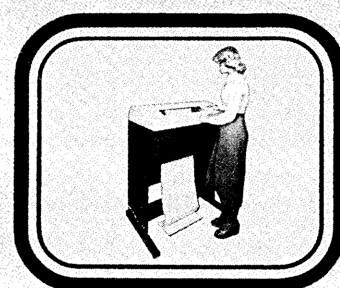

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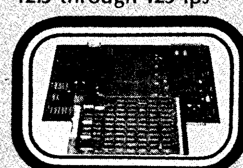
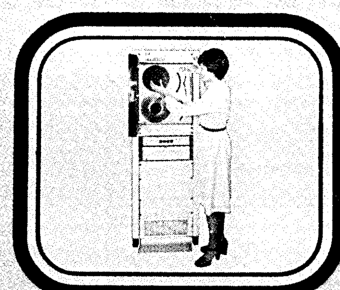
1600 bpi PE
12.5 through 125 ips





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CIRCLE 2 ON READER CARD

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With each advancement of computer communications technology, a Teletype* product has been there to meet the need.

Today, the latest Teletype product to follow in this tradition of quality, performance, dependability and price is the new 4540 Series of data terminals.

Not merely a new product, the 4540 Series represents a new direction for Teletype Corporation. A change from a philosophy of product orientation to one focusing on user-applications.

The 4540 Series also represents a new commitment. A commitment to provide a wide range of system solutions to meet user needs in computer-based systems. A commitment to customers before, during and after the sale.

The new 4540 is a keyboard-display based interactive series of synchronous terminals designed for inquiry/response, data entry and data retrieval. Operating at speeds ranging from 2400 to 9600 bps, it utilizes keyboard, display, character printer and line printer modules, as well as a controller with a simplified sub-set of software modules.

Since it truly is the state of the art in data terminals, the 4540 Series is available in several configurations compatible with the most popular standard host protocols for communications control. Initially, single-display and clustered configurations will be available, with the clustered version able to accommodate a maximum of 32 devices—including up to 8 printers. All 4540's can be coupled to multi-point or point-to-point private line facilities.

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