PC WORLD

Volume 1, Number 5
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PC WORLD
Volume 1, Number 5
Communications Programs

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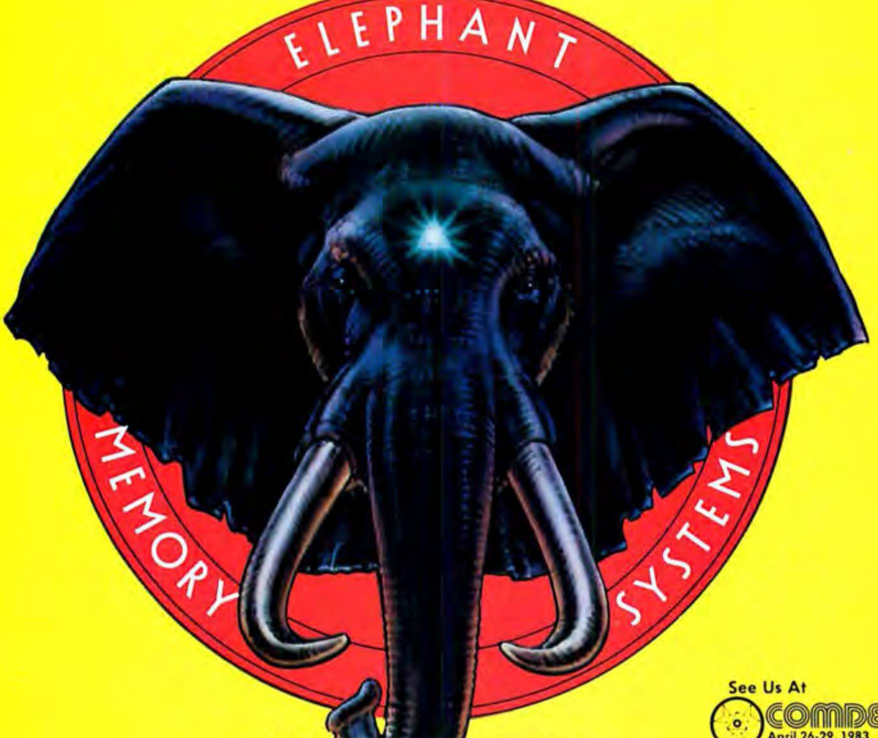

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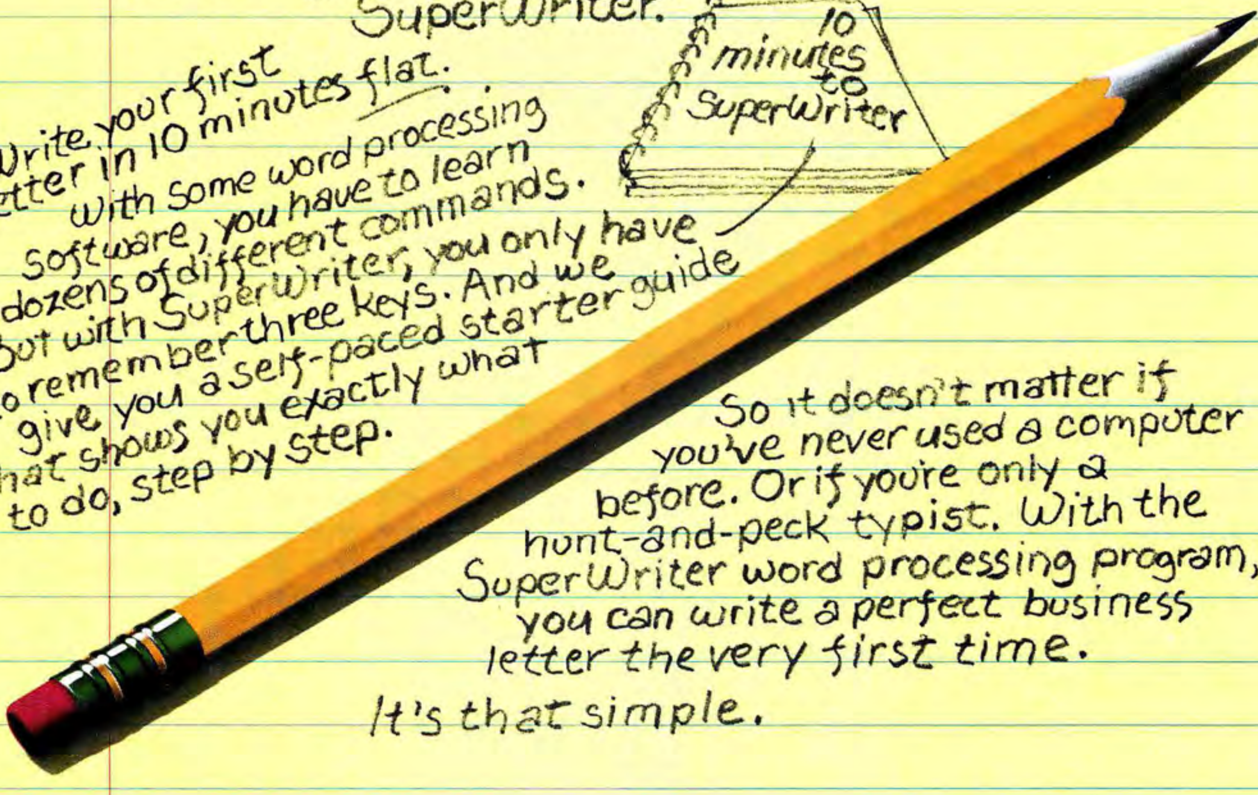

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PC World™ (ISSN 0737-8939) is published monthly for $24 one year, $39 for two years, $53 for three years by PC World Communications, Inc., 555 De Haro St., San Francisco, CA 94107. Additional postage outside the US and Canada $24 per year surface, $101 per year airmail. Second-class postage paid at San Francisco and at additional mail offices. POSTMASTER: Send address changes to PC World, Subscription Dept., P.O. Box 6700, Bergenfield, NJ 07621.
Editorial and Business Offices: 555 De Haro St., San Francisco, CA 94107, 415/861-3861
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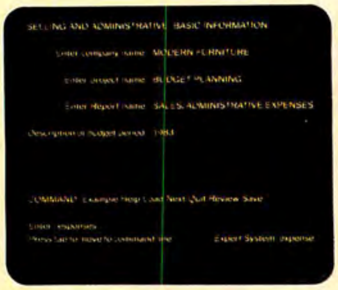
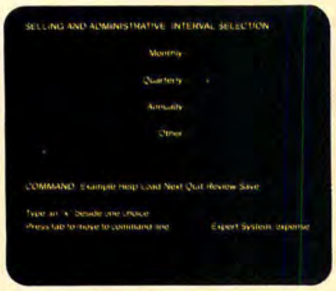


Gentlemen, start your computers.

Time: 0



Select budget intervals.

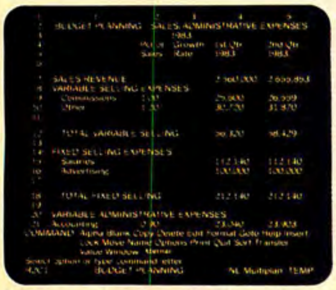
Time: 0.5

Enter sales revenue.

Time: 1.0

Enter selling expenses.

Time: 1.5



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Time: 5.2

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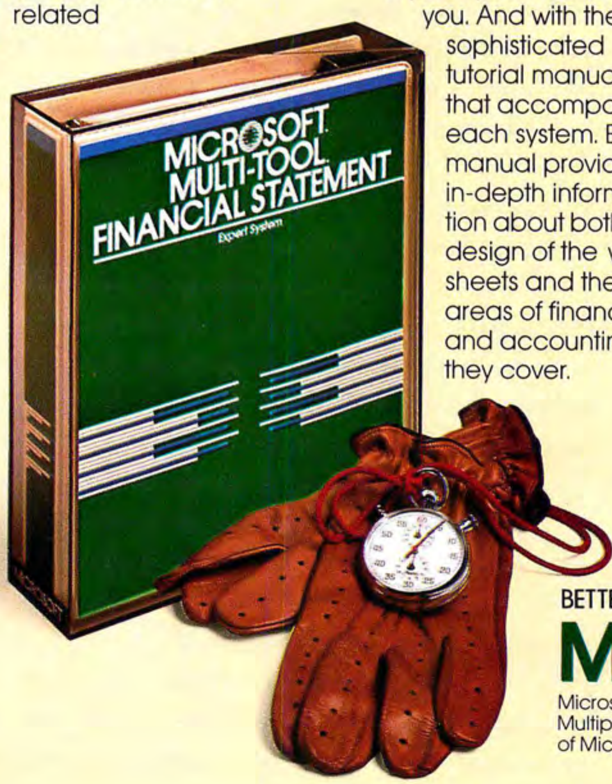

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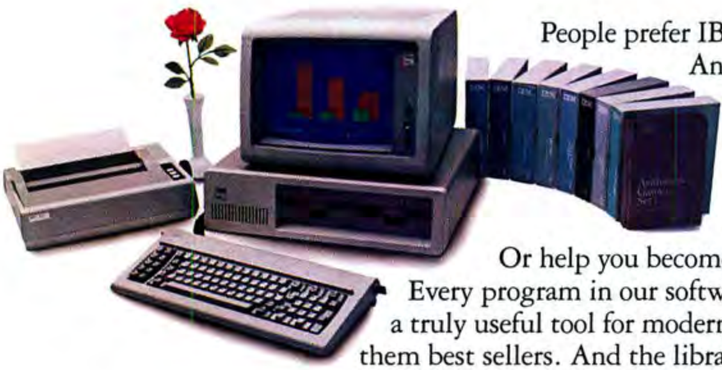

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PC WORLD

The Personal Computer Magazine for IBM PCs and Compatibles

State of the Art

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Review

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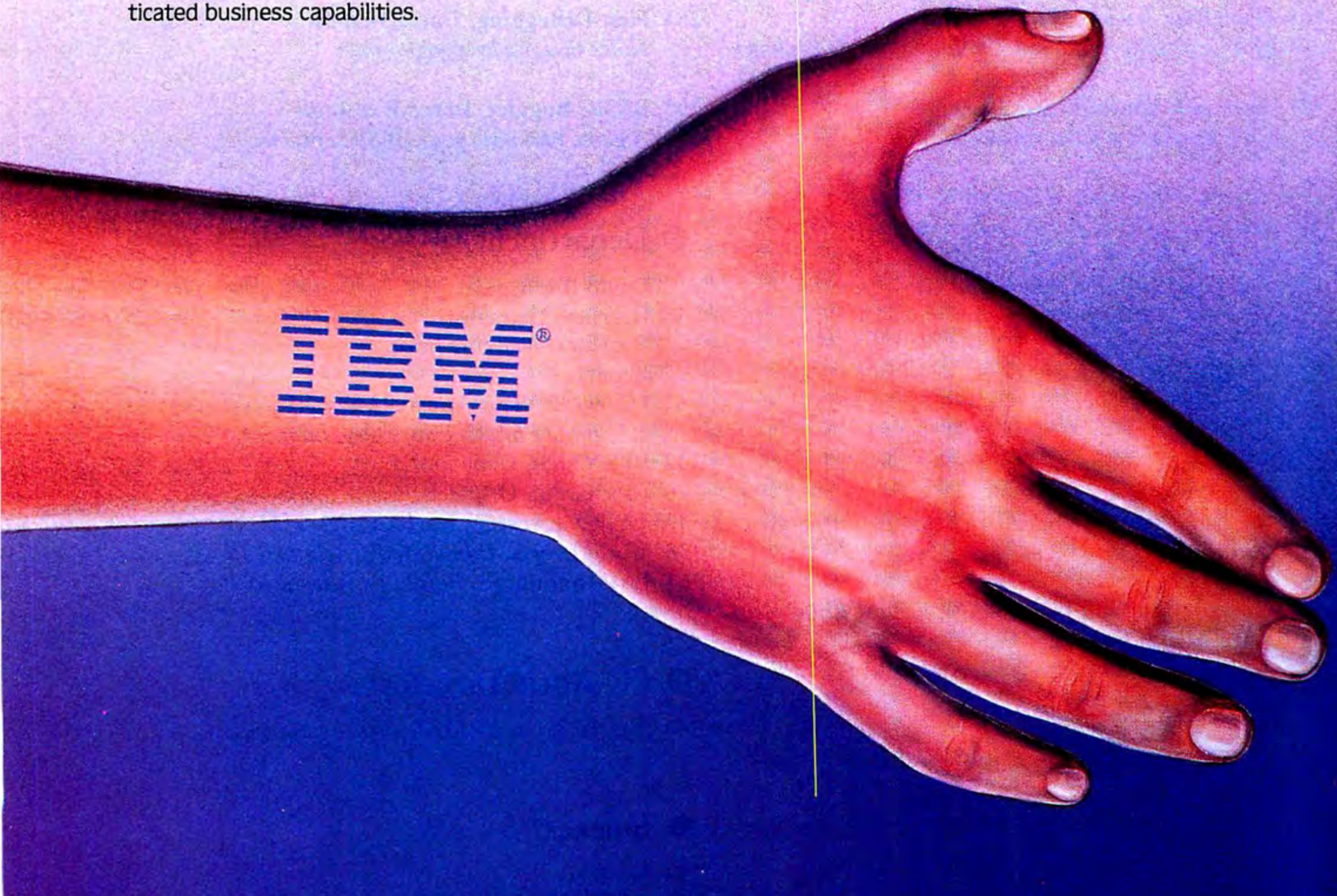

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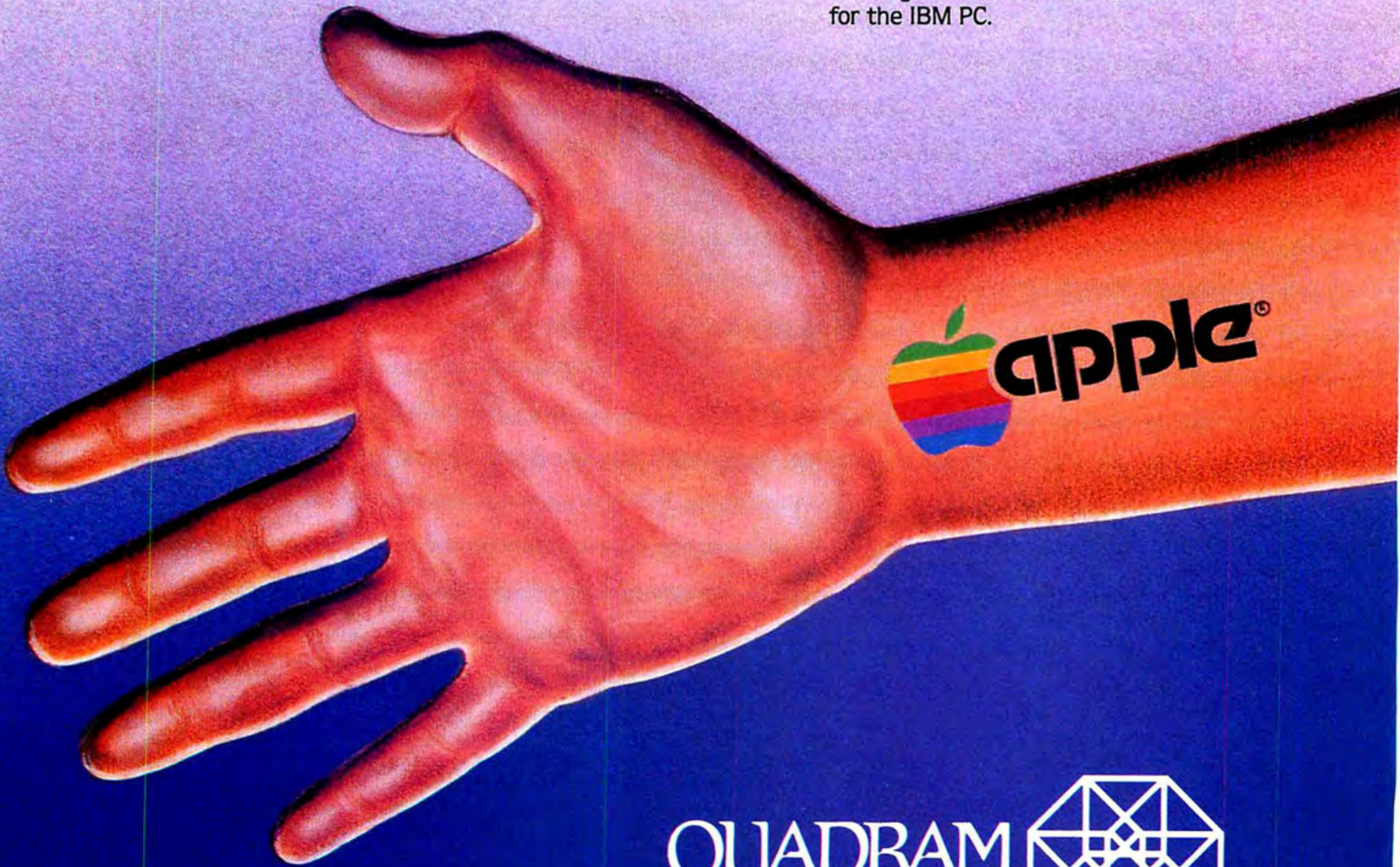

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Reader Service #61

David Bunnell

Catching the World Off Guard

A recent headline in *Computerworld* declared that the data processing (DP) departments in many corporations had been caught off guard by personal computers. Although DP departments in many corporations had been planning to introduce "micros," as they call them, on a very controlled basis within the next year or two, personal computers started to show up in just about every corporate department before these plans could be realized, without any input from company DP departments.

The PC is such a useful tool for the management of information that people have adapted to it at an amazing pace considering its complexity. When a PC shows up on an assistant manager's desk, it not only gets the attention of other assistant managers but is noticed by the manager and director as well.

For many reasons, some of which are nearly logical, DP departments have found this situation a real nightmare. Of course, they find it frightening that so many PCs are already in place, but the real nightmare is that they come in so many brands and models—Apple IIs, IBM PCs, TRS-80s, North Star Advantages, Apple IIIs, Fortune 32:16s.

"How are we ever going to hook these little beasties together so we can start controlling them" seems to be one of the most urgent concerns.

This situation is nothing new because personal computers have been catching people and institutions off guard since their birth in 1975. I expect that they will continue to do so until the entire fabric of all our organizations is restructured into patterns far more diversified and interchangeable.

Implementing a corporate PC policy when PCs seem to multiply like rabbits has given DP departments and their comrades in corporate planning enough challenges to keep them in a tizzy through the remainder of the decade.

The reason for the PC's rapid acceptance is that increasingly more business and professional jobs revolve around managing quantities of information. Workers who use personal computers have an advantage over their colleagues and competitors. The PC's ability to rapidly create and shape documents and reports enables workers be fast on their feet as they scramble up the corporate ladder or launch enterprises of their own.

The real danger comes when the acceptance of information is based more on form than on content. You can do more than access, manage, and format information with a PC—you can create it.

The DP nightmare is not without foundation. If everyone had a computer and the multitude of computers were not interfaced with each other, how would we know that we were all working from the same assumptions?

However, tying all computers together wouldn't necessarily return control to DP departments. Corporate data would actually become increasingly decentralized. DP departments would try hard to control this trend with access codes and security schemes, but over time this strategy would break down. Thus, one of the ultimate effects of personal computers in corporations will be to disseminate power.

Not only will DP departments be caught off guard, but so will the people who think they run the show. Corporations, governments, and all other institutions will become assemblages of autonomous groups.

By bringing sophisticated information management skills to the work place, the personal computer will ultimately lead to more democratic institutions.

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Reader Service #57

Kearney Rietmann

Protecting the Future

Is Digital Research chasing after a key to the IBM personal computer market? Or is the company holding the key to software portability? These two questions came to mind with the company's announcement on May 27 that its family of programming languages and software productivity tools will soon run under PC-DOS. Up to now these products have been compatible with the CP/M operating systems only.

Recognizing PC-DOS as the most popular operating system for the IBM PC, the industry's number-one-selling 16-bit personal computer, Digital Research made the decision to support PC-DOS with its programming languages and productivity tools. High-level languages, according to Digital Research language experts Allen Beebe and Carmen Governale, are "the key to software portability" between one hardware environment and another. The company's aim, they say, is to standardize software across operating environments to enable software developers to penetrate as much of the personal computer market as possible. The intention is to "protect the future" by ensuring easy migration to new hardware environments.

By committing itself to software portability, whose future is Digital Research actually protecting? Certainly the company is protecting its own future by expanding its languages market. Digital Research's recent announcement also noted that by supporting PC-DOS the company will provide a "bridge" to its 16-bit single-user, multitasking operating system, Concurrent CP/M-86 (which Digital Research claims will be a future standard). Undoubtedly, Digital Research is striving to protect the future of Concurrent, which hasn't caught on well in the IBM PC market, either because it can't compete with IBM's chosen operating system or because it is ahead of its time and too few people are aware of its capabilities.

The major issue is Digital Research's desire to "protect the future of all professional software developers." The company sees its move to support PC-DOS as a way to help developers avoid some of the problems of transporting products from one environment to another in a market where new hardware is being developed at an unpredictably rapid pace.

As software developers and many end users know, software is often written for a specific operating environment. When a new-generation microcomputer is introduced, a problem arises because little applications software is immediately available. The appearance of new hardware leads software developers into the time-consuming process of transporting software from one environment to another. An example of this situation is the Intel 8086 microprocessor upgrade from the 8080. Although the chip was introduced in 1978, software developers didn't make the transition from the 8-bit world to the new 16-bit world until late 1981 and early 1982.

In the past Digital Research's answer to the portability problem resided with its family of CP/M operating systems, which, through a technique called object code portability, allows software designed for one 8-bit (or 16- or 32-bit) machine to run on another machine using the same processor and operating system.

Kearney Rietmann

For migration from one processor to another, however, Digital Research's portability response is high-level languages. By developing applications in one of Digital Research's languages, rather than in processor-specific assembly language, software developers should be able to transport their applications quickly and efficiently to new environments as they appear in the marketplace. The high-level languages don't promise instant portability from one processor to another, but the approach will hopefully ensure a shorter time lag than the 3 to 4 years between the introduction of the Intel 8086 and the appearance of a body of applications software designed for the processor.

Improving the process of transporting software is important for several reasons. Programs have to be moved from 8-bit to 16-bit environments, from 8086/8088 processors to the 68000, from mainframe and minicomputers to microcomputers, and, inevitably, from 16- to 32-bit microcomputers. Digital Research's recommendation that software developers write programs in high-level languages could make the concept of portable software a reality.

Developers, however, are not about to follow Digital Research's recommendation if it means producing high-level language programs that run at slower than assembly language program speeds. For the approach to take hold program speed will have to be assured through the development of compilers that apply the languages to each new microprocessor that appears in the marketplace.

By supporting PC-DOS with its languages, Digital Research may win itself a larger share of the IBM PC market. This possibility would certainly benefit the company, but the hope is that the high-level language approach will make transporting software an easier process than it has been in the past. If that happens, the entire industry will benefit.

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ANNOUNCING THE END OF WORD PROCESSOR CONFUSION

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Well, we can help. If you'll just invest the next three minutes reading this, we'll tell you about a word processor that makes picking the right one a real breeze.

FIRST, A WARNING. There are two things you must do when evaluating any word processor. First, be careful. It's no secret that many of today's claims about being easy to learn and use just don't stand up to careful comparison. Watch carefully for complicated codes and programs that require "training sessions." Secondly, be selective. Buy a word processor you can use on a daily basis, not one that requires another "training session" when someone goes on vacation. In other words, be very careful to select the word processor that's absolutely the best and easiest to use. Which is what we'll now introduce you to.

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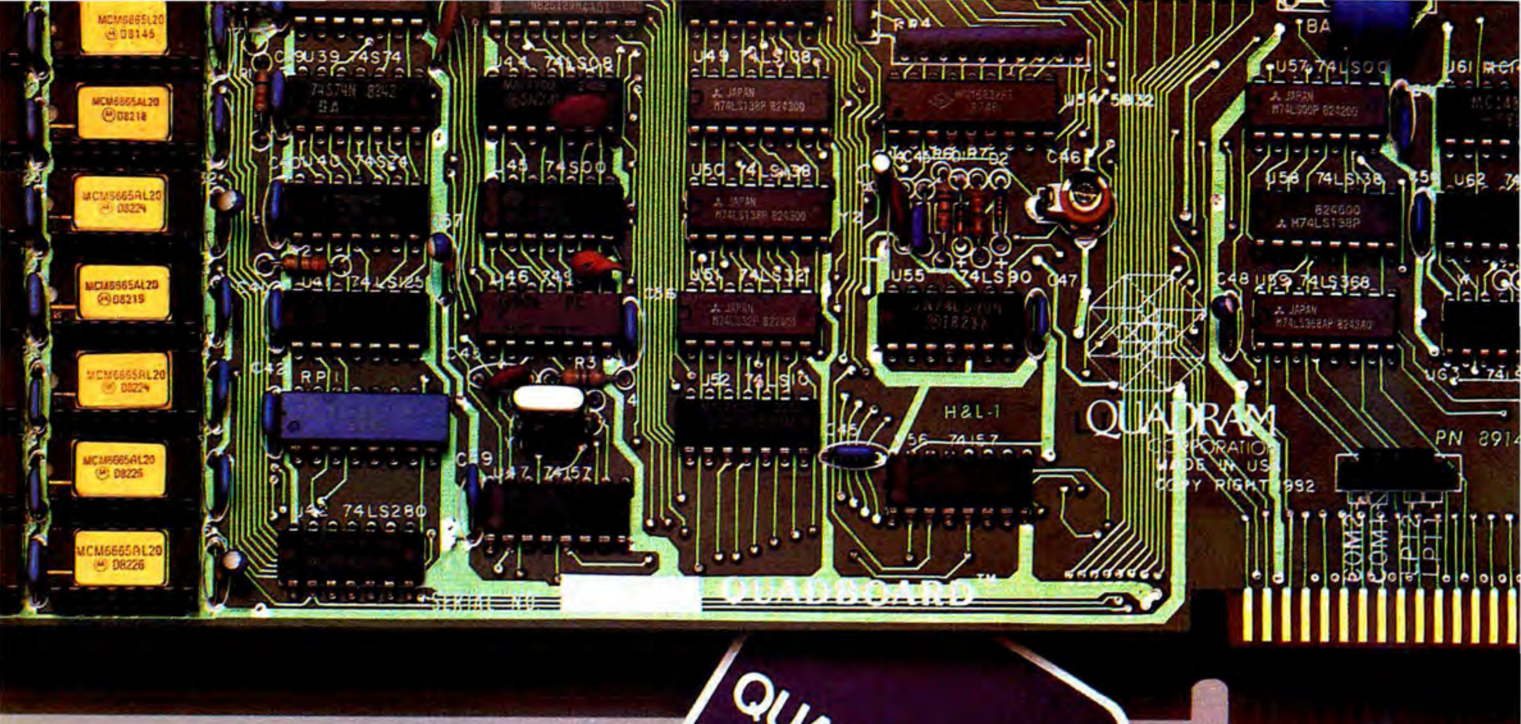
Reader Service #145



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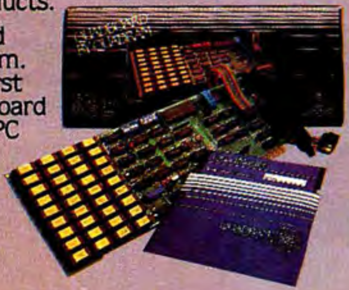

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Reader Service #149

To Speak Computerese

For about 5 years now I have worked around the newest state-of-the-art high technology and computers, and I am still afraid of the Intelligent Machine. My kids, who are 5 and 8 years old, love all machines—TVs, calculators, typewriters, and most of all computers. My son recently got a hand-held computer game from Japan that included Japanese instructions. I couldn't make heads or tails of the game and searched for a translator. Two days later, having had all the instructions nicely translated, I explained them to my son, who promptly replied that he already knew them. After 2 days of pushing buttons, he had found out how it worked.

It is frightening to realize that at 36 I must be too set in my ways to adapt to these new machines. Yet I feel that I should learn to manipulate a computer, since this technology supposedly will soon control the world. Or rather, those who control computers will control the world.

What is this phenomenon, this mental block that many others share with me? Am I afraid of a computer? No! It's just a machine that does nothing until it is turned on and operated by a person. On that level I am more afraid of a garbage disposal, which needs only electricity to start munching my silver spoons.

Am I afraid of pushing buttons? No! I can handle both a TV and a typewriter with great ease. And that

also answers the next question: Do I need to know what is inside the machine, how it works, or how to fix it before I can operate it? No, none of these things scares me in the least.

Am I afraid of having to learn another language? Since I speak five languages fluently (none of them computer), that also seems unlikely.

My kids (who love computers) go to a private school, where they are taught everything in French. One might think that starting kindergarten and suddenly not understanding a word of what is being said would be confusing for a 5-year-old. But I'm happy to report that they seem to absorb all nuances of speech and grammar through the very pores of their skin.

Ask them to translate a word or even a sentence into English and they'll tell you they can't do it. But the whole conglomeration of sounds nevertheless makes sense to them. Lucky them. Most of my languages were learned poring over dictionaries and grammar books and translating sentences word by word. After 4 years of study, I still could not speak or understand the languages until I visited a foreign country for a few months.

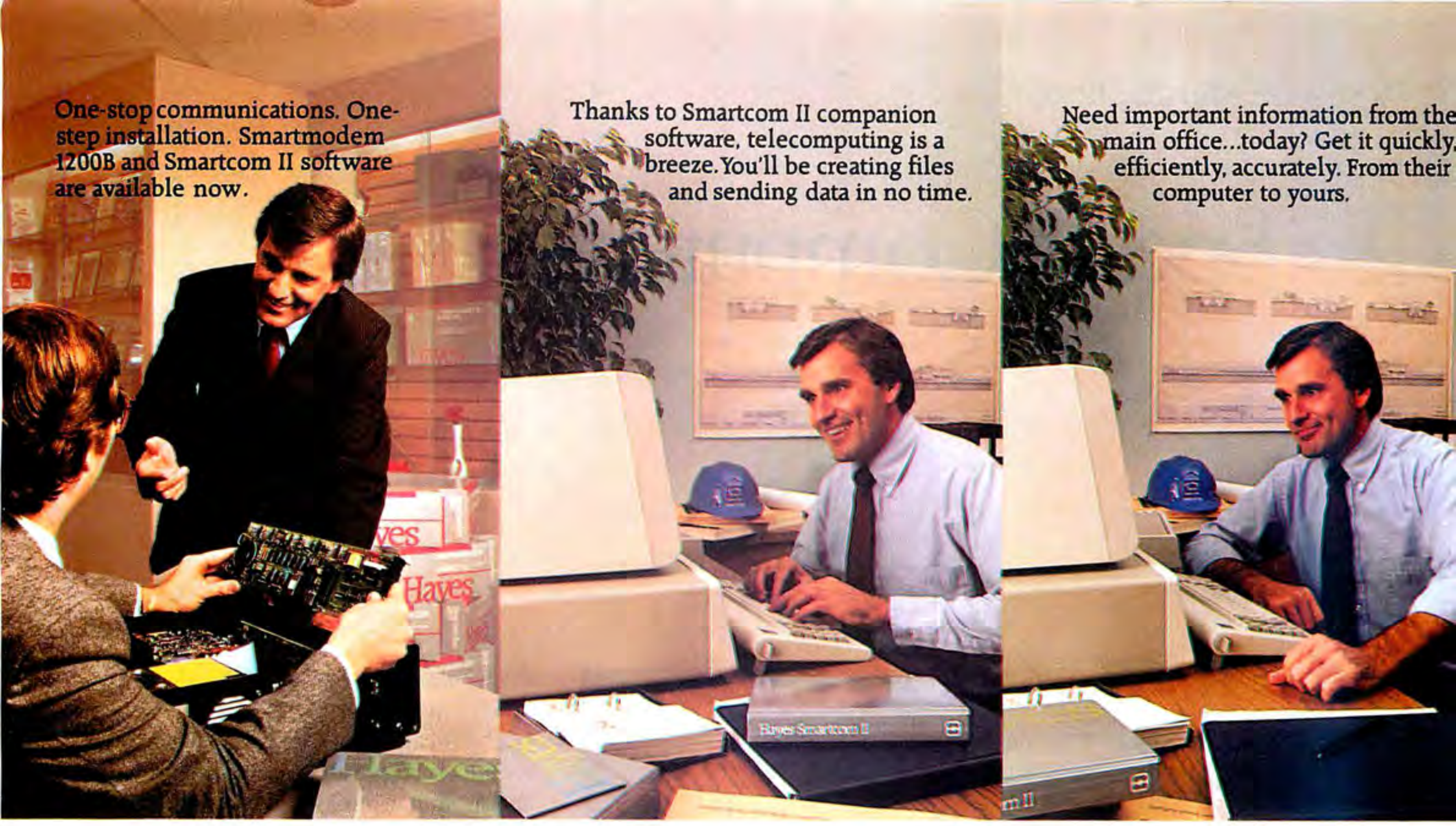
Comparing the way my children absorb languages with the way I had learned, I realized that I'm not afraid of the computer. I am afraid of the manual!

Oh, to be a child again, to learn by absorption rather than by studying grammar, by pushing buttons rather than by reading manuals.

Write me a manual that reads like a novel, and I promise that I— and most adults—will quickly overcome the fear of computers. Make it an adventure story, with maybe a glitch and a few crashes to overcome. Have some programs that get married, some that get divorced, and add the obligatory good guy-bad guy chases. And please give it a happy ending.

Now how do I save this? Oh yes, Ctrl-KD. I could really get to like this machine after all.

Martine Boot is marketing director for Tall Tree Systems in Los Altos, California.



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Reader Service #221

Letters

Color Blind

Lawrence J. Magid's *REMark* in Vol. 1, No. 2 left me a little confused. Oh, I understood the explanation about the 720 by 350 resolution of the Monochrome Display Adapter versus the 640 by 200 resolution of the Color/Graphics Adapter. I also understood the explanation of the Hercules Graphics Card, including the need for nonstandard software support. What I didn't understand was Mr. Magid's economics and his apparent color blindness.

He complains about the "cost of several hundred dollars" to turn his monochrome PC into a graphics PC. He then heralds the Hercules Graphics Card as "hardware to remedy an IBM design flaw." The Hercules ad on page 348 of the same issue of *PC World* says that the card costs $649. At an IBM Product Center, the Monochrome Display and Printer Adapter costs $335 and the Color/Graphics Adapter now costs $244 (down from $300 on March 8). That's a total of $579 to support two monitors simultaneously versus $649 to support only one.

Mr. Magid has also conveniently overlooked the need for color. He points to Corona, Eagle, COMPAQ, and the Apple Lisa as having high-resolution text and graphics, but none of these have color. In spite of his downplaying the importance of the TV attachment capability of the IBM PC, can you imagine the popular reaction if IBM had announced a personal computer that didn't support color? The only color monitors that exist today at anywhere near a reasonable price are TVs or TV-frequency monitors. Unfortunately, 640 by 200 (or 80 by 25 text) is just about the maximum resolution at which these monitors can be driven.

Technology is progressing rapidly. Soon there will probably be a low-cost, high-resolution color monitor and adapter. I'm certain that we will then read another editorial by Mr. Magid blasting IBM for not anticipating this trend a year-and-a-half earlier.

Hal W. Jennings
Boca Raton, Florida

Anachronism

In Vol. 1, No. 2 Lisa Stahr's article "To Build a Better Mouse" ends with the suggestion that the mouse is a passing fad, partly because it increases the likelihood of system failure. To support this idea, Alex Stein is quoted as saying something quite absurd: "Mouse software requires dot-pinpointing techniques that increase the possibility of software crash." Experienced programmers these days know enough to filter from the input to a program anything that is meaningless or dangerous, such as a mispinpointed mouse. Reading that quote is a little like hearing someone say that the army's new weapons won't work because the cavalry's horses are not strong enough to carry them.

Richard King
Berkeley, California

Floor Mice

I liked Lisa Stahr's article "To Build a Better Mouse" (Vol. 1, No. 2). But I have an additional suggestion—put the mouse on the floor where it belongs.

Car drivers, sewing machine operators, and piano and soccer players are all conditioned to work with their feet while performing other activities. For most adults this type of coordination is performed without thinking. In this way, while the feet controlled the cursor, the fingers could remain on the keyboard, the eyes on the monitor, and the mind on the task at hand.

David Bynum
Stony Brook, New York

The Nuisance Reconsidered

I would like to respond to Charles Kelly's *REMark* column regarding software copy protection (*PC World*, Vol. 1, No. 3). I don't intend to rehash all the same old arguments, but I do have two points to make.

First, I would agree with Mr. Kelly in hoping that software publishers will act reasonably and responsibly. However, I do not understand how he can make a statement like, "The small increase in revenues gained [through copy protection]...is more than offset by the inconvenience, time loss, and nuisance...." Has he conducted research to measure whether we are actually talking about a "small increase"? My opinion (also without research) is that it is a rather large increase. I feel that the issue should not be whether to copy protect, but how to develop reasonable and responsible copy protection. To me this means providing one backup with the disk sale and putting in place a fair and effective program for the replacement of damaged disks.

My second point is in response to Mr. Kelly's comments regarding the use of hard disks with copy-protected software. His comments are well taken, but he overlooks another aspect of hard disks—the sharing of one disk by multiple CPUs. If copy-protected software could be successfully placed on a hard disk, the user could then access the software with illegal CPUs without making a pirate copy.

If the copy-protected software fully loads into memory, the nuisance is minimal. If not, I offer this suggestion to the vendor: provide two disks with your software, each holding a portion of the system. Copy protect the first and fully load this portion into memory. Do not protect the second disk that must remain in the drive while using the system. With this approach the copy-protected disk is less likely to become damaged since it receives minimal use, and the second disk can be placed on a hard disk.

George F. Weiss
Red Bank, New Jersey

More Nuisance

Suppose a product were available that could produce low-cost copies of any physical object it were applied to? Just imagine: automobiles, appliances, business machines, and even *PC World* could be faithfully reproduced at the touch of a button. Such a device would be an important business tool to make backups of equipment subject to down time. But would such a tool be misused?

I mention this imaginary product only to dramatize the dilemma software producers face regarding copy protection of their products. Unlike your guest columnist Charles Kelly (*PC World, REMark*, Vol. 1, No. 3), I, as a software author, do not consider copy protection a "nuisance tax."

Copy protection may just be one of our society's fundamentally irreconcilable issues. There has been ample discussion of it in the press over the last several years but little movement toward agreement. In his article Mr. Kelly explores the notion that if software producers and users could agree to some other alternative, software would not need copy protection integrated into the software itself. Unfortunately, history has shown that this is an unattainable goal.

The one alternative that has a chance of working is, to paraphrase Mr. Kelly, to promise the unauthorized user with costly and embarrassing legal retribution. This approach works well with products that require close vendor support, but in my view it is not effective for general software products sold by the thousands or tens of thousands.

Unless Mr. Kelly's "moral" alternative is seen by users to have an unfavorable cost/benefit ratio, I believe it too will fail as a deterrent to unauthorized use.

Mr. Kelly also discusses protection schemes that preclude the use of hard disks. This is an unfortunate problem. But from the software producer's point of view, the hard disk and its bigger brother, the local network, offer vast opportunity for unauthorized copying. Clearly, the task is upon software producers to provide copy protection in these environments if they wish to market for them profitably.

I hope that readers of *PC World* will take these comments in the spirit they are offered, as observations and opinions gained from many years of experience as both user and developer.

Copy protection may be a nuisance to users, but as a software producer, I consider it bad business practice to let software "leave home without it."

Chet Floyd
Manhattan Beach, California

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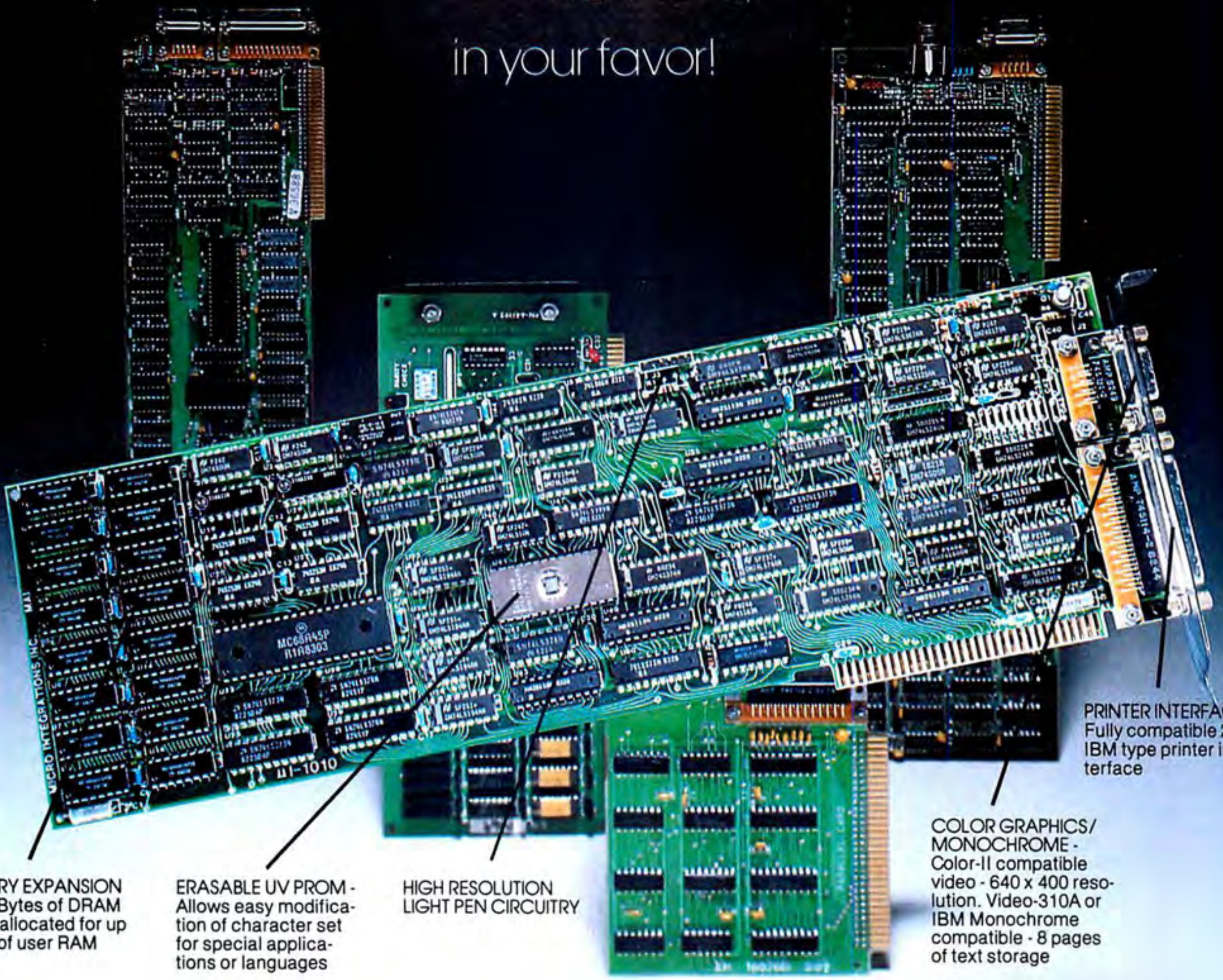

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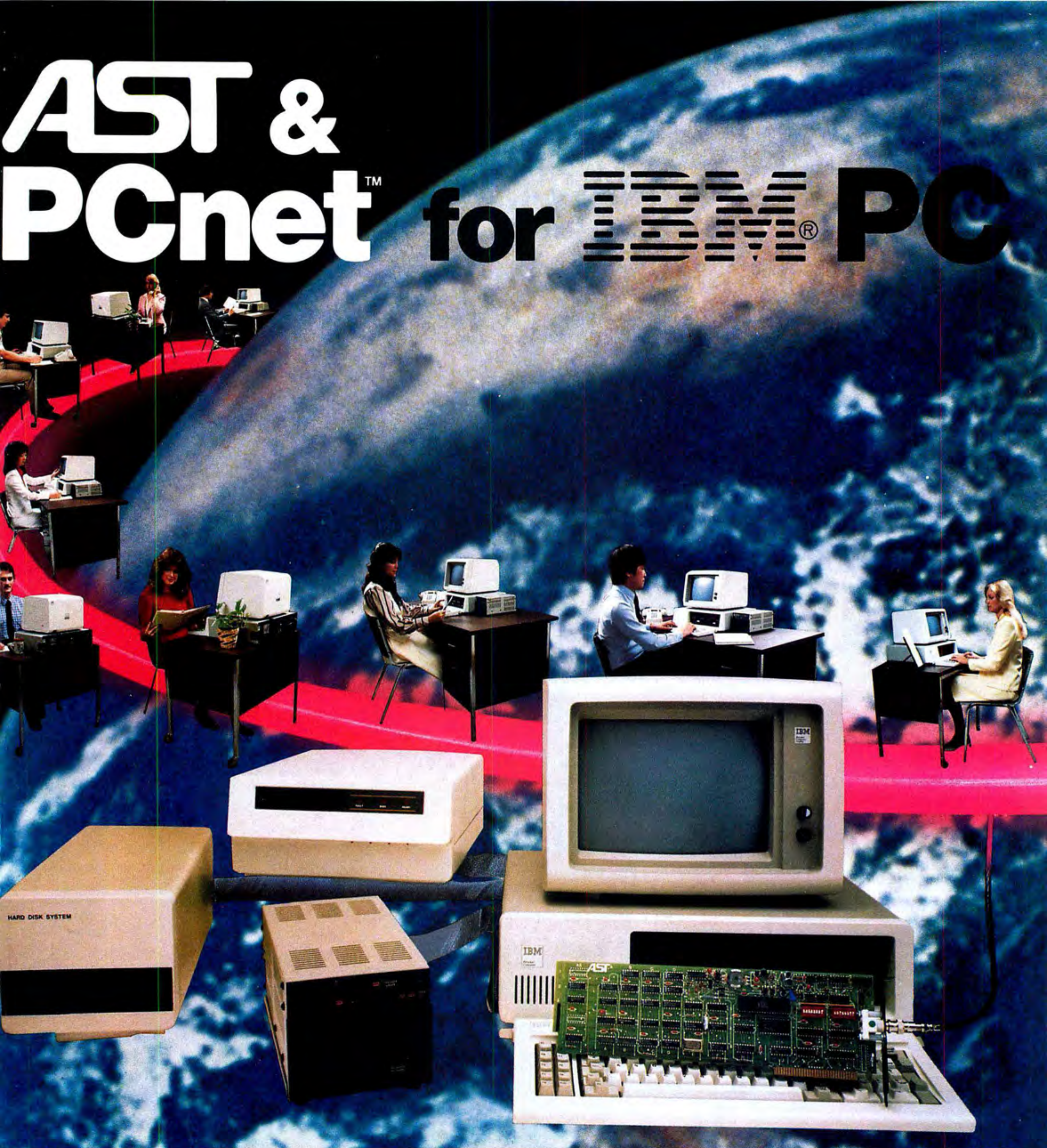
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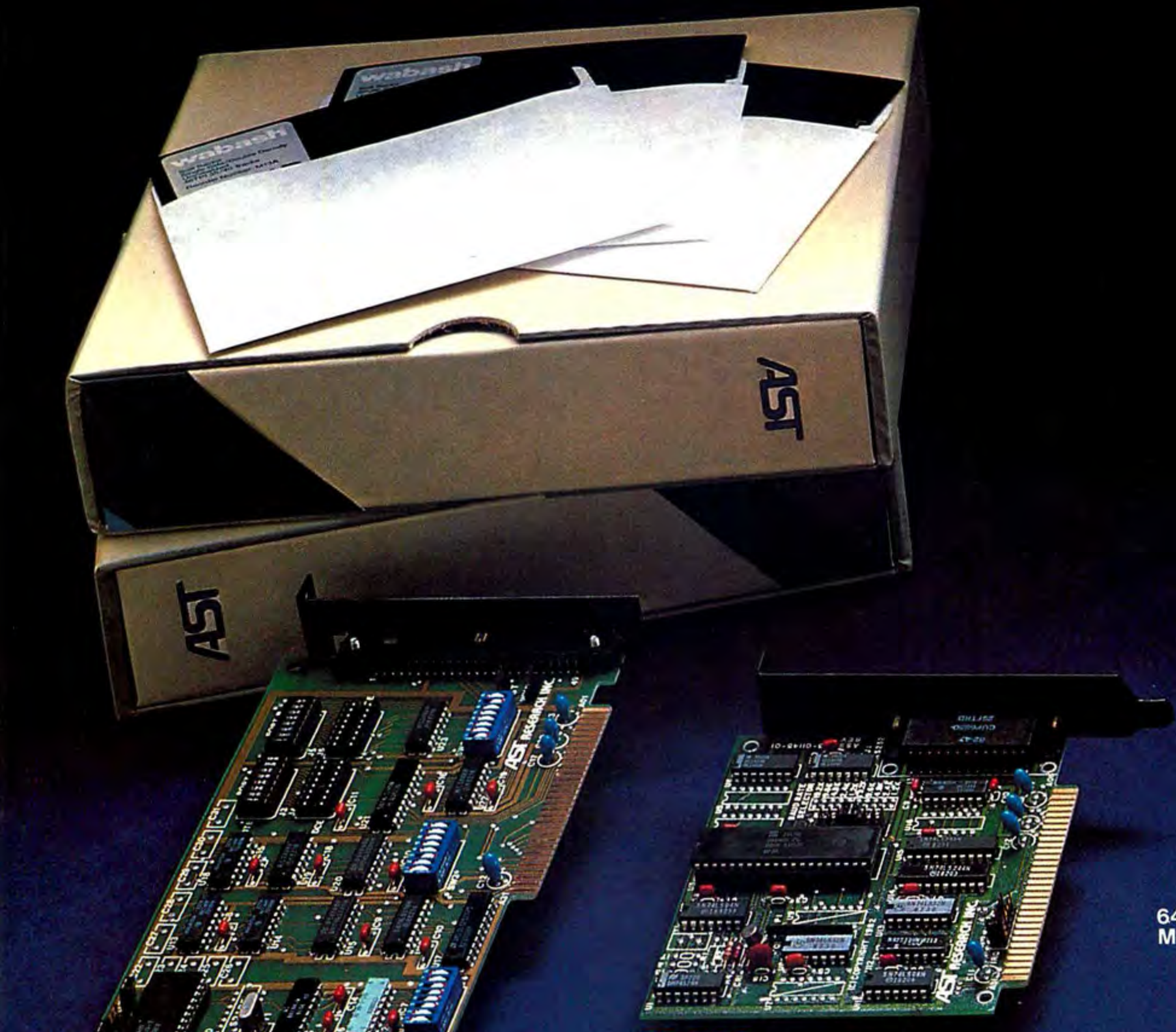

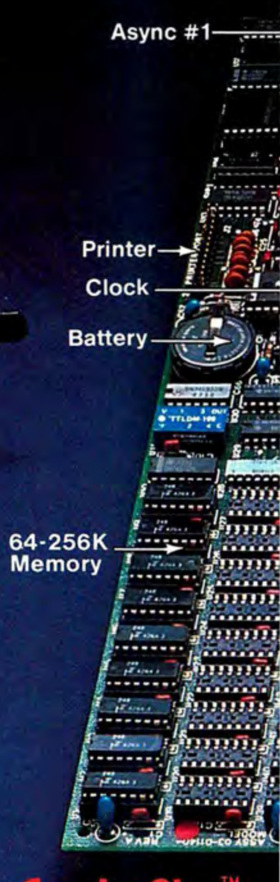

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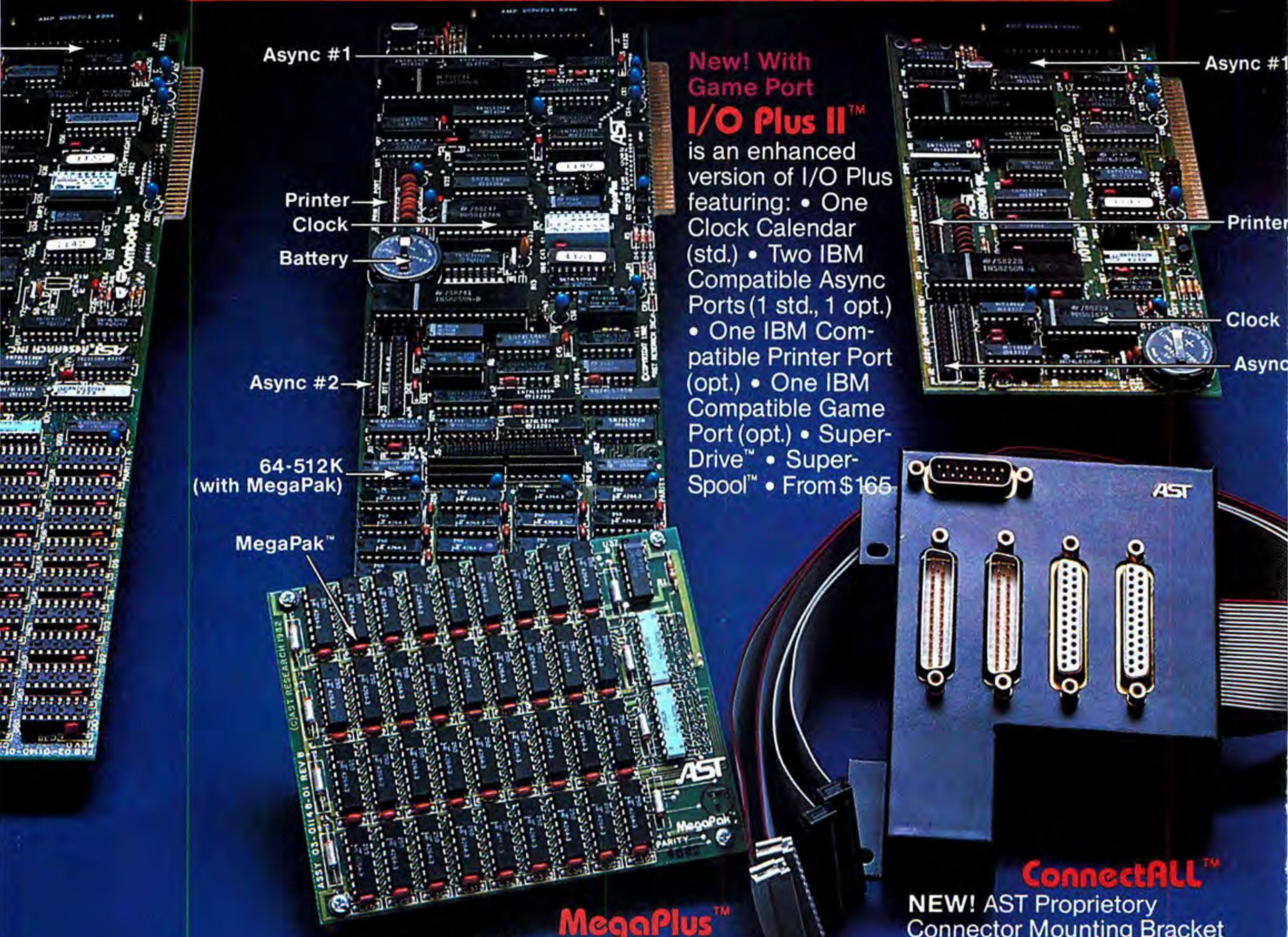

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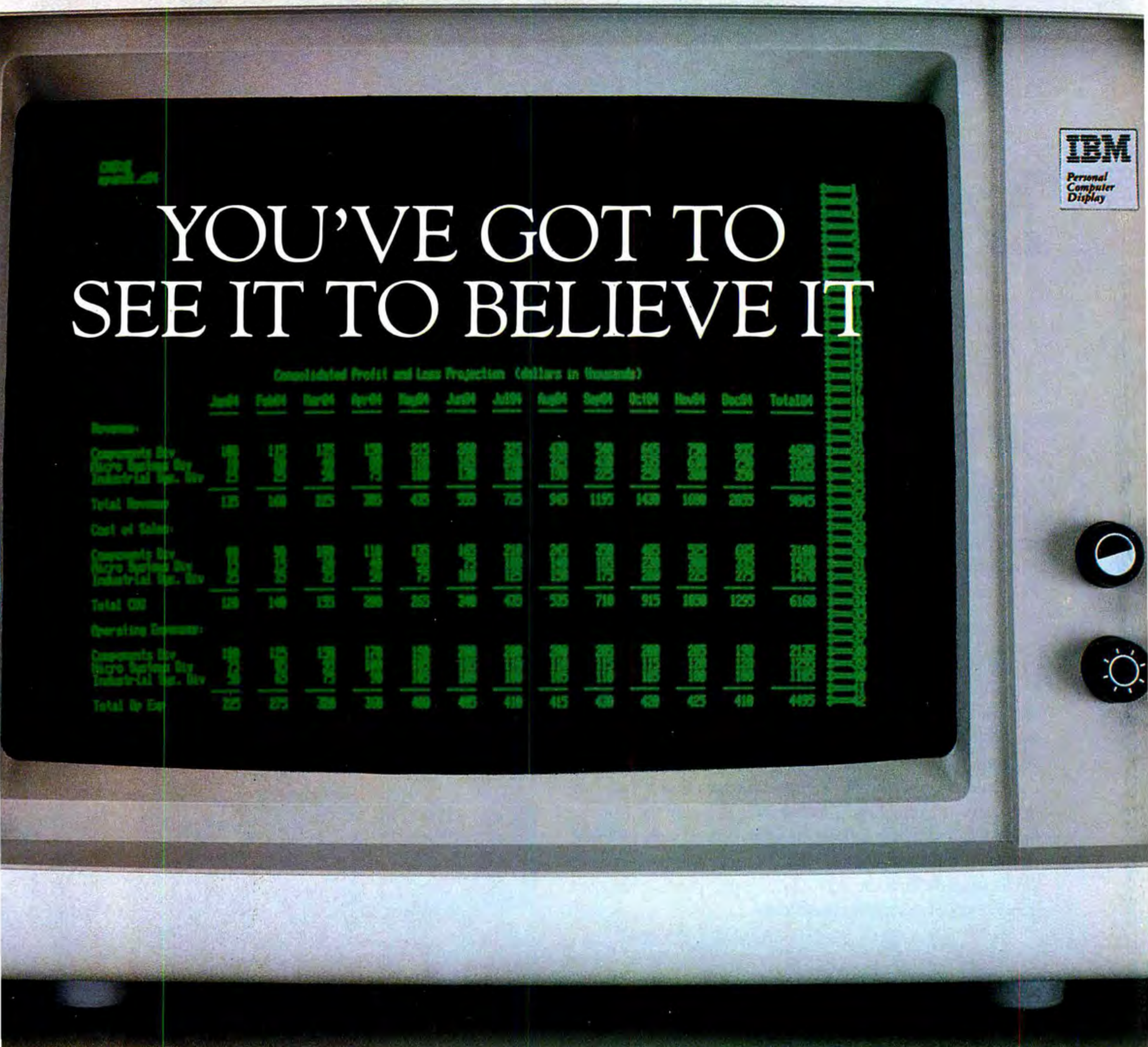
YOU'VE GOT TO SEE IT TO BELIEVE IT
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Mighty Chips

James Fawcette

Something exciting is going on. But like most significant events, it is not happening quickly. Spurred on by developments in integrated circuit technology, a new generation of personal computers is taking shape, and the IBM PC and its clones are at the forefront.

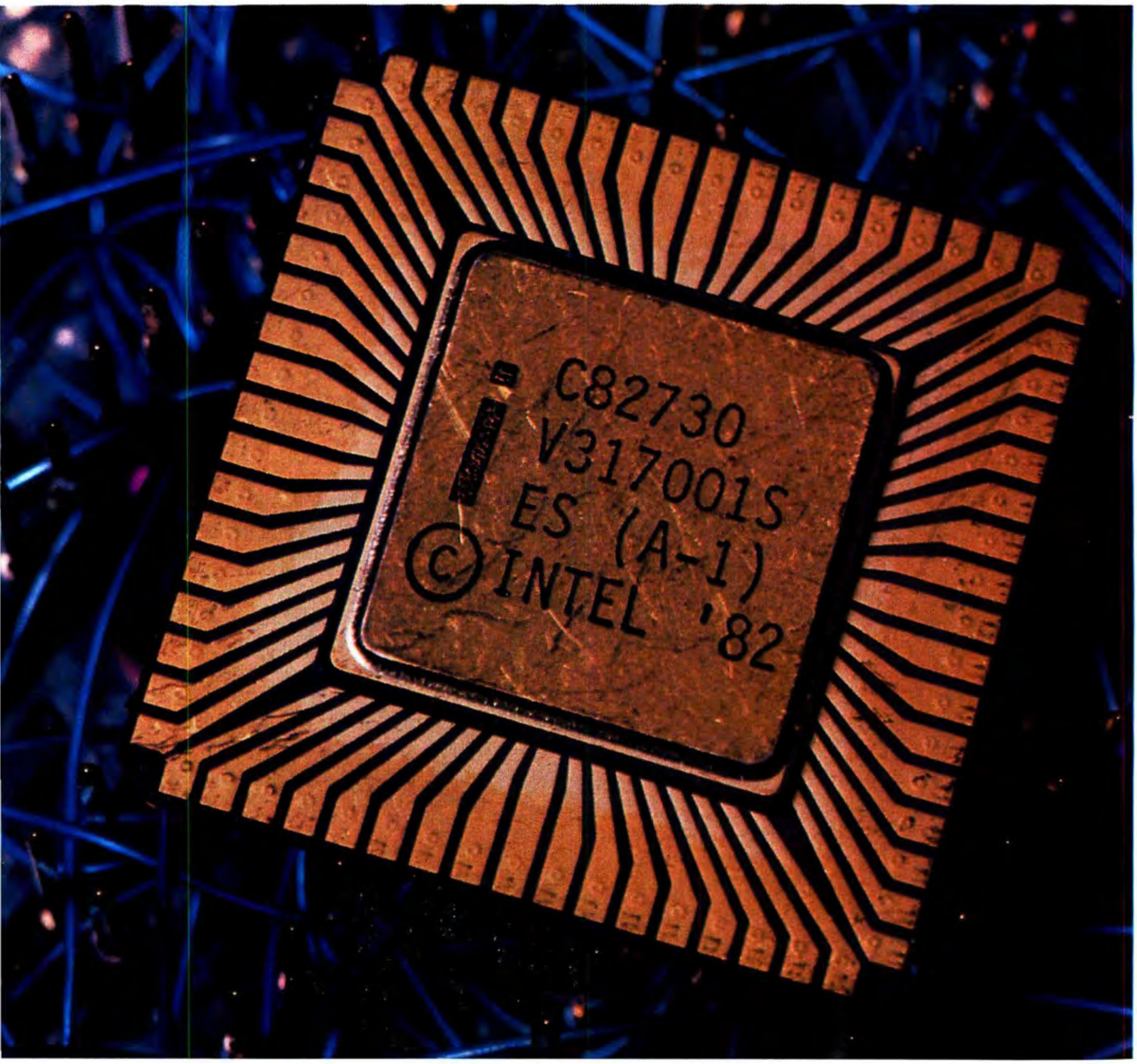
As IBM PC users, it's sometimes hard to remember that the inanimate metal boxes in front of us are susceptible to evolution. But occasionally a product is introduced that forces the complete redesign of our personal computers.

Integrated circuits (ICs), the devices that bring intelligence to our machines, have reached a new level of technological achievement, and now the computers that use them must advance as well. Strange as it seems, these small silicon chips are setting the guidelines for the next generation of personal computers.

The Chip Makers

Now that personal computers have caught on, the semiconductor manufacturers who make ICs are eyeing the swelling market for personal computer ICs.

Dozens of newly developed semiconductor chips are being aimed at the personal computer market. These chips range from hard disk controllers that speed access time to linear predictive coding processors for speech recognition. With these new ICs driving personal computer design, we'll soon see machines we once only reasoned would exist: diskless computers running a wide array of software loaded over telephone lines; computers that display text exactly as it will be printed, with justified margins, superscripts and subscripts, and bold and italic typefaces on screen; and systems with greater, more accessible graphics.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As computer design is simplified by these advanced ICs, product differentiation will become greater. This portends the death of those PC clones capable only of basic spreadsheet and word processing operations. Instead, to survive in the increasingly cost-competitive, standardized personal computer market, small-system manufacturers will tailor their products for niche markets.

Big Blue

Intel Corporation, located in Northern California's renowned Silicon Valley, is one of the largest and most innovative chip manufacturers in the industry. IBM has been committed to Intel products for years; the PC is built around Intel's 8088 microprocessor and, as recently as late 1982, IBM invested $225 million in a minority share of Intel stock. A commitment this size is a good indicator of IBM's faith in Intel products. IBM's good faith and multimillion-dollar investment is guaranteed by Intel's long-standing promise that software written for the 8088 will run on all its future processors.

By taking a close look at the Intel ICs, we can gain valuable insight into the capabilities of the IBM PCs that will be built around them. The design philosophy of Intel's IC family differs radically from that of competitors Motorola, National Semiconductor, and Zilog. Diverse chip designs mean that the system designs of the IBM PC and its competitors, such as Apple's Lisa (based on the Motorola 68000 microprocessor), will also be radically different.

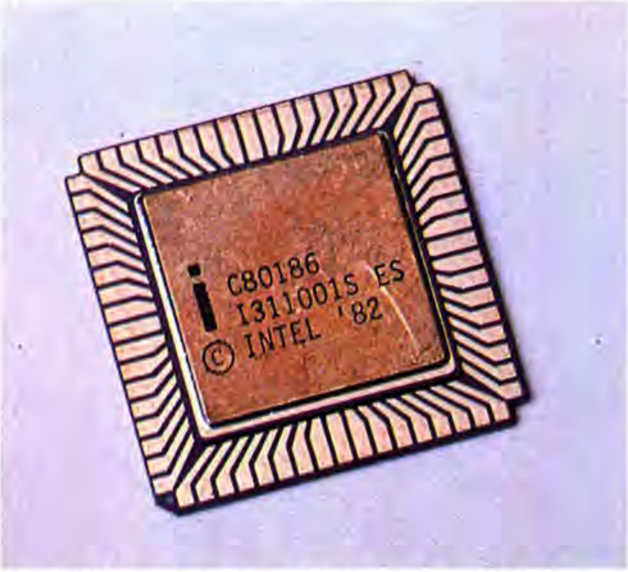
The Microprocessors

Of the many Intel chips being produced, some will have a greater impact on the computer industry than others. In the vanguard will be the new microprocessors.

Design of the PC was shaped by IBM's surprising selection of the 8088. This choice caught most industry observers off guard since IBM, also the world's largest semiconductor manufacturer, had traditionally used its own designs for computer logic. Once Big Blue settled on the 8088, Intel's design philosophy was firmly implanted in the PC—from the 8088's segmented memory scheme to its 16-bit registers and 8-bit bus.

Like the 8088, each of the four microprocessors Intel is now readying for production could dramatically influence the design and performance of tomorrow's PCs.

The 80186. The recipe for putting an entire central processing unit (CPU) board on one chip is easy. Take an 8086 (the 16-bit bus big brother of the 8088), speed it up, and then add most of the support chips essential to making the 8086 run in a personal computer. Reduce the size with the help of computer-aided design until all the chips fit onto one sliver of silicon, and *voila,* you have the 80186 (186), an entire motherboard on a chip.



The 80186 is many times faster than its 8086 parent.

While firming up plans for full-scale production of the 186, Intel is currently providing samples of the chip to computer manufacturers, including MAD Computer and Durango Systems. The rewards for using this newest chip are many: manufacturing costs are cut since a single IC is less expensive to buy than a boardful of them; physical CPU size is reduced, opening the way to shrink overall computer size or to put more power in the same box; and development time is cut for computer designers, which means considerable savings for system makers.

The 80188. If the 186 is too rich for your taste, the 80188 (188) may be more suitable. As with the 186, the 188's core CPU and support chips are melded on a single IC; like the 8088, however, the 188 has an 8-bit interface to the outside world (the 186 has a 16-bit interface). The 188 decreases costs by allowing computer manufacturers to use less expensive 8-bit peripherals. Although the 186 has received more publicity so far, the 188, aimed squarely at the massive 8-bit computer market, is expected to be used in greater numbers, at least in the short term.

The 80286. Powerful multiuser systems will benefit the most from the 80286 (286), possibly the most powerful microprocessor commercially available to date. Squeezing 150,000 transistors on a chip, the 286's designers have integrated a pair of HMOS-III (Intel's own proprietary process technology) 8086s and numerous other very large scale integration (VLSI) components. The resultant chip is two to three times faster than the Motorola 68000 even though both chips can address about the same amount of memory. The 286 has very high speed (1.5 million instructions per second, five to six times faster than the 8086), about 16 megabytes worth of addressable physical memory, the ability to address a virtual memory of 1 gigabyte per task (equal to the capacity of 100 IBM XT Winchester drives), and the ability to provide several layers of multiuser security on chip. Although a 4 MHz version of the 286 is now available, deliveries of a 10 MHz version have been delayed until later this year. (The complex timing of a microprocessor's operations is set by a clock reference. A 4 MHz microprocessor runs roughly 40 percent slower than an equivalent chip with a 10 MHz clock.)

The 80386. Not yet built, the 80386 (386) is promised for 1984, but the release date may slide to 1985. If the 286 is vastly more powerful than the 8088 or 8086, then the 386's potential is staggering. Complementary metallic oxide semiconductor (CMOS) process technology, which lowers power consumption, is being used to build this 32-bit chip. Intel, Motorola, and National Semiconductor are already jockeying for position in what will be an intense competition for the 32-bit market. Motorola is claiming that its 68020 will be the first widely available 32-bit microprocessor when it is introduced later this year, although NCR has already scooped the industry with its 32-bit chip. Hewlett-Packard, not to be outdone, has put 450,000 transistors on a single proprietary 32-bit microprocessor, which is used in the $20,000 to $30,000 HP 9000 work station.

How will these processors impact the personal computers that use them? The most obvious effect will be faster performance. Even the budget model 188 boasts two to five times the instruction and execution speed of the 8088 in today's PC. A 286 is about twice again as fast as the 188, and next year's data-gobbling 386 will have more speed than anyone can immediately use.

Since the 188 is ideal for low-priced portable computers, it creates the ironic probability that a PC-compatible portable may soon be available that will run the IBM PC's full line of software and run it faster than the full-sized PC.

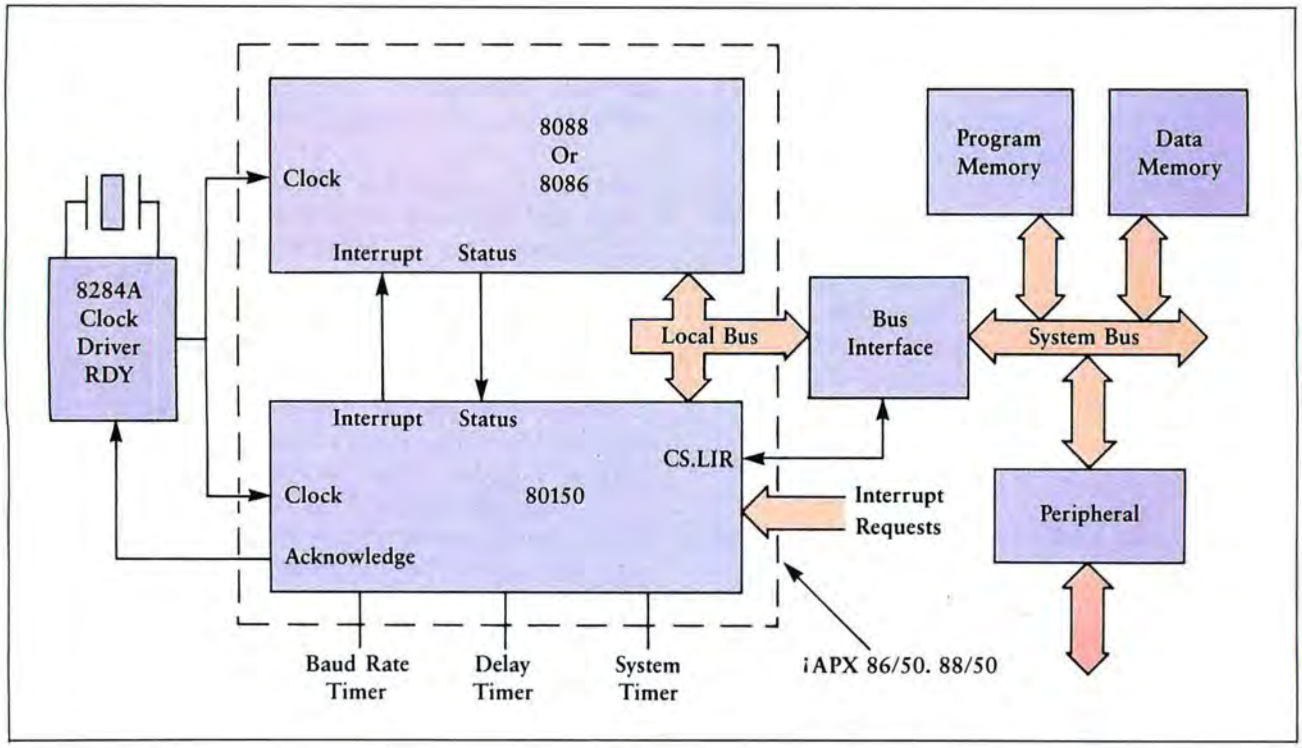
Software on Silicon

One chip ready to plug into the next generation of personal computers is the 80150 (150) CP/M software-in-silicon operating system. A complete CP/M-86 operating system is stored in ROM on this chip, along with drivers for input and output devices.

Use of a 150 CP/M chip will eliminate the traditional booting up procedure of loading an operating system disk and reading its contents into operating RAM. Instead, the user will simply turn on the computer and press a CP/M-86 button. Again and more importantly, this chip lowers overall computer production costs since a disk drive and attendant control circuits are replaced by a solitary chip.

Another chip, similar to the 150, has Intel's proprietary RMX operating system in silicon. This little-known RMX chip is also suitable for present and future IBM PCs.

Many people question the wisdom of putting software in silicon. "Software should be soft," says Bill Gates, chairman of the board at Microsoft. He points out that operating systems are constantly updated; for instance, Microsoft will soon offer a revised version of MS-DOS that supports networking. Such updates can't



Block diagram of Intel's 80150 CP/M on a chip with the 8088 or 8086 microprocessor

readily be added to a hardware production line and certainly won't help the ROM chips already in users' computers.

Still, Intel argues that its choice of CP/M makes the 150 practical. "We picked CP/M because it is a mature operating system," says Intel's product marketing engineer for software on silicon, Carl Buck. "We'd have more difficulty with a less developed product." The many versions of MS-DOS helped eliminate that operating system from consideration. Yet according to Digital Research President John Rowley, Intel left some room on the 150 chip to add to CP/M in the future.

Also, use of the 150 CP/M chip doesn't preclude the use of other operating systems. PC-DOS could still be loaded into a system and run, making use of the 150's input/output drivers.

Portables

Having software on silicon opens the way for very powerful diskless portable computers. The minimum configuration for a 188-based unit with the 150 CP/M operating system could include one or two BASIC applications programs in ROM, providing spreadsheet and word processing power in a unit the size of a keyboard with a small flip-up screen. Intel Product Marketing Engineer Tony Zingale suggests we may soon see truly usable portables selling for around $500.

More ambitious and expensive portables could accept applications software over telephone lines, loading them into a variety of media. Several memory technologies will compete for room in portable computers, including magnetic bubble memories, already being used in the Grid and Teleram computers. Commercially available bubbles have 4 megabit capacity, while 10- to 16-megabit bubbles are projected for the near future. Japan's NEC reported a major breakthrough that within 5 years will allow bubbles to store 1 gigabit of data. Of course, 8 of those bits are needed to store 1 byte of data.

Vying with bubbles in some applications and complementing them in others are electronically programmable read-only memories, or EPROMs. Like ROM, EPROMs are nonvolatile chips. Unlike ROM, EPROMs can be reprogrammed. Intel now offers 256K EPROMs, and it is anticipated that other companies will offer 256K EPROMs before the year's end.

Graphics

The space created on the motherboard by the 186 and friends will enable computer designers to add more graphics capability to their systems. Like the 150 there are co-processor chips ready for the task.

A pair of Intel ICs, the 82720 (720) graphics display controller and the 82730 (730) text co-processor, are touted as providing vastly enhanced and simplified displays. With the 730, text can be displayed on the computer screen as it will be printed out. Italics can be mixed with straight text, and superscripts and subscripts are shown without the annoying and often misleading arrows common in today's software.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FEATURES

Mr. Smith, I will contact you in the near future to set up a demonstration of our 82730 text coprocessor. In the meantime, if you have any questions, please feel free to contact me -- my card is enclosed.

Sincerely,

A. Fine

Alistair Fine
Marketing Manager

JD:jl

Enclosures

With the 82730 text coprocessor text is displayed on-screen just as it will be printed.

Editing can be speeded up by the 730's support for split screens, multiple windows, dual cursors, smooth scrolling, and table-driven linked lists. Displays of up to 200 characters per row and 128 lines per screen can be supported, and unique character sets, such as Arabic or Japanese, can be built.

Even more capability can be added through the 720, an IC that works with or without the 730. Introduced in September 1982, the 720, a joint effort between Intel and NEC, is said to be integral to graphics plans for NEC's 8086-based Advanced Personal Computer.

One application in which the 720 and 730 will shine is opening windows on-screen. Most computer users are familiar with the ability of Apple's Lisa to link spreadsheets, graphics, and word processing through multiple displays, or windows, on one screen. Lisa uses memory-hungry software and dedicated hardware. Apple's initial release uses 1 full megabyte of RAM, and Lisa will soon be offered with 4M of internal memory in addition to a mandatory 5M hard disk.

For comparison, the IBM PC, limited by the range of the 8088, can address 1M tops. VisiCorp's *Visi/ON* promises Lisa-like graphics and program-linking capabilities for the IBM PC, with lower memory demands and no dedicated hardware other than a mouse. Although *Visi/ON* supposedly runs faster with an 8087 math coprocessor, VisiCorp will not comment on whether its software will make use of the 720 or the 730.

Bit-Mapped Graphics

Both Lisa and *Visi/ON* use bit-mapping, a process that the 720 and the 730 are said to simplify. In plain words, to create an image on-screen, the electron gun that illuminates the screen must be positioned and then turned on and off. Data to do this is stored in RAM as a bit-map memory corresponding to positions of pixels lit on the screen. For one-level monochrome displays, 1 memory bit describes each pixel; for color and levels of grey, several bits must be used to describe each pixel.

Creating images is a lengthy chain of simple operations. In a system that uses the 8088 alone, the microprocessor is heavily burdened and the software runs slowly. Using complementary chips to take up part of the processing chore will speed up the process considerably. This is where the 720 and the 730 come in. By doing tasks such as looking up and manipulating a library of commonly used figures, quickly accessing the bit-map memory, and rewriting the bit map, both chips speed text and graphics operations.

Flat vs. Segmented Memory

Use of the 720 and the 730 demonstrates Intel's design philosophy and how this philosophy impacts the IBM PC. Computers such as Lisa that are based on the Motorola 68000 have a flat memory, while computers based on the 8088 or 8086 use segmented memory. According to Intel, segmented memory (see "How the PC Thinks," *PC World*, Vol. 1, No. 1) works better for text and graphics manipulation than its flat counterpart. Ordinarily in processing any string of characters, changing a single letter in a string of text means repositioning every character in a document. But since segmentation uses pointers to locate data in memory, only the pointers locating the beginning and the end of a passage of text have to be changed. Similarly, pointers in memory can be used to position bit-map data corresponding to multiple windows on-screen, eliminating the need to recalculate and manipulate the entire bit map. Segmented vs. flat memory has become somewhat of a religious issue in the semiconductor industry.

Intel and Motorola also differ on how much burden to put on the CPU. Motorola's 68000 is faster than the 8088 and the 8086 and can address more memory than either of those chips or the 188 or the 186. But the 186 and the 286 are substantially faster than the 68000. Also, the 286's ability to address 16M opens the way to using large memory segments, strengthening Intel's case for segmented memory.

In many 68000-based high-end systems the computer designers have decided to use a co-processor, either bit slice, or in one case, an 8086, to do graphics. Many people are skeptical of Intel's graphics approach, but Intel maintains that its approach will allow computer designers great flexibility. In an ultimate system, multiple 720s and 730s could be combined to handle interactive windows under the direction of a 286 processor, while more complex imagery (beyond the practical ability of bit-mapping) could be managed by an 80287 math coprocessor, the next generation cousin of the 8087. The creation of three-dimensional graphics that can be rotated on screen for advanced computer-aided design and manufacturing systems, for instance, is best handled by vector graphics rather than bit-mapping.

Software Demands

Yet there is more to computer design than hardware. Software must be written to take advantage of the new ICs' promise. In the case of the 286, no operating system yet exists that can take full advantage of its capabilities. Plug-ins currently on the market that add the 286 to the IBM PC provide little more than a faster 8086. Only new operating software will use the new chips to their fullest potential.

One solution on the horizon is a 286 version of XENIX due to be introduced mid-1983. XENIX, a multiuser operating system with a visual shell similar to MS-DOS, is a takeoff on Bell Labs' UNIX operating system. A licensing agreement among Intel, Bell Labs, and Microsoft, the author of XENIX and MS-DOS, is reportedly being negotiated. Negotiations between Intel and Digital Research to provide a CP/M variant for the 286 have been underway for some time but have reportedly stagnated.

For lower-end systems Microsoft is said to be upgrading MS-DOS to accommodate networking. This advance comes at the right time, as the 188 and 186 open up sockets that could be used for local area network chips such as the programmable Ethernet chip from Intel.

As long as software and hardware keep growing rapidly together, PC users will be offered a continuing stream of improved computers and ever more capable plug-in boards. The variety seems endless and next year's crop exciting.

James Fawcette is executive vice-president of EW Communications, a technical magazine publishing company in Palo Alto, California.

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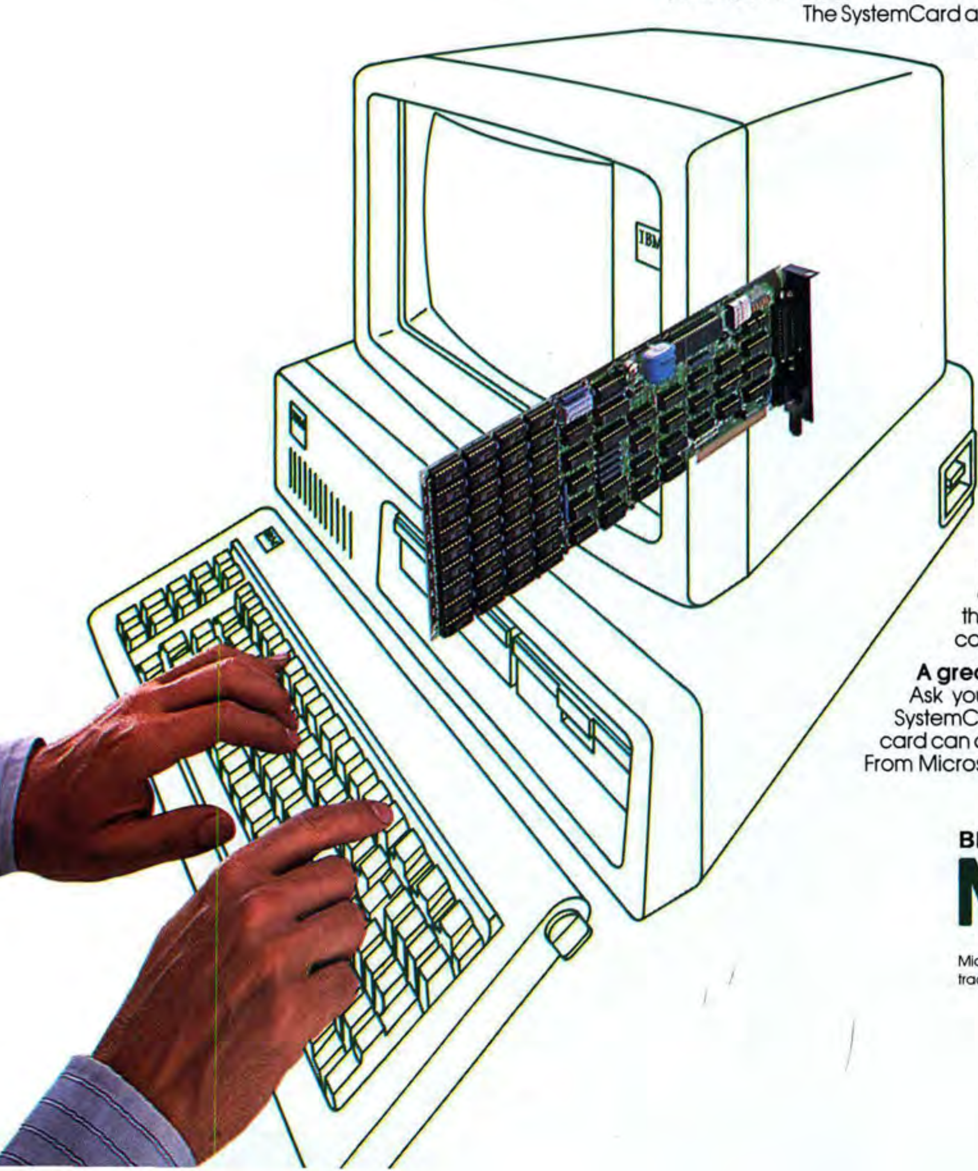

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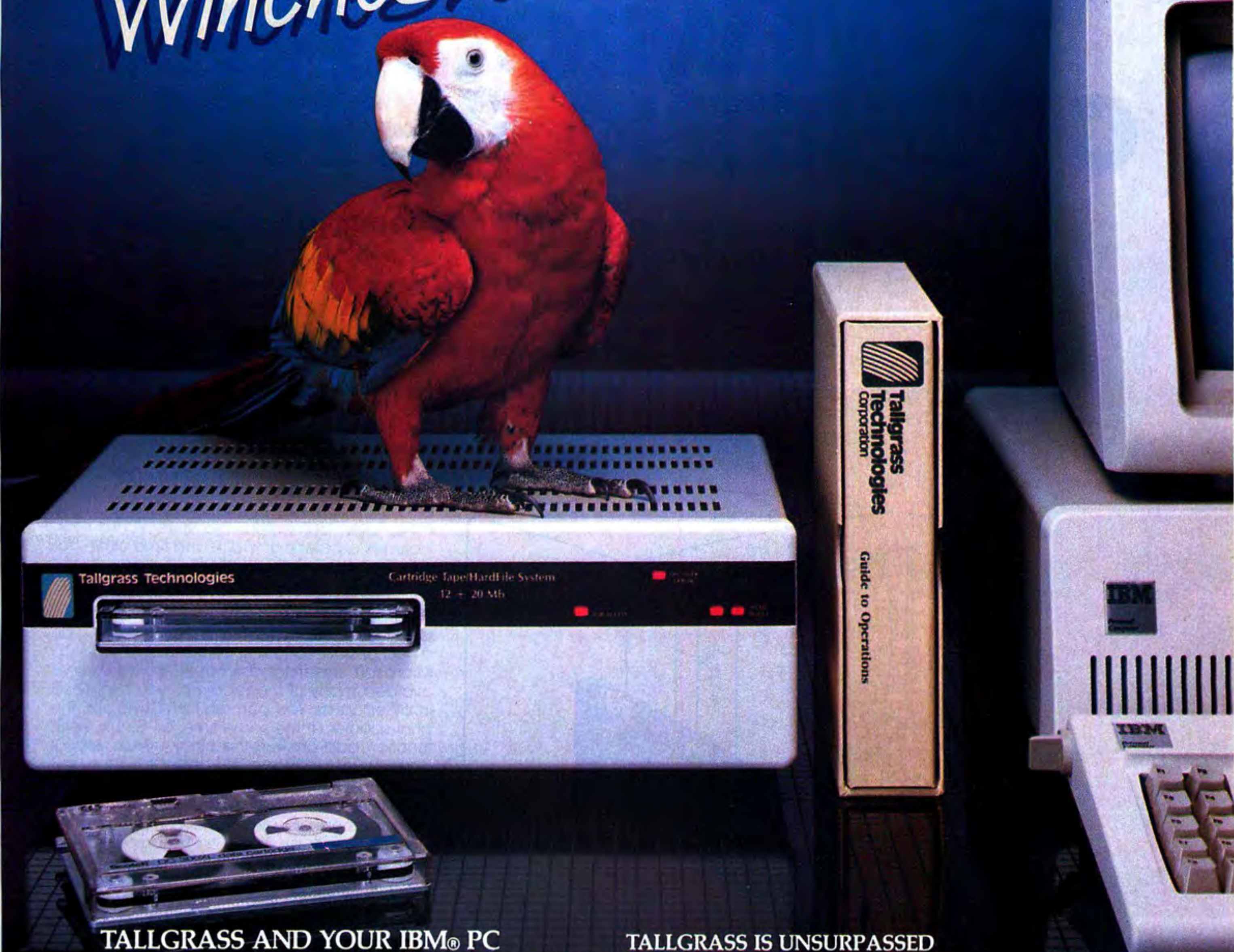

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Drawing with Curves

Proven technology unites with the PC to provide a new state of the art for computer graphics.

Steven Cook and Karl Koessel

For many years the field of computer graphics has been dominated by images created using straight lines. Even circles are composed of small, straight-line segments connected to form a ring. But a small Southern California company hopes to change that with the introduction of conography, a technology that creates images using parts of ellipses instead of lines.

Despite its high-tech name and high price tag, computer graphics today is little more than an electronic version of connect-the-dots. Video displays provide a field of dots, called pixels, that the computer can connect as needed to form an image. This works well for images composed of vertical and horizontal lines; however, it poses a problem for diagonal lines, and it just barely works for curves.

The earliest computer graphics were created using pixel graphics technology; each pixel of an image was calculated by the applications software. A major advance in computer graphics was vector graphics, so called because programs need specify only the starting point, direction, and length of a line—the logic to calculate pixels is implemented in hardware and software transparent to applications programs. Vector graphics are faster than pixel graphics and require much less data to describe an image.

But vector graphics do not eliminate the problems of displaying circles and curved lines, because either each pixel of the image must be specified individually or enough points must be specified so that the image will appear to be round when the points are connected by lines. Changing the length of a line is easy, but changing the size of a circle or curve involves recalculation of the entire image.

This problem occurs because changing the scale of a curved image increases the number of points used to create it. If the same number of points are used to define a larger image, then the lines become too apparent and the curved image takes on the appearance of a polygon (see Figure 1).

Conography creates curved images in the same way that vector graphics creates lines: programs specify the characteristics of a curve and the conographic hardware and software take care of the details. The result is a tremendous increase in speed and a reduction of the data required to draw a curved image.

In its simplest interpretation, conography is an "engine" for generating curves. This engine accepts instructions that specify the starting point and the shape of the desired curve. The instructions are geometric (algebraic) in nature and independent of output device properties, such as vertical and horizontal resolution. The conographic engine adjusts the image to the resolution of the output device. Using this methodology, graphic images are transportable between devices and even between computer systems, provided the system the image is transported to has its own conographic engine.

Using Conographic specifications this

Conography is not new; it has been around since 1969 and has been incorporated into several military and commercial graphics systems. What is new is its availability to personal computer owners. Because curves appear in so many images, the impact of this technology promises to be far-reaching. The combination of low-cost computers and high-power graphics technology will allow computer graphics to be used in many areas where the cost is currently prohibitive.

Complex and Simple Curves

Natural curves range from simple to complex; regardless of the efficiency of a curve-generating technique, more time (for computation) and more information (description) is needed to generate a complex curve than to generate a simple curve. To streamline curve generation, conography generates images using only one type of curve, the conic family of ellipses, or more specifically, the general elliptical arc.

Included in the family of the general elliptical arc are some of the most common and useful curves: the circle, an ellipse whose major axis, or longest diameter, is equal to its minor axis, or shortest diameter (Figure 2); the circular arc; the ellipse and elliptical arc (Figure 3); and the straight line, or vector, a degenerate elliptical arc whose minor axis equals zero (Figure 4). The members of this family of ellipses have been given the name C-curves. Algebraically, C-curves are simple, second-order (two-dimensional), parametric curves.

> Only six parameters are necessary to specify a particular ellipse.

Complex curves that are not included in the C-curve family can be generated by fitting C-curves together to approximate the desired image, in the same way that vector graphics approximates curved images using straight lines. Surprisingly, C-curves or multiple C-curves perform extremely well at approximating uncommon curves.

C-curve Mathematics

To generate a C-curve the conographic engine must be given a starting point and the shape of the curve. Because of the simple nature of ellipses, only six parameters are necessary to specify a particular ellipse: X_0 and Y_0 (the starting point) and J, K, L, and M (which describe the shape). These six parameters not only provide enough information to define the shape of an ellipse and its

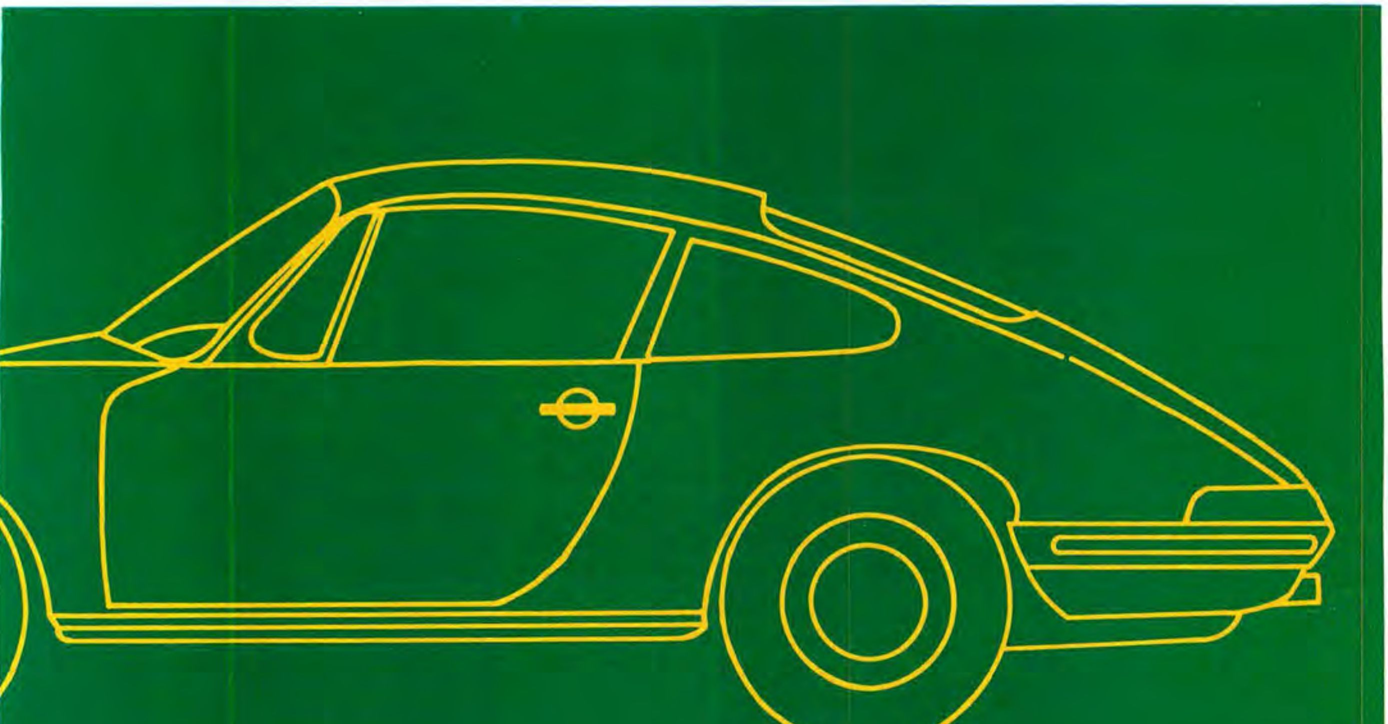


image was produced with only 400 bytes—5 percent of the data required for a vector representation.

position, but also specify at what point of the ellipse to begin drawing and in which direction to draw. The conographic curve generator plugs these parameters into the following equations:

$X(t) = X_0 + J \cdot (\cos(t) - 1) + K \cdot \sin(t)$

$Y(t) = Y_0 + L \cdot (\cos(t) - 1) + M \cdot \sin(t)$

Changing t from 0 through 90 degrees draws a quarter ellipse. Drawing may start at any point on the ellipse, so the length of a quarter ellipse is not necessarily ¼ the length of the ellipse. It is, however, 90 degrees of elliptical arc, hence the term quarter ellipse (see Figure 5). Conography uses 90 degrees of arc as the default size for C-curves because the quarter ellipse fits most situations. A seventh parameter, the final value of t, may be supplied if more or less arc is desired.

The impact of this technology promises to be far-reaching.

In addition to the rich variety of figures in the C-curve family and the ability of C-curves in concert to mimic more complex curves, this family of simple curves has numerous other useful properties. Perhaps the most remakable properties of C-curves are those relating to their behavior under the common operations of translation, scaling, and rotation. The C-curve family is closed under these operations, which means that translating, scaling, or rotating C-curves yields C-curves. Secondly, the general algebraic form of C-curves is as easy to translate, scale, and rotate as is the algebra of vectors—in fact, the operational algorithms are virtually identical.

Functional Capabilities

C-curves are infinitely variable in shape and orientation. Because of this variety, combinations of C-curves can be used to create curved edges that are visually pleasing or that satisfy other requirements. For example, conography can duplicate curves achieved by using a French curve or a draftsman's spline.

A French curve is a flat drafting tool that has a variety of curved edges and is used to create a smooth curve along a set of points. With conography, C-curves can be made to pass through a set of user-specified control points with user-specified slopes for each point. Thus, conography can be an effective electronic French curve.

A draftsman's spline is a flexible strip, typically made from wood, hard rubber, or metal, that can be threaded through rotatable slotted pins. The pins are placed at each point through which a desired curve is required to pass. Elasticity forces the spline to slide through and/or rotate each slotted pin until the spline achieves a physical equilibrium, resulting in a smooth curve. Such smooth curves are readily accomplished with conography because every point in every C-curve is infinitely differentiable. By properly constraining the first and second derivatives, C-curves can function as electronic splines.

Besides these special drafting applications, conography can be used as an electronic template to generate circles, circular arcs, circular segments, circular sectors (pie wedges), ellipses, elliptical arcs, elliptical segments, elliptical sectors, and straight lines. These figures make up the majority of curves found in business presentations, architecture, design, and engineering applications.

Computing Areas

Efficient computation of areas bounded by curves is another feature of conographic technology. Often no closed-form solution exists for computing the area of a figure bounded by one or more complex curves. Instead, the area must be approximated by numerical analysis methods. Since C-curves are simple curves, however, area computations for figures bound by C-curves are closed form and simple. An algorithm has been developed for computing the area within any closed contour bounded by C-curves (which include straight lines). Hence, one may also easily compute the area between a C-curve and its chord (the line joining its endpoints), the area of an ellipse or circle, or the area of an elliptical wedge (relative to the ellipse's center).

The Conographic Engineers

Luis Villalobos, Joseph Meshi, Al Harano, and Howard Miller are very excited about conography. Their company is Conographic Corporation, which owns exclusive rights to conography. These men are sitting on the proverbial pot of gold, and they have high hopes for the future. The first step in their plan is the CONO#COLOR adapter, which will be available later this year. It is designed as a replacement for the IBM Color/Graphics Adapter.

Although it will be fully compatible with the IBM Color/Graphics Adapter, the CONO#COLOR adapter differs from the IBM product in several ways. CONO#COLOR will be able to display 256 different colors. Any 16 of those colors may be displayed at one time, in text or graphics mode, using up to 640 by 400 pixels.

The CONO#COLOR adapter has 128K bytes of memory that it uses to display its 256,000 (640x400) pixels in 16 colors. The memory is configured in 32K groups (called banks), so only 32K of the PC's video memory area is required. Each of the four banks can be selected and addressed as needed to display an image. The software to be included with the CONO#COLOR board will have the necessary logic to manipulate the board's video memory banks to produce high-resolution, 16-color images. In lower resolution modes the

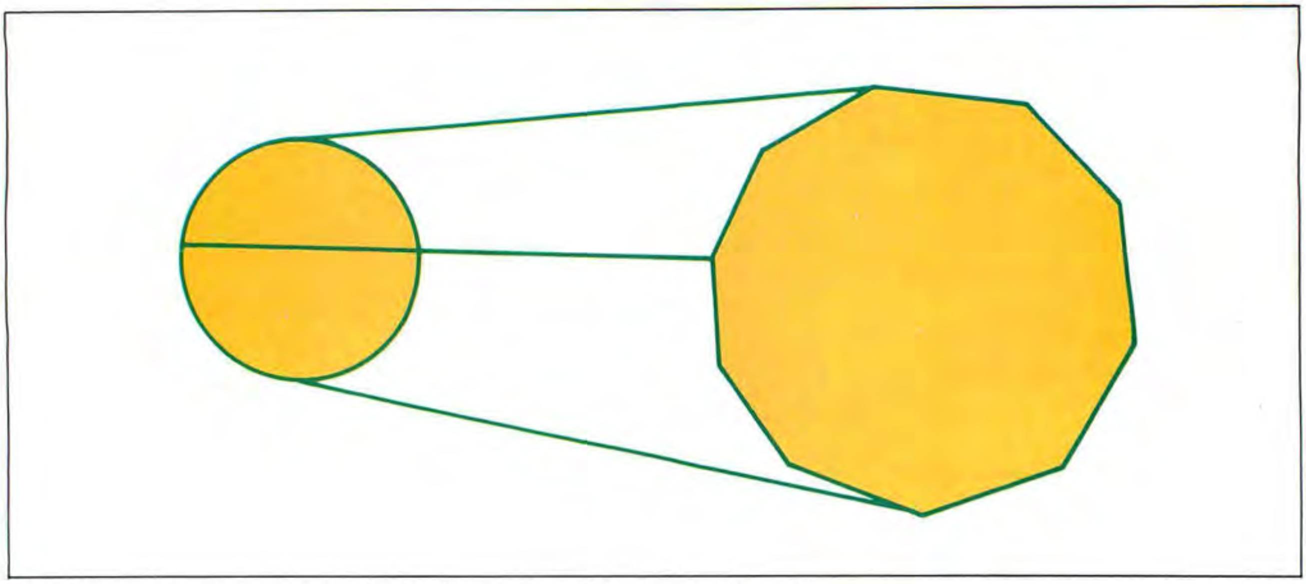
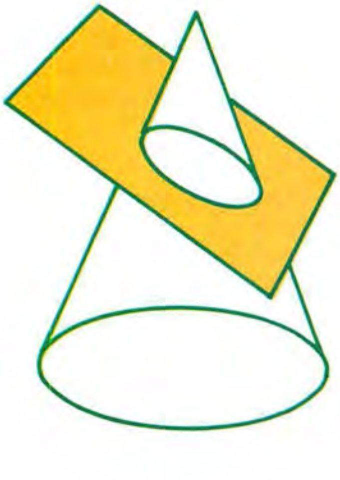


Figure 1: Vectors become apparent when curved objects are enlarged.



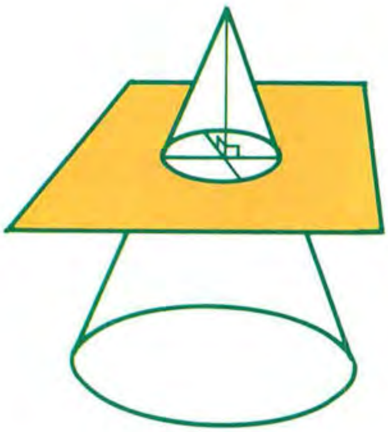


Figure 2: An ellipse can be viewed as the intersection of a plane passing through a cone.

Figure 3: The circle is a special ellipse.

Figure 4: A straight line is a mathematically degenerate elliptical arc.

banks can be individually selected as pages for display or update, so animation can be achieved by displaying one page while others are modified.

By itself the CONO#COLOR board cannot generate conographic images. Optional software called *CONO-LIB* must translate conographic parameters from applications programs into pixel data that can be displayed. *CONO-LIB* is the

Conography creates curved images in the same way that vector graphics creates lines.

conographic engine for the PC, and it should soon be available for use with a wide variety of products, including video adapters, printers, and plotters.

In addition to a curve generator, *CONO-LIB* will have utility routines to calculate conographic parameters of C-curves that satisfy a variety of user-specified point and/or slope combinations, as well as utility routines to perform moving, scaling, and rotating of C-curve images.

An optional plug-in module that can be attached to the CONO#COLOR adapter to speed the translation of conographic parameters to images is also planned. Called CONO#GEN, it will have its own 6809 microprocessor dedicated to generating and manipulating conographic data. CONO#GEN will reduce the time needed to create an image, freeing the PC's 8088 microprocessor to perform other tasks while an image is being generated.

One area in which conographics shows great potential is three-dimensional graphics. When coupled with perspective transformations of images, the resulting capabilities would be greater than those offered by even the most sophisticated computer graphics equipment available today, and at a cost that would make the technology available to every personal computer owner.

Conographics offers advantages of speed, data compression, and portability that should one day make it the standard technique for generation of graphic images. In the not-too-distant future, connect-the-dots will become a relic of computer graphics history, and everyone will be drawing with curves.

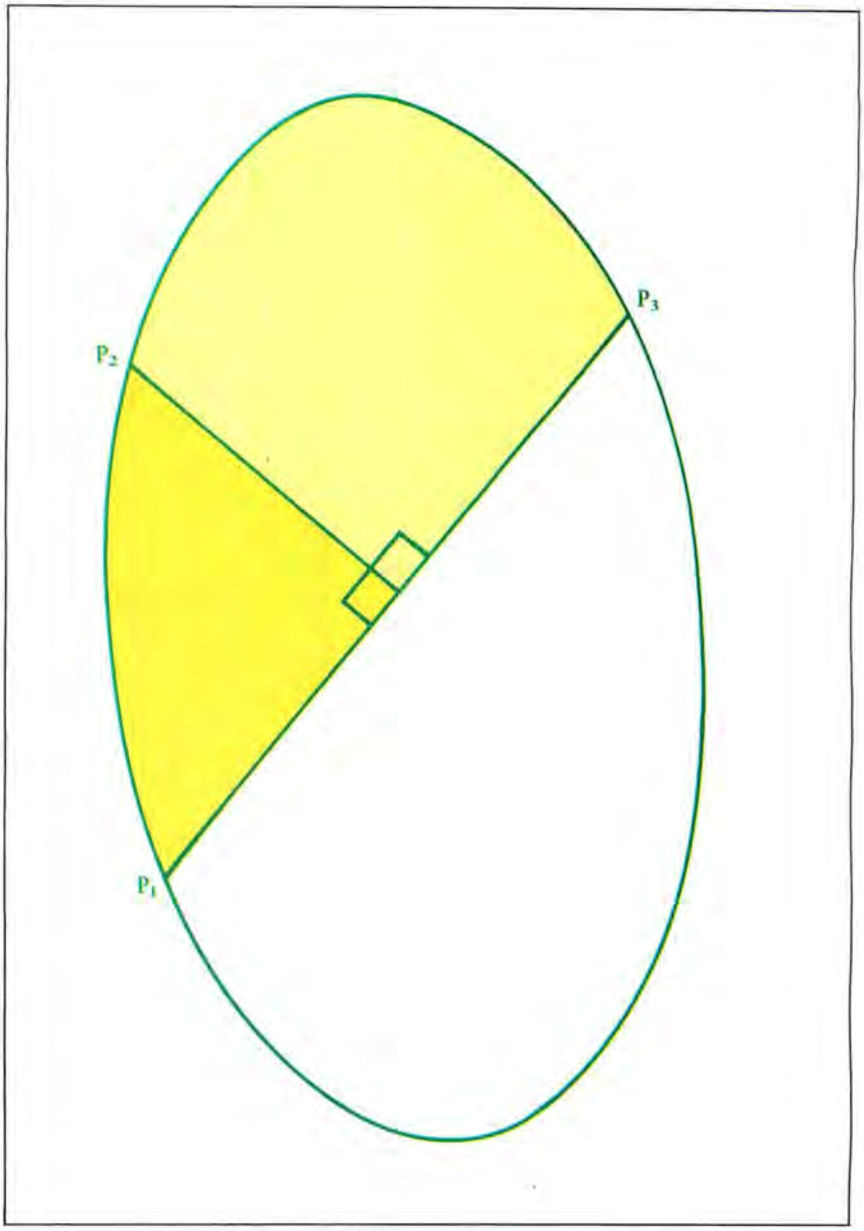


Figure 5: A quarter ellipse is 90 percent of elliptical arc, not necessarily ¼ the length of the ellipse. P_1P_2 and P_2P_3 are both quarter ellipses.

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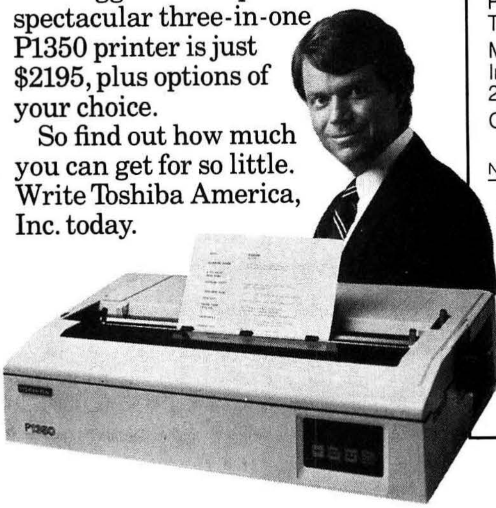

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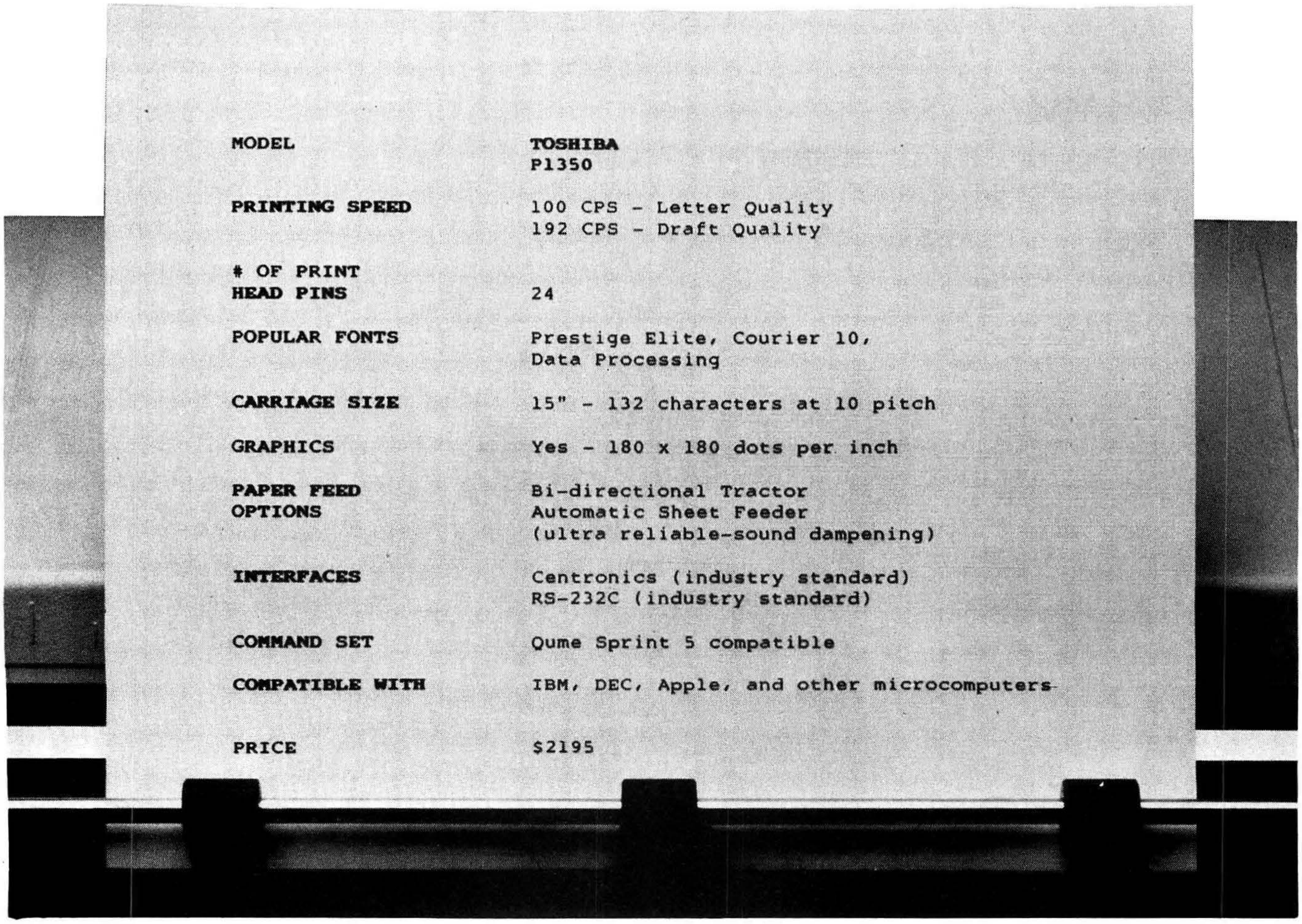


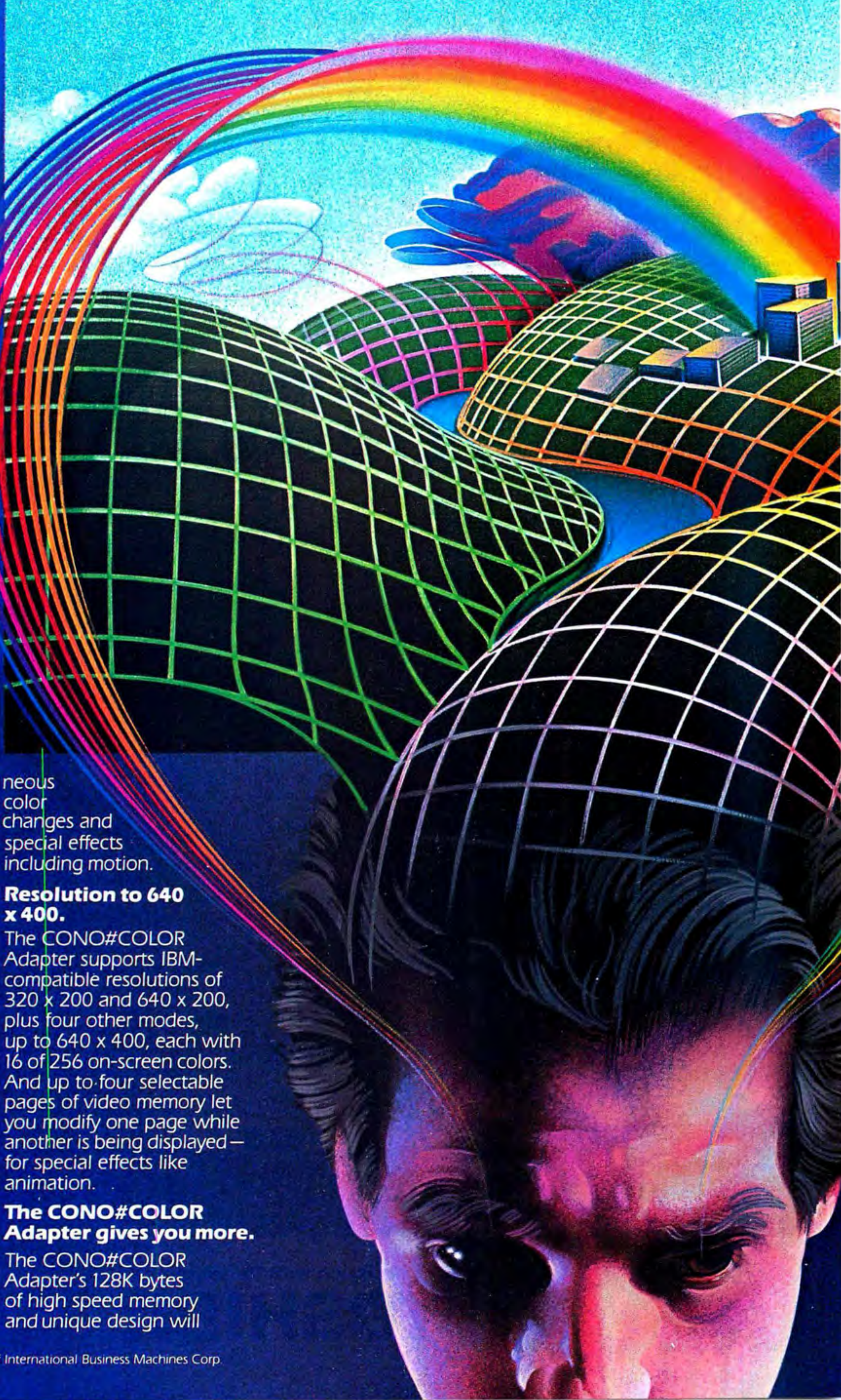
MODEL	TOSHIBA P1350
PRINTING SPEED	100 CPS - Letter Quality 192 CPS - Draft Quality
# OF PRINT HEAD PINS	24
POPULAR FONTS	Prestige Elite, Courier 10, Data Processing
CARRIAGE SIZE	15" - 132 characters at 10 pitch
GRAPHICS	Yes - 180 x 180 dots per inch
PAPER FEED OPTIONS	Bi-directional Tractor Automatic Sheet Feeder (ultra reliable-sound dampening)
INTERFACES	Centronics (industry standard) RS-232C (industry standard)
COMMAND SET	Qume Sprint 5 compatible
COMPATIBLE WITH	IBM, DEC, Apple, and other microcomputers
PRICE	$2195

In Touch with Tomorrow

TOSHIBA

Reader Service #285

From your mind's eye to the screen.



Bring images to life, with color, resolution, and the speed of thought.

Use CONO#GRAPH™— the intelligent color display graphics system for your IBM PC. CONO#GRAPH delivers the performance of a professional graphics workstation for the price of a business graphics system.

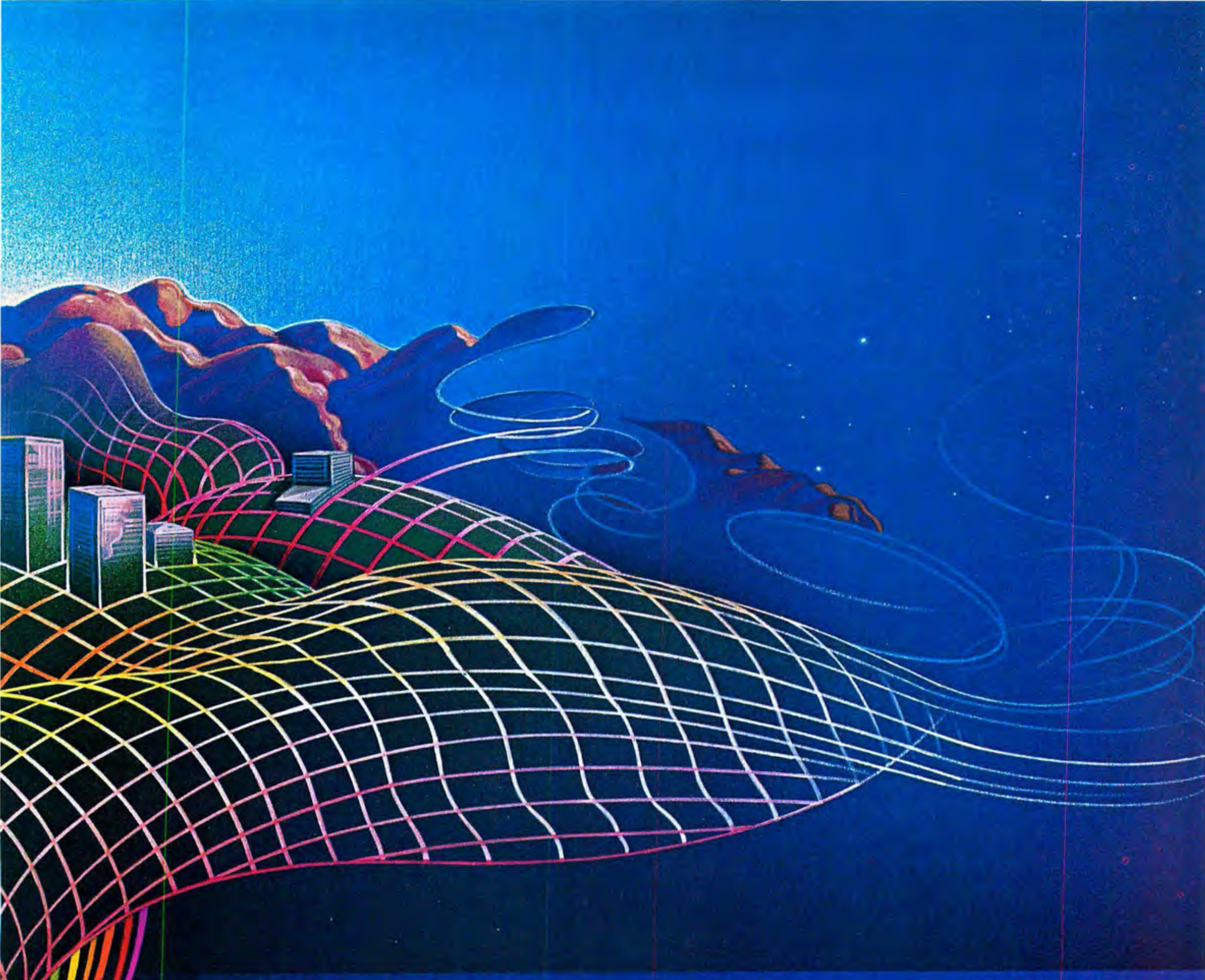
The modular CONO#GRAPH system lets you start with the CONO#COLOR™ Adapter for quality color and high resolution, and later add the optional CONO#GEN™ module for increased processing power and speed.

Choose from 256 colors.
The CONO#COLOR Adapter provides a spectrum of 256 colors. Select a palette of 16 colors for simultaneous on-screen display. Modify the palette dynamically to provide instantaneous color changes and special effects including motion.

Resolution to 640 x 400.
The CONO#COLOR Adapter supports IBM-compatible resolutions of 320 x 200 and 640 x 200, plus four other modes, up to 640 x 400, each with 16 of 256 on-screen colors. And up to four selectable pages of video memory let you modify one page while another is being displayed— for special effects like animation.

The CONO#COLOR Adapter gives you more.
The CONO#COLOR Adapter's 128K bytes of high speed memory and unique design will

Reader Service #47



reduce your image build-up time, and eliminate any flicker when scrolling. Four different output channels are provided—including IBM-compatible digital IRGB-as well as RGB analog, true NTSC at all resolutions, and channel-selectable RF. The CONO#COLOR Adapter also features a light pen interface capable of resolving ±1 pixel, and an interface to the CONO#GEN high performance graphics processor.

Add CONO#GEN for speed and processing power.

CONO#GEN is a powerful graphics processor that greatly reduces image creation and manipulation times. Its dedicated Motorola 6809 microprocessor frees your IBM PC's microprocessor to perform other tasks. Special purpose hardware generates vectors, circles, ellipses (at any orientation), arcs and conic curves at up to 800,000 pixels per second. Hardware also provides a 2K x 2K addressable area, rectangle fill, line texturing and high speed erase.

CONOGRAPHY™ for device independent graphics.

CONOGRAPHY is to curves what vectors are to straight lines. Using CONOGRAPHY, images are produced with less data. The result is faster image transmission, lower data storage requirements, fewer calculations, and device independent graphics.

Easy to install.

The CONO#GRAPH system is easy to add to your IBM PC. The CONO#COLOR Adapter substitutes for IBM's Color/Graphics adapter. The CONO#GEN module connects to the CONO#COLOR Adapter to provide added speed and processing capability. Both together fill a single expansion slot. And they're modular, so you can add color and resolution now and speed later.

Easy to use.

Efficient software makes graphic images simple to create. The CONO#GRAPH system supports the IBM graphics and character modes so that existing software runs without modification. And the CONO-LIB™ program provides an extensive library of subroutines for scaling, rotation, fill, image creation, labeling, recall, and more—under PC-DOS for BASIC, C, PASCAL, FORTRAN, or assembler. Future software will include CP/M-86 compatibility and sophisticated yet easy-to-use application programs.

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Simple, isn't it? The COMPAQ™ Portable Computer can do what the IBM® Personal Computer does. To go.

It runs all the popular programs written for the IBM. It works with the same printers and other peripherals. It even accepts the same optional expansion electronics that give it additional capabilities and functionality.

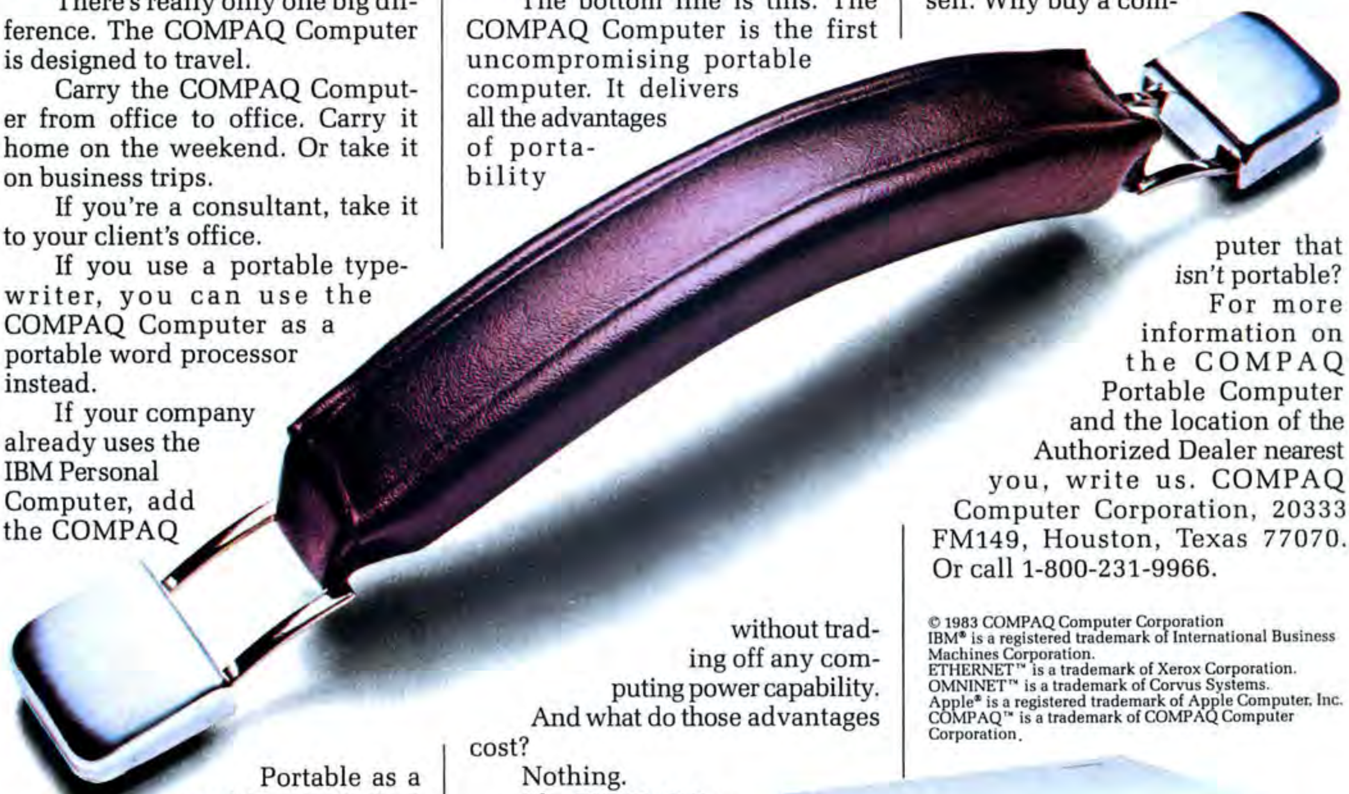
There's really only one big difference. The COMPAQ Computer is designed to travel.

Carry the COMPAQ Computer from office to office. Carry it home on the weekend. Or take it on business trips.

If you're a consultant, take it to your client's office.

If you use a portable typewriter, you can use the COMPAQ Computer as a portable word processor instead.

If your company already uses the IBM Personal Computer, add the COMPAQ Portable as a mobile unit that can use the same programs, the same data disks, and even the same user manuals.



There are more programs available for the COMPAQ Computer than for any other portable. More, in fact, than for most nonportables. You can buy them in hundreds of computer stores nationwide, and they run as is, right off the shelf.

With most other portables you'd probably need to buy an additional display screen because the built-in screen is too small for certain tasks, like word processing. The COMPAQ Computer's display screen is nine inches diagonally, big enough for any job, and it shows a full 80 characters across. And the built-in display offers high-resolution graphics and text characters on the same screen.

The bottom line is this. The COMPAQ Computer is the first uncompromising portable computer. It delivers all the advantages of portability without trading off any computing power capability.

And what do those advantages cost?

Nothing.

The COMPAQ Portable sells for hundreds less than a comparably equipped IBM or APPLE® III. Standard features include 128K bytes of internal memory and a 320K-byte disk drive, both of which are extra-cost options on the IBM. Memory and additional disk drive upgrades are available options to double those capacities.

In the standard configuration, the COMPAQ Computer has three open slots for functional expansion electronics as your needs and applications grow. It accepts standard network and communications interfaces including ETHERNET™ and OMNINET™.

If you're considering a personal computer, there's a new question you need to ask yourself. Why buy a computer that isn't portable?

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Reader Service #34

PC WORLD View

News and Notes for the Computing Community

Miriam Medom

The *PC World View* staff is avidly attuned to new developments in computer technology, and we hear lots of rumors, speculation, and advance news that interest us. We want to share the most promising and unusual of these developments, and we'll do that here. We've reserved the "Grapevine" section of this column for industry reports, speculation, and rumors that we find especially enticing.

E. F. Hutton Says No

While most major corporations are installing hundreds or even thousands of computer work stations to give their managers individual computing power, the brokerage firm of E. F. Hutton has declined to decentralize its computer facilities. Rather than putting a PC on every broker's desk (as Merrill Lynch is rumored to be doing), Hutton plans to retain its network of 5000 dumb terminals and connect them to 350 new minicomputers from Data General.

When questioned about this strategy at a recent conference, E.F. Hutton's executive vice-president, Norman Epstein, noted, "We want to extend personal computing power as far down into our organization as we can go and still maintain central control."

According to other participants in that conference, however, E. F. Hutton may soon be doing the listening. Several key people in the microcomputer industry who were at the conference asserted that they knew of hundreds of personal computers within the brokerage firm, and one software supplier cited his orders for multiple copies of an operating system.

Summa Cum Robot

The Community College of Anne Arundel County, Maryland, has given new meaning to the phrase *high tech* by inviting a robot to speak at the school's graduation ceremony. And not just any robot—this distinguished guest is Robot Redford, brainchild of Bill Bakaleinikoff of Petaluma, California. Actually, Bill is both the author and the voice of Robot Redford's commencement address, which is stored on audio tape to be played back for the august ceremony, as R.R. politely moves about to make eye contact with all sections of the audience.

We're not sure how well the high-tech guest will handle the "Pomp and Circumstance" procession, though, or where the college will find a robe to fit this 3-foot tall collection of tin cans and circuitry.

Big Blue's News

Paging Mr. Goodchip

Last month we reported that IBM had initiated an on-site service program for large-volume buyers of PCs. Now we've learned that IBM will provide its technicians with hand-held terminals that receive and send digital radio signals. Instead of the traditional beeper carried by people whose work takes them to many places during the day, the IBM field service personnel will be armed with these two-way radio terminals with which they can communicate directly to one of several IBM 4300 mainframe computers.

Just like a paramedic at the site of an accident, the technician can radio diagnostic information to the mainframe, receive assistance within a matter of seconds, and repair the damaged product (or at least know what parts are needed). The radio-computer communications network will also be used to contact technicians as they travel from one customer to the next or to notify them of urgent service calls.

We don't know if this tiny terminal has a bell, but we know this much about it: the project is a joint effort of Motorola and IBM, and the terminal has recently been approved by the FCC. The device weighs 28 ounces, measures 4 by 7¾ by 1⅓ inches, and has a liquid crystal display that can show two lines of 27 characters each. It has an alphanumeric keypad and programmable function keys, as well as an unspecified amount of RAM and ROM. IBM will field test the new communications system next January, but Motorola plans to market the terminal independently by the end of 1983.

Roll 'Em Out

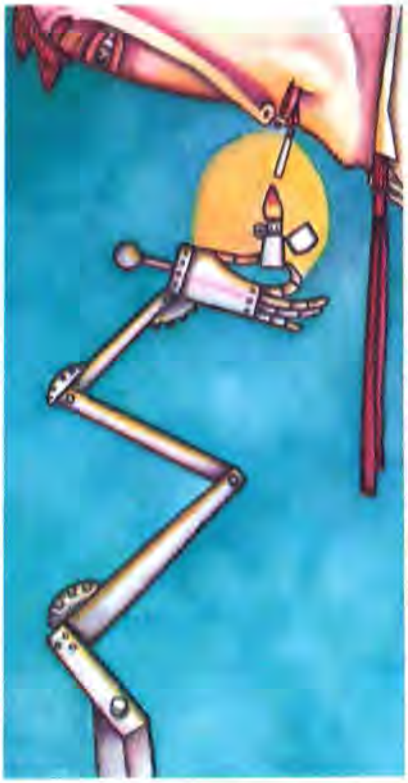
Computers, typewriters, copiers, and now furniture. IBM has announced that its Systems Supplies Division will market the Synergetix work station, a cabinet where the PC hardware and software can be locked up when not in use. The self-contained work station is mounted on casters for easy mobility. This new means of PC portability is considerably bigger than an Osborne, but it costs only half as much—$850.

The Missing Umlaut

So far the PC has not had the overwhelming success in Europe that it has had in the United States. One reason is the lack of software available in languages other than English, although many program publishers are working overtime to remedy the situation.

In Germany, however, a different software problem plagues the PC. It seems that the PC uses software to define all the international characters, such as accent marks, and these characters are assigned the high-order ASCII numbers (129 through 255). The German standard for transmission of characters is 7 bits, however, and the high-order numbers require 8-bit transmission. Most German letter quality printers are not built to receive 8-bit signals and therefore cannot print the special characters, such as the crucial umlaut.

To add to the computer's difficulties the German-language version of *WordStar* is too big for a 64K machine, and when the program is loaded into a 128K PC, it uses 7-bit code, so it cannot display the umlaut and other special characters. That's probably okay, though, since the German printers won't print them anyway.



High-Priced Muscle

Besides getting its own cabinet on wheels from IBM, the PC has also been given expensive new robotic muscles to flex. The 7540 Manufacturing System is a robot arm capable of moving in four directions and carrying a payload of 55 pounds. The PC can be used to program the new robot using a special language. The 7540's price is a hefty $37,000 (without the PC), and the programming language costs another $2500.

Move Over Source, CompuServe

A new on-line information utility has opened its ports, so to speak. The latest nationwide network is Delphi, a service of General Videotex Corporation of Cambridge, Massachusetts (617/491-3393). Delphi's prices are competitive: $49.95 for a permanent subscription, $5 per hour during evenings and weekends, and $20 per hour on weekdays. The service offers an appointment calendar, computer banking, electronic mail and bulletin boards, games, a subscriber publishing service, and a library of data bases.

Mystery of the Month

Michael Trombetta of Manhasset, New York, reports a hardware mystery that garbled his output.

"I couldn't get my printer to work with my PC, so I returned both the printer and the PC to my dealer. We connected my printer to other computers and my PC to other printers and finally found what we thought was the problem. In our excitement to see if we had solved the problem, we connected my printer to the outlet on the monochrome board without turning the PC off. Disaster!

"The screen turned to nonsense. Each character seemed to be replaced by a different character so that, for example, 'Current date' was replaced by something like 'Epggmcf svfm.' We swapped monochrome cards with another PC; with the other card my PC was fine, and with my card the other PC displayed nonsense. To make a final check we installed my card back in my PC and to our amazement my PC worked perfectly.

"Some weeks later I turned on my PC and there was the 'Epggmcf svfm' message. I know a technician who lives nearby, so I removed the monochrome card, carefully wrapped it, and drove to his house. Unfortunately, he wasn't home, so I drove back home and reinstalled the card in my PC. You guessed it! My PC was perfect; all the card needed was a drive in the fresh air.

"I thought the problem might have been caused by static electricity, but the second incident occurred when it had been raining for several hours, so I don't think there was much static electricity that day."

What Michael didn't tell us is whether there was a Russian submarine off Long Island on those two days. Any ideas?

Mystery Solutions

We've received two well-reasoned explanations for the dog and electric blanket mystery presented in Vol. 1, No. 2. As often happens, our correspondents disagree. Herewith their solutions.

Joe Long, of Madison, Alabama, writes: "Apparently, when your friend bundled up in her electric blanket, some of the blanket got against the power supply and blocked its air intake vents. The fan was unable to pull enough air through the power supply, and it began to overheat. About the time the dog made himself comfortable in the blanket, the power supply overheated to the point where the thermal circuit breaker activated, turning off the power supply to save it from damage. The presence of the dog was merely a coincidence.

"Because the computer had already finished saving her file, no data was lost when the hard disk shut down. By the time she had turned off the computer, checked all the plugs, and moved the power supply to its new location, the power supply had cooled off enough for the thermal circuit breaker to reset itself. So, when she turned the system back on, everything worked normally. Elementary, my dear Medom!"

John Draut, a hardware design engineer for hard disk supplier Davong Systems of Sunnyvale, California, takes another tack: "Computer systems designed to be sold in an international marketplace are designed to have removable power cords. This enables a foreign PC user to change the American standard cord easily to one that has the proper plug for the outlet. Now what probably happened to our lady in distress was that the dog jarred the cord loose from the power supply. It is quite possible that the cord looked attached, because international safety codes require that the power connection be shockproof and that the power will disconnect before exposing any live parts. Note that the woman checked the connections after she had turned the supply off. If she had left the power switch on, she would have discovered that cause of the mystery when checking the power connection."

Our thanks and a doff of the old deerstalker hat to both of these experts. Their advice is both learned and pertinent, and the fact that such reasonable men disagree should invite still more explanations from our community of experts.

Grapevine

Mouse Match

In a move to eliminate—or at least reduce—software piracy, VisiCorp reportedly will use a coding system to tie each *Visi/ON* mouse to its own software packages. According to industry sources, this new hardware-software encryption scheme will involve an individual code stored in each mouse and a corresponding code written permanently on the master disk of each software package sold for use with that one mouse. Unless both codes are recognized as present, neither the mouse nor the software will function.

Although this method of protection is sure to discourage many pi-rates, it may require extra preparation and follow-up efforts from all software firms that release products for use with *Visi/ON*. Maintaining accurate records of who owns which mouse and what independent company's software will operate with that mouse could be a challenge, especially when problems arise, such as defective disks or program updates. Ah, but that's where computers really shine. . . .

More than a Pretty Picture

IBM recently announced a new product that integrates the sensational 581 plasma display (see "Displaying the Future," Vol. 1, No. 2) into a work station of sorts. The 3290 information panel consists of the plasma display screen, which can hold up to 9920 characters, a keyboard, and a "pod" that snaps onto the back of the screen. At present, the 3290 is intended for use as a terminal for communication with mainframe computers, including IBM's System/370, 4300 series, and 30XX systems. The link between the 3290 and any of the large computers currently requires a 3274 control unit. The price of the 3290 is $7100.

One industry observer speculates, however, that the 3290 might become a powerful stand-alone computer or a sophisticated adjunct to the PC. He attended a demonstration of the 3290 recently and learned that the pod attached to the back of the display screen contains a 68000 microprocessor and 72K of memory. Thus, he predicts that this unit could be tied into a disk drive unit or to a PC; this task might even be accomplished now with one of the several 3274 emulation packages available for the PC. Whether or not IBM chooses to utilize the 3270 as a stand-alone product in the future, it would make an excellent CAD/CAM device or simply the utlimate in display screens.

One More Micro

According to industry sources, Hitachi will introduce its version of a PC-compatible computer on August 1. A Hitachi spokesperson calls this machine a PC lookalike rather than a true compatible, but he didn't explain the difference. He also said that Perfect Software and Sorcim are readying programs for the machine and that other vendors are also likely to offer programs for it. The Hitachi machine utilizes the 8088 microprocessor, has 128K of RAM, and is available with MS-DOS and CP/M-86. The computer is supplied with both color and monochrome capabilities, RS-232 and parallel interfaces, and a connection for a light pen. The machine will cost $2695 with one disk drive and $3195 with two.

XENIX for Lisa and PC

According to industry reports, Microsoft has created a simplified version of its XENIX operating system for sale to individual users through computer stores. In the past Microsoft's XENIX (a specialized version of UNIX licensed to Microsoft by Bell Labs) has been sold to computer manufacturers, who in turn market the operating system to users along with their hardware. The retail-oriented XENIX will be called XENIX 3.0 and will be released first for Apple Computer's Lisa. The PC version is slated for release in the fall of 1983, industry sources note.

These sources also state that XENIX 3.0 will separate the operating system into three components: a run-time module, text processing operations, and a programming environment. Each of these components will be available separately for the user. In conjunction with the Lisa version of XENIX 3.0, Microsoft will offer a plug-in board that converts the computer to a four-user system.

Both Lisa and PC versions of the operating system will use Microsoft's newly developed user interface (reportedly nicknamed MUSH for Microsoft User Shell) for continuity with the company's other products. This interface is essentially that used with *Multiplan* and Microsoft's other applications programs.

Peanut to K-Mart

Although this may be old news (magazine lead times being what they are), an intriguing variety of industry sources are reporting that IBM and K-Mart officials are negotiating to do business together. The object of their joint efforts would be IBM's as yet unannounced home computer, which has long been dubbed the Peanut in speculative descriptions and rumors. This move, if indeed accomplished, could be a wise one; K-Mart has performed better than most retail merchandise chains during the economic slump of 1981-82, and the inclusion of computers in its one-stop-shopping service seems only natural.

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- System status screen messages
- System expandable to eight drives using only one slot in your IBM PC
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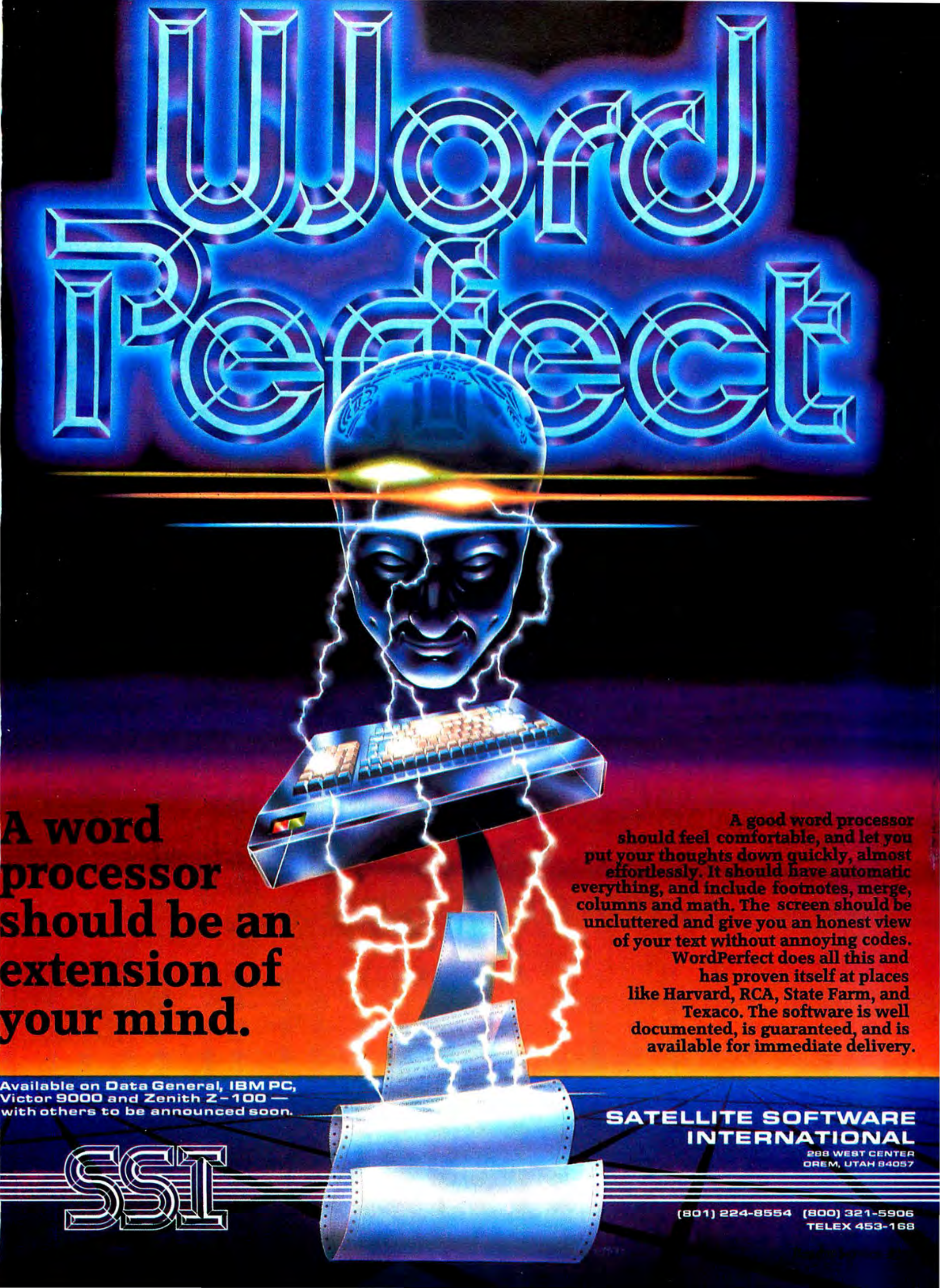
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[2]Option: 1200 Baud Modem

The Communicators

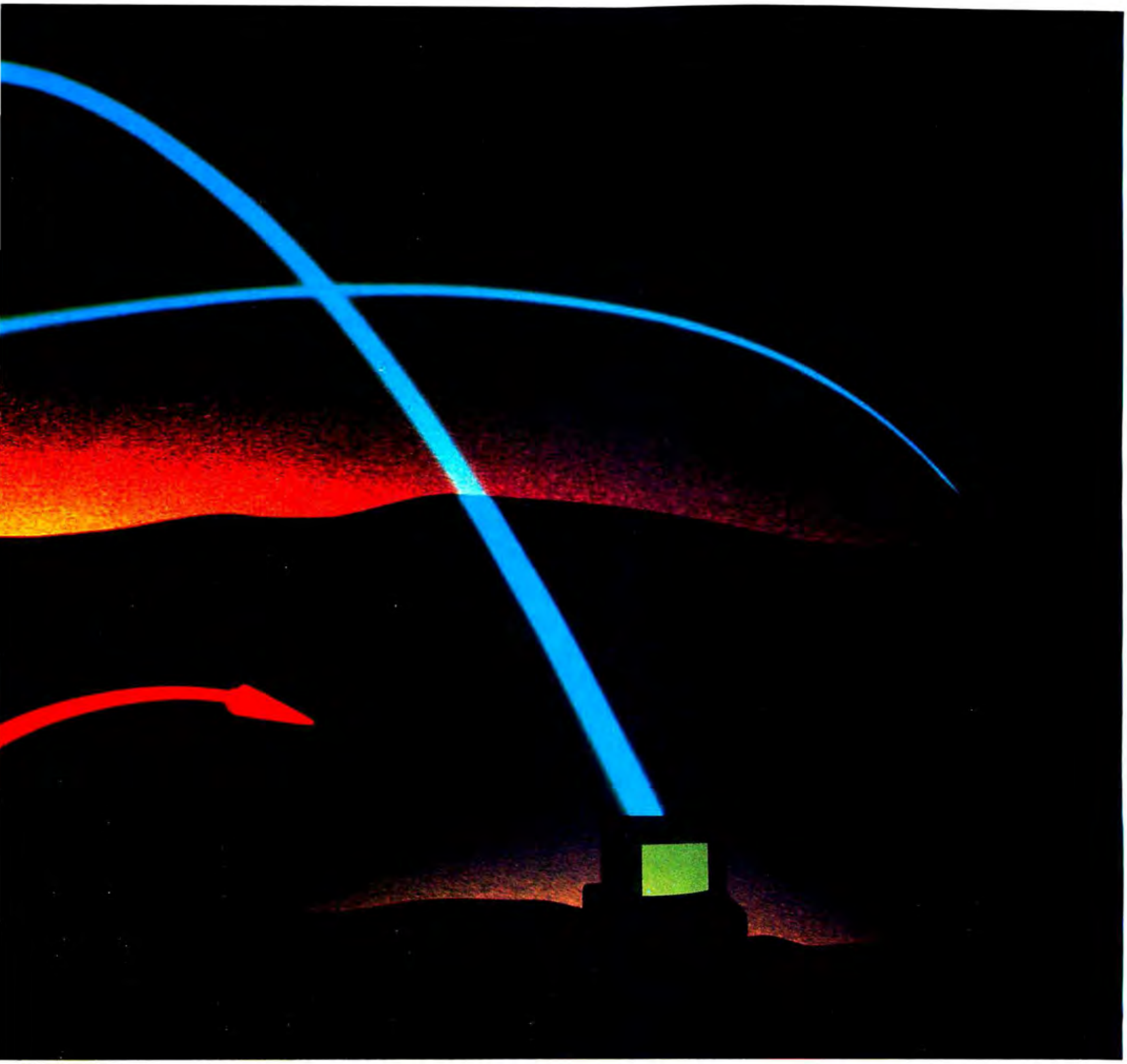
Larry Jordan

Telecommunications can broaden your horizons and make your computer more useful. This look at the most important features of communications programs will help you select the one that's right for you.

When my IBM PC was delivered in February 1982, I selected a communications software package easily. The only two available were COMM.BAS, which came on the PC-DOS disk, and the *IBM Asynchronous Communications Support* package. I did not know much about personal computer communications at the time, but the thought of being able to operate the office mainframe from my house intrigued me. Without knowing what I was getting into, I immediately purchased the *IBM Asynchronous Communications* package, a Hayes Smartmodem, and an asynchronous communications adapter. After putting all the pieces together and making several awkward attempts to communicate with the office Prime computer, I really started rolling. I could use my modem to converse with the Prime, and the modem would dutifully follow my every whim. I could also churn out hundreds of lines of FORTRAN without going anywhere except to the refrigerator for a soda. I felt I had all I would ever need for communications until I discovered electronic bulletin boards.

The first time I called a local bulletin board I learned that my communications software was not quite as capable as I had thought. There were software patches (a fancy word for software enhancements or error corrections) and games available on the board, but I had no way of capturing the program listings as they scrolled by on my monitor.

By talking with friends I learned that I needed software that would transform my IBM PC into a smart terminal with the ability to send and receive disk files. The *IBM Asynchronous Communications* package was sup-



posed to provide that capability, but it had many limitations. After several futile attempts at modifying the IBM package, I gave up and started adding enhancements to the COMM.BAS program. It was at about this time that I received my first copy of an absolutely wonderful communications package called *PC-Talk*. Not only did this package give me the smart terminal capabilities I needed, but also excellent documentation and easy-to-follow source code.

Since those early days of PC communications, many powerful smart-terminal communications programs have been released for the PC. Some were initially designed for CP/M-based computers and have been converted to operate under PC-DOS; other new packages have been written specifically for the IBM PC. My latest count showed over 20 commercially available packages and 5 public domain packages. Due to the large number currently available, it is more difficult than ever to choose a package. To make the task easier for a PC owner just getting into communications, I have described the characteristics and capabilities of communications packages. I have also briefly reviewed 12 communications packages and developed a summary matrix that shows how well communications capabilities have been implemented in these packages (see Table 1).

Essential Characteristics and Capabilities

As with any other software package, no single communications program is likely to satisfy all wants and needs. The best one can hope for is to find a package that provides most of the essential features and some additional nonessential but desirable features.

Although business and personal applications of communications software are often different, some common communications capabilities are required by both. Business and personal applications must usually have the ability to send and receive disk files and to communicate in terminal or conversation mode. Business software, however, will often have to support the volume of large files that are transferred in many business communications applications. The following paragraphs discuss the common capabilities needed in these two types of software. The unique features of each are discussed later in this article.

Communications Parameter Selection

To properly communicate with another mainframe or microcomputer (called the *host system*), you must be able to select the appropriate communications parameters required by the host system. These parameters include baud rate, number of data bits, type of parity error-

● = Excellent ● = Good ● = Fair — = Not Supported

Feature	ASCOM Ver 2.1
Data capture direct to disk file	Excellent
Data capture to memory buffer	Excellent
On-line display of capture buffer	Excellent
On-line editing of capture buffer	—
Filtering of received control characters	Good
Optional add/delete of linefeeds	Good
Upload wait for host prompts	Fair
Upload text throttle (delay between lines)	—
Menu of prestored uploadable strings	Fair
Transmission of prestored strings	Fair
Transmission of a true break signal	Excellent
Tab to space conversion	Good
XMODEM protocol file transfer	—
Protocol error-checking file transfer	Excellent
XON/XOFF support during file send/receive	Excellent
Non-ASCII (binary) file transfer	Excellent
Operation with non-auto-dial modem	Excellent
Auto-dialing telephone directory	Fair
Auto-dialing modem support	Good
Auto-redial of last telephone call	Fair
Auto-redial of last call until connect	Fair
Modem/telephone hangup	Good
Return to operating system without hangup	Good
Elapsed time of call display	—
On-line switch between originate/answer	Good
On-line selection of duplex with toggle	Good
On-line selection of comm parameters	Good
On-line listing of selected parameters	Excellent
On-line printer on/off toggle	Good
On-line viewing of disk directories	Excellent
On-line viewing of disk files	Excellent
Deletion and renaming of disk files	Excellent
1200 baud receive/download operation	Good
Save/reload of customized parameters	Excellent
Batch operation from operating system	Excellent
Command file power/flexibility	Good
Remote takeover and operation	Good
Efficient use of available memory	Excellent
Display of help files	Excellent
Line 25 abbreviated help menu	—
Ease of command key use	Good
Quality of user manual	Fair

Table 1: IBM PC Communications Software Compared

Comm/Text Editor Ver 1.0	Crosstalk Ver 3.0	Data Capture /pc	IBM Async Ver 2.0	LogOn Ver 1.3	LYNC Ver 3.0	PC/ InterComm Ver 1.0	PCMODEM Ver 1.4	PC-Talk Ver III	Smartcom II	Telios Ver 1.0
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checking, and number of stop bits. The communications software may provide default values for these parameters, but it must also provide the option of modifying the default values both before and after a connection is made with a host system.

Duplex Mode Selection

A communications package should provide a way to switch between half-duplex and full-duplex modes, because business and personal communications applications often require connection to both half-duplex and full-duplex host systems. Most information services and bulletin board systems operate in the full-duplex mode, but other microcomputer and mainframe systems may operate in half-duplex mode.

Command and Conversation Modes

Communications software should be operable in a command or a conversation mode. The command mode is required for off-line communications between the PC keyboard and the communications software to perform functions that do not involve the remote host system. For example, operations such as changing a telephone number in a dialing directory or viewing selected communications parameters have to be conducted without interaction with the remote host system. When off-line command mode functions have been completed, however, the software must be able to return to the on-line conversation mode to continue interactive communications with a host system.

> I felt I had all I would ever need for communications until I discovered electronic bulletin boards.

Error Handling

A software package's ability to handle data errors is vitally important. A good package should either warn you before an error occurs, so that preventive action can be taken, or provide a clear error message when an error does occur. The package should also allow you to continue with communications despite a minor error. Operations that can result in significant errors should also be designed to let you abort a command before the error is made. For example, if an attempt is made to return to the operating system before captured data has been saved, you should be told that the data will be lost. You then should have the chance to go back and save the data before finally returning to the operating system.

Data Capture

Data capture, also called downloading, is the process of storing received data in memory or in a disk file. Most communications applications will require this capability. Some packages allow data capture directly to a disk file, whereas others allow data capture to random access memory for later storage in a disk file. Some packages provide both options. Most hobbyists don't need capabilities other than direct-to-disk capture, but some business applications require the memory capture option so that the captured data may be modified before it is written to disk.

Some communications packages also let you select the type of data to be captured. You can elect to capture only incoming data transmitted from a host system, only outgoing data entered from the PC keyboard, or both incoming and outgoing data. This option is good for business applications, but most hobbyists can live without it. If only local keyboard input is being captured, a file can be opened and a series of batch mode commands entered into the file. Then the file can be closed and immediately put into operation. Frequent use of this option can improve the efficiency of data communications and reduce communications costs for a business.

Data Upload

The term *upload* is used to describe the process of transferring a local disk file to a remote host system. Both business and personal communications make use of this capability to transfer files containing memos, reports, data, or programs to remote computer systems.

Data Capture to Printer

A communications package should have the ability to simultaneously display and print out data as it is received over the phone line. Sometimes it is necessary to print a computer conversation with another person or the menu of files that can be downloaded from a bulletin board to eliminate repeat listings of the menu during download file selection. You may also want to get a printed record of sessions with time-sharing systems for future reference. This feature is particularly useful when transactions result in fund transfers.

A single key toggle that turns the print function on and off without interrupting the transfer of data is also a desirable feature. This option allows the user to send text selectively to a printer by pressing one or two keys. Software that requires you to go into the command mode to turn the print function on is cumbersome and requires either an interruption of incoming data flow or a pause in outgoing data transfer before printing can be initiated. This frequently results in the loss of desired data as it scrolls off the screen.

XON/XOFF Support

File transfer applications that involve data transmission rates greater than 300 baud often require the XON/XOFF communications speed-matching protocol. This protocol allows the software designer to use less memory (RAM) for a communications receive buffer (an area reserved to hold incoming data) because communications speed-matching will not have to be handled solely by the buffer. When the buffer begins to fill up as the result of a speed mismatch, the software tells the host to stop sending data by issuing an XOFF character. When the buffer is emptied, the software signals the host to resume sending data by issuing an XON character. Most mainframe computers use this XON/XOFF protocol, so business applications that involve file transfers with mainframe computers can make use of the capability.

> You should not have to reboot the computer each time a communications session is completed.

Manual and Auto-Dial Modem Support

Even though you might have only a manual-dial modem, when selecting a software package it is a good idea to get a package that will support both manual and auto-dial modems. Having a communications package that supports only manual-dial or auto-dial modems limits flexibility in hardware configurations. With the current rapid increase in modem capabilities and the rapid drop in modem prices a new auto-dial modem may become a necessity long before expected. An auto-dial modem might also have to be relinquished for a period of time for repairs, resulting in the need to use a spare, manual-dial modem.

Dialing Directory

When a software package allows the storage of telephone numbers that can be used with auto-dial modems to access remote systems, the package should also allow the user to list the directory of available telephone numbers. Numbers that are buried in command or batch files are inconvenient to locate when they have to be dialed without using the command or batch file. It is also good to have a brief summary listing of the major communications parameters that will automatically be invoked when a number is dialed from the directory.

Originate/Answer Mode Switch

To receive a call from a remote terminal or another computer, the modem must be switched from the originate mode to the answer mode. Manual-dial modems provide a switch that activates the mode change, but intelligent modems may be switched manually or through software control. Communications packages often allow you to switch from one of these modes to another by pressing one or two keys.

1200 Baud Modem Support

A communications package should be able to support both 300 and 1200 baud (bits of data per second) communications. The ability to upgrade from a 300 baud modem to a 1200 baud modem without buying a new communications package can save software and training costs. Almost all communications packages use different commands to perform the same function, so changing to a new package means that communications users have to learn new commands.

Return to Operating System

A communications package's ability to return control to the operating system is often overlooked when a package is being evaluated. You should not have to reboot the computer each time a communications session is completed. Entering a simple command should enable you to leave the communications program and return to the operating system to perform other computer operations. Many packages use a function key or an Alt-key combination to provide a shortcut back to the operating system. Other packages require you to go through a series of menus before returning to the operating system. Either option is acceptable, but the single- or dual-key shortcut is faster to execute and easier to remember.

Disk Directory Listing

Another useful feature is the ability to list the disk directories of all disk drives. When you are uploading files, this function allows you to select files for transfer. When you are downloading files, it allows you to select file names that are not currently in use. If the program stores communications parameters in disk files, the disk directory listing provides a menu of parameter files. For programs that support batch file operation, this option allows a menu of available batch files to be displayed.

Review

Prestored Strings

Frequent communications with systems that require log on commands can mean a great deal of repetitive typing. In such cases prestored character strings that can be transmitted to a host system are a useful feature for both business and personal applications. Many communications software packages for the PC allow prestored strings to be uploaded with one or two keystrokes, making this feature even more convenient. When prestored strings are provided by a package, the user must be able to list the strings quickly while logged on to another system; it is easy to forget which string goes with each key, so a quick reminder is sometimes necessary.

Break Signal

Many mainframes and some information services require a break signal to interrupt program execution. A communications package should be able to send a 200- to 600-millisecond sustained high signal (equivalent to a logical 0) with one or two keystrokes. This signal will interrupt a program in progress or get the immediate attention of an information service system.

Operating System Required

Care should also be taken when selecting a communications package, because available packages may operate only under PC-DOS, CP/M-86, or the UCSD p-System. Some packages will run under only one of these systems, but others are available for more than one operating system. A package designed to run under one system will not operate under another. Files downloaded using a CP/M-86 communications package cannot be accessed later under PC-DOS because the disk formats are different.

User Help Files

Help files are important in frequently used communications packages. They are also helpful for the user who is not accustomed to a particular package. Help files are not a replacement for a good user manual, but they provide a quick reference for the keys required to perform certain functions. These help files should be readily accessible and written in clear, concise English.

Documentation

A communications package is incomplete without a good user manual. A package that contains all the features described above is of little use without a manual that tells how to use the features. A manual does not have to contain the background information on communications, but it must fully explain each feature.

User Support

When all else fails, you must be able to get support from the software publisher. Good user support means that a technical person is available when needed to help solve applications problems. No communications software package is perfect, particularly new ones on the market, and most of the problems encountered cannot be solved by a software salesperson. Before purchasing a software package, you can check with local IBM PC user groups and other people who own and use the package to be sure it is well supported.

Additional Desirable Features

Many commercial communications applications require several software features beyond those described in the previous section. The PC must deal with mainframe communications idiosyncrasies, which may include communicating in more than one character code (for example, ASCII and EBCDIC). Business communications may also require frequent large file transfers or multiple file transfers beyond the scope of personal communications. Differences in work hours and time zones may also require unattended-operation communications capabilities.

Upload Throttle

When files are being uploaded to a mainframe system, it may be necessary to match the file transfer rate with the response of the mainframe. Some host computer systems will not allow you to send a line of data until you are prompted to do so. The prompt, a signal indicating that the mainframe is prepared to receive more data, may be a letter, a character, a number, or a combination of all three. Data sent before the prompt is received are usually lost. Uploading a file to such a system without providing a mechanism to wait for prompts results in the truncation of each line; a subsequent listing of the file will show the beginning of each line missing. To match the upload speed of the IBM PC with the system response of a mainframe, it is sometimes necessary to throttle the upload.

Communications software packages provide several types of upload throttles. The three major types are time delays, character receipt delays, and character prompt delays. A time-delay throttle allows you to select the length of the time delay between the upload of each line of data. A character-receipt delay throttle allows you to specify the number of characters that must be received from the mainframe before a new line of data is uploaded. A character-prompt delay allows you to specify the exact character string that must be received from the mainframe before a new line of data is sent.

Linefeed Control

Some communications software packages add linefeeds after each carriage return received or transmitted, but others do not. Business communications software should let you decide whether to have linefeeds sent following each carriage return or added after each received carriage return. Without this capability, transferred files may have to be edited to remove or add linefeeds and conversation mode communications may be difficult to perform.

If a linefeed is being added to each transmitted line by a remote system and another one is being added by the PC's communications package, the received data will have a blank line between each line of data. If linefeeds are not being added to the end of each transmitted line by the host and the PC's communications package is not adding one, the data received by the PC cannot be listed and edited until linefeeds are added. If data is being received in the conversation mode and neither the IBM PC software nor the remote station software is adding linefeeds at the ends of data lines, each line will overprint the previous line on the PC monitor, making it difficult to read the data.

> Prestored character strings that can be transmitted to a host system are a useful feature for both business and personal applications.

Binary Data Transfer

A full-featured communications package should allow the transfer of non-ASCII files. It is often necessary to transfer machine code files, rather than source code, to protect the source code from being stolen or modified. Some BASIC language communications software will not send or receive machine code, because some of the binary strings contained in the files appear to the communications program as end-of-file markers, causing the transmit or receive mode to terminate abnormally. Business applications usually require that communications software be designed to overcome this problem.

Protocol File Transfer

The term *protocol file transfer* is used by many software vendors to describe special file transfer techniques. These techniques are different for each package, but they generally do the same thing. The protocol signals (sometimes called *handshaking*) used by these packages allow them to transfer text, data, and machine code files and to perform sophisticated error checking to be sure files are transferred properly. The handicap in using these protocol file transfer techniques is that the computers on both ends of the communications link must be using the same software; there is no standard that governs these protocols and no two are exactly alike. This means that a business must standardize its communications software to take advantage of protocol transfers.

Remote Control

Some IBM PC communications packages allow users to call in from a remote location and take over the operation of a computer as if they were sitting in front of it. To perform this function both systems must be using the same software. Businesses can use this capability to transfer files to or from an unattended computer. For example, a branch office can send a file to the home office in another time zone before or after normal working hours.

Command Files

Command files allow the storage of several parameters in a disk file for repeated use. These files may contain many or all the software package commands that can be entered from the keyboard. Communications parameters such as parity and number of data bits may be modified, and a telephone number can be automatically dialed by a command file.

Batch Mode

Batch mode operation is similar to command file loading and execution, but it supports several commands not supported by command files. A command file can modify communications parameters and dial a telephone number when used with an auto-dial modem, but a communications operator must take over to continue the session after the communications link is established. A batch file can modify communications parameters and dial a telephone number, but it can also continue the communications session after the connection with the remote system is established. Log on messages can be sent and files transferred between the IBM PC and any other system without operator assistance. A batch file may also be written to delay execution until a specified period of time has elapsed.

Character Filter

Some mainframe and microcomputer communications software transmits control characters. These characters do not print on most computer terminals, but the characters are printed on an IBM PC. To eliminate these annoying and sometimes confusing characters, the program must filter them out of the incoming stream of data. Some PC software packages allow the user to turn the filter on or off by executing a command string. Business applications that require remote demonstrations of software running on a computer that transmits control characters would benefit from the filter option.

Translation Table
Translation tables allow the program to redefine incoming or outgoing character codes. Any of 256 codes can be redefined so that a different character code is passed to the IBM PC than the one received, or a different character code is sent out through the communications port than was entered at the keyboard. EBCDIC code for a given character can thus be converted into ASCII code. Certain characters can be redefined as nulls or spaces or can be left out of the translation table entirely so that they will be filtered out of incoming or outgoing data.

Tab-to-Space Conversion
The IBM PC sometimes uses tab (Control-I) characters to represent spaces in stored files. These tab characters save valuable disk space by representing up to 8 spaces each. Other systems, however, do not always follow the same convention. To keep files that contain tab characters intact, it may be necessary to convert tab characters into spaces. Several IBM PC communications packages provide a facility for turning this automatic conversion on and off by issuing a command from the keyboard.

Telephone Hangup
Some business communications involve systems that do not automatically break the telephone connection when you log off. To break a connection with one of these systems, you should be able to execute a software command that "drops the line" when an auto-dial/auto-answer modem is being used. Without this option the modem might have to be turned off to break the connection, and frequent off/on cycling of a modem may shorten its life.

External File Manipulation
It is often necessary during a commmunications session to delete old files as new ones are created. It may also be necessary to rename files created by a communications software package (for example, a command file) or those that have been improperly named during file downloading. It may also be necessary to run a BASIC program or execute a DOS command (for example, a FORMAT or CHKDSK command) during a communications session. These operations can be done more quickly and easily if they can be performed without exiting the software package. The IBM PC communications packages that provide these options should save a company time and money if file transfers are performed frequently.

Auto-Redial
Some local information services used by hobbyists run on microcomputers and allow only one user at a time, while others have a limited number of incoming connections. The telephone numbers of these services are frequently busy. Instead of manually redialing a number from the keyboard, an auto-dial modem may be software controlled to redial a telephone number until a connection is made. Software packages that offer this capability also provide an alarm signal that gets the user's attention when the carrier signal of a remote system is finally detected. It is often necessary to use an auto-redial to get through to a bulletin board system on weekends or holidays.

> The XMODEM protocol can be used to receive binary files, but the host computer must be able to send files using that protocol.

Elapsed Time of Call
It is convenient to have an elapsed-time-of-call indicator when communicating with a time-sharing information service. Information services generally charge a rate based on connect time, so the elapsed-time indicator can help save connect-time costs. This feature can also serve as a reminder of costs when calling a long-distance number to get in contact with a host computer system.

XMODEM Protocol
Most CP/M bulletin board systems use the Ward Christensen XMODEM protocol to transfer files. This protocol is similar to the protocol file transfer technique described earlier in this article in that it requires a protocol-matched system; the XMODEM protocol, though, is in the public domain. (See "XMODEM Comes to the PC.") Software that supports this file transfer technique allows the user to take advantage of 99.6 percent error-free file downloading from CP/M bulletin boards. The XMODEM protocol performs checksum error detection for transferred blocks of data, and blocks containing errors are automatically retransmitted.

XMODEM Comes to the PC

When transferring files between computers over the telephone lines, there is always the chance that electrical noise will result in data transmission errors. To ensure proper transfer of files the communications software must detect data transmission errors and retransmit data that contains errors. Many people think that asynchronous parity error detection provides that capability. It does not. Parity error detection only tells you when a data transfer error has occurred, but it is up to you to retransmit the data and correct the error.

Parity error detection is not actually performed by most IBM PC communications packages. If a program does detect errors, it may not inform you of the errors as they occur. If it did provide instant notification, you could immediately retransmit the data. *ASCOM*, for example, places asterisks in a file where parity errors are detected, but you may not realize the errors occurred until long after the file is transferred. To ensure error-free data transfer you need a protocol file transfer technique.

The protocol file transfer is a set of rules that specifies a set of ASCII handshaking characters and the sequence of handshaking required to perform certain functions. Protocol handshaking signals allow communications software to transfer text, data, and machine code files, and to perform sophisticated error checking.

The handicap in using protocol file transfer techniques is that the computers on both ends of the communications link must be using compatible software. There is no standard that controls these protocols and almost all communications programs that have a protocol file transfer option use a protocol unique to that package. If two people want to share files, they must standardize their communications software to take advantage of protocol transfers.

The Ward Christensen XMODEM protocol is one specific file transfer protocol that may become a default standard in personal communications because of its widespread use on CP/M bulletin boards and because of its inclusion in low-cost personal computer communications packages such as *PC-Talk III*. It has not gained widespread acceptance in business communications packages, partly because the protocol is public domain; most business communications package designers use unique protocols to force businesses to use their software on both ends of the communication link. Users of communications software deserve a standard protocol that can be used with any computer, regardless of the software packages employed.

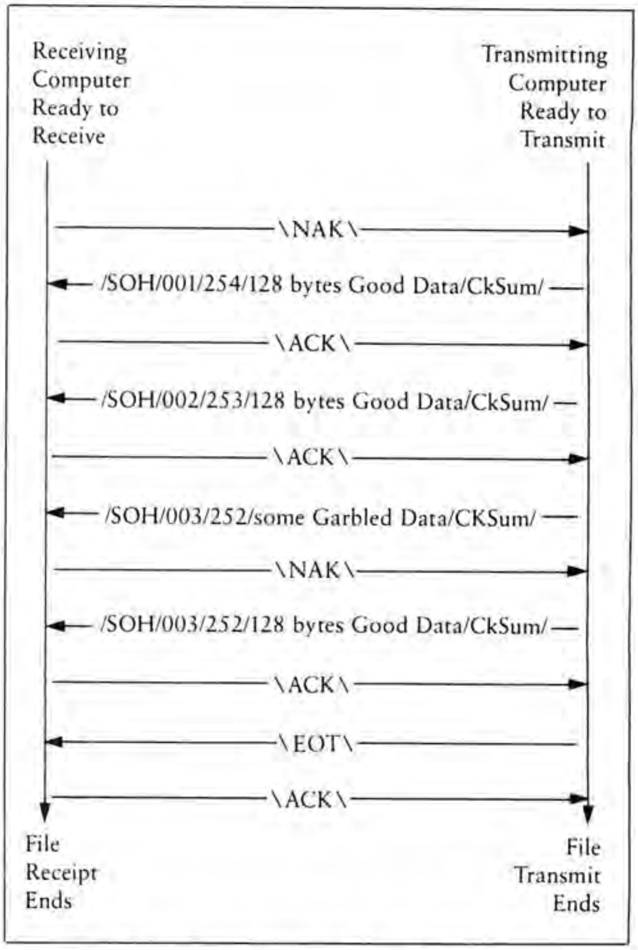


Figure 1: XMODEM Protocol File Transfer

The XMODEM protocol is illustrated in Figure 1. Using XMODEM, the transmitting computer does not begin the transfer of data until it receives a signal from the receiving computer indicating that it is ready to receive data. The receiving computer indicates its readiness by sending the Negative Acknowledge (NAK) character (ASCII 21) to the transmitting computer every 10 seconds until the file transfer begins. If the file transfer does not begin after the receiving computer has sent 9 NAKs, the process must be manually restarted.

After a NAK is received, the transmitting computer sends a Start of Header (SOH—ASCII 01) character, followed by the ASCII character with

(continues)

Evaluating Communications Software

The evaluation and selection of a communications package may not be an easy task. Changing needs and capabilities in a business environment and changing budgets in a hobbyist situation contribute to the complexity. But as is the case with other software packages, decisions have to be made based on the best information available.

The initial step in selecting a software package is to assess your communications needs. A list of all essential features should be developed, followed by a list of desirable features. Only then should available communications software packages be considered. An evaluation matrix similar to the one shown in Table 1 allows you to place communications packages in proper perspective by showing their strengths and weaknesses graphically.

Public domain and inexpensive BASIC programs are excellent learning tools.

As part of the evaluation of communications software, experience with any package is valuable. Public domain and inexpensive BASIC programs are excellent learning tools. You can experiment with these simple programs and learn a great deal about communications through trial and error. There are many bulletin board and private host systems operating in major metropolitan areas that can be used as guinea pigs during this learning process. Mastering a simple BASIC communications program will help you evaluate the capabilities you will need for serious communications.

The following are brief reviews of several commercially available IBM PC communications packages. Only the highlights—both good and bad—of each package are presented. The packages require at least one disk drive, a modem, an asynchronous adapter, and an RS-232C cable. Other requirements are noted at the end of each review. Table 1 accompanying this article rates the 12 programs in terms of the characteristics and capabilities described earlier.

ASCOM

Although *ASCOM* has been available on CP/M systems for years, the PC-DOS version I tested offers some advanced features, including auto-answer and auto-dial support for the Hayes Smartmodem. It has a batch file capability that can be used—if you have good programming skills—to auto-redial a busy telephone number or perform unattended file transfers. It also has a RUN command that allows DOS functions such as CHKDSK and FORMAT to be performed from within the program. The RUN command will also let you test software immediately after it is received from another computer. *ASCOM* can be set up to translate selected characters into other characters, enabling you to communicate with terminals or remote systems that use a non-ASCII character code such as IBM's EBCDIC code.

Although *ASCOM* is a powerful business-class, assembly-language program, it does have some shortcomings, particularly when used for personal communications. *ASCOM* does not provide a dialing directory, making use of the system with several remote systems cumbersome. The software does not allow you to select 7 data bits without specifying either even or odd parity; by not being able to use 7 data bits and ignore parity, *ASCOM* cannot be used with systems that always set the parity bit to 1 or 0. The package does provide its own unique protocol file transfer, but it does not support the public domain XMODEM protocol.

ASCOM, Dynamic Microprocessor Associates, 545 Fifth Ave. #602, New York, NY 10017, 212/687-7115. List price: $175. Requirements: 64K, 80-column monitor.

Communicator/Text Editor

As the name implies, the *Communicator/Text Editor* is both a communications package and a text editor. Unfortunately, it is not outstanding in either category. As a communications package it offers a limited number of capabilities, and as a text editor it is far surpassed by many other IBM PC packages. All incoming data can be captured to memory (up to BASIC work-space size limitations) and edited before being stored in a disk file. Lines such as direct statements in BASIC merge files can be removed from either the top or the bottom of the file. The capture buffer can be listed on the screen or retransmitted to another host. The contents of another disk file can also be added to the captured data before it is sent to another host. A file may be modified slightly for particular hosts and sent to each host individually, and then deleted from memory completely.

This package has three major weaknesses. The first is the lack of a communications parameter listing and change command. The only way to list the communications parameters in use is to list the telephone directory used to dial the host system. The parameters (parity, number of data bits, and number of stop bits) can only be changed by changing the dialing directory and redialing the host; the parameters cannot be changed while you are on-line with a host.

The second major weakness is the dialing directory. The directory is actually a data file that comes with some example setups. To support the host systems you call, you have to read the file into memory and use the

the value of a block number to signal the start of a 128-byte block of data, followed by the "one's complement" of the block number. The "one's complement" is the block number XOR 255. For example, the one's complement of 1 is 254; 2 is 253; 3 is 252, and so on.

The transmitter then sends the 128-byte block of data followed by an error-checking checksum. The checksum is calculated by adding the ASCII values of each character in the transmitted 128-character block; the sum is then divided by 255, and the remainder is retained as the checksum.

After each block of data is transferred, the receiving computer computes its own checksum and compares the result to the checksum received from the transmitting computer. The receiver also verifies that the block started with an SOH and that the block number is correct. If the two values are the same, the receiving computer sends an Acknowledge (ACK—ASCII 06) character to tell the receiver to send the next sequential block. If the two values are not the same, the receiving computer sends the transmitter a NAK to request a retransmission of the last block. This retransmission process is repeated until the block of data is properly received or until nine attempts have been made to transmit the block. If the communications link is noisy, resulting in improper block transmission after nine attempts, the file transfer is aborted. The receiver checks each block in this manner until the entire file has been transmitted.

XMODEM uses the two block numbers at the start of each block to be sure the same block is not transmitted twice because of a handshake character that got lost during the transfer. The receiving computer checks the transmitted block to be sure that it is the one requested. Blocks that are retransmitted by mistake are thrown away. When all data has been successfully transmitted, the transmitting computer sends the receiver an End of Transmission (EOT—ASCII 04) character to indicate the end of the file. The receiver acknowledges the EOT with an ACK, and the transfer terminates.

The XMODEM protocol offers the IBM PC several advantages over other protocols and file transfer methods. The XMODEM protocol is in the public domain, which makes it readily available for software designers to incorporate into a communications program. In addition, the protocol is easy to implement using high-level languages such as BASIC or Pascal. And XMODEM only requires a 256-byte communications receive buffer, which makes it attractive for IBM PC owners who have 64K systems.

XMODEM also allows a user to transfer non-ASCII, 8-bit data files (e.g., COM, EXE, and tokenized BASIC) between microcomputers because it calculates the end of a file based on file size and uses handshake signals to indicate the end of a file instead of relying on an end-of-file marker character (Control-Z) to terminate a file transfer.

XMODEM error checking is superior to normal asynchronous parity error checking.The parity method of error checking is 95 percent effective if the software on the receiving end checks for parity errors. XMODEM error checking is 99.6 percent effective, and the software on the receiving end must check for errors. Parity errors detected do not result in automatic retransmission of the bad data; errors detected by XMODEM result in data retransmission until no errors are detected or until nine retransmissions have been attempted. Finally, the protocol is used by many CP/M bulletin boards, and having the protocol in a communications package allows the IBM PC user to receive error-checked files from these bulletin boards.

package editor to modify the numbers and parameters. The documentation manual attempts to explain the parameters contained in the file and the techniques required to modify them, but the actual modification of the file is complex. Some parameters have to be in specific columns and have specific punctuation or they will not work properly. A directory data base with a full screen layout like the one used in *PC-Talk* and *PCMODEM* would be easier to use.

Finally, the *Communicator/Text Editor* needs more power. It is a good single-line editor, but it does not approach the capabilities of full-screen text editors such as *EDIX* or the IBM *Personal Editor.*

Communicator/Text Editor, Electronic Data Systems Corp., 7171 Forest Ln., Dallas, TX 75230, 214/661-6273. List price: $125. Requirements: 96K, 80-column monitor.

Crosstalk

Crosstalk is a feature-rich assembly language package suitable for many business applications. Communications parameters can be altered from the keyboard to match a host system or brought in from a batch file. A batch file can also be used to dial a host computer. Files can be received directly to disk or received in a memory buffer for later transfer to disk. *Crosstalk* can also transfer files to another *Crosstalk*-controlled computer using a special protocol that allows multiple file transfers with special error checking. The package offers limited multitasking by allowing simultaneous download to disk while in the command mode (another screen), listing a disk directory, or listing a disk file. The most powerful *Crosstalk* feature, however, is its remote take-over mode. *Crosstalk* can be set up with an auto-answer modem so that another *Crosstalk*-controlled PC can call in and perform any DOS functions.

Crosstalk does have some minor weaknesses. It has a dialing directory, but the directory lists only the file names that contain the telephone number and communications parameters for host systems. To see the telephone number or the parameters associated with a specific host system, you have to list that host's command file using another *Crosstalk* command. The package works well with a Hayes Smartmodem (dial and auto-redial are supported), but you have to reset almost all the Smartmodem internal switches before the package can be used properly (this has to be performed only once unless you use several communications packages or have a host system on your PC).

> *Data Capture/pc*'s menu-driven design is wonderful for a novice just learning communications, but once you have become proficient with the package, the feature is annoying.

The protocol transfer capability of this package is also a good feature, but the protocol used is unique to *Crosstalk*. An XMODEM protocol option would add power, particularly for home users who access CP/M bulletin boards.

Crosstalk, Microstuf, Inc., 1845 The Exchange #140, Atlanta, GA 30339, 404/952-0267. List price: $195. Requirements: 64K, 80-column monitor.

Data Capture/pc

This package has been popular on the Apple II for several years and was recently released for the PC. The software is a combination of BASIC and machine code that allows the user to modify the software for special needs while retaining the data transfer speed needed for 1200 baud applications. *Data Capture/pc* not only allows you to capture received data to either disk or memory, but also to send data from a disk file or send selected text from a memory buffer. It also allows you to select any or all control characters to be filtered from captured data.

Data Capture/pc's greatest strength, however, is its printer control. It allows you to print the entire contents of the capture buffer or any selected range of lines from the buffer. The same print control applies to disk files; you can send all or part of a disk file to the printer.

If you are accustomed to using a communications software dialing directory, you will be disappointed with *Data Capture/pc*. The package allows you to save all operating parameters to be used with specific host systems in unique command files for later use, but the only way to get a Hayes Smartmodem to dial a number with this package is to issue commands directly to the modem.

Data Capture/pc's second weakness is its menu-driven design. This feature is wonderful for a novice just learning communications, but once you have become proficient with the package, the feature is annoying. The software does have a "fast menu" mode, but to perform most operations you have to go through at least two command levels.

An annoying feature is the Quit command; instead of returning you to the operating system, it leaves you in BASIC. Finally, all the *Data Capture/pc* program code cannot simultaneously fit into the memory of a 64K system. Small-system owners will have to use a version of the program that chains two modules together, which can be annoying because of the time delay when a module is being loaded from the disk.

Data Capture/pc, Southeastern Software, 7743 Briarwood Dr., New Orleans, LA 70128, 504/246-8438. List price: $120. Requirements: 128K, 80-column monitor.

IBM Asynchronous Communications Support

Version 2.0 of this package is now available and is a marked improvement over 1.0. The new version allows the user to capture directly to disk data that is received from any ASCII system, not just data received from another IBM system. It also allows the user to send data to a remote system that operates slower than the IBM PC by supporting prompted uploads.

Like many other packages this one allows you to save all operating parameters in a batch file for reuse with specific systems. The system also protects the novice by toggling off the print mode when download to disk is activated; this can be annoying, however, if you use a high-speed printer and wish to produce a copy of conversation mode interaction with a host system.

The greatest strength of this package is its documentation. Like most other IBM software packages each command and feature is explained in detail. A communications novice can learn a great deal by studying this documentation manual.

The IBM package, although significantly improved with the new version, is still not in the same class with many other commercial smart terminal packages. It is a good choice for use with mainframes, but it is a poor choice for personal use. The screen display is choppy due to the way in which the BASIC program handles screen output.The package provides no dialing directory and no filtering of control characters. It does have a protocol transfer option, but the protocol is unique to this package—it cannot be used with another microcomputer user unless the remote system is using the same package.

Worst of all is the menu-controlled design. To perform most functions the user has to go through several layers of menu choices, a process that quickly becomes annoying to the advanced user. A fast menu mode that allows the user to bypass the listings of menu choices should have been provided.

IBM Asynchronous Communications Support, IBM Corporation, P.O. Box 1328, Boca Raton, FL 33432, 800/462-3333. List price: $60. Requirements: 64K, 40- or 80-column monitor.

LogOn

The *LogOn* package, though well designed, operates under the p-System and is of little use for the majority of PC owners whose only operating system is PC-DOS. It provides an excellent file display technique. A file can be loaded into a buffer and scrolled up and down, either a line or a page at a time. The same buffered data can also be sent to a remote host or cleared from the buffer to prepare the system for other operations.

LogOn has most of the same weaknesses as the *Data Capture/pc* software. First, it is menu driven and the menus get old after several hours of use. Changing communications parameters and turning the data capture on and off are cumbersome due to the menu-controlled design. Second, it has no direct download to disk capability; this limits file transfers to the size of available memory (approximately 20K in a 128K system). Data captured in that buffer also cannot be selectively sent to a printer or disk file; either all data is sent or no data is sent to these devices. Third, it has no dialing directory; all communications parameters specific to a particular host are stored in a data file and cannot be reviewed without loading the file. Finally, the software cannot generate a break signal, so its use with mainframe systems is limited.

LogOn, Ferox Microsystems, Inc., 1701 N. Fort Myer Dr. #611, Arlington, VA 22209, 703/841-0800. List price: $150. Requirements: 128K, 40- or 80-column monitor.

LYNC

LYNC is an assembly language package that offers two powerful features. Besides a standard smart terminal mode, *LYNC* can be placed in either a LYNC mode or a Remote mode. While in the LYNC mode it can communicate with a remote *LYNC* system to perform protocol file transfers of any type of file. This mode also allows a user to list the directories of the disk drives on either end of the communications link as well as use wildcard file names (similar to the * and ? DOS substitute characters) when sending or receiving files. The Remote mode allows you to access (using a password) and operate your IBM PC from a remote location using another microcomputer or a dumb terminal. The software will also dial a telephone number when used with a Hayes Smartmodem.

This software package does have several significant limitations. It uses dialing files instead of a dialing directory, which limits its appeal for personal use. *LYNC* also does not allow transmission of binary files; the package has an XSEND command that converts COM and EXE files into ASCII hexadecimal characters as the files are being transmitted. The hexadecimal files have to be converted back into binary files on the receiving end. Another weakness is the absence of a filter for downloaded control characters; these characters can be annoying and clutter up files received from mainframe computers.

Finally, the Remote mode does not allow you to operate memory-mapped, full-screen software from a remote location. Remote operation is limited to software that prints a line at a time on the monitor (sometimes called TTY or teletype compatible).

LYNC, International Software Alliance, 1835 Mission Ridge Rd., Santa Barbara, CA 93103, 805/966-3077. List price: $155. Requirements: 48K, 80-column monitor.

PC/InterComm

The *PC/InterComm* package is specifically designed to allow the IBM PC to emulate (perform almost exactly as) a Digital Equipment Corporation (DEC) terminal. If you need the capabilities of a DEC VT52 or VT100 terminal to access an office computer, this package is the one for you. The instruction manual frequently references DEC terminal characteristics, and the package includes a DEC VT100 user manual. This assembly language package loads quickly and operates smoothly. It supports optional addition or deletion of linefeeds following carriage returns for use with mainframes, and it supports the XMODEM protocol for use with CP/M bulletin boards.

PC/InterComm is useful for business applications, but it is not recommended solely for personal use. It allows you to save and reload customized communications parameters, but it does not provide a dialing directory. The software also does not offer full support for file-transmission speed matching with mainframe computers. It provides XON/XOFF handshaking and time-delay upload throttling, but it does not include prompted upload capability.

PC/InterComm, Mark of the Unicorn, Inc., P.O. Box 423, Arlington, MA 02174, 617/489-1387. List price: $99. Requirements: 64K, monochrome monitor.

PCMODEM

This compiled BASIC software is an excellent personal communications package that takes full advantage of the Hayes Smartmodem. It has an excellent dialing directory that can be configured with the names, telephone numbers, communications parameters, and log on commands associated with particular remote computer systems. By selecting a number from the *PCMODEM* dialing menu, you can set up the required communications parameters and automatically dial a host. After connecting with the host, log on is achieved quickly and easily by pressing the PC function keys. If a telephone number is busy when dialed, *PCMODEM* allows you to redial the number automatically every 2 minutes until a connection is made. *PCMODEM* also has two excellent file transmission features. You can select a specific time delay to occur after each line is transmitted. This feature accommodates speed matching with slow remote systems. *PCMODEM* will also receive files with the Ward Christensen XMODEM protocol.

The *PCMODEM* limitations for personal communications are few but significant. First, the package allows transmission of ASCII files only. Binary files cause abnormal file transfer termination in both send and receive modes; the XMODEM protocol can be used to receive binary files, but the host computer must be able to send files using that protocol. Second, memory management is a problem with *PCMODEM*. The Compiled BASIC version distributed on the *PCMODEM* disk is too large to load into a 64K system. An Interpretive BASIC version is available for use with 64K systems, but it will not support downloading large files at 1200 baud.

PCMODEM, Solution Software Systems, 117 South Main, Mt. Prospect, IL 60056, 312/893-5111. List price: $79.95. Requirements: 96K, 80-column monitor, Hayes Smartmodem.

PC-Talk III

Because of the Freeware concept originally used to distribute this software and the wide distribution resulting from that method, *PC-Talk* has become the benchmark that other PC communications packages are measured against. With the release of version III, *PC-Talk* will remain a strong contender for first place in the communications software race. *PC-Talk III* is distributed in both Interpretive and Compiled BASIC, and the interpretive version can be compiled without modification. It will load into a 64K system, but the compiled version requires at least 96K. Interpretive BASIC is limited to 300 baud operation for large file transfers, where the host does not support XON/XOFF handshaking, but Compiled BASIC will operate at 1200 baud with no XON/XOFF assistance.

New features added to *PC-Talk III* are time delay and character prompted upload, and the ability to transmit and receive binary files. The Ward Christensen XMODEM protocol has also been given a boost in the PC communications marketplace with its addition to this package. The package works well with manual and auto-dial modems and provides an excellent dialing directory. The prestored strings capability has been increased from 10 to 40 strings of 126 characters in *PC-Talk III.*

PC-Talk III does have some limitations, but if you are a good BASIC programmer, you can eliminate them by adding enhancements. The software allows you to strip linefeeds that follow carriage returns when transmitting a file to a mainframe, but it does not support linefeed stripping when communicating in conversation mode. Finally, the package allows the user to select characters to be stripped or translated when they are received from a remote computer, but the maximum number of characters that can be specified is three.

PCMODEM allows tranmission of ASCII files only.

The second weakness in this package is the method of documentation. The documentation is 70 pages long and is well written, but it comes on a disk and has to be printed by the user. This is an inconvenience for people who wish to dig into the documentation immediately after getting the package, but it does facilitate copying the documentation for other users.

PC-Talk III, The Headlands Press, Inc., P.O. Box 862, Tiburon, CA 94920. Requested Contribution: $35. Requirements: 64K, 80-column monitor.

Smartcom II

As you might expect, this package is a good match for the Hayes Smartmodem. It is designed to use all the capabilities of either the Smartmodem 300 or Smartmodem 1200, and it does. Parameter files for each host you call can be saved on disk and reloaded from a directory; telephone numbers stored in these files can be used to call host systems automatically.

Macro files may also be stored for each host. The macros are command strings (up to 16 for each macro) that can be sent to a host to perform repetitive tasks, and they can be set up to respond to a specific host prompt character or to transmit after specified time delays. The best application of these macros is with information utilities such as CompuServe and The Source; the entire command string required to move from one subject area to another can be stored in a macro file that is loaded when the information utility parameter file is loaded.

Another strong feature of this package is the Files menu. It allows the user to create, display, erase, print, and rename disk files. *Smartcom II* also has a remote takeover mode that allows other *Smartcom II* users to call in and run the PC under password control. The strongest feature of this package, however, is the user manual. Besides providing an excellent description of each program feature, it provides good information on general communications, a feature not provided by most communications packages.

Although this package is powerful when used with the Hayes Smartmodem, it has two weaknesses. First, the software is menu driven, which will irritate some users. I generally do not like menu-driven communications software, but I did not mind the way Hayes used menus in this package. Many of the submenus that were displayed by selecting items from the main menu were displayed on the screen below the main menu, so you are not constantly moving from one screen to another as with most menu-driven software. The second weakness is the way *Smartcom II* displays on a color monitor. Every time a line scrolls off the top of the screen the entire screen fills with colored snow. This is an unfortunate design error; it really hurts an otherwise outstanding piece of software.

Smartcom II, Hayes Microcomputer Products, Inc., 5923 Peachtree Industrial Blvd., Norcross, GA 30092, 404/449-8791. List price: $119. Requirements: 96K, monochrome monitor.

Telios

Telios is the last package discussed only because of its location in an alphabetical sort. This is a powerful assembly language communications package that has a high performance-to-price ratio. As you can see in Table 1, *Telios* has most of the capabilities provided by *ASCOM*, *Crosstalk*, and *Smartcom II*, but it is easier to use than these packages. It is command driven, and its commands are consistent and well documented in software help files and in the accompanying documentation.

Telios offers two unique features. First, you can use the IBM PC cursor control, PgUp, and PgDn keys to scroll back and forth through 20K of information received during conversation mode communications with a remote computer. Second, TELIOS downloads files directly to disk, and the downloading can be paused and restarted with the stroke of a single function key. Downloading at 1200 baud can also be performed without XON/XOFF interaction with the remote computer.

For communications with mainframes *Telios* allows communication with or without linefeeds following carriage returns and supports both time-delayed and host-prompted file transmission. You can also save and reload customized communications parameter files for reconfiguration of *Telios* to match different host systems.

Although *Telios* is a powerful business communications package, it has some weaknesses when used for personal communications. The package can be used to

PC-Talk has become the benchmark that other PC communications packages are measured against.

auto-dial telephone numbers with several popular intelligent modems, either directly or from within a stored command files, but it does not provide a dialing directory. It also supports the XON/XOFF handshaking protocol during file send and receive operations, but it does not provide an error-checking protocol transfer. The addition of XMODEM protocol support would enhance the personal communications appeal of this package.

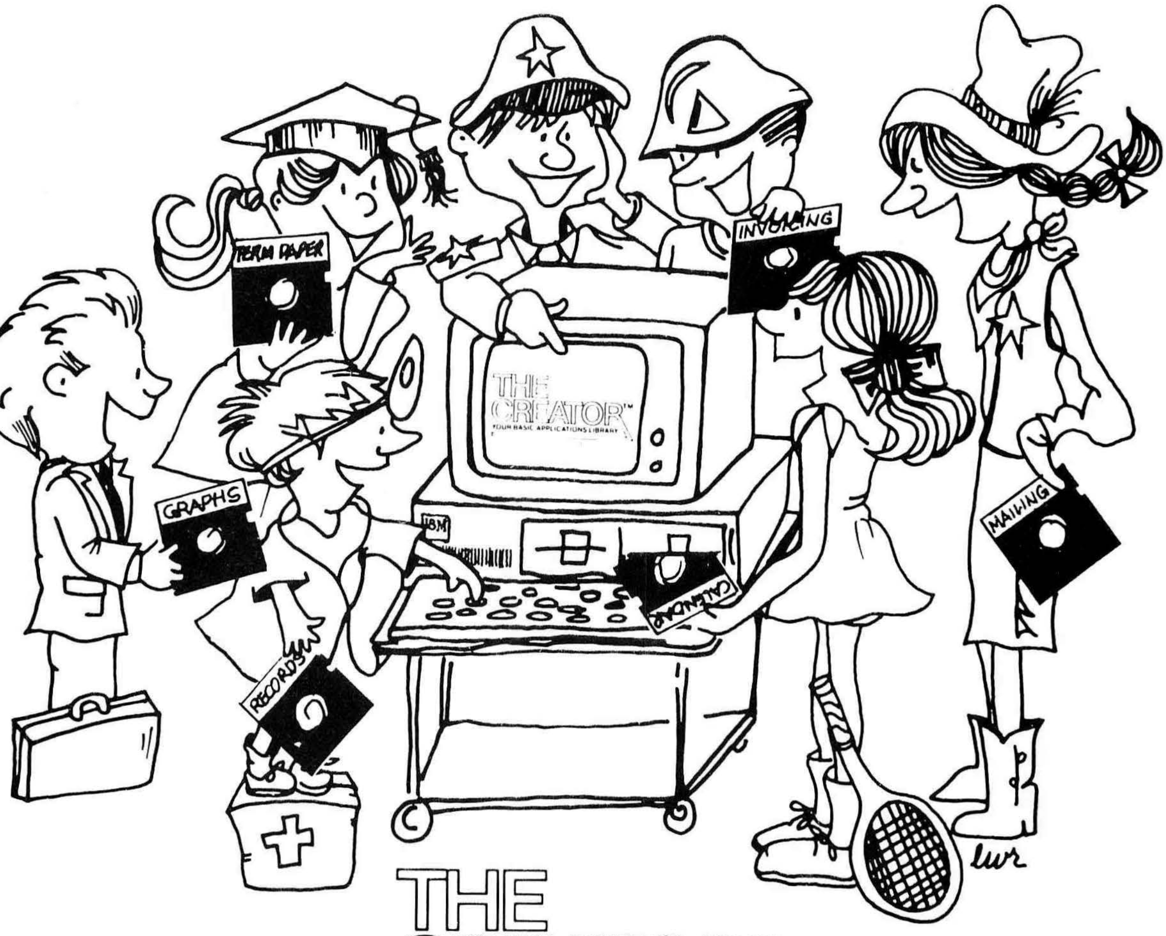
Telios, Genasys, 11820 Parklawn Dr., Rockville, MD 20852, 301/468-6900. List price: $99.95. Requirements: 64K, 80-column monitor.

The Final Analysis

After using all the packages reviewed here, I prefer *PC-TALK III* for home use and *Crosstalk* for business use. Both are powerful packages that are easy to learn and use. They are both command driven, so prolonged use of either package can be done without the frustrations of moving back and forth through layers of menus. Both packages are capable of sending and receiving binary files with or without protocol transfer, and both are capable of downloading files while operating at 1200 baud. Colors can be added to either one simply and easily, and they both work equally well with IBM color and monochrome displays.

However, as *Smartcom II* and *Telios* improve, the authors of *PC-Talk III* and *Crosstalk* will have to strive harder to stay ahead, because these packages are not far behind.

Larry Jordan is a freelance writer who manages power plant startup engineers for the NUS Corporation. He has coauthored the book Communications and Networking for the IBM PC, *to be published this summer by the Brady Company.*



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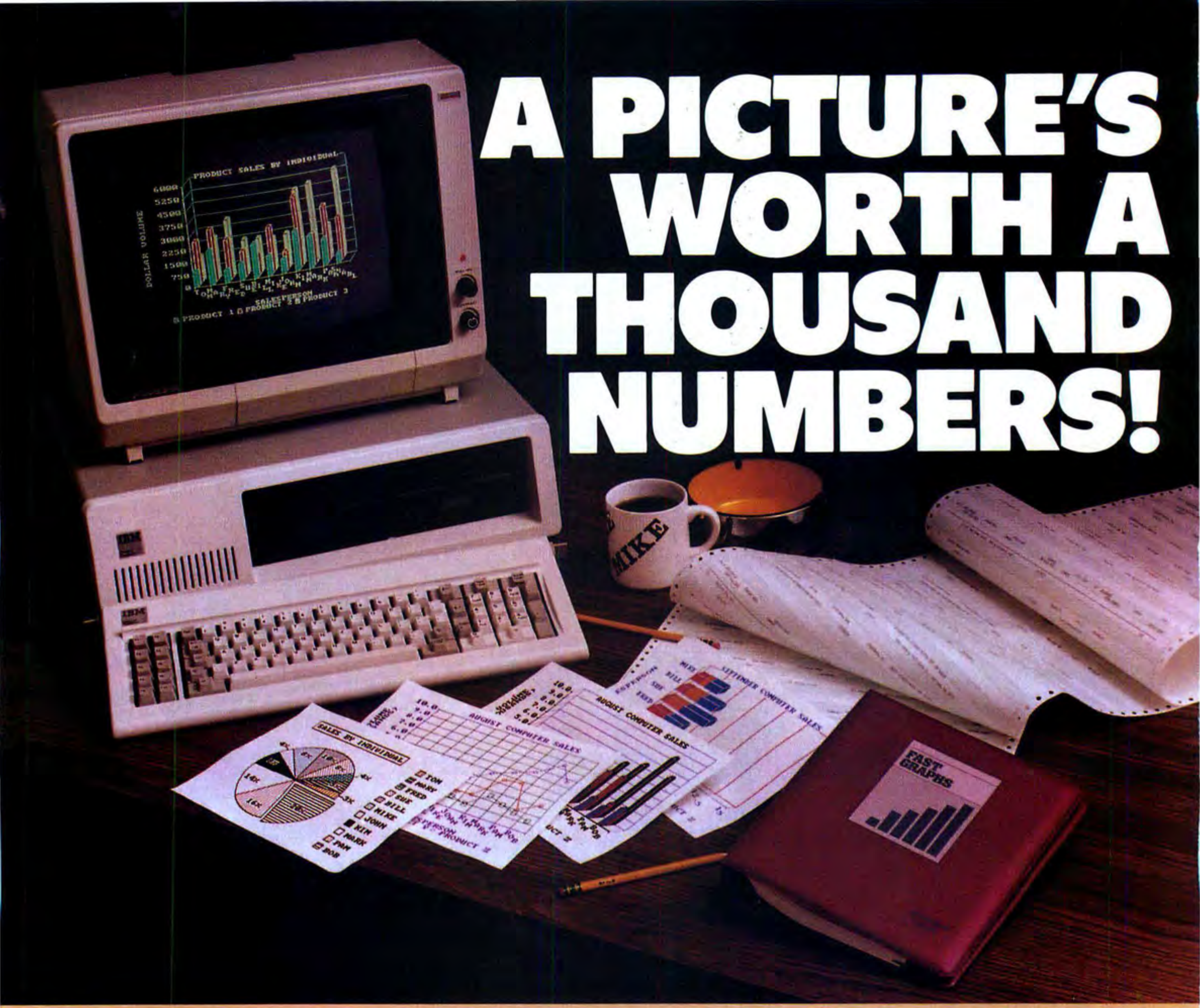

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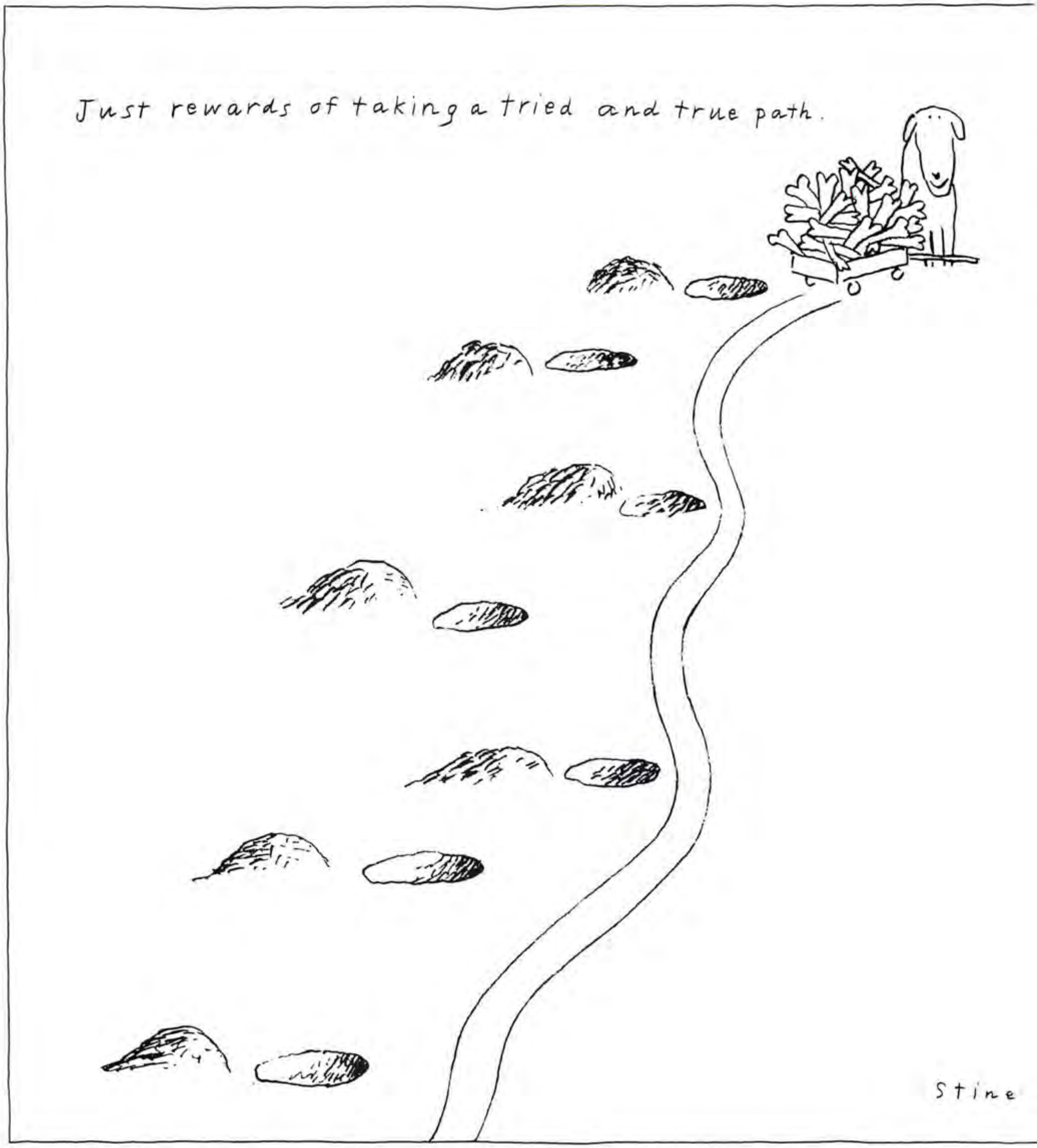

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The Next Best Thing to Being There

Operating your PC from far away was a remote possibility until now.

Richard Steck

It's a hot, muggy night in downtown Los Angeles and you're holed up in a cramped hotel room with red carpeting and a purple bedspread. Like any other successful salesman you have a list of orders as long as your arm and an equally intimidating pile of correspondence that you need to send to your secretary. You grab your partner, an inconspicuous, Japanese-made portable computer, and attach a modem and phone cables to ready it for action. Within minutes you're transmitting your day's orders and letters directly to an IBM Personal Computer at headquarters. Before disconnecting, you quickly run the commission program. You'll eat prime rib tonight.

A few days later you're back at home. The word processing program for your home PC is primitive compared to the one at the office, so you connect to the PC at work with the help of a 1200 baud modem. Using the WordStar *disk in the office PC, you do your call reports while sitting at home. A few hours later on the way out the door to another sales call you attach an auto-answer modem to an inexpensive leased line dedicated to incoming computer calls. Co-workers and clients with communications capabilities in their computers can leave notes in your absence. You leave the house knowing you have everything under control.*

This scenario is not an excerpt from a science fiction novel, but a hypothetical account of what can be done with *Remote Access*, a program written by Jim Davis of Custom Software in Bedford, Texas. With the help of a 300 or 1200 baud modem, *Remote Access* connects an IBM PC or terminal to a distant PC through the Asynchronous Communications Adapter. Once connected, this unique program lets you operate a distant PC as if you were actually sitting in front of it.

> *Remote Access* is especially convenient when you are accessing a PC from a remote terminal.

Like the many communications programs now in use, *Remote Access* automatically dials and answers, sends and receives files, and even activates a printer. Unlike these other programs, however, *Remote Access* gets into the distant computer's DOS, letting you run programs from your location. The only stipulation is that the applications program to be run must be in the distant PC's disk drive; *Remote Access* does everything but change disks for you.

When you start up *Remote Access* on a PC, a menu is displayed that permits you to perform housekeeping functions such as setting specifications for your RS-232C port. You can also specify the baud rate at which your communications port operates (any standard speed from 110 baud to 2400 baud), your ASCII bit configuration (the common PC convention of even parity, 7 data bits, and 1 stop bit is the default), time-out value (the time in minutes of allowed inactivity before *Remote Access* resets itself and the PC), and optional passwords for incoming callers.

PC to PC

Operating a PC remotely from another PC or common ASCII terminal is the simplest use of *Remote Access.* When used PC to PC, almost every key on the host PC (the computer called with *Remote Access*) is activated by the remote PC (the calling PC or terminal) with the exception of Ctrl-A, Ctrl-C, Ctrl-S, and Esc. With *Remote Access,* Ctrl-A is used to simulate the PC's Alt-key combinations; to activate Alt-P on the host, for example, press Ctrl-A followed by P. Ctrl-C is used by the remote system to activate a Ctrl-Break on the host system; Ctrl-S performs the familiar Ctrl-NumLock function, which stops the screen from scrolling.

Esc is used for special purposes. If you press Ctrl-Alt-Del to reset the host PC from your remote PC, for instance, you'll reset your own PC but probably disconnect yourself from the host. To get around this, press Esc and then R to reset the host. With programs provided with *Remote Access* you can even change Esc R to another keystroke sequence.

Cursor Control

Along with reassigning keystrokes, *Remote Access* is capable of converting the host PC's cursor movements to those required by a remote terminal. Almost all terminals made in the last 15 years offer some form of cursor control. Using either a Ctrl-key combination or an Esc key sequence, you can move the cursor to specific areas on the screen, or create blinking or highlighted characters. The codes that control cursor movement vary from system to system, however, so it is unlikely that any two terminals have similar cursor control codes. This is why *Remote Access* is especially convenient when you are accessing a PC from a remote terminal.

When you're on a remote computer dialing a system with *Remote Access*, you are asked for your name and password. Once the correct password is supplied, the PC-DOS A> prompt appears and you are ready to operate the host PC from your remote keyboard. If your terminal type is stored in the host system with your password, you can operate in full cursor-control mode. If your terminal type has not been stored with your password, or if you wish to change your terminal type, simple enter Terminal. A list of about two dozen popular terminals is then offered for your selection.

For those of you contemplating the use of cursor control from a remote terminal, 300 baud communications may be too slow for programs, such as *WordStar*, that make heavy use of cursor control. As you run *WordStar*, the top line of the screen indicates the line and column numbers at which your cursor is located. This cursor indicator changes each time the cursor moves on the screen. At normally high console speeds the cursor indicator changes almost instantly. At lower speeds, however, you can see the cursor jump back and forth between the actual cursor position and the line and column marker positions. Operations such as scrolling cause the entire *WordStar* screen to be repainted. This repainting occurs very slowly at 300 baud, making programs that are heavily reliant on cursor control impractical to use; at 1200 baud these programs are usable but still slightly annoying.

System Log

Your call to *Remote Access* is logged in a System Log file that can be read, stored, or erased by a host system operator. The log file contains the caller's name and the time and date of the call. Since the remote system can reset the host by pressing Esc R (the equivalent of Ctrl-Alt-Del) on the remote keyboard, you might wonder what happens to the date and time settings for PC-DOS when the host system is reset.

Remote Access stores a boot delay value preset to 28 seconds that is called by the START.BAS program immediately after booting. If a reset lasts more or less than 28 seconds, the host operator can plug in a new value to keep the system log more accurate. Passwords afford the host system a reasonable amount of protection in *Remote Access.* Even though it's difficult to deliberately

> *Remote Access* is designed for unattended operation.

cause a system crash with PC-DOS, a few extra measures of protection can be taken. One step is to have the START.BAS program disable Ctrl-Break; another is to save the *Remote Access* programs on disk with the ',P' option. Unfortunately, someone trying to crash the system can do so once past the initial password.

Remote Access is designed for unattended operation, including accepting and storing messages from a remote caller. By typing MAIL the caller starts a program that accepts a short message from the caller and stores it on the host system disk. For message privacy *Remote Access* also encodes the message using a simple encryption technique.

File Transfer

But what use is a host-remote connection if you can't transfer files? Normally a TYPE *filename* command issued by the remote system lists the contents of a file on the host's screen and communications port. Once this list is completed, the remote is ready to capture the file. If the file has lines longer than 80 characters, however, *Remote Access* will send a 'Carriage Return-Linefeed' after 80 characters are sent. Because of the unacceptability of this procedure, *Remote Access* uses a utility program called GETFILE for uninterrupted file transfer. After typing GETFILE you are prompted for the name of the host file you wish to receive. Then you capture the file with your normal communications program. File transfers from the remote system to the host are accomplished with a complementary program called PUTFILE.

PC-DOS 2.00

Remote Access runs under both PC-DOS 1.10 and 2.00. Because a program of this nature interacts with PC-DOS internals, chances are good that *Remote Access* will also offer two versions, one of which will take advantage of the new features in PC-DOS 2.00.

If you need general-purpose access to your PC from a remote terminal, a rudimentary bulletin board system, or a system for swapping public domain programs among friends, *Remote Access* is the program to use. For $89 Jim Davis will supply you with approximately 1500 lines of unprotected BASIC source code, allowing you to customize the program to your needs. The code is a good tutorial on advanced PC techniques. Davis also offers to customize *Remote Access* for terminals not on the terminal list for about $5. For the price and for all it offers, *Remote Access* is a tough act to follow.

Richard Steck is the vice-president of management information systems for a Chicago investment firm. He is also librarian of the Association of PC Users in that area.

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Color Graphics with a Plus

Plantronics' Colorplus Adapter and Draftsman software allow you to extend the color graphics capabilities of the IBM PC.

Nelson Johnson

The future belongs to graphics. Computers of all sizes are based fundamentally on the use of graphic images in one form or another. Even word processing can be interpreted as a graphics process because the character set displayed on the screen consists of simple graphics patterns made up of pixels, dots of light created by the illumination of phosphorescent substances by a scanning electron beam. Putting these tiny graphics patterns on the screen involves a process that requires fast, small, complex, and economical circuits.

When the IBM Personal Computer was launched in August 1981, it featured a graphics adapter officially named the Color/Graphics Monitor Adapter. (Adapters are also referred to as boards or cards.) Another adapter, the Monochrome Display Adapter, was intended for word processing and did not support graphics functions. IBM has been criticized by some who say that it was unwise to separate the two functions. Combining pixel graphics (the control of each pixel or "picture element") and high-resolution characters on the same display (monitor) would make combining graphs and charts into reports easier.

In display technology the name of the game is cost effectiveness. Graphics can be produced at extremely high resolution, as high as 1024 by 1024 pixels. But the cost for this resolution is also high—as much as $3000. Such expense may be justified in an industrial environment, but not for most individual users.

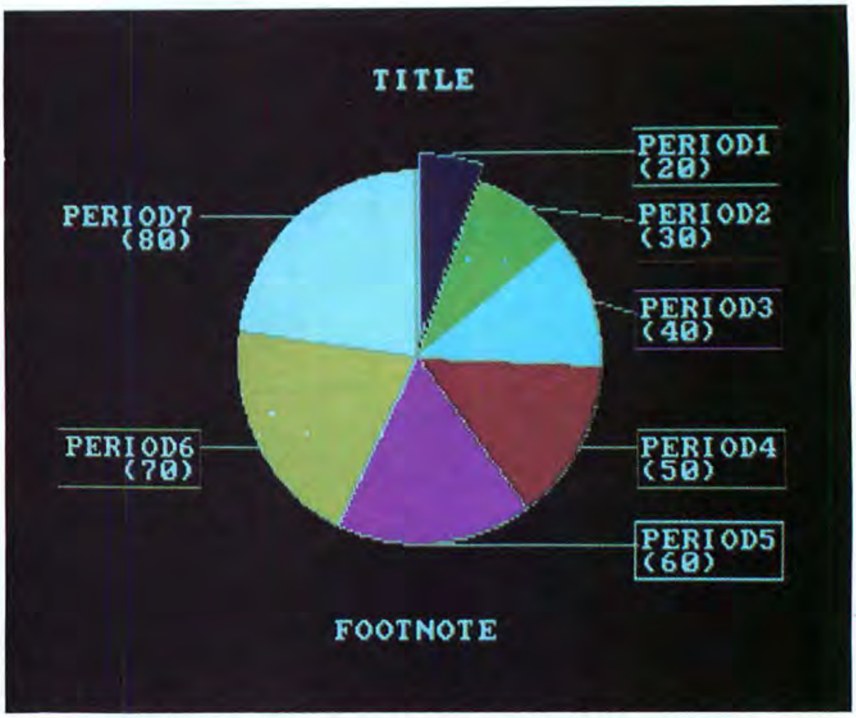

Figure 1: Medium-resolution pie chart created with the Draftsman for the Colorplus adapter

In my observation of IBM during the time that I have owned my PC, I have discovered that the company, a resourceful organization, often does things with a wisdom that is, although not infinite, nevertheless formidable. By making the display technology independent of the motherboard and concentrating on serving words and pictures separately, IBM has truly made high quality affordable for each function. In addition, the company has created two distinct groups of third-party manufacturers that provide additional options for PC users. Some of the third-party vendors allow you to use the color graphics display for enhanced high-resolution graphics, including text, and others allow you to create graphics on the monochrome display.

Display Technology

There are basic differences between the graphics generating methods used by each type of display adapter. The key to both the Monochrome Display Adapter and the Color/Graphics Adapter systems lies in their respective clock frequencies. The higher the clock frequency, the greater the bandwidth. Basically, bandwidth is a direct measure of the amount of information that can be displayed on the screen without producing a detectable flicker. The combination of bandwidth and refresh cycle determines the usefulness of the display for a given purpose.

In general, the wider the bandwidth and the higher the refresh frequency, the higher the effective resolution and the more expensive the display is to produce. The 720 by 350 resolution provided by the Monochrome Display Adapter, for example, is possible with a video bandwidth of 16.257 MHz (million cycles per second). The screen is refreshed at a rate of 50 Hz (cycles per second). The monochrome display itself is driven directly from the adapter. The display has no internal ability to control the scan of the screen; it must receive its horizontal and vertical synchronization externally.

The Color/Graphics Adapter works differently. It provides a maximum display resolution of 640 by 200, a clock frequency (bandwidth) of 14 MHz, and is compatible with the 60 Hz refresh cycle of a standard TV receiver. In accordance with the United States broadcast standard, the graphics display is interlaced, which means that the scanning electron beam in the picture tube scans all the odd-numbered lines on the screen first, and then the even-numbered lines. In all, 262½ lines are scanned in each field, for a total of 525 lines, of which only 483 are actually seen on the TV screen. To conserve memory on the Color/Graphics Adapter (and maintain lower cost) and to keep the display resolution well within the capacity of a color TV receiver, IBM chose to use only 200 of the available 525 lines.

In video display technology the refresh cycle is broken into two parts. The electron beam illuminates horizontal lines on the screen selectively, resulting in the display. Each line is traced (drawn on the screen), the electron beam is blanked (turned off), the line is retraced, the beam is turned back on, the next line is traced, and so on. A complete interlaced TV frame is produced 30 times per second (for the color graphics display). By using a higher clock speed and higher horizontal frequency than the United States broadcast standard, IBM has effectively increased the amount of information that can be displayed, and hence increased the resolution of the display.

To get a feel for the quality of the image produced by the Monochrome Display Adapter, imagine a display system that is required to display 252,000 dots of light (at various intensities) 50 times per second. The Color/Graphics Adapter displays only about half this number (128,000 dots in various colors) 30 times per second.

Beyond IBM Color Graphics

One of the limitations of the Color/Graphics Adapter is that it displays a palette of only four colors in medium-resolution mode and two colors in high resolution. This means that games are not very interesting to run and that information can have only a limited range of overlapping categories. IBM did not see a great need for more colors; it probably felt that the PC would serve as a business tool rather than as a games machine. Memory addresses were reserved, however, for liberal amounts of future display memory, whether supplied by IBM or other manufacturers.

Figure 2: Medium-resolution line graph created with the Draftsman for the Colorplus adapter

The other, perhaps more significant, reason for IBM's use of only four colors can be demonstrated by comparing the physical structure of the Color/Graphics Adapter to that of the new Plantronics Colorplus Color Graphics Adapter. The Colorplus device, which plugs into an expansion slot on the PC motherboard, is identical to the Color/Graphics Adapter, except for one physical difference: it is biplanar. This term simply means that two boards are attached to each other and held together by two nylon posts.

The Colorplus Adapter uses biplanar technology because expanding the color palette to 16 colors (in medium-resolution mode) means doubling the amount of display memory. IBM decided not to add a second plane on its Color/Graphics Adapter so that it could be sold at a reasonable price (for its performance).

In my use of the Color/Graphics Adapter for computer-aided design, high resolution is important; however, this limits me to black and white only. Because I need color in my programs, the development of alternatives to the Color/Graphics Adapter, such as the Colorplus Adapter, are welcome.

One of the aims in developing the Colorplus Adapter was to make sure that software designed for the Color/Graphics Adapter would also run on the Colorplus Adapter. This aim has evidently been achieved, since all the software I use, including *WordStar, VisiCalc,* and *MicroCad,* was developed for the Color/Graphics Adapter and works well with the Colorplus.

Installation

The Colorplus is packaged in a cushioned cardboard container similar to the one provided by IBM for its adapter. Included in the package is a warranty card and the documentation. Before you follow the instructions in the installation manual, be careful to unplug the power cord of your monochrome display (if that is the display you use) from the PC. The installation manual does not point out that if you set Switch 1 on the motherboard to the 80 by 25 color monitor setting (position 2 on, 5 on, 6 off) and leave your monochrome display plugged in, you will hear a high-pitched squeal that will increase in intensity until a puff of smoke signals that a fuse has probably blown in your monochrome display.

The Colorplus documentation as well as the *Draftsman* software that you can buy to run with the adapter does not acknowledge that some people want to combine the Monochrome Display Adapter and monitor with the Colorplus Adapter. *Draftsman,* for example, requires you to set Switch 1 before the program can be used in a system that contains both the Monochrome Display Adapter and the Colorplus Adapter. This requirement is unnecessary, considering that software pokes can be used to switch between displays or to default the system to the Colorplus Adapter. Aside from this problem, the Colorplus Adapter and Monochrome Display Adapter live quite well together on the PC motherboard.

The monochrome display is driven directly from the adapter.

Once you are aware of the omissions, the installation manual makes for easy installation and anticipates problems you might have in completing the procedure.

With any graphics adapter the quality of color produced has less to do with the adapter than with the quality of the monitor. The adapter sends digital information to the monitor, but it can't create the rich colors. The Colorplus Adapter works well with most direct-drive RGB color monitors. The Berg strip connector on the Colorplus Adapter, however, is not as accessible for the connection of a composite monitor or RF modulator as is the RCA jack on the Color/Graphics Adapter. The photographs shown in Figures 1 and 2 demonstrate that the Colorplus Adapter can produce a breathtaking range of colors—a welcome relief from the four-color limitation of the Color/Graphics Adapter.

The Draftsman

If you aren't up to graphics programming yet, you can easily create graphics using the *Draftsman* software with the Colorplus Adapter. (If you don't have this package, you can run other software that is available for the Color/Graphics Adapter.) The program is a handy business package that lets you generate a range of graphs and charts in full color.

The *Draftsman* documentation is displayed on the PC screen, which is a useful feature for people just getting started with the system. Although the documentation runs quite well as part of the on-line system, it loses in print the logical connectivity given to it by the running program. The organization of the manual is loose and illogical. It is little more than a printout of the disk documentation, and it does not give a clear description of what the system does. A summary of the functions performed by each key would be helpful.

As a business graphics package, *Draftsman* produces three basic graph formats: pie, bar, and line. I found that building all of the described formats was easy, except that the friendliness of the system had a curious effect on its versatility. It seems that the more friendly software becomes, the more restricted are the features it offers.

In many cases, having an outline of the entire structure of the program in one place would be better than going on a tour through a labyrinth of menus. You may find yourself locked into a predefined graph format that is limited in usefulness because its style is restricted by a program design that is geared to ease of learning. It is not, after all, friendly to dictate the color and style of a person's clothing, no matter how good you think it is for them. It is friendly, however, to make available to the person a range of colors and a selection of components that are made to be easily and freely assembled.

Despite its limitations, *Draftsman* is competently designed, with a good deal of explanation incorporated in the program to guide people in exploring its functions.

Mode	Graphic Width	Character Width	Foreground Colors	Background Colors
	Color/Graphics Monitor Adapter (IBM)			
Text	NA	40, 80	1 of 16*	1 of 8
Medium Resolution	320	40	3**	1 of 16
High Resolution	640	80	1 of 8	1 of 8
	Colorplus Color Graphics Adapter (Includes the above Color/Graphics Adapter Text modes)			
Medium Resolution	320	40	16	NA
High Resolution	640	80	3**	1 of 16

NA = Not Applicable
* The character may be made to blink.
** 1 of 2 palettes

Table 1: Comparison of Graphics Modes, IBM vs. Colorplus

As applications software for the Colorplus Adapter, the *Draftsman* program is ideal. The 640-by-200 resolution, four-color mode clearly enhances the usefulness of the PC as a business graphics tool. At this resolution you can use the full 80-character screen width and combine two or more graphs to depict the same data in different form. The 80-character screen also presents a more readable and professional appearance than the 40-character format used at the 320 by 200 resolution. The color palette is expanded to 16 colors at this resolution, but the images and characters are much less sharp, and there is no background color as in high-resolution mode. The 16 colors add a richness to game graphics but aren't as useful as one might expect for business applications, mainly because of the 40-character screen width. Where the Colorplus Adapter truly excels is in the provision of four colors at high resolution.

Programming the Colorplus

The Colorplus Adapter adds extended capabilities to color graphics that can be explained best by the features listed in Table 1. Shown to the left (Y axis) are the various modes of both the Color/Graphics Adapter and the Colorplus Adapter. The features associated with each mode are listed across the top.

The technical specifications that describe the design and functions of the Colorplus Adapter are intelligently written, concise, and accurate. What a programmer really needs, however, is a formal organization of the instruction sequences required to produce specific program results. This information is presented both tabularly and with examples in the technical specifications, but for some reason I had difficulty reaching a complete understanding of the overall set of functions available for programming. After extensive study, I was able to master the basic methods for producing colors; however, by that point I was left with the feeling that there must be a better way.

In addition to the standard graphics modes provided by the Color/Graphics Adapter, the Colorplus Adapter provides two additional modes: 320 by 200 by 16 (extended medium resolution, 16 colors) and 640 by 200 by 4 (extended high resolution, 4 colors).

One of the drawbacks of the Colorplus design is that it relies heavily on writing directly to registers on the 6845 CRT controller (see the *IBM Personal Computer Technical Reference* manual), with no higher level software or firmware control provided. Of course, the LINE, PSET, PAINT, DRAW, CIRCLE, and other functions in BASICA don't have the ability to control the extended features of the adapter, so you must use the OUT command to load the necessary registers.

First you select the standard mode as you would for programming the IBM adapter, using a SCREEN command. Then use the OUT command to select the extended mode (medium or high resolution). Thinking of each mode as containing half its screen buffer on each of the two Colorplus planes is helpful. These planes are literally the physical boards with the standard card designated as plane 0 and the extended card designated as plane 1. To clear the screen, you must enter the mode for plane 0 and CLS, and then change the mode to plane 1 and use CLS again. This procedure is a bit more complicated than using a single CLS command to clear the screen.

In extended high resolution you choose specific colors from the palette by selecting plane 0 and using the DRAW or PAINT command to get green or cyan. Selecting plane 1 allows you to DRAW or PAINT in red or magenta. Combining the two planes to DRAW first in plane 0 and then duplicate your drawing in plane 1 results in white or yellow.

In extended medium resolution you needn't be concerned about a palette or background. Instead, the combination of planes determines which of the 16 colors is displayed. You have to switch between planes, as in extended high resolution, but this time you can use a color from 0 to 3 (described in the BASIC manual), instead of having to use only a 1. By combining the 4 colors available on each plane in all possible pairs, you achieve the square of 4, or 16, unique colors.

All this seems somewhat complicated until you realize that computers are made to combine groups of functions into subroutines that consolidate complexity. In actual practice you would probably want to create your own PAINT, LINE, CIRCLE, and other subroutines to allow you to

> The Colorplus would benefit from an easier method of drawing in various colors.

pass the color number, desired resolution, background, foreground, and border requirements to Colorplus and thereby set up the proper mode to perform the desired function.

More Plus than Minus

My overall impression of Colorplus is favorable. Although 16 colors are available in medium-resolution mode, I feel that color at high resolution is the most important feature. In fact, I would like to see even higher resolution. If the board provided 640 by 400 resolution in black and white only, it would be that much more valuable. The advantage of high resolution is that many options are available for positioning objects on the screen, and staircasing (broken diagonal lines) is reduced. Color is valuable for separating different kinds of information, but the location of information on the screen or on printouts is often more important. The figures that accompany this article should serve to demonstrate the value of high resolution. Two graphs can be displayed side by side for comparison, and text is much more crisp and businesslike.

On the negative side, strictly from a programming standpoint, the Colorplus Adapter would benefit from an easier method of drawing in various colors. Perhaps firmware would help to perform the task of switching between the two planes. As it is, the programmer is faced with the formidable task of making sure all modes of the adapter are implemented in the right order. It would be better to be able to send a set of codes corresponding to each color at the selected resolution and let the Colorplus do the work of switching planes.

My criticisms are, after all, only those of a programmer who spends too much time staring into a CRT. Other people, who run applications software with the adapter and rarely encounter the intricacies of programming, will delight in the wealth of color that the Colorplus Adapter provides.

Nelson Johnson is the author of a three-dimensional, computer-aided design program called MicroCad. *He specializes in combining architectural and civil engineering with personal computer technology.*

Colorplus Color Graphics Adapter
The Draftsman for Colorplus
Plantronics/Frederick Electronics Corp.
7630 Hayward Rd.
P.O. Box 502
Frederick, MD 21701-0502
800/638-6211
List Price: $475 (includes both the Colorplus Adapter and the Draftsman software)
Requirements: 128K, two disk drives

Color/Graphics Monitor Adapter
IBM Corporation
Systems Products Division
P.O. Box 1328
Boca Raton, FL 33432
List Price: $300


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Drafting without Eraser Dust

The FutureNet DASH-1 system turns your PC into an efficient schematic designer.

Karl Keller

How would you like to make neat, beautifully lettered schematic drawings at your desk without creating any eraser dust? Using a mouse instead of a pencil, you can do just that with the FutureNet DASH-1 Schematic Designer and your IBM Personal Computer.

Creating schematic drawings manually with pencil, paper, and eraser is the traditional method used by electrical engineers. But this method is laden with the potential for mistakes. Integrated circuit pin numbers are easily mixed up, and redrawing a whole schematic to reposition it on the page after major additions is often necessary. While quick, freehand lettering looks rather crude, lettering with a template is very time consuming.

Computer-aided drafting isn't new. Large companies have been using sophisticated (and very expensive) graphics systems for years, especially for mechanical drafting. The FutureNet DASH-1 (Design Aid Schematic Helpmate) is a relatively low-cost add-on to the IBM PC that effectively aids electronic schematic drawing and other drafting chores.

The system enables you to develop electronic schematic drawings on screen and print them out. The program's editor allows you to choose standard logic symbols common to digital integrated circuits from the system's symbol library and apply them to your schematic drawings (see Figure 1). You can also draw logic symbols or design symbols, such as company logos, that are completely unrelated to electronics.

The system commands are described so well that I was able to use the DASH-1 system without even unwrapping the IBM manuals.

At my company, Mullett Associates, Inc., we develop electronic products for manufacturing clients, often involving both digital and analog circuit design. For our purposes the DASH-1 system works amazingly well. We have used the system for schematic design and the PC for doing engineering computations in BASIC.

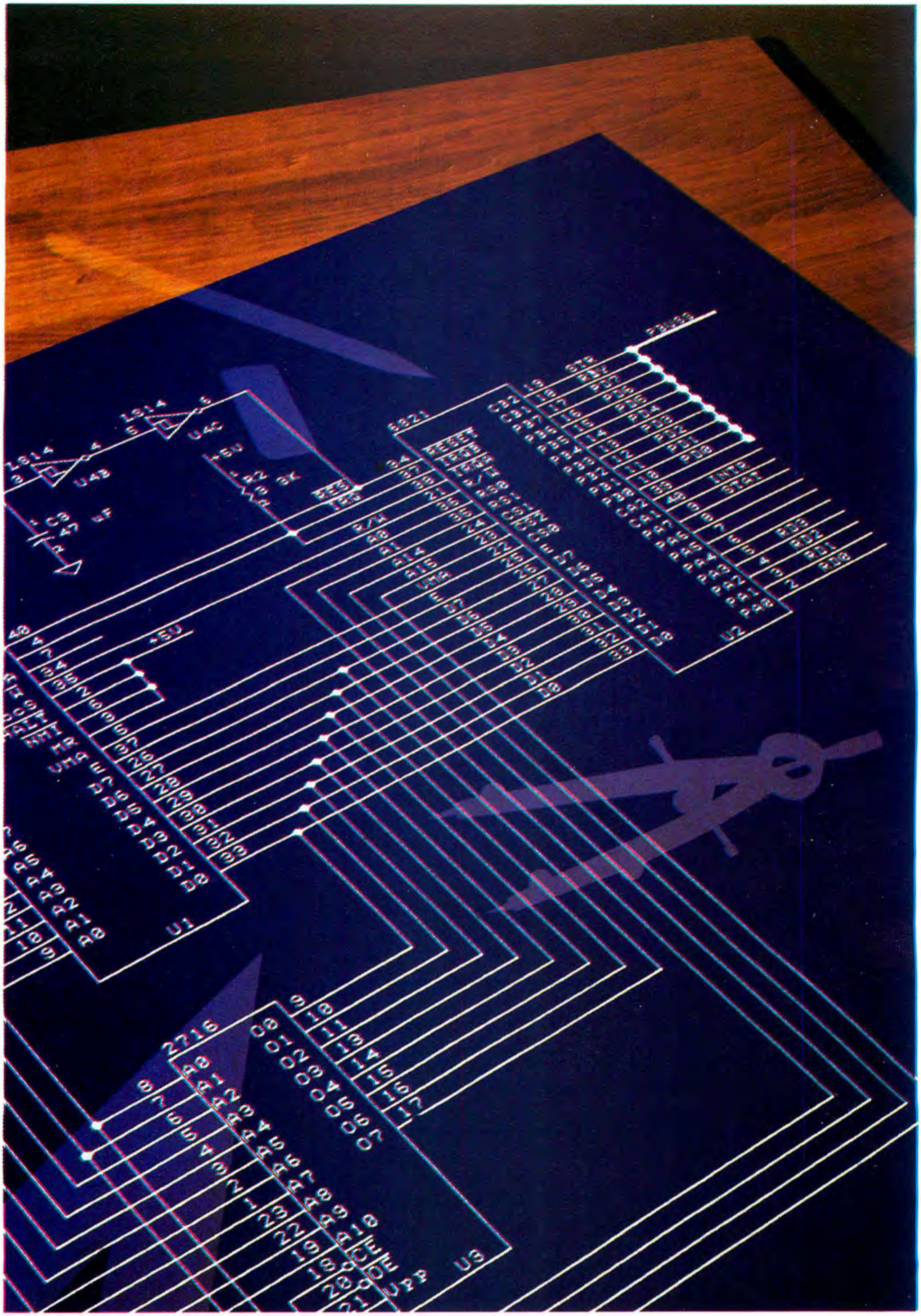
Intended to be sold as an add-on to the IBM PC, the DASH-1 system requires 256K of RAM, the IBM monochrome display, two 320K disk drives, and the C. Itoh 15-inch Prowriter 2, Model 1550 (print menu selections also accommodate the Epson MX-80 and MX-100 and the Okidata 84). The system consists of software on two disks, a graphics controller board, and a three-button mouse. For PCs that don't have the required memory, FutureNet also supplies a 256K memory board. Printout sizes are 8½ by 11 inches or 11 by 17 inches. Larger drawing sizes are possible but are awkward to produce.

First Time Use

Before using the DASH-1 system, I had not had any hands-on experience with the IBM PC, although I am familiar with several other computers. The drawings that accompany this article (Figures 1 though 7) were produced after only 10 hours at the system without any coaching.

The DASH-1 documentation is excellent. The manual is written in two sections. First is a learn-by-example exercise that covers the system commands. The system commands are described so well that I was able to use the DASH-1 system without even unwrapping the IBM manuals. The second section of the documejtion is a well-organized reference manual. Installation instructions, drawing conventions, recommendations, and appendices are also included.

Figure 2 shows the first schematic I drew. The drawing is of a Motorola 6802 microprocessor subsystem. Some standard logic symbols were taken from the DASH-1 symbol li-


6821
2716
U1
U2
U3
+5V

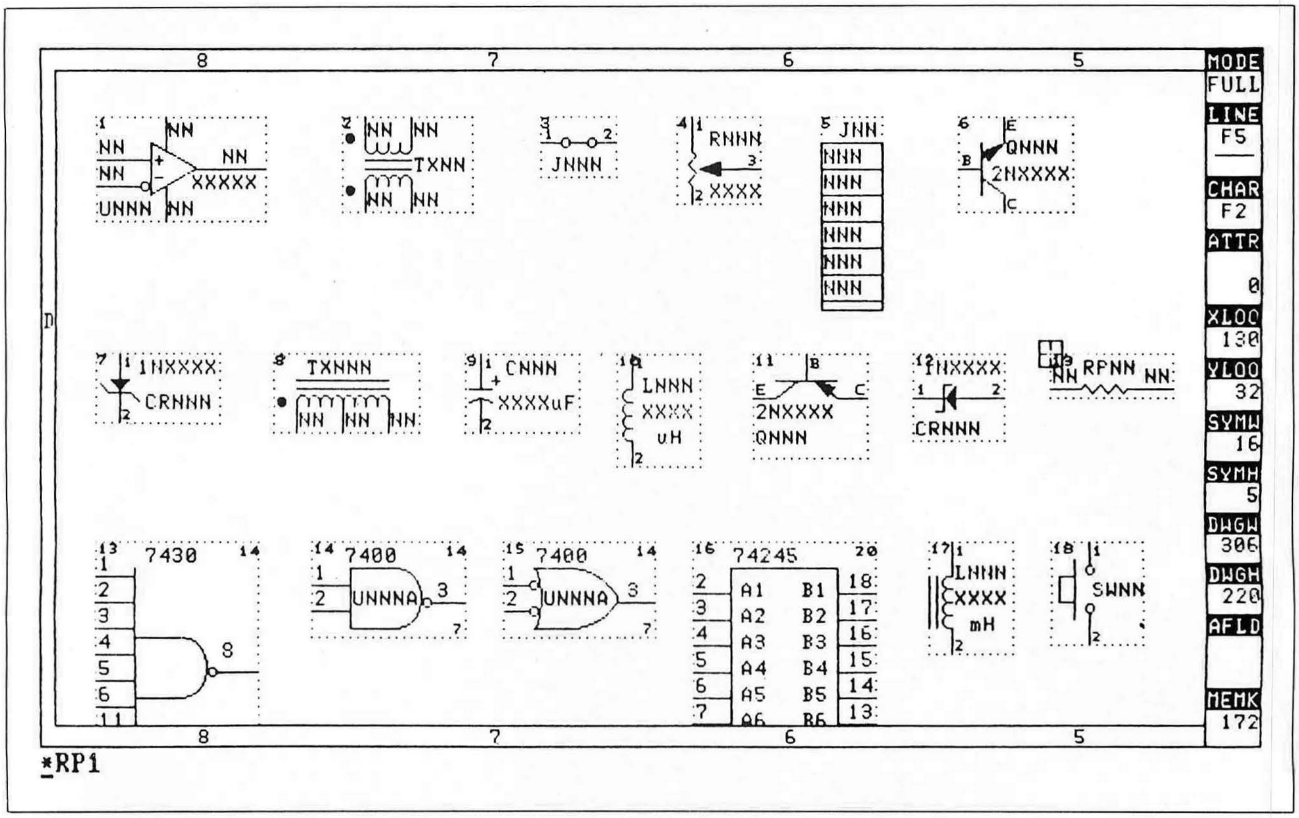


Figure 1: A selection of symbols from the DASH-1 system's symbol library. Note the complement representations of the 7400 gate section.

brary, and others I generated myself (I'm told that Motorola microprocessor parts and symbols are scheduled to be included in a future release of the DASH-1 symbol library).

The Mouse at Work

Editing (drafting) functions are performed by using the mouse and the keyboard together. The mouse is used for moving the cursor, drawing lines, erasing lines, and placing dots at line junctions. Keyboard commands select symbols, move symbols, and handle alphanumeric fields. Or, if you don't like mice, the arrow keys and commands preceded by a slash can take over for the mouse.

A neat feature of the system involves the use of the PgUp and PgDn keys. PgDn produces fast cursor movement and a full display of an 11- by 17-inch drawing (see Figure 3). PgUp displays a segment of the full drawing (see Figure 4). Thus, you can toggle between these two perspectives to produce a balanced placement of symbols on the page.

Targeting selects symbols or areas to allow you to move them around on the page. This feature solves one

> The DASH-1 system virtually precludes extensive redrafting.

of the most difficult problems in drawing a schematic: the layout on the page is often unbalanced due to an unfortunate choice of starting point or to unplanned additions. The DASH-1 system's movement flexibility is important, since it means that the system can be used for the initial drawing of a schematic; sketching out a paper drawing beforehand isn't necessary. You can also save subcircuits such as clocks or microprocessors in RAM and ROM as symbols that you call up to use again and again in different drawings.

The Symbol Library

The DASH-1 system includes a library of symbols for 40 memory parts, 50 Intel microprocessor parts, 90 discrete symbols (for resistors, capacitors, inductors, etc.), and about 250 transistor to transistor logic part numbers. The library also includes 37 graphic elements such as gate outlines and inductor loops that aid in creating nonrectangular symbols.

Most discrete symbols can be oriented on a drawing in any direction you want, and gates can be created with different logic orientations (such as the two symbols of the 7400 gate section shown in Figure 1). The system part directory can also be brought to the screen at any time (see Figure 5).

Attributes

The key to getting alphanumeric fields to print out correctly on the drawing is the attribute assigned to each field. Contrast Figure 6, for example, with Figure 4, which shows the alphanumeric fields printed.

For Figure 6 the .D command was used to display the attributes. For example, pin numbers are 1, part numbers are 3, signal names are 5, and so forth. The system even has attributes for schematic titles and for letters showing revisions. Therefore, as Figure 7 shows, you can print a pin list that identifies the connections to each pin and the pin's association to a signal name. Signal lines that are not labeled are uniquely identified by the system with '***n'.

Future releases of DASH-1 are planned that will make further use of the pin list for reports, bills of material, and design check reports. The pin list file format in the present version, however, is very clearly and specifically identified in the documentation and can be read as a string by BASIC.

Commands

The system is very comprehensive and flexible. We all know, however, that when a system is described that way, the command list is extensive, difficult, and unforgiving. But of all the "comprehensive and flexible" systems I have used, the DASH-1 is a pussycat.

There are the usual executive commands such as Load, Save, Erase, Print, and Size. Commands preceded with '.' handle symbols, and those preceded by '[' allow you to edit areas of the drawing. '/' commands are concerned with line drawing (or you can use the mouse and its three buttons), and commands preceded by " ' deal with alphanumeric fields. The symbol, area, and alphanumeric commands generally allow you to define, target, move, copy, cancel, and erase. A class of dot commands allows you to go into the symbol library. Finally, there is a set of commands for creating special nonrectangular symbols. The DASH-1 system's usefulness could be extended beyond electronic schematics to designs such as a network of interconnected computers or a system of electric utility switching stations.

> Drafting functions are performed by using the mouse and the keyboard together.

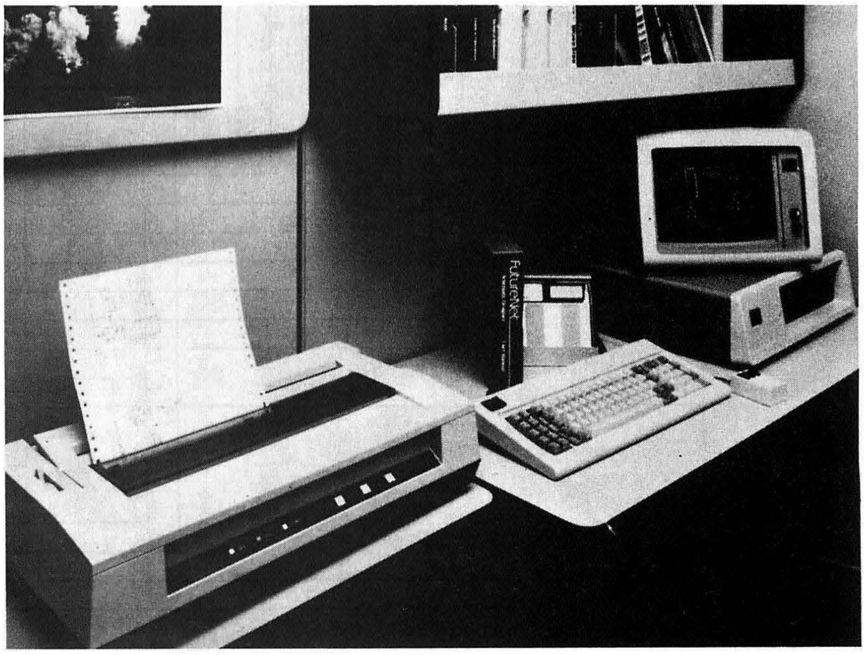
Observations

When I used the DASH-1 system, two start-up problems arose. First, the two system disks with the editor and symbol libraries were almost full. The editor and symbols stay on drive A, and on drive B you swap between disks for symbol libraries and disks that hold your saved drawings. The drawing in Figure 2, for example, took about 10K, and the pin processor output was about 7K. My advice is to have spare formatted disks ready when you use the system. Secondly, when you print on 11- by 17-inch paper, disable the paper-out switch on the printer (cellophane tape works fine) so that the drawing doesn't stop printing out prematurely.

Other than these two simple problems, using the DASH-1 system was straightforward. Plan to spend a couple hours stumbling around to get the hang of the mouse and the system commands. The tutorial sessions in the documentation will smooth this process for you. Then, after one good drawing and pin list, you are about 90 percent expert.

Overall Schematic

The DASH-1 system's power probably won't be obvious as you make the first schematic in a design project. But as you make changes and revisions, it virtually precludes extensive redrafting and lets you speed up repetitive tasks by saving files of often-used partial schematics and multiple-component circuits.



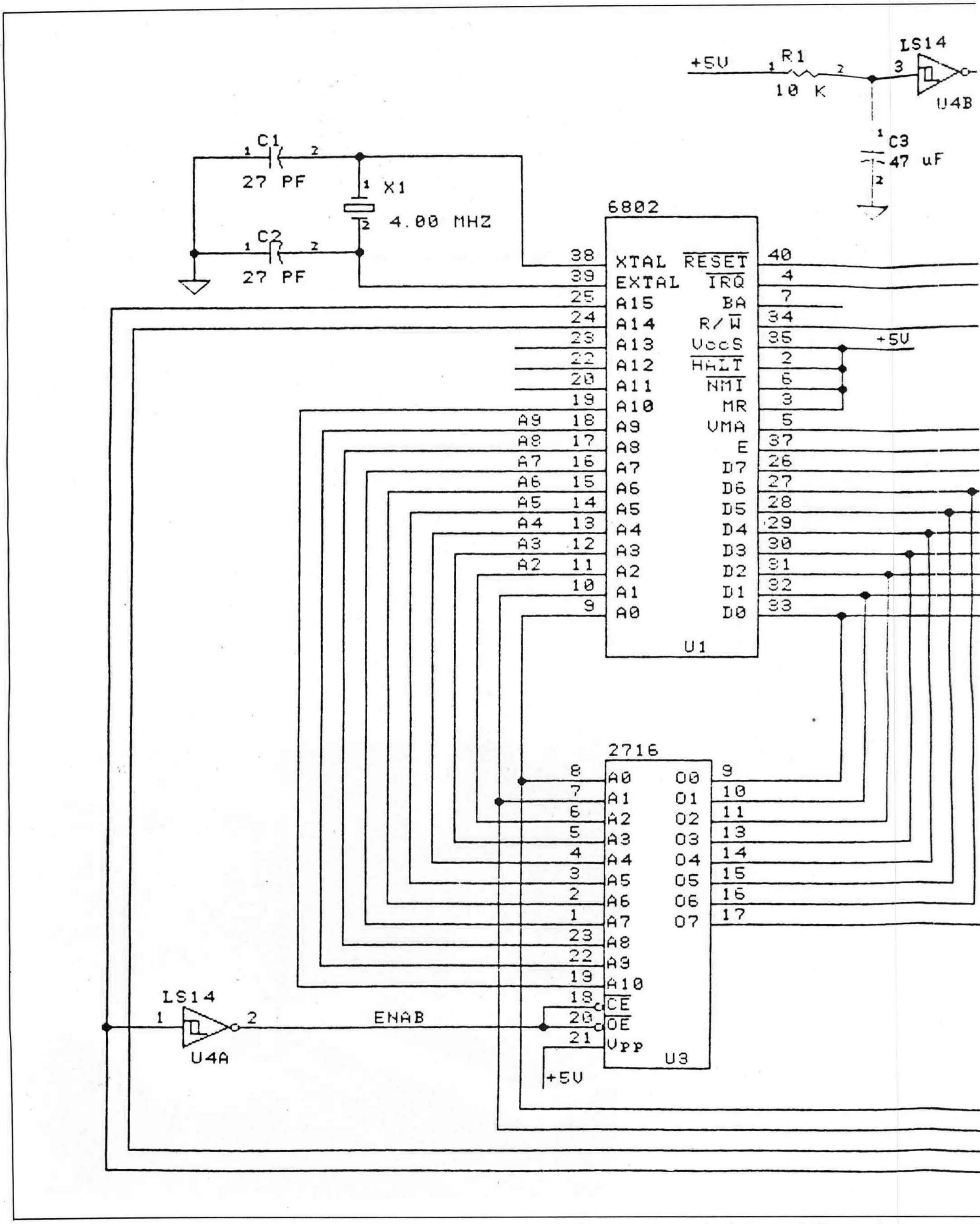
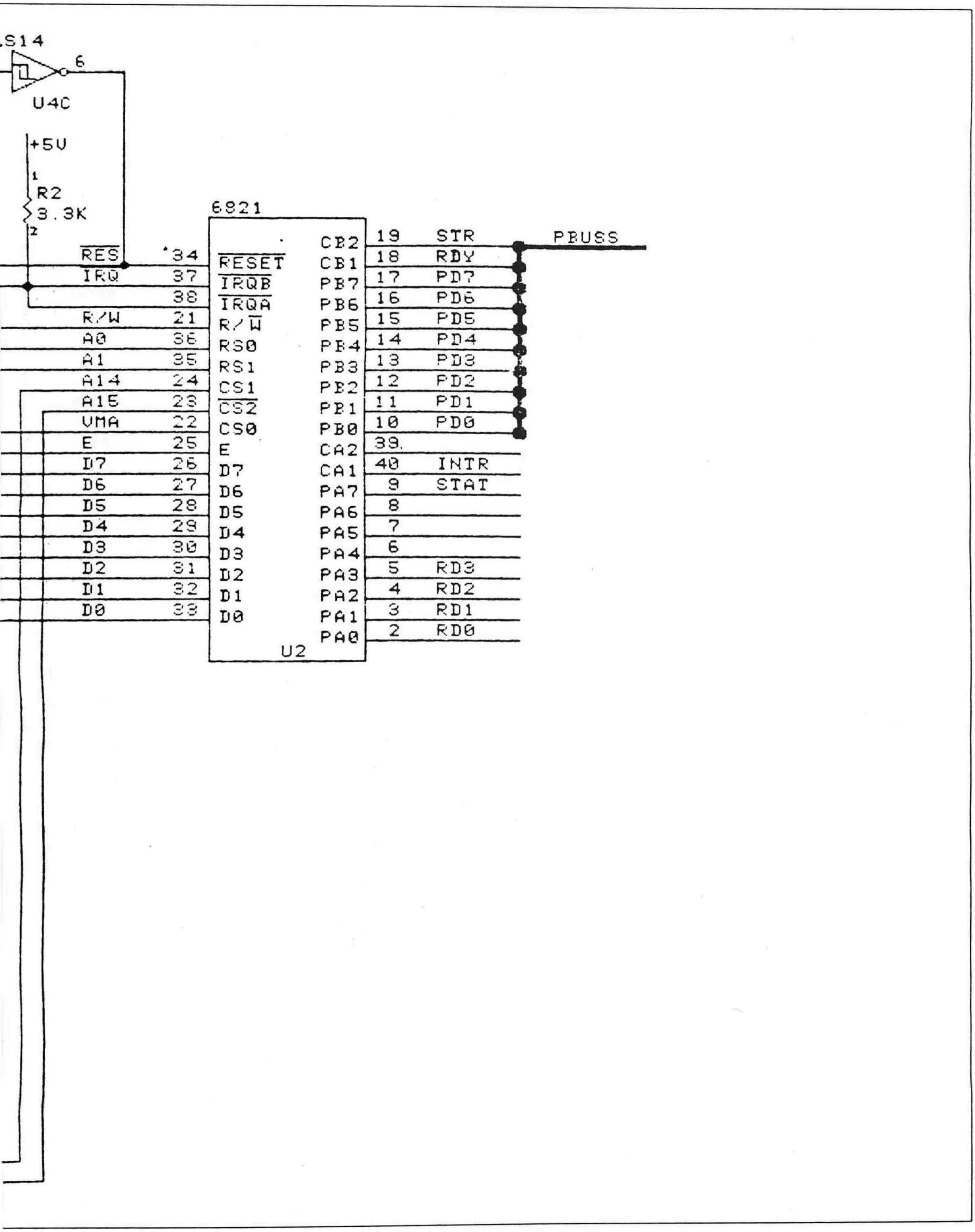


Figure 2: Schematic drawing of the Motorola 6802 microprocessor subsystem. Note the bus capability at the upper right. (Reduced from the 11- by 17-inch original.)



LS14
6
U4C
+5V
1
R2
3.3K
2
6821
RES 34 RESET
IRQ 37 IRQB
38 IRQA
R/W 21 R/W
A0 36 RS0
A1 35 RS1
A14 24 CS1
A15 23 CS2
VMA 22 CS0
E 25 E
D7 26 D7
D6 27 D6
D5 28 D5
D4 29 D4
D3 30 D3
D2 31 D2
D1 32 D1
D0 33 D0
CB2 19 STR
CB1 18 RDY
PB7 17 PD7
PB6 16 PD6
PB5 15 PD5
PB4 14 PD4
PB3 13 PD3
PB2 12 PD2
PB1 11 PD1
PB0 10 PD0
CA2 39
CA1 40 INTR
PA7 9 STAT
PA6 8
PA5 7
PA4 6
PA3 5 RD3
PA2 4 RD2
PA1 3 RD1
PA0 2 RD0
U2
PBUSS

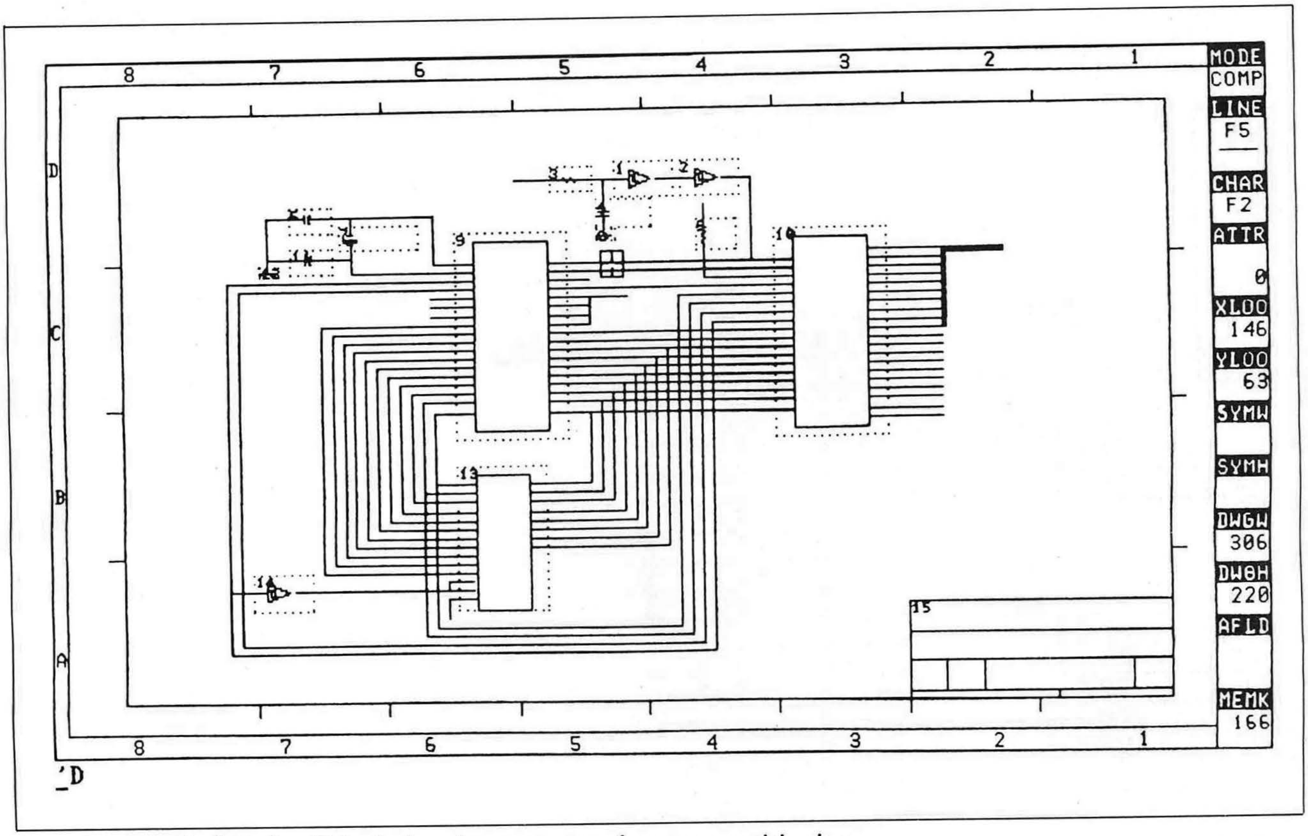


Figure 3: The full 11- by 17-inch drawing on screen for gross positioning.

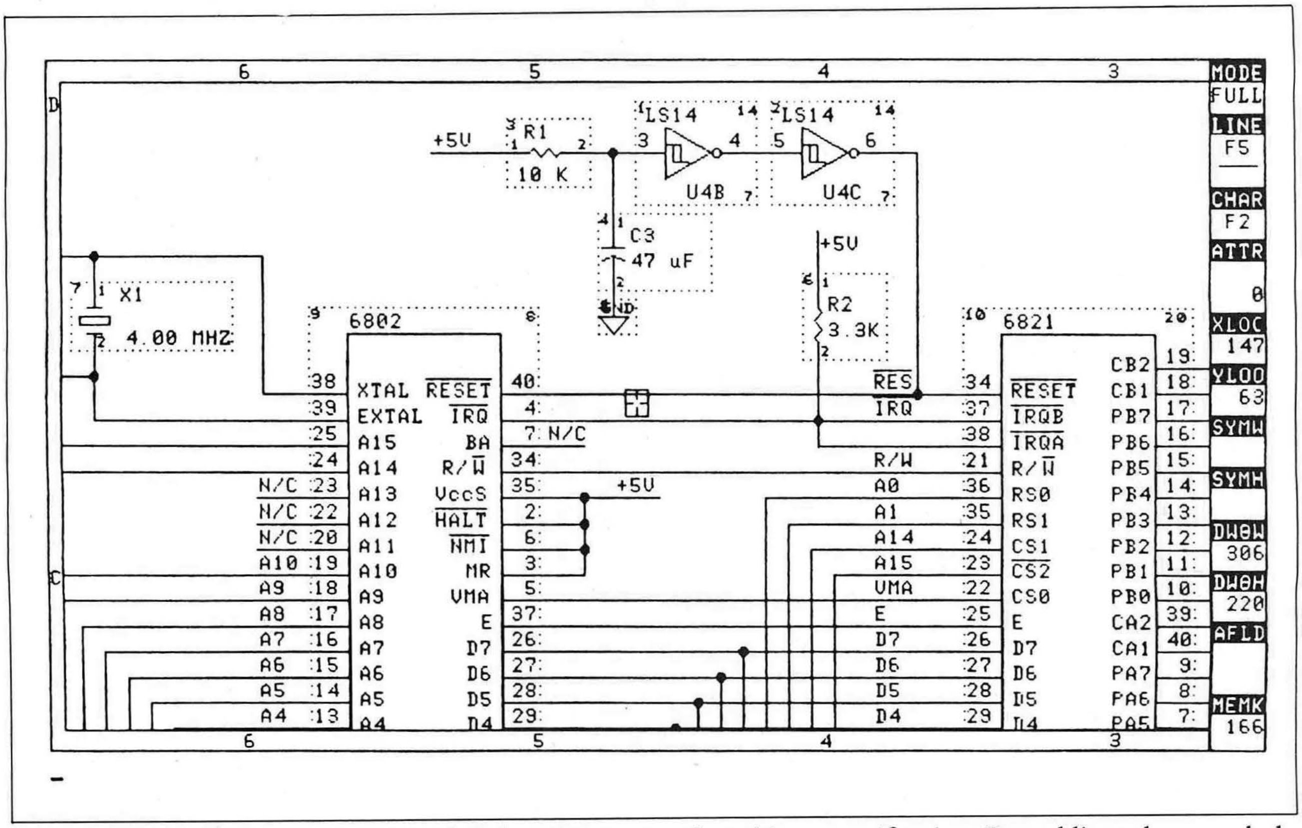


Figure 4: Display of a segment of the full drawing at normal working magnification. Dotted lines show symbol boundaries but are not printed.

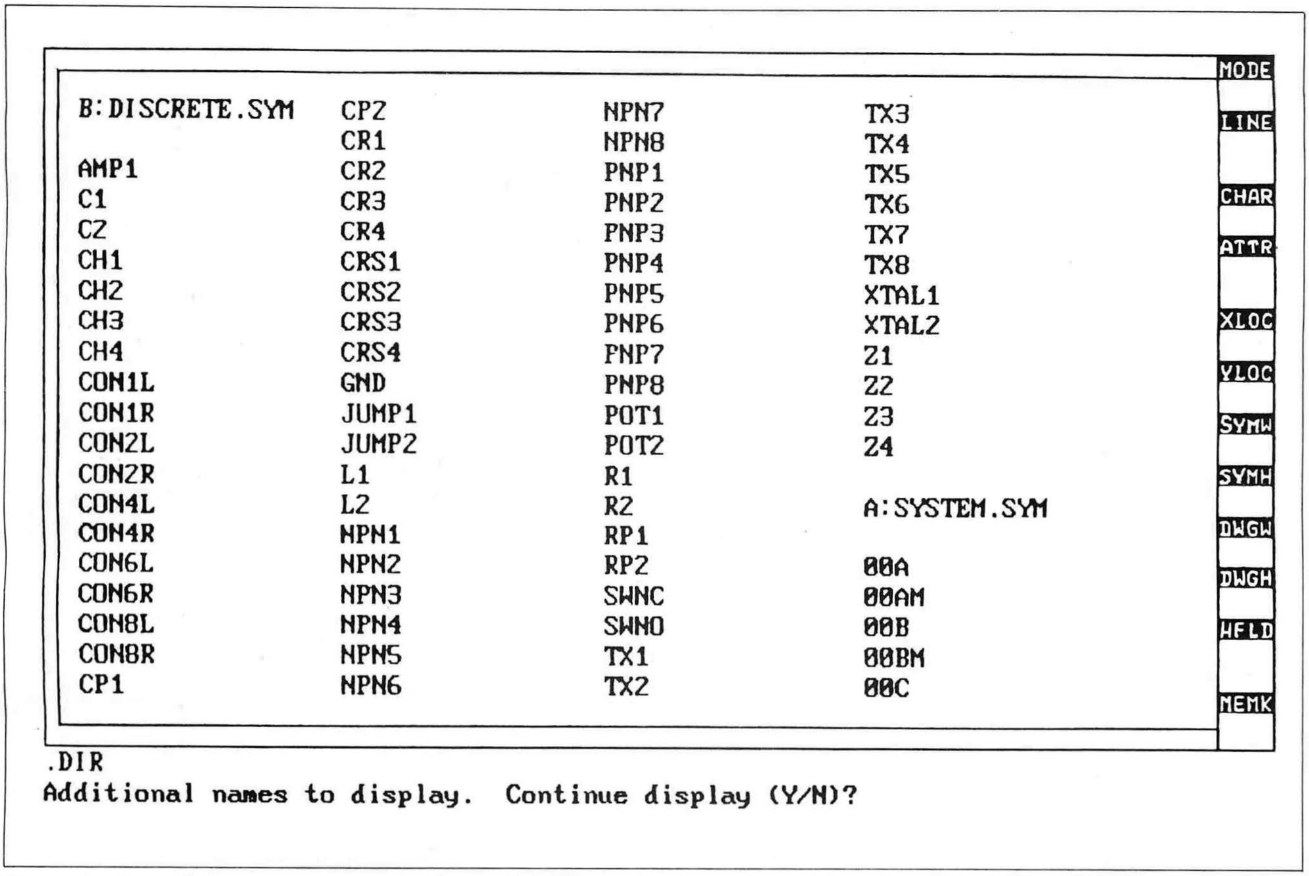


Figure 5: Part of the on-screen system part directory, which can be displayed any time during editing.

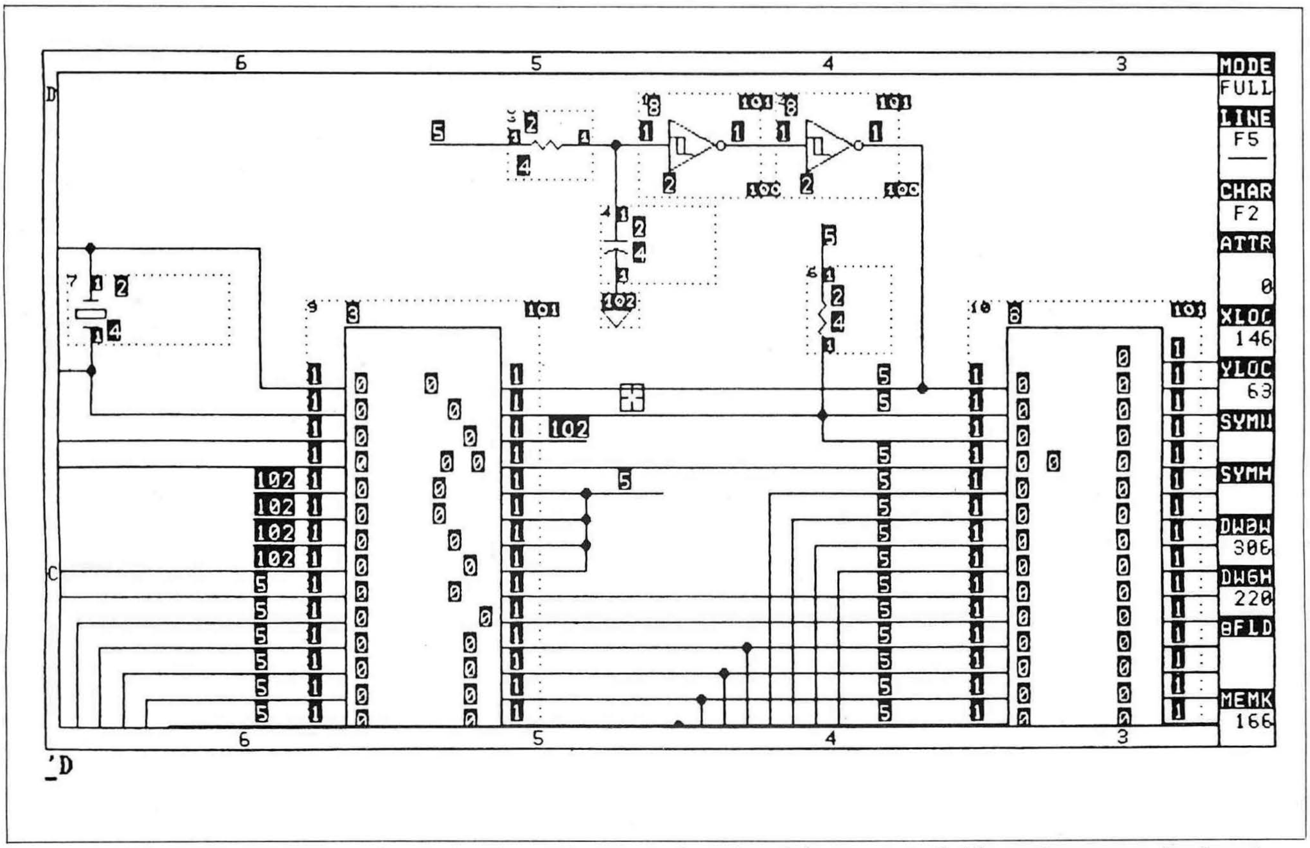


Figure 6: The same segment as shown in Figure 4, except that the alphanumeric field attributes are displayed.

DWG	TITL50	6802 MICROPROCESSOR TEMPLATE	
DWG	DNUM51	00026-01	
DWG	DREV52	A	
DWG	DPAG53	1 OF 1	
DWG	DATE54	MAR 29, 1983	
1	LOC 2	U4B	
1	PART3	LS14	
1	PIN 1	3	***1
1	PIN 1	4	***2
1	PIN 1	7	GND
1	PIN 1	14	+5V
2	LOC 2	U4C	
2	PART3	LS14	
2	PIN 1	5	***2
2	PIN 1	6	-RES
2	PIN 1	7	GND
2	PIN 1	14	+5V
3	LOC 2	R1	
3	VAL 4	10 K	
3	PIN 1	1	+5V
3	PIN 1	2	***1
4	LOC 2	C3	
4	VAL 4	47 uF	
4	PIN 1	1	***1
4	PIN 1	2	GND
5	LOC 2	C1	
5	VAL 4	27 PF	
5	PIN 1	1	GND
5	PIN 1	2	***3
6	LOC 2	R2	
6	VAL 4	3.3K	
6	PIN 1	1	+5V
6	PIN 1	2	-IRQ
7	LOC 2	×1	
7	VAL 4	4.00 MHZ	
7	PIN 1	1	***3
7	PIN 1	2	***4
9	LOC 2	U1	
9	PART3	6802	
9	PIN 1	1	GND
9	PIN 1	2	+5V
9	PIN 1	3	+5V
9	PIN 1	4	-IRQ
9	PIN 1	5	VMA
9	PIN 1	6	+5V
9	PIN 1	7	N/C
9	PIN 1	8	+5V
9	PIN 1	9	A0
9	PIN 1	10	A1

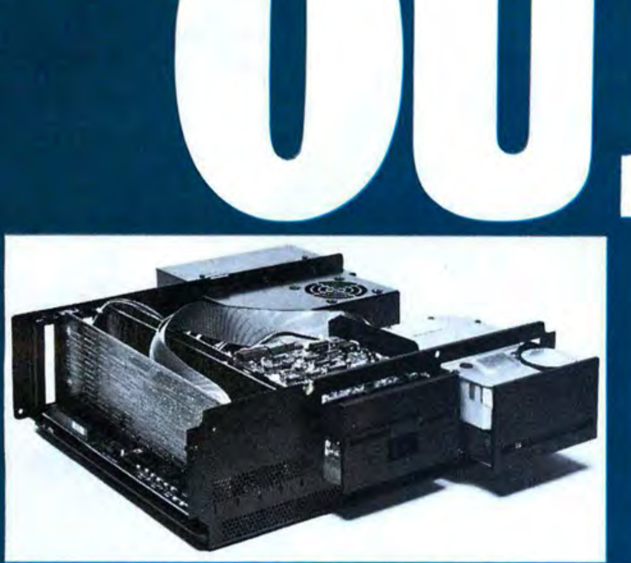
Figure 7: The pin list printout derived from Figure 1. Signal names '*n' were assigned by the DASH-1 to lines not named by the user.**

When FutureNet releases the planned flow chart package, the DASH-1 system may be the tool that enables up-to-date documentation to be produced and made available during a software development project. It's also fun to think of other automation-prone graphics applications that use standard symbols over and over again. And, most important, when the task isn't drafting, the PC is available for other workstation applications like scientific computation, word processing for manuals and procedures, and PERT or CP/M for project management. At $6000 you spend more for the FutureNet drafting tool than you spend for pencil, paper, and erasers. But, for me, the DASH-1 system is worth it.

Karl Keller is vice-president of Mullett Associates, Inc., an independent electronics engineering firm in Los Angeles.

FutureNet DASH-1 Schematic Designer
FutureNet
21018 Osborne St.
Canoga Park, CA 91304
213/700-0691
List Price: $5980 for the DASH-1 graphics controller board and software and the mouse; $6960 with 256K memory board; $12,960 with an IBM PC configured with 256K, two disk drives, and 15½-inch-wide dot matrix printer/plotter; $14,955 for an IBM XT version of the complete system.

OURS VS. OURS



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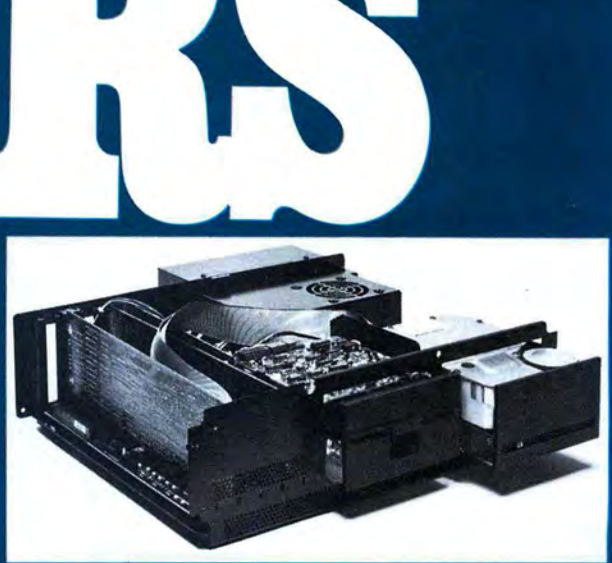

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Computers come in two parts.

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Without software, a computer can't do anything. And vice versa. You have to buy both.

Buy the software first.

Since the reason you're buying a computer is to get the capability the software gives you (remember it's the software that tells the computer what to do), it makes good sense to pick the software first.

Start by making a list of the things you want the computer to do. Possibilities include word processing, inventory control, accounting, graphics, recordkeeping—you name it, there's probably software that does it.

Next take your list into a computer store and ask the salesperson to demonstrate software that will do the things you want.

Even though you'll need a computer for the demonstration, keep in mind the computer is just a vehicle. The software is the driver. Once you've decided on software, picking the rest of the computer system will be that much easier.

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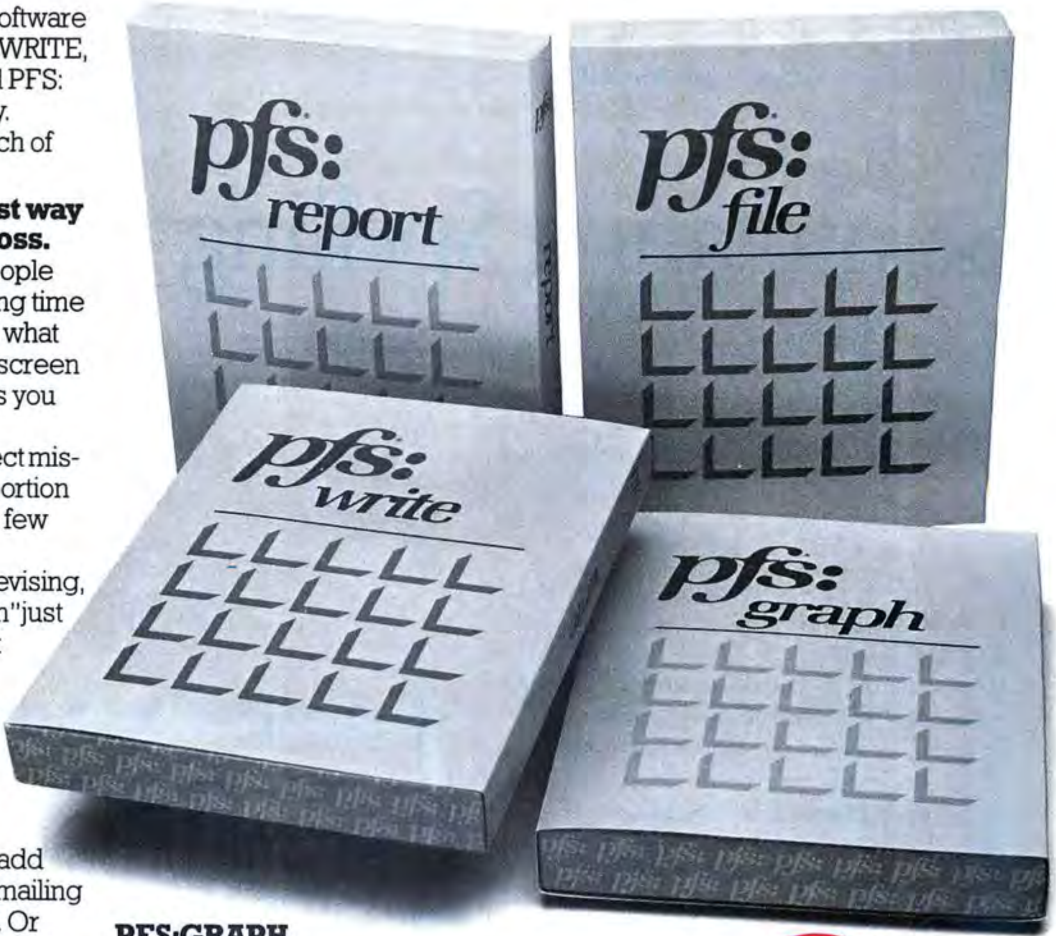

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REPORT is a powerful analysis tool that works with FILE.

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Reader Service #178

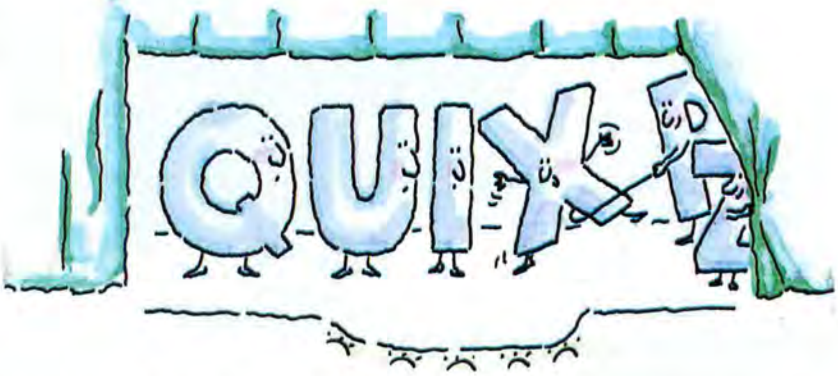
Scintillating Spelling

Fun finding fancy rhymes and spotless spelling with The Word Plus

Douglas Clapp

If you're in the market for a speller, you've probably noticed the plethora of splendiferous assemblages that promise to eradicate even the most recondite, errant, and invidiously erroneous consortium of characters.

Yes, each word is spelled correctly. Use may be questionable, but the spelling is right, thanks to *The Word Plus,* a collection of spelling and dictionary-related tools that may be used separately for a variety of text-related functions.



Spelling Session

A typical spelling session with *Word Plus* begins when you enter the command TW from DOS. TW, for *the word,* is an umbrella program that coordinates three programs: Spell, Review, and Markfix. After you specify a file to check, TW offers a number of options. You can set the program to create a special dictionary of words used frequently. If desired, the program will save a complete line of text along with all suspect words when it checks a file for spelling. The text is available during review if you wish to see the questionable word in context.

The option 'Ignore lines starting with ?' is helpful for lines beginning with dot commands or other formatting characters that word processors insert into text. Lines that begin and end with a specific character, another typical format identifier, may also be ignored. Uppercase words may be bypassed, which is handy if you're proofing material such as assembly language listings full of ADDAs and LAHFs.

The ability to specify what the program won't check is the best assurance that *Word Plus* will work correctly with most well-known word processors. You can save defaults after you've customized *Word Plus* for your particular word processor.

Once the options have been defined, TW calls Spell into action. Spell races through your text, creates a file of words not in its dictionary, and charts its progress with the messages 'Compiling word list', 'nn unique words', 'Checking main dictionary', 'Listing unmatched words', and 'nn unmatched words'.

Next up is Review, which takes the list of possible misspellings and presents them, one at a time, for review. During Review you have ten options, each performed by a single keystroke. Suppose the first word you were shown was *quix.* If the spelling is correct, you can Update (U) the word to an update dictionary or send it to a Special (S) dictionary. The Update dictionary is searched automatically when you use *Word Plus;* the Special dictionary is checked if specified as an option.

A suspect word may be Marked (M) in the text for later change or correction or Discarded (D) if, for example, the word is a proper name or a correctly spelled technical term.

Word Plus pays for its keep with the commands Lookup (L) and Correct (C). If you want to change *quix* to *quid,* for example, you can simply press C and type in the change. If you are unsure of the spelling you want, hitting L when presented with *quix* begins a dictionary search that returns one or more words similar in spelling to *quix*. A typical display might be

0-Quip
1-Quit
2-Quiz

Pressing C causes the screen to display 'QUIX Corrected to ___'. You can then replace *quix* with one of the suggested spellings by pressing the number next to the desired word. If Lookup leaves you still unsure of the correct spelling, you can press *V* to View the line of text that includes *quix*.

During Review *Word Plus* lets you change your mind about the use the of a word and skip to the Previous word (P) or the Next word (N) and then Resume (R) where you left off in the list.

Once you have worked through the list of possible misspellings, press ENTER and Markfix appears on the stage. Using the results of Review, Markfix replaces corrected words, marks words you've selected, and then tells you the number of words marked, the number of words corrected, and how many words have changed in length. A screen prompt alerts you to reformat text if corrections have changed word lengths.

Advanced Options

If the above functions were all *Word Plus* had to offer, it would be a good tool. The programs perform flawlessly, input is convenient, and searches and replacements are extremely fast. Many users may never go beyond the typical session just outlined.

But there's more. Spell and Markfix may both be used separately. Entering 'Spell b:example.text' displays a list of words in Example.txt not found in *Word Plus*'s dictionary. The output of Spell and other programs may also be piped by the use of various program switches. The command 'Spell b:example.txt$p' sends the list of offending words to your printer. Ending the same command with '$fb' sends the list to a file on drive B named Errwords.txt. The file Errwords may then be edited with a text editor or used by Markfix.

When used alone Markfix has some surprising applications. Typically used this tool takes a list of misspelled words and their corrections and conducts the actual replacement process. With that in mind, it's easy to perform an automated rewrite of a document. Use your text editor to create a list of words and replacements (each pair of words must be on the same line and be separated by a slash). Want to rewrite a letter to Senator Sam for delivery to Congressman Connors? Make a list:

Senator/Congressman
Senate/House

Then send Markfix on its way to make the replacements.

Hyphens and Homonyms

Splitting words for hyphenation is sometimes a problem for word processing programs, particularly when setting type in narrow columns. The program Hyphen correctly inserts hyphens at line breaks into words of a specified length throughout a file. It may also be used one word at a time; you type the word, and it gives the correct hyphenation. Hyphen inserts characters used by *WordStar*, but it can easily be adapted to hyphenate text for other word processors.

Homonyms, words with similar sounds but different meanings, are a problem for both human and electronic spellers. *Word Plus* can't tell you if the correct word is *peace* or *piece*, but it does have a file named Homonyms.txt that contains a list of frequently confused words. When used with Markfix, the potential offenders are marked in your text for further action.

Looking and Finding

Word Plus's dictionary can be accessed directly with either Lookup or Find. If you've ever been baffled trying to look up a word you weren't sure how to spell, you'll love Lookup. Simply type 'Lookup' and your best approximation of the word you want, and you'll be rewarded with the correct spelling.

Lookup typically makes a short search that assumes the first letter of your approximation is correct. To search for combinations with different first letters, the addition of '$L' tells Lookup to go for broke.

The Find command is used when you are sure of at least some of the letters in a word. The wild card characters ? and * represent one letter and any number of letters respectively. Entering 'zo?' finds *zoo* and *zoe*. The combination 'zo*' finds:

Zodiac	Zodiacal
Zoe	Zombie
Zombies	Zonal
Zone	Zoned
Zones	Zoning
Zonked	Zoo
Zoological	Zoologist
Zoology	Zoom
Zooming	Zooms
Zoophyte	Zoot
Zounds	

Find will delight poets with its ability to find rhymes. To find all the words that end in *ingly*, type 'Find*ingly'. Scanning the entire dictionary is possible with 'Find*'.

A purely fun command is Anagram, which rearranges the letters in a word to discover other legitimate words. An easy example is the command 'Anagram live', which produces *live, evil, veil,* and *vile.*

How Many, How Often?

For many users WC.COM (word count) will be an indispensable feature. There's not much to using WC; just type WC and the name of the file to count, and in a few seconds you'll get a count of the number of words in the file. While not the most sophisticated counter, WC is blindingly fast; a 7310-word file chosen as a test was processed in 15 seconds.

Once you know how many words are in a file, you may want to know how often each word occurs. The tool to use for this is Wordfreq, a utility that counts the occurrences of each word in the text, sorts the list in ascending or descending frequency, and writes the list to a file with the extension .frq. Wordfreq displays the total number of words, the number of unique words, and the number of words used only once.

Tool Types

Word Plus's "tool" concept becomes clear when you examine the files that make up the program. With the exception of Homonyms and Myexcept (both text files) and Maindict (the compressed dictionary file), the 15 *Word Plus* files are all .COM files.

The tools are used as additional PC-DOS command files—DIR, TYPE, etc. If you're comfortable entering 'DIR b:BAS', you should have no trouble with 'WC b:example.txt' or 'Hyphen b:example.txt $18'. The characters '$18' in the last example tell Hyphen to hyphenate only words longer than 18 characters.

Because the tools are written in assembly language, they are fast and small. WC.COM is 1167 bytes in length, and Lookup.COM is 2046 bytes. The programs are obviously not an evening's work; they are excellent examples of well-thought-out code that has been highly optimized for both size and speed.

The Dictionary

Two disk dictionaries are supplied to accommodate either single- or double-sided disk drives. The larger dictionary comprises about 45,000 words and occupies 139,392 bytes on a double-sided disk. The smaller dictionary is 105,344 bytes, a size that allows a single-sided disk to hold the dictionary and the most commonly used tools. A second single-sided disk holds WC, Anagram, and other less frequently used tools. One double-sided disk holds both the larger dictionary and the 13 other programs that make up *Word Plus.*

Fitting 45,000 words into only 139,392 bytes is not an easy task. Author Wayne Holder employed a text compression algorithm that makes use of a redundant series of characters. For example, the words *win, window, windy,* and *windless* all share the characters *win.* Taking advantage of the repeating characters results in a high degree of compression. In turn, greater compression results in faster disk reads and fewer disk accesses.

Manufacturers of spelling checkers often tout their dictionary as the best or the most complete. *Word Plus* does not use a standard dictionary. Instead, the dictionary is the result of over a year's work processing text files to determine what words are actually used and misused. The dictionary was then checked for errors by specialized computer programs and hand checked against *The New American Dictionary of the English Language* (Houghton Mifflin, 1979).

No electronic dictionary can possibly include every word in the English language, at least not at the present stage of disk storage technology. *Word Plus*'s dictionary seems a reasonable compromise in terms of size, speed, and selection. The Update and Special dictionary options should satisfy the needs of those who use specialized vocabularies.

Documentation

The Word Plus User's Guide is a 48-page manual that clearly explains the many possible uses of *Word Plus.*. Included are a complete table of contents, a quick reference guide to commands, and a thorough explanation of possible error messages. The text is printed in large, legible type. The manual includes numerous examples and does double duty as an engaging introduction to text analysis. Unlike many manuals, this one doesn't have any misspellings.

Hope on the Horizon

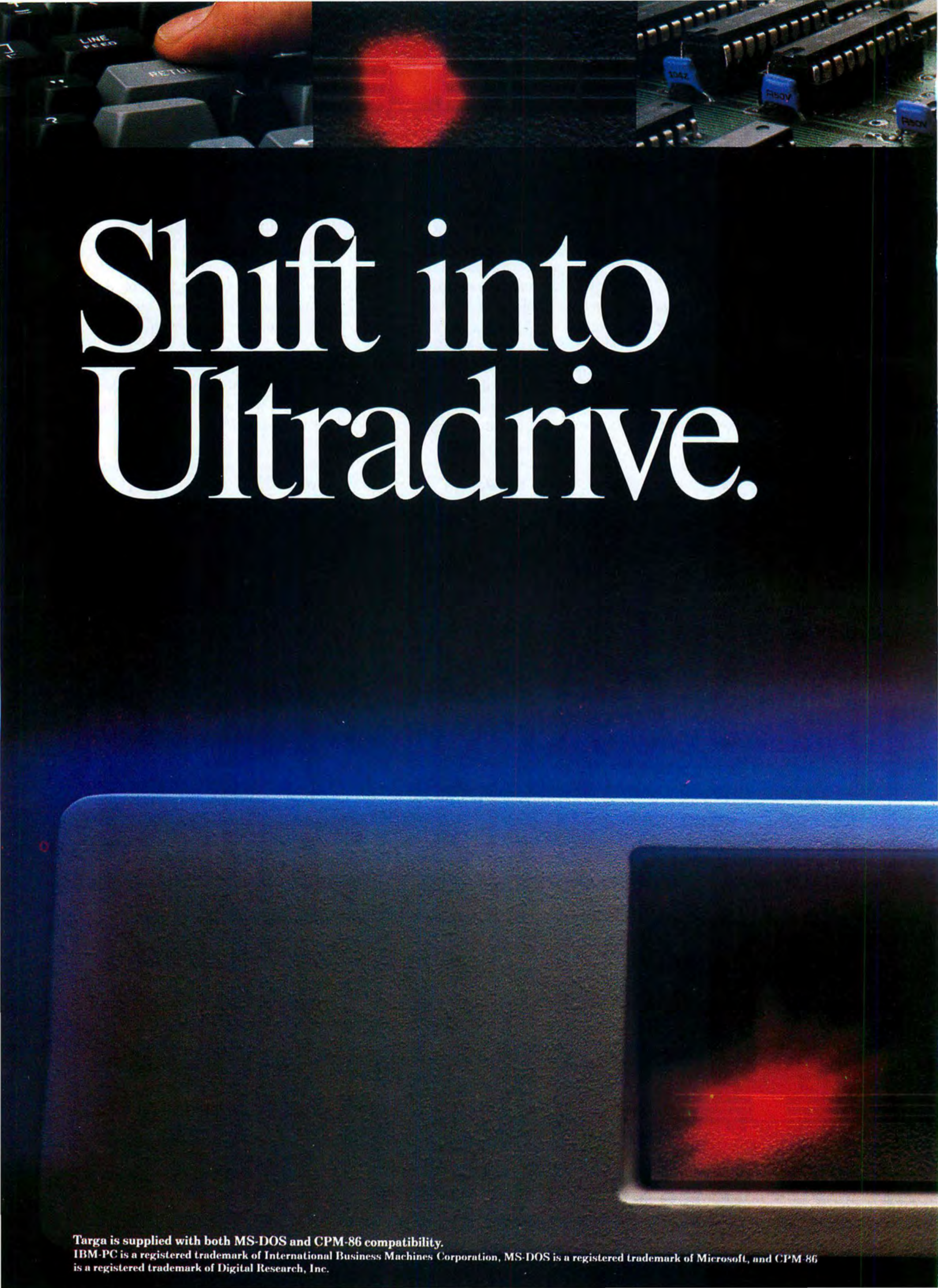
A speller can't solve all your writing problems. If you're a lousy writer, a speller will transform your spelling, but not your punctuation, usage, or style.

But there is hope. Oasis Systems' newest offering is *Punctuation + Style,* a program that promises not only to catch punctuation errors, but also to critique your text for misused or overworked phrases. It's also designed to suggest changes from passive to active voice.

When used together, *Word Plus* and *Punctuation + Style* may well offer the ultimate in computer text correction and analysis. By itself, *Word Plus* is an excellent choice for spelling checking and correction. If your taste runs to crossword puzzles or anagrams, it's the only choice.

Douglas Clapp is a contributing editor for InfoWorld *who specializes in personal computers.*

The Word Plus
Oasis Systems
2765 Reynard Way
San Diego, CA 92103
619/291-9489
List Price: $150
Requirements: 64K, one disk drive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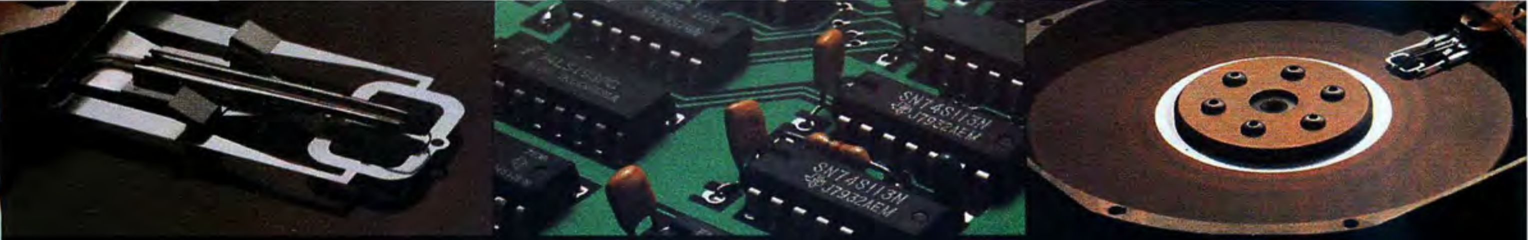

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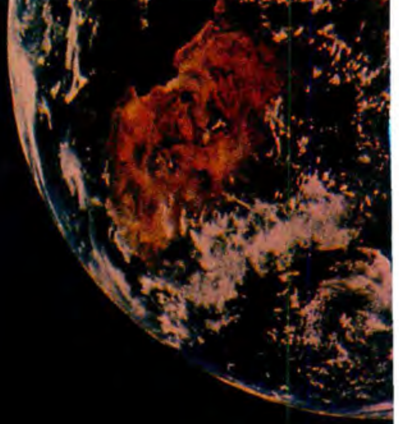

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Reader Service #149

For Game Gourmets

Three games for the quick-wristed, voracious, or lexicological gamester.

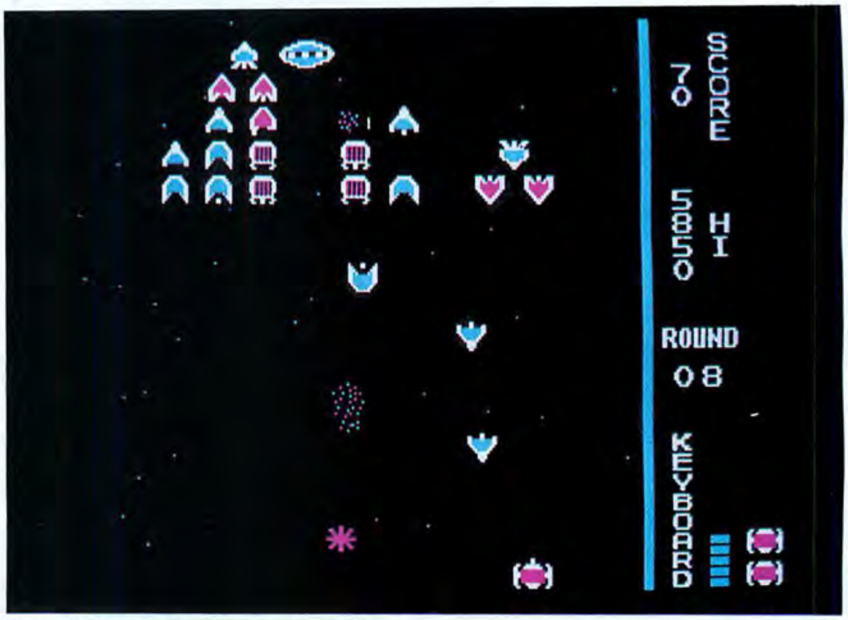
Richard Cook

The time-honored talents of the video arcade masters—reflexes faster than flying photons and boundless ruthlessness in blasting every moving creature in sight—are as much in demand as ever. But now the inscrutable glowing screen challenges you in ways that require more than just a quick hand on the joystick. Read on, if you dare...

Cosmic Crusader

Look out zap 'n dodge fans. Here comes yet another extraterrestrial challenge. The aliens are restless and out for Earthling blood. Only you can prevent the complete destruction of humanity.

Fortunately for Mother Earth, you are well equipped with energy torpedoes and defensive shields. Your reflexes are swift and sure, your strategy is cunning, and you have years of experience in previous campaigns. What? You don't? You're only a space cadet fresh out of the Academy? In that case, I'd better give you a crash course in how to be a Cosmic Crusader.



Cosmic Crusader Screen Graphics

Playing the Game

Cosmic Crusader is easy to play but difficult to master. Your spaceship, located at the bottom of the screen, can slide either left or right, or stay in one place. An energy torpedo is your weapon for instantly destroying any alien vessel. To avoid your own ship's destruction you must either dodge all enemy ships and torpedoes or rely on your limited supply of defensive shields. These shields can protect you from anything, but they last only 2 seconds and, remember, you can't shoot while using them.

Swarms of alien spaceships attack your ship from the top of the screen. While stationary, the enemy ships make easy targets; naturally, they aren't stationary for long. Kamikaze ships continuously break away from their rows to swoop down on you, firing rapidly all the while. With suicidal zeal the aliens crash their ships into yours if their torpedoes don't destroy you first.

As the savior of humankind your mission is to destroy every alien ship, not an easy task by any means. If just one enemy vessel gets by, Earth will be pulverized into dust. You wouldn't want that on your conscience, would you?

Mission Enjoyable

Your responsibilities as the Cosmic Crusader are awesome and terrifying. Before too long, though, you will begin to enjoy annihilating your powerful enemy. To respond to the call of battle, insert the *Cosmic Crusader* disk into the disk drive and turn on the PC. Choose a playing level from 1 through 9, preferably a higher level, since at higher levels more bonus points are awarded for successfully destroying the first wave of alien ships.

You can play *Cosmic Crusader* with either the keyboard or a joystick. Surprisingly, the keyboard is almost easier, though the screen action is quick and responsive no matter which control you use. The game's bright colors and sharp graphics enhance the realistic sense of motion as stars and enemy ships fly past. You'll cheer each time you atomize a wave of aliens, and choke with rage whenever you lose a ship.

You have three ships at the start of the game, and one extra ship is awarded every 2000 points. The number of ships and shields remaining is displayed throughout the game at the far right of the screen. The refueling stations are special targets to aim for: each one you blast is worth 50 points and one extra shield. Command ships, when diving, are worth 100 to 500 points each. The flagship is worth 200 points, but it can drop deadly antimatter clusters on your ship, so be careful when attacking.

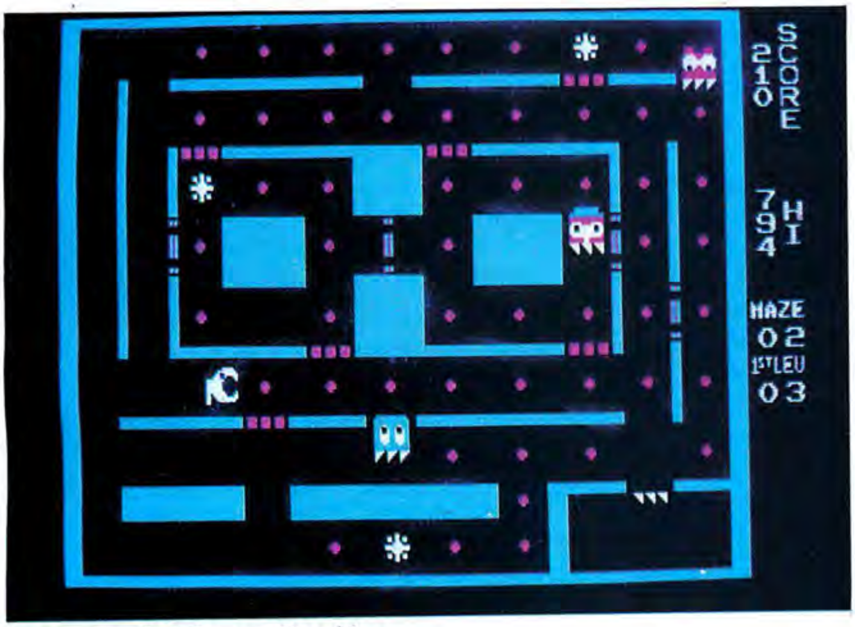
Cosmic Crusader has some special features that make your mission seem more like play than work. Ctrl-K lets you choose which keys control your movements, fire your torpedoes, and raise your shields. Ctrl-O turns the sound effects on or off. Ctrl-R resets the high scores to zero and the keys to their default settings. And if you are about to lose control, Esc freezes the action.

In the excitement of playing *Cosmic Crusader,* you may lose your place on the keyboard and hit the wrong key. This could be fatal to your mission, so Earthling engineers have provided a safety feature: a warning sign flashes and the action freezes momentarily so you can find the correct key.

Honorable Discharge

Now for some bad news and some good news. The bad news is that your assigned task is as endless as it is thankless. Destroy one swarm and a tougher swarm takes its place. You will never escape this alien onslaught, for the enemy's breeding habits are as formidable as its weapons.

The good news is that when you are finally blasted into cosmic dust, your six highest scores can be recorded for posterity next to your name, rank, and serial number. Although you will perish in the line of duty, your name will live on, at least until someone else gets a higher score.



Snack Attack II Screen Graphics

Snack Attack II

My first reaction upon seeing *Snack Attack II* was, "Oh no, not another *PacMan* imitation. Aren't there already about 500 on the market?" Stoically, I inserted the game disk into the drive, switched on the PC, and began to play. After a few rounds I changed my mind and decided that while *PacMan* is still a great game, *Snack Attack II* is even better.

Playing the Game

If you are familiar with *PacMan,* you have a fair idea of what *Snack Attack II* is all about. For those of you who aren't familiar with the former, imagine a maze on your screen. Sprinkle gumdrops throughout the maze and place a magic star near each of the four corners.

Your player is a mobile mouth with a spinning tail. It races through the maze eating as many gumdrops as possible, with four gumdrop guards in pursuit. If a guard catches it, the mouth explodes, unless it has just made a meal of one of the magic stars. In that case the mouth reverses roles and chases the guards. The guards die when caught, only to be regenerated moments later.

At the onset you have three mobile mouths, and you get an additional mouth when you reach 1000, 2000, 4000, and 8000 points. Your goal is to eat as much as possible with each mouth before it is caught and exploded—never mind all those calories. If a mouth manages to eat all the gumdrops in a maze, the screen clears and a different maze appears.

Three different mazes appear in turn on the screen. Each has a safety box where the mouth can hide from the gumdrop guards. The guards can move into two of the three boxes, so the mouth mustn't settle in for long.

An apple suddenly appears in the maze from time to time. When the mouth eats this apple, it temporarily gains the power to move twice as fast as before. You receive points for each gumdrop, guard, and apple the mouth eats. For each of the six playing levels the high score and the name of the player who achieved it are shown after a game. At that time a new high score may be added.

Hidden Calories

The graphics look great. Each guard has a different shape and color, and the different mazes make the game more interesting than *PacMan*. Only the third maze is similar to *PacMan*, however, in that it has openings in the sides that allow your mouth the freedom to move quickly from one end of the maze to the other. The first two mazes are fully enclosed, which is less fun.

Your goal is to eat as much as possible with each mouth before it is caught and exploded—never mind all those calories.

Six skill levels are offered to sharpen your hunger pangs. Almost anyone can play at Level 1, while Level 6 moves so fast that only a quick mouth can survive. The sound effects, such as a clock that ticks faster at each level, are amusing but can be turned off if necessary.

Snack Attack II is easier to play with a joystick, but using the keyboard is not a difficult adjustment. The screen action is very responsive to the touch. An exceptional feature is Ctrl-K, which allows you to set any of the keys as your directional controls.

Just Dessert

Snack Attack II is a simple but polished program; no problems interfere with serious gumdrop gobbling. This game's improvements over *PacMan*—the speedup of the mouth after it gobbles an apple, the safety boxes, the skill levels, and the different mazes—give it an edge over its famous predecessor.

Word Challenge

What do the words *war, drench, loge, caller, chord,* and *wrangle* have in common? They are all examples of words created from the letters in *Word Challenge,* a complex and versatile word game.

Anyone familiar with *Boggle,* the Parker Brothers board and dice game, will know how to play *Word Challenge.* In both games you try to find as many words as possible in a random assortment of letters. Points are awarded for each word you find that your opponent misses. The highest score determines the winner.

Playing the Game

The object in *Word Challenge* is to put words together from letters in a grid. The hitch is that each consecutive letter you pick in forming a word must be contained in an adjacent square of that grid.

The letters in the grid are chosen randomly by the computer. You select the grid size of either 9, 16, or 25 squares. A small grid is illustrated in the screen photo, "Word Challenge: Small Grid." This particular grid contains 98 hidden words. Some easily discovered examples are *sea, see, seam, seem, muse, ruse, use, amuse,* and their plural forms, a total of 16 words.

Your opponent in *Word Challenge* is named LEX. At the easier playing levels LEX is a pushover, but as you progress toward more advanced levels, LEX's IQ rises quickly until it commands a 90,000-word vocabulary. At the highest level even skilled human players are no match for the computer—a pair of *Boggle* aces were overwhelmed by Lex, 150 to 0.

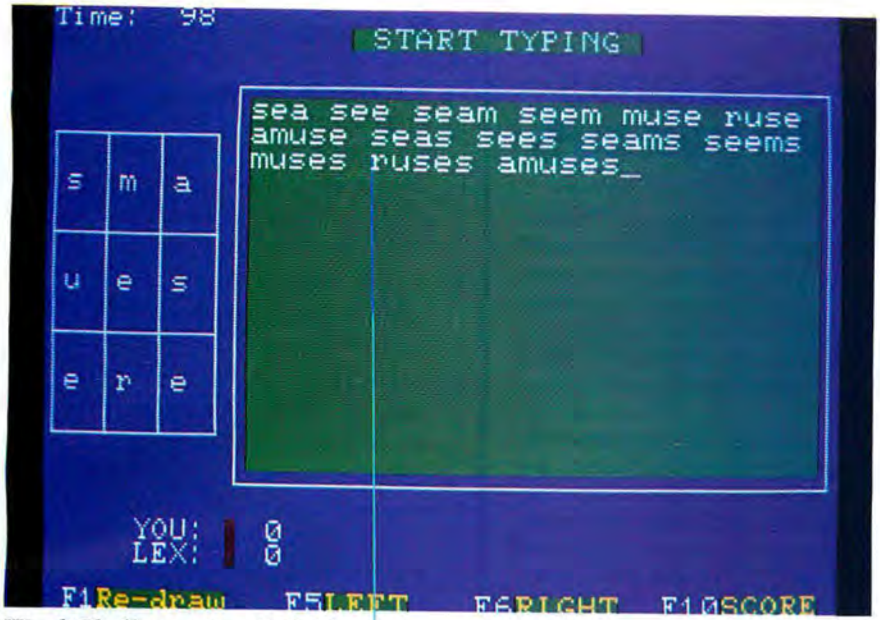
Word Challenge is easy to set up. Just put the disk in the drive and turn on the PC. After the title page appears, you are given the choice of typing M to see the option menu or S to start the game. Be forewarned, though, that after you give *Word Challenge* the signal to start a game, the playing grid appears and the timer starts faster than you can spell *action.* Don't waste time gawking like a hypnotized rabbit—focus on the grid and key in words as fast as you can.

The menu offers 11 options for selecting game format or style. Some of these are Difficulty Level (from A to Z), Timer (amount of time you have to find words), and Square Size. With such a variety of options, you may spend more time choosing your game style than you actually spend playing.

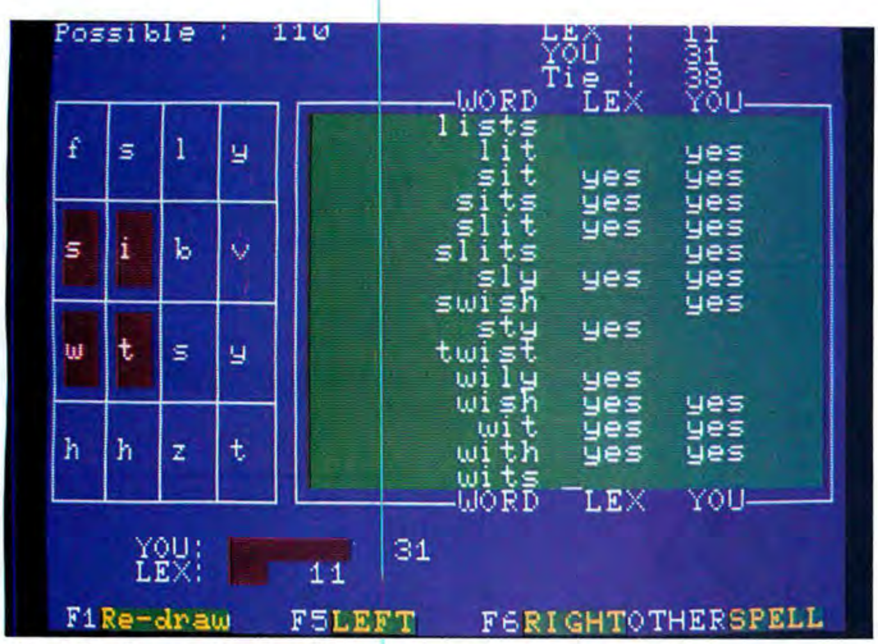
When your time for finding words runs out, the scoring phase of the game begins. The words that you and LEX have found are listed on the screen. You choose among five scoring methods offered by the option menu, but normally you receive points for any word you find that LEX missed, and vice versa. If you enter a word not included in the *Word Challenge* vocabulary, such as *groovy* or *byte,* the scorekeeper questions you but will accept on faith that the word is legitimate and award you points. The scorekeeper assumes that you won't take credit for nonsense words.

Evaluation

Word Challenge can be played on either a monochrome or a color monitor. While the monochrome image is fine, the color graphics are far more appealing. The graphics design is



Word Challenge: Small Grid



Word Challenge: Scoring Phase

clear and functional, and bright colors help distinguish different parts of the playing area. The graphics quality becomes important after you stare at the screen for a long stretch, something you can't avoid doing.

To make your prolonged staring more enjoyable, *Word Challenge* offers some eye-catching features. One is a timer that counts down the remaining seconds. Pressure from this timer is reinforced by a thermometer that shortens with each passing second. As a reminder of the words you have already found, a box containing these words appears to the right of the grid. Thermometers at the bottom of the screen show at a glance what your score is compared to LEX's score.

Word Challenge makes use of four function keys. F1 redraws the screen, a feature that actually is not needed. F5 and F6 rotate the grid to the left and right to provide different viewing angles. For me, rotating the grid was confusing, but others may find it helpful. F10 stops the clock and begins the scoring process if you can't find more words and don't wish to wait for the timer to run down. F10 also calls up the menu after each game.

LEX proves to be a worthy opponent regardless of how well you play. Its ability can be adjusted from the level of a preschooler to that of a verbal Einstein. In fact, the only way to beat LEX at the higher levels is to list every word it finds plus words not contained in its 90,000-word vocabulary. The English language includes approximately 750,000 words, so you do have a bit of slack, even if you don't know words like *polyhedrosis* or *quadripartite.*

Problems

Word Challenge is a terrific game, but it has some problems. For instance, there is no way to prevent the menu options you have selected from reverting to their default settings at the end of each game. You can overcome this drawback to a certain extent by setting the Winning Score option at the highest possible level, 999; this allows you to play a number of rounds before choosing all your options again. The program, though, should not force you to reselect menu options for each game.

Another needed improvement is to make the grid letters larger. They are too small for easy scanning, even in the color mode; on a monochrome monitor you practically have to press your nose against the screen and squint.

In addition to these problems, I ran across what seems to be a program error. Occasionally during the scoring phase, *Word Challenge* gave me a word or two that I hadn't entered. Was this a mistake, or was the program giving me a break? Was it feeling sorry for me because I couldn't come up with a better word than *dumbo*? If so, no thanks—I can find my own words even if they aren't in the dictionary.

Review

Documentation and Packaging

The packaging and documentation for *Word Challenge* is the best I've seen in any game. Everything needed to play is contained in a compact, durable vinyl folder with inside pockets to hold the disk, playing manual, licensing agreement and warranty, and mail-in comment card.

The playing manual is excellent, and concise illustrations are provided when appropriate. Overall, the manual's well-planned organization makes it a useful reference guide.

Playing *Word Challenge* requires a good vocabulary, so it's educational as well as fun. For that reason I highly recommend it for any parents worried about their children's zap 'n dodge game addictions. Youngsters can play *Word Challenge* at almost any age and upgrade the skill level as they progress. A good dictionary placed next to the PC will undoubtedly see a lot of use.

Word Challenge takes you a step beyond games with rampaging aliens and ravenous mouths. Dealing with the complexity of words requires creative thought, surely a better pastime than blasting spaceships into video dust.

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5-12 Wilde Ave.
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Word Challenge
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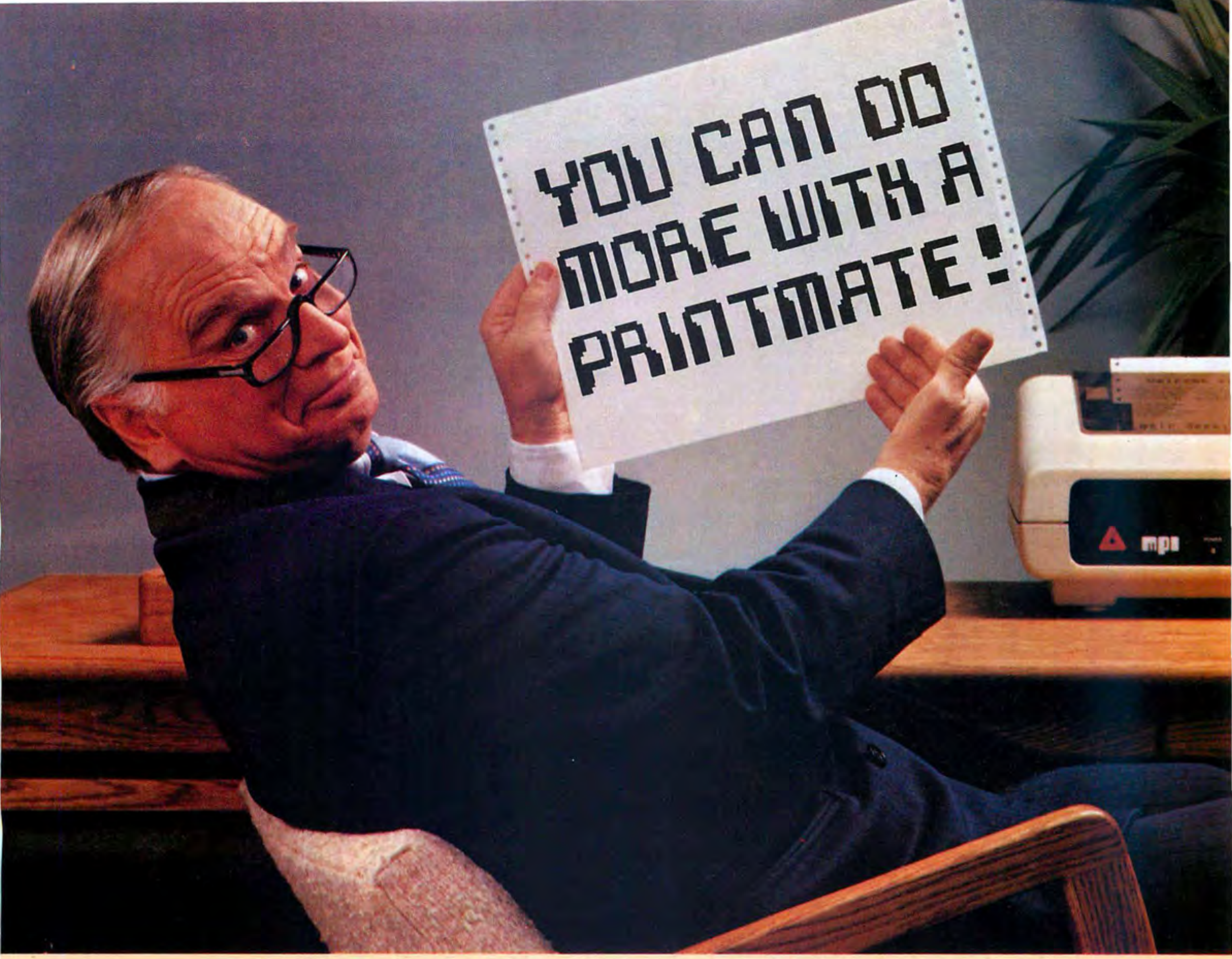

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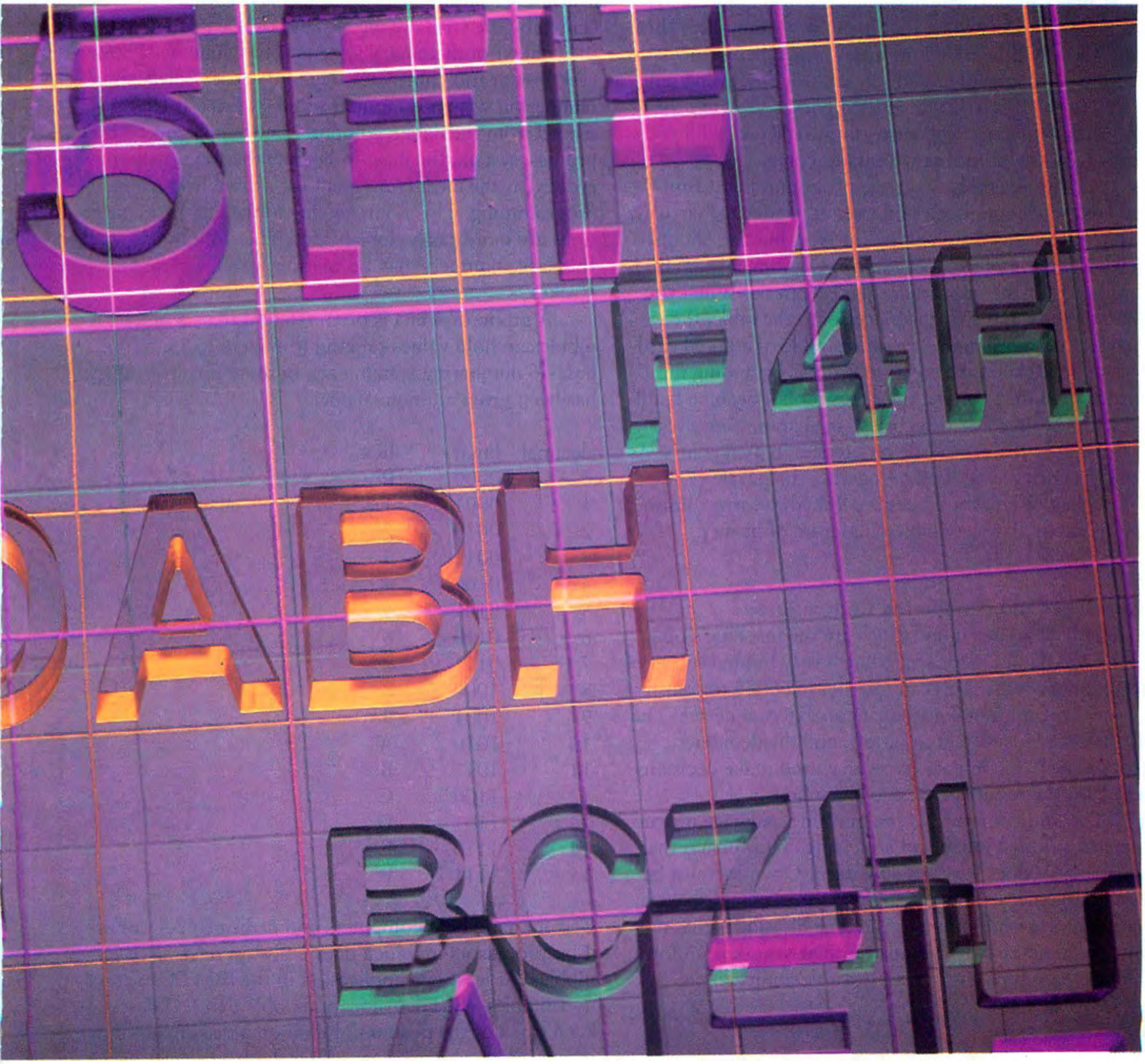
Like a cabinetmaker or machinist, a programmer's skill depends upon knowledge of the materials with which he or she works and the tools of the trade. Assembly language materials are crude—like a rough-hewn block of wood or an uncut bar of steel—but the tools available to work instructions and data into a finished program are extremely sophisticated and versatile.

The IBM Macro Assembler and the LINK and DEBUG programs provided on the DOS disk are the tools of the assembly language programmer. Learning to wield such tools skillfully may be a painful and sometimes difficult process. But programming skill grows exponentially with experience, and the rewards are great.

This article introduces you to assembly language programming and teaches you how to use the IBM Macro Assembler. This tutorial introduces hexadecimal (hex) numbering and how data is referenced and used by the 8088 microprocessor. These basics lay the proper foundation for further developing assembly language skills. Future articles in *PC World* will teach you to actually write assembly language programs. You'll be writing in assembly language with the second installment. The series emphasis is on writing assembler code in systematic modules and interfacing with PC-DOS.

The most obvious motivation for learning how to program using 8088 mnemonics is maximizing program execution speed. Arcade-type games and word processing programs must execute very quickly; the best are written in native 8088 code. Lotus' *1-2-3*, for example, is written entirely in assembly language, and this feature gives the product a tremendous speed advantage over competitive programs.

Software intimacy with the machine's hardware requires that the code be written in assembly language. The basic input/output system (BIOS) that is the foundation of all communications with your PC is written in


F4H
BCZH

native 8088 mnemonics. Programs designed to interface with the BIOS must also be written at this level. RAM disk programs, print spoolers, and high-speed data acquisition equipment drivers are some examples.

Software developers who were in on the ground floor of the 8080 and Z-80 explosion know that one advantage of working at the machine-code level is the ability to interface directly with a computer's operating system. Today, as was true in the 1970s, programmers who are able to interface with the CP/M operating system are in demand. The new generation of 16-bit computers is likely to evolve around MS-DOS, Microsoft's operating system that controls the IBM PC (called PC-DOS). Applications programs that interface directly with MS-DOS must be written with the assembler.

Since IBM has acquired a large chunk of stock in Intel, manufacturer of the 8088 and its workalike brother the 8086, we can expect that many new computers IBM introduces will be based on Intel chips. These processors are directly compatible with the central processing unit (CPU) in the PC. And where IBM goes, so follows the rest of the industry. Therefore, knowledge of 8088 coding will be useful for many years to come.

Finally, assembly language programming is fun! Granted, the complexities of assembly language virtually ensure some frustration along the way, but this should make using it more of a challenge. Creating a program is similar to solving an intricate jigsaw puzzle. When you open the box and spill the pieces onto the table, the puzzle is no more than a chaotic jumble of colored cardboard. You'll start the creation process by finding the corners and then solving the edges. You'll become familiar with the various "categories" of shapes. Your eyes will begin to discern subtle differences in area colors. As patterns emerge you'll piece together the puzzle's subassemblies. When the pieces are linked to form a finished product, you have assembled a picture of beauty.

Data Types and Numbering Conventions

Assembly language foundations are the machine's opcodes and data. Opcodes are like a very limited subset of BASIC statements. You can instruct the 8088 to transfer data either within memory or to an external device. The 8088 can add, subtract, multiply, and divide numeric data, as well as compare two values and make decisions based on the results of these comparisons.

The limited nature of the machine language instruction set is both a curse and a blessing. The curse is that each opcode does very little by itself. Opcodes must be strung together in complex patterns to accomplish even the simplest programming task. The blessing is that there are few commands to memorize, their syntax is uniform, and they combine easily with great flexibility.

The data that the 8088 processes is also simple and flexible. The basic unit of value or truth is the *bit*, or *binary digit*. A bit is simply a switch that indicates on or off, true or false, 1 or zero. At the lowest level, everything the CPU does is dependent on the state of certain bits. It is possible to consider the computer's memory as one long string of 1s and zeros.

Although most programming involves groups of bits (called bytes and words), in many cases you must reference individual bits. For example, the PC's high-resolution graphics screen is a string of over 128,000 bits. Each bit set to 1 is displayed as an illuminated dot; dark dots (not illuminated) indicate where a bit has been reset to zero. BIOS programmers have assigned bit values to certain hardware status "flags." As another example, it is possible to determine if the keyboard is in the CapsLock state by examining a single bit.

The binary numbering system is an integral part of low-level programming. Some of the instructions executed by the CPU are meaningful only when viewed in the context of the binary system. Binary numbers, however, are far too clumsy for day to day use. The decimal numbering system is familiar to most, but it is far removed from the data a computer understands. A compromise system, the base-16 hex numbering system, has evolved as the most convenient for assembly language programming. This is largely due to the fact that conversions are more easily done between hex and binary and that large numbers may be written with fewer keystrokes.

A group of 4 bits is often referred to as a nibble. A nibble can hold values ranging from zero to 15. In the base-16 numbering system each of these possible values has been given a unique name:

decimal	binary	hex
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Certain hand-held computers and dedicated devices use 4-bit processors in which data is always referred to in nibbles. At least one application in the IBM PC expressly uses nibbles: the File Allocation Table that DOS uses to keep track of the position of data on a disk breaks down most logically into groups of nibbles. I bring up nibbles mainly as an aid to understanding the hex numbering system. By far, the most often-used bit-grouping is the byte, a grouping of 8 bits (2 nibbles).

Individual bits of a byte are referred to as numbers from zero through 7. The count is started from the rightmost, or least significant, bit (LSB). A byte contains values ranging from zero to 255 (decimal), which is 00 to FF (hex). This means that if you add 1 to a byte that is already equal to 255, it cycles, or wraps, back around to zero. Bytes are represented in hex notation as a pair of nibbles suffixed with the letter *H*, such as 2FH. The first, high-order, nibble is the number of 16s (like the 10's digit in a decimal number). The second, low-order, nibble is the units digit.

> The pointer and index registers offer new categories of convenience for the 8088 programmer.

Conversion of a hex byte to its binary representation is a simple matter of breaking the byte down into nibbles and then writing the 1s and zeros that make up each nibble:

2FH byte (hex) 2 F nibbles (hex) 0010 1111 binary

Bytes are handy units of information used to represent strings of characters that are to be printed or sent over a communications line. There is no assembly language data type that corresponds to the BASIC "string," but a series of adjacent bytes can hold identical data. Each such byte will contain an ASCII value. The ASCII standard is a systematic convention used to represent character or string data. Using ASCII, the BASIC string 'Hi there' would be represented by

H	i		t	h	e	r	e	.
48H	69H	20H	74H	68H	65H	72H	65H	2EH

When numbers larger than FFH must be represented, 2 bytes are juxtaposed to form a word. A 16-bit word contains values ranging from zero to FFFFH (65,535 decimal), a value often referred to as 64K. The 2 bytes that represent a word are in reverse order—the least significant byte (LSB) comes first, and the most significant byte (MSB) is directly above it in memory. The number 22FFH will be stored in memory as FF22. Usually this "backwards" representation is invisible to the programmer (the assembler does the switching). But it is necessary to know this fact, especially when you are using DEBUG.

The word is an important type of bit-grouping. The IBM is a 16-bit computer, and it operates most efficiently on 16-bit values, so integer variables are stored and manipulated as words. Likewise, the locations in memory of string data and integer variables are tracked by 16-bit address pointers.

Signed Numbers

A special numbering convention is used to keep track of negative values. This is the two's complement convention, which takes advantage of the limitations of computer memory. When a word of memory has been assigned a value of 1, adding FFFFH results in the word becoming zero, as if FFFFH had the value of -1. It follows that adding any value greater than 7FFFH (half the highest value possible) to a value less than 8000H will exhibit a response identical to subtraction. When the two's complement convention is used, the high bit (15) of a 16-bit word is referred to as the sign bit. If this bit is 1, then the number is negative.

Two's complement numbers are often called integers. The terms *integer addition* and *integer multiplication* refer to operations that assume that the highest bit is being used to indicate the sign of the number. Since there are only 15 bits to hold the absolute value, it can indicate only numbers from zero to 7FFFH (32767 decimal). It appears that 0000H and 8000H should both represent the same value (0 and -0), but 8000H is treated as the most negative number, so 16-bit integers can range from -8000H (-32768) to +7FFFH (+32767).

To form a negative-signed number, start with its positive counterpart, break it down into binary, reverse all 1s to zeros and all zeros to 1s. Then merely add 1 to the result. For example, to form -30ABH:

```
    3    0    A    B      break into nibbles
    0011 0000 1010 1011     convert to bits

    1100 1111 0101 0100   flip-flop all bits
 +  0000 0000 0000 0001     add 1
    -------------------
    1100 1111 0101 0101   = AF55H (note sign bit = 1)
 +  0011 0000 1010 1011     verify by adding 30ABH
    -------------------
  1 0000 0000 0000 0000
```

Notice that adding 30ABH to AF55H actually results in a sum of 10000H, but since the memory word will hold only the lowest 16 bits, the highest bit is dropped, and the sum is saved as 0000H. So adding the two's complement to the original number is identical to subtracting it from itself or adding it to its negative counterpart.

The same convention can be used for representing signed bytes. When the highest bit of a byte is a 1, you can assume that it is a negative number. Signed bytes range in value from -80H (-128) to +7FH (+127).

A process called sign extension sometimes allows a 16-bit number to be represented in an 8-bit byte. You simply take the highest bit of the LSB and replicate it through all bits of the MSB.

```
         00000001B  =  +01H
00000000 00000001B  =  +0001H  (sign extended)
         11010011B  =  -53H
11111111 11010011B  =  -0053H  (sign extended)
```

Here's a final note on bit fields. While values are normally broken into bytes or words, occasionally programmers try to pack a lot of information into a small area. One example is the way PC-DOS keeps track of the time/date stamp of a disk file. Since only 12 months are in a year, Microsoft thought it foolish to reserve an entire byte to store the month reference. Likewise, the day can be a number from 1 to 31 only. Microsoft chose to store the month, day, and year as a 2-byte bit field in this format:

———byte———								———byte———							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
y	y	y	y	y	y	y	m	m	m	m	d	d	d	d	d

'ddddd' is a 5-bit field, so it can hold numbers from zero to 32 (1-31 valid). 'mmmm' is a 4-bit field, so it can hold numbers from zero to 15 (1-12 valid). 'yyyyyyy' is a 7-bit field, so it can hold numbers from zero to 127 (0-119 valid). The value of the year field is added to 1980 to yield a year from 1980 to 2099.

Another example of an odd-sized bit field is seen in medium-resolution graphics. The graphics hardware will display only four colors in medium-resolution mode. To keep this information compact, each byte of display memory is viewed as a set of four 2-bit fields. Two bits can hold values from 0 to 3, just enough to indicate which of the four colors to display.

8088 Addresses

As you know, the 8088 is capable of accessing over 1 million bytes of memory (i.e., addresses from 0 through FFFFFH). This is one of the chief advantages over earlier 8-bit CPUs. But the 8088 is a 16-bit machine, and 16 bits can hold only values up to 64K. To be able to store values in addresses above 65,536, it was necessary to work out a sophisticated memory addressing scheme that involves memory segments.

FFFFFH is one less than 2^20, so memory locations need to be addressed that may be as large as a 20-bit number. The designers of the 8088 could have reserved a couple of 4-bit segment pointers and allowed each of 16 64K segments to be accessed. Instead, they chose a more flexible system that uses 16-bit segment pointers, which can point to any of 65,536 16-byte "paragraphs." Any address within 64K of the segment pointer is thus available for program code and data.

This concept of segmentation might best be explained by analogy. Imagine a desk clerk at the Mega-Room Hotel. The clerk's job is keeping track of room keys and messages for each of the hotel's more than 1 million guests. Behind the reception desk is a tall array of pigeonholes corresponding to each of the hotel rooms. Each floor has 16 rooms, with over 65,000 floors in the hotel.

The clerk, who used to play professional basketball with the Lakers, is tall enough to reach the shelf for floor 4096, a total of 65,536 rooms. When he receives a message for the guest in 65537, he gets out his trusty stepladder and climbs up one rung. This gives him room access to 65,551. He can no longer reach down to the bottom shelf without crashing to the floor, so he has a range of 16 to 65,551. He can still place messages in any of 65,536 pigeonholes.

Notice that the clerk would be equally correct if he referred to room 16 as being on level one when he's standing on the floor, or as level zero when he's standing on the first rung of the stepladder.

The clerk hates getting mail for room number FFFFFH (1,048,575) because he must scale 61,440 of the ladder rungs to put the shelf within reach. But once he's up there, he can take care of the the entire 4096 upper floors (rooms F0000H to FFFFFH).

The 8088 segment pointers, or registers, are like the stepladder the clerk uses to access the different shelves of pigeonholes, or paragraphs of memory addresses. His 4096-shelf "reach" is analogous to one 64K memory segment, and the number of the rung he stands on is the value of a segment register.

Just as the clerk must climb the rungs of his ladder to reach the upper floors of the hotel, the segment registers must be used to access the higher portions of IBM PC memory. Segments may overlap; many of the pigeonholes that can be reached from the first rung of the ladder are also within reach from the floor or the second rung.

Many programs initialize all the segment registers to the same value.

A notation convention has developed to keep track of addresses in this memory segmentation scheme. The format is

ssss:oooo

in which 'ssss' is the segment number and 'oooo' is an offset within that segment. Addresses named in this manner are always represented in hex. Some examples are:

0000:30AB	30ABH from the absolute start of memory
F600:0007	a high memory address (ROM BASIC)
0040:0000	first byte of the BIOS data segment
0000:0400	another way to specify the same address

The last two examples illustrate how segments may overlap. Address 0000:0400 is the same memory location as 0040:0000. In fact, there are 1000H (4096) ways to refer to some addresses. This may be cause for some confusion, but the result is a great deal of flexibility in memory management; with only a few changes to segment references programs can be loaded and executed at any memory paragraph. It doesn't matter, for example, whether DEBUG is loaded at 03AB:0000 or 04FE:0000; its execution will be unchanged.

Normally you will not need to know the 20-bit address of any byte. A segment and an offset are a perfectly good reference. But to calculate the absolute 20-bit address of any byte in memory, the segment reference can be multiplied by 16 and added in the offset reference. Just as a multiplication by 10 is accomplished in the decimal system by shifting all the numbers to the left and appending a zero to the right, in the hex system the value is shifted by 1 nibble. Thus 1234:5678 is the 179B8Hth byte from the start of memory.

	1234:5678	segment:offset format
	12340H	segment * 10H (shift left by 4 bits)
+	5678H	add offset
		———————
	179B8H	absolute memory location

You have seen how numbers are represented when working in assembly language, and you have looked at the binary numbering system and have seen how convenient the hex system is to use. You have studied signed numbers, ASCII characters, 8088 segmented address notation, and have noted the significance of 4-, 8-, 16- and variable-length bit fields. Now let's take a look at how the 8088 manipulates these values.

8088 Architecture

Like most of today's microprocessors, the 8088 has a set of registers that hold and manipulate data. Each of these registers is 16 bits wide, but many of them can be used as two 8-bit registers to manipulate individual bytes.

Figure 1 diagrams these registers and divides them into groups. The general registers are used in much the same way as variables in a BASIC program. You can transfer values to or from them, as well as perform arithmetic operations. In addition to being "general purpose" each register has specific, special-purpose functions. The names of these registers reflect their special uses.

AX is often used as an accumulator because certain arithmetic operations automatically leave, or accumulate, their results in this register. Some operations work faster when AX (or AL) is one of the operands.

BX can be used as a base register. When you are working with arrays or tables of data, it is often useful to assign BX the address of the base of the table. There are special (fast) ways to get at data in a table pointed to by BX. Also, BX must point to the base of a translation table when the XLAT instruction is executed.

CX is a counter. Some operations can be automatically repeated many times. These operations use CX as a counter to keep track of which iteration is being performed and to test for when the operation is finished. One special opcode, LOOP, is similar to BASIC's FOR...NEXT construct. CX is used as *n* in the 8088 equivalent of

FOR n = m TO 0 STEP -1

You can't ask the CPU to do any arithmetic operations with a segment register as an operand.

DX is a data register for certain arithmetic operations, namely 32-bit multiplication and division. Multiplying two 16-bit values can, of course, result in a product that is 32 bits long (FFFFFFFFH or 4,294,967,295). When two 16-bit values are multiplied, the 32-bit result is returned in two registers: DX and AX. DX will hold the most significant word, and AX will contain the least significant word. Similarly, DX is used to hold the high 16 bits of any 32-bit dividend. After the division, the quotient is found in AX and the remainder in DX. DX is also used as a port pointer in some types of I/O operations.

The special uses of these general registers are tricky, and perhaps difficult to remember. Some people consider them a flaw in the 8088's design. By way of comparison, the general registers of the Motorola 68000 CPU may all be used for any purpose. Figure 2 lists the specialties of each 8088 register. You might find it a useful cheat sheet when the machine is doing something that you didn't put in the program.

Pointer and Index Registers

One of the advanced features of the 8088 is its wealth of memory addressing modes. With earlier processors programmers had few options for accessing the computer's memory. With the 8080 they could say, "give me the byte, or word, at address xxxx" (xxxx being a 16-bit absolute address). Or they could say, "load a pointer register with xxxx, then retrieve the byte, or word, at the address pointed to by that register." Note: the Z-80 includes the option of retrieving data at an offset of -128 to +127 from certain pointer registers.

Hands On

The pointer and index registers offer new categories of convenience for the 8088 programmer. You can set a register to point to the base of a table and then say "retrieve the data that is xxxx bytes above that register," or use a second register to specify the offset from the base: "retrieve the data that is at the address formed by adding these two registers." Finally, data can be manipulated that is offset from a base plus an index plus an offset.

In other words, when memory is accessed you specify an effective address, which may consist of the combination of up to three of the following: the variable address held in a base register (BX or BP), the variable address held in an index register (SI or DI), a constant offset (16-bit value). What's more, any such effective address is calculated as an offset from an associated segment register. And you also have the capability of "overriding" the normal segment register with one of your choice.

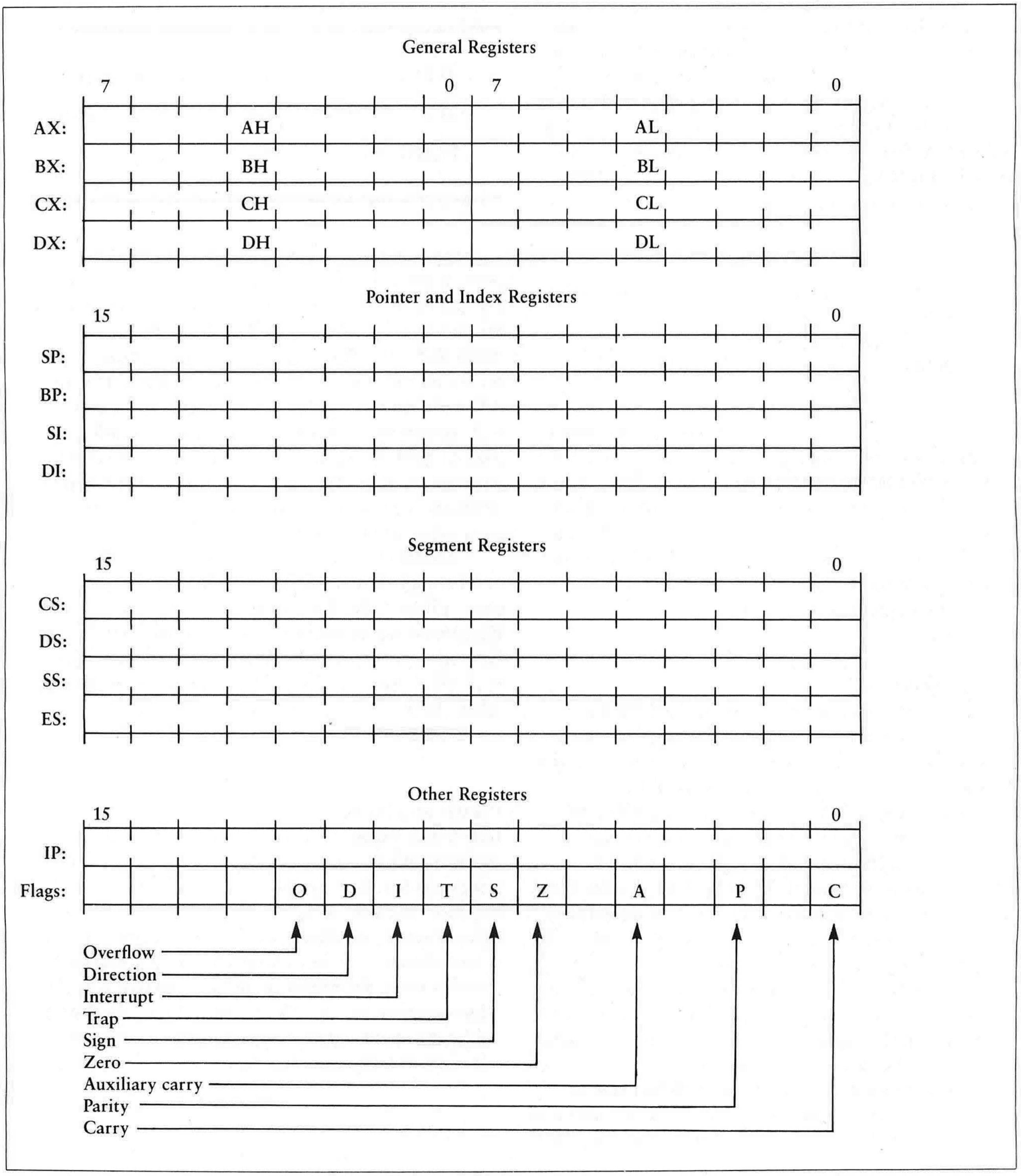


Figure 1: Registers Diagram

All this flexibility boils down to the following: it is conceptually easier to keep track of your program and its data. You can segregate the opcodes of your program from its data and easily differentiate between different data types.

Integer variables are a breeze to handle. Lists of data and character strings are easy to visualize and work with. Two-dimensional arrays can be accessed in assembly language in much the same way as they are in BASIC and other high-level languages. For example

```
MOV     AX, MY_ARRAY[BX+SI]
```

says "retrieve the data that is in the row that starts at the address in BX and is in the SIth column of the table that starts at the address of MY_ARRAY." This is nearly the same as the BASIC statement

```
LET     AX = MY.ARRAY(BX,SI)
```

The index and pointer registers can sometimes be used interchangeably, but each has its own special significance. The SI and DI index registers are most useful in manipulating and testing strings of characters.

SI is used as the source index. When you transfer strings of data from one address to another, you point SI to the address where the string currently resides, and it indexes the source data. Some operations will automatically increment or decrement SI. It is normally used in forming an effective address that is an offset within the data segment (DS).

DI is the destination index and is the counterpart of SI. String move operations expect DI to point to the new address for the string—the string's destination. When used as a simple index (in a nonstring operation), DI

AL:	Source operand for:	AAA; AAD; AAS; DAA; DAS; CBW; OUT; SCASB; STOSB; XLAT; 8-bit MUL, IMUL
	Destination for:	AAA; AAD; AAS; DAA; DAS; IN; LODSB; XLAT; 8-bit DIV, IDIV
AH:	Source operand for:	SAHF
	Destination for:	LAHF; CBW
AX:	Source operand for:	CWD; OUT; SCASW; STOSW; 8-bit DIV, IDIV; 16-bit MUL, IMUL
	Destination for:	AAM; AAD; CBW; LODSW; 16-bit DIV, IDIV; 8-bit MUL, IMUL; low-word of 16-bit MUL, IMUL
	Some variations of the following operations execute fastest, or take fewest opcode bytes when AX or AL is one of the operands: ADC; ADD; AND; CMP; MOV; OR; SBB; SUB; TEST; XCHG; XOR	
BX:	Used as base register to form effective address of memory operands. With DS, points to lookup table used in XLAT.	
CL:	Used as counter for some forms of: RCL; RCR; ROL; ROR; SAL; SAR	
CX:	Tested for zero in JCXZ. Used as counter in LOOP; LOOPNE; LOOPE; REP; REPNE; REPE	
DX:	Source operand for:	high word of 16-bit DIV, IDIV
	Destination for:	CWD; high word of 16-bit MUL, IMUL
	When the address of an input or output port is greater than FFH, DX must be used as an indirect pointer for IN and OUT.	
SI:	Points to source string for and is automatically altered by: CMPS; LODS; MOVS. Used as index register to form effective address of memory operands. Default Segment is DS.	
DI:	Points to destination string for and is automatically altered by: CMPS; MOVS; SCAS; STOS. Used as index register to form effective address of memory operands. Default segment is DS, except in string operations default is ES.	
SP:	Points to the current location within the hardware stack. Affected by: CALL; INT; INTO; IRET; POP; POPF; PUSH; PUSHF; RET. Default segment is SS.	
BP:	Used as base register to form effective address of memory operands. Default segment is SS.	
DS:	Points to source segment of all string operations. Affected by LDS.	
ES:	Points to destination segment of all string operations. Affected by LES.	
SS:	Must clear interrupts (CLI) before altering this segment register.	

Figure 2: Register Specialties

points within the data segment. But for all string operations (MOVS, STOS, CMPS, and SCAS), the DI register describes an offset within the extra segment (ES).

A stack is a data structure used to keep track of temporary values quickly and efficiently. The SP and BP registers are employed in conjunction with the 8088's hardware stack.

SP is the stack pointer. It automatically keeps track of the current top of the stack, and it is manipulated with the PUSH, POP, CALL, and RET opcodes and may be initialized with a MOV opcode. Once it is initialized, you usually don't need to bother with it. It always points to an address in the stack segment (SS).

The importance of understanding the CPU flags cannot be stressed enough.

BP is called the base pointer. It is useful for accessing data on the stack, usually parameters that are being passed to a subroutine. When an effective address is formed using BP as the base register, the data is assumed to be in the stack segment unless a segment override is specified.

As I mentioned earlier, accessing a full megabyte of memory with 16-bit pointers requires a segmented memory scheme. The 8088's segment registers are the basis upon which it operates. Whenever the 8088 calculates an effective address to access memory, it does so in the context of a memory paragraph specified by one of the segment registers.

Although it is quite useful to be able to break your program into distinct code and data areas by using separate segments for each, many programs simply initialize all the segment registers to the same value. PC-DOS's external commands (.COM programs) all make use of this option. The .EXE programs created by the compilers and the assembler produce code that normally defines separate segments for the code, data, and stack of their output programs.

The segment registers don't "act" the same as the general or index registers; they have a different role to play. For one thing, you can't ask the CPU to do any arithmetic operations with a segment register as an operand. Also, there is no way to place a value directly into a segment register. You usually move the value into a general register and then transfer it to the segment register.

As with the other registers, the names of the segment registers have been chosen to reflect their main function.

CS points to the start of the code segment. All the opcodes that the CPU fetches and executes will be contained in the current code segment. Programs may be broken into several different code segments. You might want your main program in one segment and all its subroutines in another.

DS is the data segment register. All program variables and arrays usually reside in the data segment. Effective addresses point within this segment, unless a segment override is specified or BP is part of the calculation. String operations assume that the source address of the string is somewhere in the data segment.

ES is called the extra segment register to which a string will be transferred in a string move. String comparisons expect that one of the strings to compare is in the extra segment. Whenever it is useful to be able to point to an external segment (e.g., video memory), ES is handy to have around.

SS defines the bottom of the stack segment. All data pointed to by SP or BP are in this segment. Since the stack grows downward (the more data PUSHed onto the stack, the closer SP gets to absolute zero), SP will often be initialized with a high value such as FFF0H.

Two special registers don't fit in any of the previously mentioned categories. These two "other registers" are not manipulated in the same way as the rest of the registers. Each is affected in predictable ways by the execution of certain specialized opcodes.

IP is the instruction pointer, but unlike the other pointer registers, you'll never use it to point to data. The CPU uses it to keep track of the address of the opcode that it is currently executing. Commands like JMP, CALL, and RET affect IP by replacing its contents with new addresses. The "short jumps" that result from the JA, JB, JE, etc. are really arithmetic operations that the CPU performs with IP. You will always specify a label for the jump and allow the assembler to generate the correct offset. But it is interesting to note that the offset is a 8-bit signed number that is sign-extended and then added to IP. This results in execution continuing at a new address.

Flags is a 16-bit register containing 1-bit values that describe the results of arithmetic and logical operations. Every decision that your program makes is based on the condition of these flags. A flag SET of true means that it has a value of 1; when RESET, cleared, or false, it is zero.

8088 Flags

The importance of understanding the CPU flags cannot be stressed enough. The only way to make a decision in an assembly language program is to do an arithmetic or bit-logic operation, test the flags, and then force execution to the desired branch of the program.

Each CPU flag has its own name and role. Because of their importance, I'm going to discuss each individually as well as in selected combinations. Although I haven't started discussing the 8088 instruction set, I'll be mentioning some opcodes by name. You might want to review this section after acquainting yourself with the opcodes. I'll also mention the two-letter abbreviations that DEBUG uses when it displays the value of the flags register.

The CPU flags can be subdivided into two groups. Some flags are controlled by the program in order to affect the way the CPU operates. Others are altered by the CPU to reflect the status of the results of arithmetic and logical operations.

Processor Control Flags

'DF "Direction Flag" UP = 0 DN = 1' affects the string operations (MOVS, CMPS, SCAS, LODS, and STOS) and automatically adjusts the string pointer registers (SI and/or DI) after operating on the data. This flag determines the direction of that adjustment. When DF = UP, the registers are incremented. Otherwise, the operation goes backward from high addresses to lower addresses.
Set DF to DN (down or backwards) with STD.
Clear DF to UP (or forward) with CLD.

'IF "Interrupt Flag" DI = 0 EI = 1' enables or disables maskable external interrupts. When IF is DI, the CPU will take no notice of hardware interrupts (like the keyboard or timer interrupts). This means that the CPU will pay full attention to your code—it won't pause to perform "background tasks." This flag is often cleared when timing considerations are crucial or during the execution of a hardware interrupt service routine. Note: internal (software) interrupts are always recognized.
Set IF to EI (enable interrupts) with STI.
Clear IF to DI (disable interrupts) with CLI.

> Perhaps the trickiest part of assembler programming is learning how to direct the flow of your program.

If 'TF "Trap Flag" ' (not displayed by DEBUG), equals 1, then the CPU is in a special "debugging" state. After each instruction is executed, an INT 1 occurs. This allows a debugging program to single-step through a program (even a ROM program). DEBUG uses this function. Note: if you dump address 0000:0004, you will see the address of the single-step routine within DEBUG that is executed after each instruction.

Set or clear TF by PUSHing the flags register (PUSHF). Next, set or reset the 8th bit of the pushed value and execute POPF to get the value back into the flags register. The routine that handles INT 1 should terminate with an IRET, which will restore flags, keeping the trap active.

Arithmetic and Logical Result Flags

Perhaps the trickiest part of assembler programming is learning how to direct the flow of your program. In BASIC you can make a complex decision in one line of code:

```
10   IF X<Y OR (X=Z AND Y>Z) THEN X=X+1 ELSE Y=Y+1
```

But this same decision in assembly language must be made in several stages. To demonstrate the difference, the following steps are close to what is needed in assembly language:

```
10   IF X < Y THEN GOTO 100
20   IF X <> Z THEN GOTO 200
30   IF Y <= Z THEN GOTO 200
100  LET X=X+1       'answer is TRUE
120  GOTO 300
200  LET Y=Y+1       'answer is FALSE
300  'program continues ...
```

When you make a decision based on an arithmetic operation (add, subtract, compare, etc.), you must know whether the operands are signed or unsigned. For example, when FFFFH is considered a signed number, its value is -1, but as an unsigned number it is 65,535. Obviously, in the former case FFFFH is less than zero, and in the latter case it is greater.

You can't get away with asking, "is this number less than that number?" You must ask, "is this unsigned number below that unsigned number?" or "is this signed number less than that signed number?" To ask the correct question you'll need to memorize two facts: unsigned numbers are below, above, or equal; and signed numbers are greater, less, or equal.

More to Come

I have covered a great deal of material: the binary and hex numbering systems, the two's complement convention for representing signed integers, and the 8088 registers and the flags that are so essential to assembly language programming. At times, I've gotten ahead of myself and mentioned parts of the 8088 instruction set, but I've hardly grazed the surface of what the 8088 can do or how to go about making it perform the miracles of which it is capable.

If you are serious about learning 8088 assembler programming, your best bet is to study several references. What doesn't seem clear in the first reading will start to make sense later, after several authors have explained the same process in different ways. Also, several of these concepts are difficult and complex. You will often need to understand one concept before advancing to another.

This article has covered the most basic concepts. A future article in *PC World* will talk about the opcodes and teach you to write a short program so you can get

> You must carefully check your logic before running an assembly language program; a single JB when you meant JL can drive you crazy.

your feet wet with the Macro Assembler. I suggest that you study the following books carefully: *The IBM Macro Assembler* and *The IBM Disk Operating System* by IBM; *The 8086/8088 Primer* by Stephen P. Morse (Hayden Book Company, Rochelle Park, New Jersey, 1982); and the *iAPX 86,88 Book* by Intel Corp. (Reston Publishing Co., Reston, Virginia, 1982).

This article has referred to the IBM Macro Assembler. If you would like to avoid the $100 price tag on that particular package, send a formatted disk and return postage to David Whitman, Department of Chemistry, Dartmouth College, Hanover, NH 03755, 603/643-2115. You will receive a copy of CHASM, an 8088 assembler written in BASIC. This is being distributed under the FREEWARE scheme. If you like the program, send a $20 donation to the author.

Dan Rollins is a freelance programmer and technical writer. Parts of this article will be adapted for his forthcoming book, IBM PC: 8088 Macro Assembler Programming *and are used by permission of the Macmillan Publishing Co., Inc., copyright 1983, Dan Rollins.*

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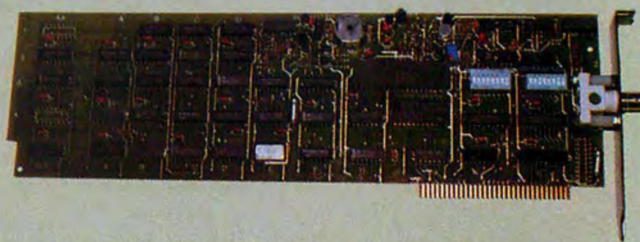

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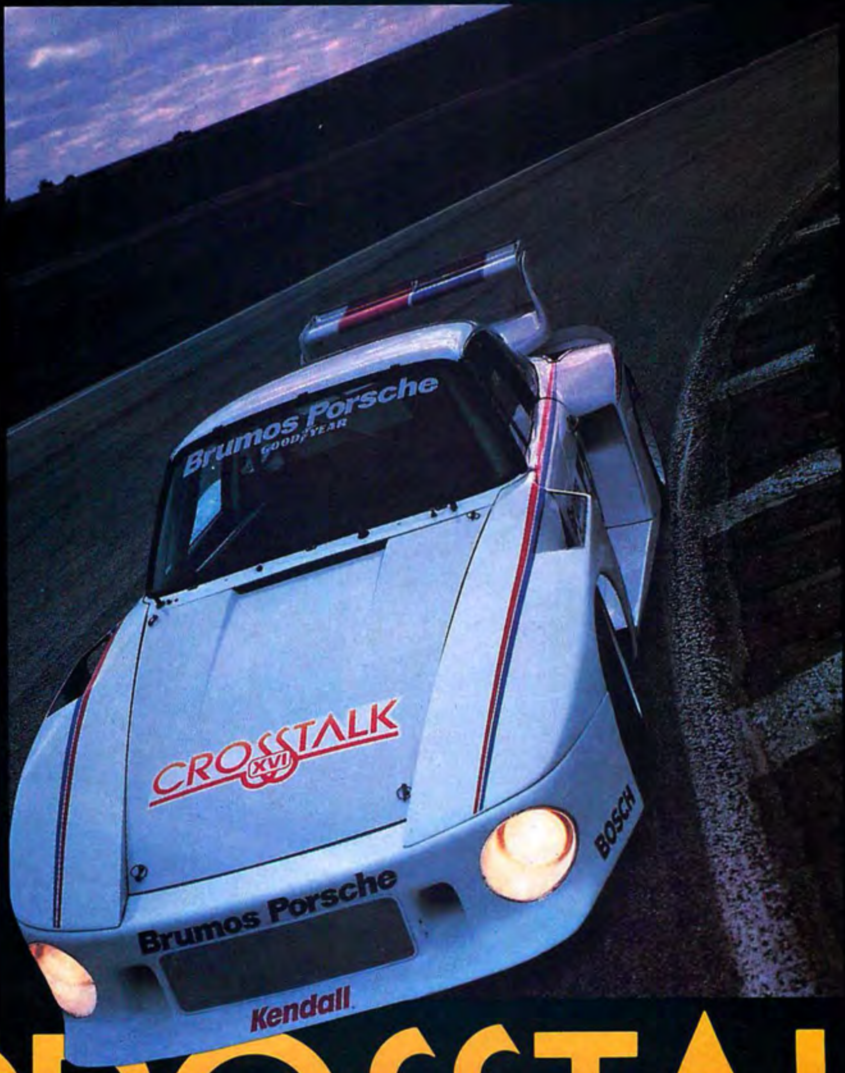

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Hard Disk Backup

Software and hardware techniques for backing up your hard disk

Johnathan Sachs

Like putting money in the bank or keeping a card up your sleeve, backing up the data on a hard disk can ensure that you don't lose valuable information to system failures, power outages, or human error. With fast processing speeds and large amounts of storage offered, many people are catching on to the idea of using hard disks to manage their growing data bases.

Instead of a floppy disk drive's 360 bytes of data, hard disks offer from 5 to 40 megabytes, and the systems read and write about 20 times faster than floppy disk drives. While some people may think a few thousand dollars for a hard disk is too much to pay, the actual cost per byte of hard disk storage can work out to less than 25 percent of the per-byte cost of a floppy disk drive.

However, the added capability of a hard disk creates a new problem. Backing up even a 5-megabyte hard disk requires 14 floppy disks and takes about 10 minutes, not counting the time it takes to feed all the disks into the drive. So how can you conveniently back up all that data?

The Software Solution

You can speed up the backup process with two techniques that I call differential and incremental. The differential technique works like this: after making a full backup of the hard disk, you make a number of subsequent backups, each time copying all the files that have changed since the full backup was made. You continue making differential backups of the hard disk files until so many files have changed that the backups become inconveniently large, taking almost as much time and effort as making a full backup. Then you make another full backup of all your data and start the process over.

> In version 2.00 of PC-DOS, IBM introduced a program called BACKUP as part of the software support for its hard disk.

With incremental backup, once the full backup has been made, files are backed up only when they change. Unlike the differential technique, the size of an incremental backup does not grow with time. The time that can pass before you have to make another full backup is limited by the number of incremental backups you would have to restore to reconstruct the entire contents of the hard disk.

Differential and incremental backups work best if your hard disk holds many small files, only a few of which change frequently. If you keep information on a large data base, you are likely to have a few long files that change frequently as you update the data base. In this case differential and incremental backups are nearly as large as a full backup of the hard disk.

Backup Programs

In version 2.00 of PC-DOS, IBM introduced a program called BACKUP as part of the software support for its hard disk. The program requires two parameters. The first defines the file or files to be backed up and the second specifies the disk drive on which to make the backup. For example, to copy all files on drive C (the hard disk) onto a floppy disk in drive A, you enter

```
C>BACKUP c: a:
```

BACKUP prompts you to insert a disk in the target drive and press a key. When you do so, the program erases all files on the disk and starts copying.

Because BACKUP erases everything on the floppy disk to which it is copying the hard disk files, you shouldn't use the same set of disks for each backup. If a power failure occurs or your system breaks down while you are performing a backup, the program can ruin your previous backup before you have created a new one. Instead of using one set of backup disks, you should develop a system that uses at least two sets of disks (sets A and B, for example). Back up your data on set A one day and on set B the next, and continue alternating disks each day.

If BACKUP fills a disk before the procedure is completed, it prompts you to insert new disks as many times as necessary. BACKUP writes in a special format that enables it to save files larger than a disk's capacity. Because of this format, you cannot access backed-up files directly. When you want to use your backed-up files, you must copy them back to the hard disk with the PC-DOS 2.00 program RESTORE.

You can use BACKUP to make differential and incremental backups. A backup of files that have changed since the last backup of any kind is easy to make. Simply run BACKUP with /M:

```
C>BACKUP c: a:/m
```

This means back up only files that have been created or modified since the previous backup. BACKUP can tell which files have been created or modified by checking a bit in each file's directory entry. BACKUP turns the bit on when it copies a file; whenever the file is modified, DOS turns the bit off.

To create a backup that copies all files changed since the last full backup, you must know when the last full backup was made. Suppose it was made on May 1, 1983. To create the incremental backup use /D:

```
C>BACKUP c: a:/d:5-2-1983
```

This means back up only files that have been created or modified on or after May 2, 1983. If the May 1 backup were done at the end of the working day, the procedure would copy every file that was modified since then.

DOS 2.00 supports subdirectories (those that reside in other directories as though they were files), and BACKUP normally backs up only files in the current directory (the directory you're working on at the moment). However, you can back up files from a family of directories with /S, which means back up the files in the current directory and all its subdirectories. To back up an entire disk, back up the disk's root (main) directory with /S.

Some other hard disk manufacturers provide backup programs that are different from IBM's. Some programs back up only the entire hard disk. Others let you back up particular files or groups of files (such as all files named with the same extension), making no provision for differential or incremental backups.

A particularly complete, menu-driven backup program comes with Davong Systems hard disks. You can use the program to back up and restore all or selected files on a disk. The program also lists the contents of a backup disk, much as the DOS DIR command lists the files on a disk and allows you to make full, differential, and incremental backups.

The Hardware Answer

One way to reduce the time required to back up a hard disk is to copy hard disk files onto a removable disk cartridge. Removable disk cartridges have long been available in the mainframe and minicomputer world but have only recently been introduced for the IBM PC.

One advantage of removable disk cartridges is that the backup software can be much simpler than software for floppy disks because the removable disk is so fast that differential and incremental backups are unnecessary. The backup program simply makes a full backup of a hard disk on the removable disk. The program may even make a "volume backup," a copy of every part of the hard disk, whether it holds data or not, without suffering an undue penalty in backup speed.

Genie Computer Corporation, one of the earliest contenders in the removable disk cartridge market, has been shipping devices for the IBM PC since late 1982. The company's flagship product is Genie 5 + 5, a hard disk subsystem (a hard disk drive, a controller board, and a power supply) with one fixed Winchester drive and one removable 5¼-inch cartridge drive, each holding

Eight-Inch Disk Drives

Several companies make 8-inch disk drives that are more convenient than IBM's standard 5¼-inch drives for backing up hard disks.

The 8-inch drive is an older design than the 5¼-inch drive, but it can store more data on a disk—up to 1.2 megabytes in double-sided, double-density format.

Unlike 5¼-inch disks, 8-inch disks use a standard recording format that almost all computers accept. You can write an 8-inch disk on almost any computer and read it on almost any other computer, at least at the bits and bytes level. If the two computers do not use the same operating system, you must run a program that translates files between one operating system's directory format and the other's.

The standard 8-inch disk format is single-sided and single-density and records only about 250K of data per disk. Disks in this format are not useful for hard disk backup purposes. Most modern computers have alternate recording modes that are nonstandard but store two to four times as much data per disk.

5 megabytes of data. Software supplied with the subsystem can back up the hard disk drive on the removable drive in less than a minute.

Genie also makes fixed-only drives with capacities of up to 20 megabytes. These drives use the same controller board as the Genie 5 + 5 and can be backed up on multiple (up to four in this case) 5-megabyte removable disk cartridges.

In recent months many companies have announced hard disk subsystems containing removable disk drives. There's a catch, though: many of these products contain a new 3.9-inch cartridge drive manufactured by Syquest Technology. Syquest has had production problems and has not been able to deliver large quantities of drives as quickly as expected. Thus the products using those drives are destined to remain paper tigers for a few months at least.

Digital Tape Cartridges

If removable disk cartridges aren't the answer to your backup needs, you might try removable digital tape cartridges. These cartridges are not to be confused with the audio tape cassettes used for storage with many personal computers. The systems are designed specifically for digital data recording and can save 10 to 40 megabytes of data at speeds that compare favorably with backing up on floppy disks.

Tallgrass Technologies was one of the first companies to offer a removable digital tape cartridge for the IBM PC. The unit offers a hard disk drive holding 6, 12, or 20 megabytes and a built-in digital tape cartridge drive that can record 12.5 megabytes in about ten minutes. Tallgrass has

What Standard?

Once you buy a disk or tape cartridge system, you'll probably want to use it to exchange big data files with fellow computer users. When you try, you may get a nasty surprise.

Most disk cartridge drives use one of two standard designs—Dysan's 5¼-inch cartridge or Syquest's 3.9-inch cartridge—but most of them use different recording formats. There is little chance that a disk cartridge written on your computer will be readable on your neighbor's unless he or she happens to have the same brand of disk subsystem.

Tape cartridge drives have the same problem. Most use the same standard cartridge, but there are no widely observed standards for recording data on the tape. The chances are slim that a tape recorded on one kind of drive can be read on another kind.

With ½-inch tape, the situation is better. There are three recording standards currently in use; data is recorded at densities of 800, 1600, and 6250 bytes per inch. Almost every ½-inch tape drive in existence can process at least one of these standard formats. Thus, if you get a ½-inch tape drive, you will be able to exchange tapes with a large proportion of the ½-inch-tape-equipped computers in the free world.

Device	5-inch Disk	8-inch Disk	Disk Cartridge	¼-inch Tape Cartridge	½-inch Tape Reel
Capacity	.36M	.25M–1.2M	5M–10M	10M–40M	40M
Data Rate	10K/sec	10K/sec	500K/sec	20K–90K/sec	10K–100K/sec
Typical Device Cost	$500	$1000–$3000	$1500–$3000	$1000–$2500	$3000-$8000
Typical Media Cost	$4–$8; $12–$25/M	$5–$10; $4–$8/M	$80–$100; $8–$20/M	$20–$30; $.60–$2.50/M	$15–$20; $.50/M
Compatibility	PC-to-PC only	.25M format only	no	no	yes
Comments	Price does not include adapter card				Capacity & cost for 2400-inch tape recorded at 1600 bytes/inch

Table 1: Hard Disk Backup Hardware Compared

also introduced a digital tape-only unit for backing up IBM's hard disk.

Davong Systems recently introduced a digital tape cartridge drive, the U620T, that records 18 megabytes per cartridge. The drive attaches to Davong hard disk subsystems, including those made before the U620T was announced. Equipped with its own controller board, the drive can be used to back up an IBM hard disk or another manufacturer's hard disk.

Reel-to-Reel Tape

Another medium for hard disk backup is ½-inch-wide reel-to-reel tape. This is the tape that large computers have traditionally used for high-capacity storage. One reel of tape 2400 feet long can hold about 40 megabytes. Half-inch tape drives have not caught on in the microcomputer world because they are clumsier and more expensive than other backup devices and do not offer substantially more speed or capacity. They do use standard recording formats, however, enabling you to exchange tapes with most large computer systems.

Two makers of ½-inch tape subsystems for the PC are Innovative Data Technology and Alloy Computer Products. Both companies make subsystems that can be used to back up a PC hard disk or to enable PC applications programs to read and write reel-to-reel tapes from both mainframes and personal computers.

Disk or Tape

The type of backup device that is best for you depends, of course, on the kind of backup features you need (see Table 1).

For speed, removable disk cartridge drives are the clear winner. They read and write at speeds comparable to hard disks, making them faster than most tape backup devices. For capacity, ½-inch tape comes in first, with digital tape cartridges next. Removable disk cartridges provide the least capacity, which means that they may be an inconvenient backup medium if you have a large-capacity hard disk.

Removable disk cartridges let you back up your hard disk file by file, and you can have applications programs read files directly from the backup disks if that suits your purposes. Digital tape cartridges and ½-inch tape both require that you restore files to the hard disk before using them, which may create problems if you need to access your backup files often.

What about reliability? For makers of removable disk cartridge devices, this is a sensitive point. Many industry experts criticize removable disk cartridges for their vulnerability to shock and contamination.

Digital tape cartridge drives and ½-inch tape drives are more reliable than removable disk cartridge drives. Their combination of time-proven designs and relatively simple mechanisms give them an edge that will be hard to beat. Although removable disk cartridge technology is not new, it has not been applied to microcomputers until now. Many of the drives and cartridge designs in PC-compatible subsystems are new, and they may have to mature a bit before they can be trusted completely.

These facts don't necessarily mean that today's removable disk cartridges are hazardous to your backup procedures. "It's a relative world," observes Jim Porter, publisher of *Disk Trend*, an annual market study of the disk drive industry. "They [the new removable disk cartridges] will be a lot better than the removable cartridges that have been used in business computers for many years." If they are less reliable than sealed, dustproof hard drives, they are probably at least as reliable as the floppy disk drives they replace.

The Future

Over the next few years we will probably see removable disk and digital tape cartridge drives increase in capacity as they come down in price. Digital tape will maintain its capacity advantage over removable disk cartridges and will probably replace removable disks as a backup medium when cartridge tape drive prices drop to a level that users can easily accept. This trend will be reinforced by the increasing storage capacities of hard nonremovable disks, which will outrun removable disks as they have outrun floppy disks.

Cartridge disk and digital tape drives will both become more reliable as improved devices and media are developed. Half-inch reel-to-reel tape drives have been used longer than either cartridge disks or digital tapes and are likely to improve more slowly than the newer media. Never common on microcomputers, they will disappear from the backup device market as removable tape cartridges advance. At the same time, ½-inch tape drives will be used more widely for exchanging data with large computers as microcomputers become better able to process huge files.

Backup problems won't go away as long as hard disk capacities continue to challenge the capabilities of removable media devices. As new software and hardware develops, however, we can hope for better solutions to tougher problems.

Jonathan Sachs is an independent consultant living near San Francisco who specializes in end user documentation and text processing software development.

Streaming and Nonstreaming Tape Drives

Tape drives come in two types: streaming and nonstreaming. A nonstreaming tape drive moves the tape past the read/write head each time the computer commands it to read or write a record. After performing the read or write, the drive halts until it is given another command.

A streaming tape drive moves the tape past the read/write head continuously. Once the tape starts moving, the computer must supply data as fast as the drive can write or accept data as fast as the drive can read.

Since a streaming tape drive does not have to be able to control tape motion rapidly and precisely, it is simpler, cheaper, and more reliable than a nonstreaming drive. A streaming tape drive is well suited for backing up disks. Since a hard disk is much faster than a tape drive, a properly designed backup program has no trouble keeping up with the moving tape.

For operations other than backup, a streaming drive is not nearly as useful. Most programs read and write at irregular times and cannot cope with a streaming drive's need for a constant flow of data. Although streaming drives can be used to process records one at a time, they do so slowly and use tape inefficiently.

Most of the tape cartridge drives available for the PC are streaming drives. This reflects their intended use as backup devices.

Although streaming ½-inch reel-to-reel tape drives are available, many ½-inch drives are of the nonstreaming type. This reflects the mainframe custom of using tape to store large files that can be processed sequentially.

Cartridge tape subsystem
Half-inch tape subsystem
Alloy Engineering Company
Computer Products Division
12 Mercer Rd.
Natick, MA 01701
617/655-3900

Hard disk/tape cartridge subsystem
Tape cartridge subsystem
Davong Systems, Inc.
610 Palomar Ave.
Sunnyvale, CA 94086
408/734-4900

Genie 5 + 5 hard/removable disk subsystem
Genie fixed disk subsystem
Genie Computer Corporation
31125 Via Colinas #908
Westlake Village, CA 91362
213/991-6210

Fixed disk subsystem
IBM Corporation
Systems Products Division
P.O. Box 1328
Boca Raton, FL 33432

Tape cartridge subsystem
Half-inch tape subsystem
Innovative Data Technology
4060 Morena Blvd.
San Diego, CA 92117
619/270-3990

Hard disk/tape cartridge subsystem
Tape cartridge subsystem for IBM fixed disk backup
Tallgrass Technologies Corporation
11667 W. 90th St.
Overland, KS 66214
913/492-6002

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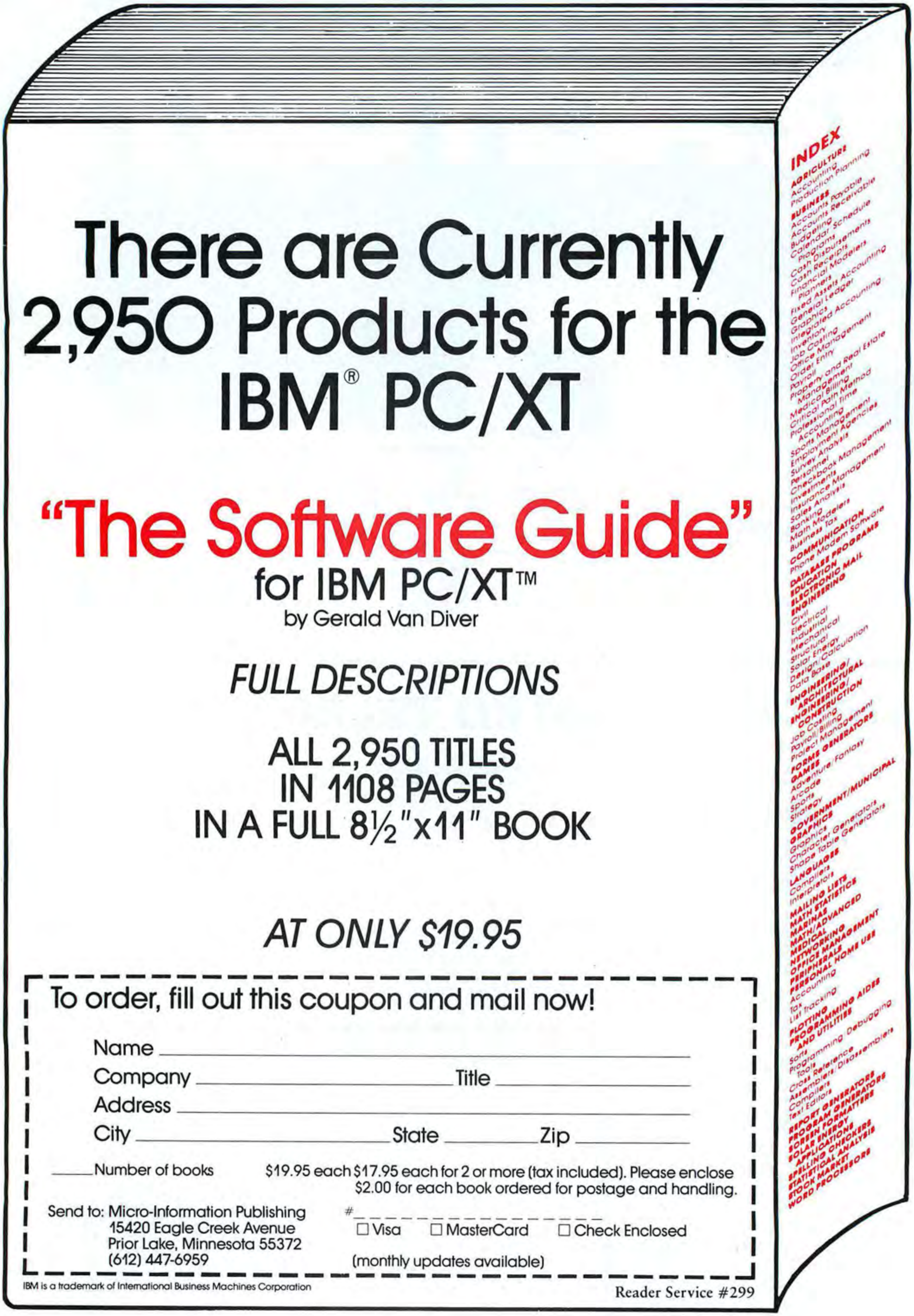
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SPELLING CHECKERS
STATISTICAL ANALYSIS
STOCK MARKET
WORD PROCESSORS

Typeset It Yourself

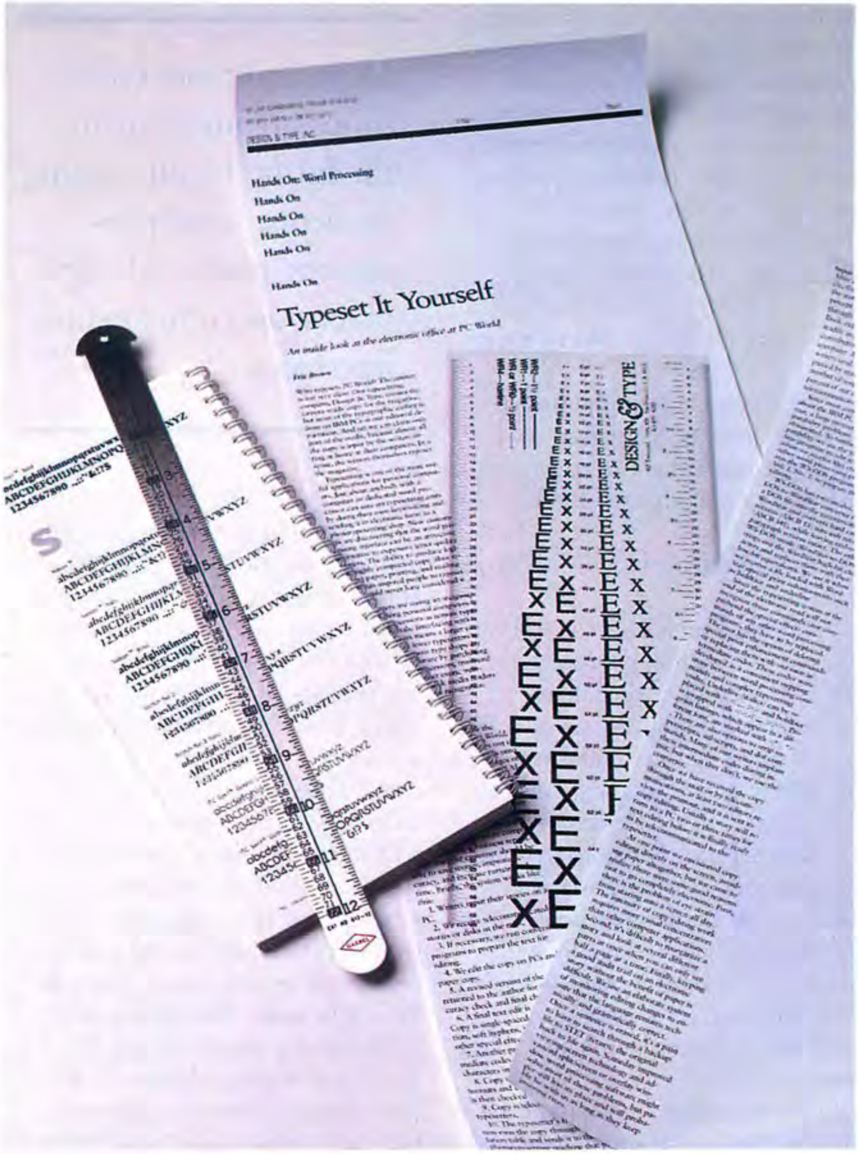
An inside look at PC World's electronic office

Eric Brown

Who typesets *PC World?* The answer is not very clear. Our typesetting company, Design & Type, creates the camera-ready copy for the magazine, but most of the typographic coding is done on IBM PCs in our editorial department. And yet we can claim only part of the credit, because almost all the copy is input by the writers sitting at home at their computers. In a sense, the writers themselves typeset the magazine.

Typesetting is one of the more useful applications for personal computers. Just about anybody with a computer or dedicated word processor can save on typesetting costs by doing their own keystroking and sending it in electronic form to a phototypesetting shop. New customers are discovering that the word processing interface can be an attractive alternative to expensive letter quality printers. The ability to produce legible, highly compacted copy (thus reducing paper, printing, and mailing costs) has inspired people to typeset who would never have considered it before.

Typesetters are seeing an increase in clients using personal computers and word processors as remote typesetting terminals. Interfacing with word processors means a larger customer base and fewer typesetters to pay. More and more type shops are investing in the future by purchasing



modems, word processors, front-end computers, and other exotic interfaces such as multidisk media readers and optical character recognition (OCR) scanners.

The PC World Story

The following describes how the electronic office works at *PC World*, from the moment an idea pops out of a distant writer's head onto the PC keyboard to the final stages of pasting down camera-ready copy. Although this article should be helpful to anyone contemplating typesetting, each job is unique, depending on the method of interface, hardware, software, and the product to be typeset. Typesetting a monthly computer magazine tends to be more complex than typesetting a business report. Either way, the customer should be able to save money, improve accuracy, and increase turnaround time. Briefly, the system works like this:

1. Writers input their stories on a PC.
2. We receive telecommunicated stories or disks in the mail.
3. If necessary, we run conversion programs to prepare the text for editing.
4. We edit the copy on PCs and on paper copy.
5. A revised version of the story is returned to the author for an accuracy check and final changes.
6. A final text edit is done on a PC. Copy is single-spaced, and justification, soft hyphens, indents, tabs, and other special effects are removed.
7. Another program converts intermediate codes and untranslatable characters into typesetting code.
8. Copy is coded manually with formats and compositional codes and is then checked for length.
9. Copy is telecommunicated to the typesetters.
10. The typesetter's front-end system runs the copy through its translation table and sends it to the phototypesetting machine that produces camera-ready copy.

Input and Edit

After an author has written an article, there are a variety of ways to get the story to *PC World*. Roughly 10 percent of our material still comes in through the mail in manuscript form. Book excerpts, for instance, are not readily available on disk, and some contributors don't have access to a computer. Another 65 percent of our writers send disks (or disks accompanied by manuscripts). A growing number of writers use modems; 25 percent of our copy is telecommunicated.

Since most contributors writing about the IBM PC have access to one, a large measure of our compatibility problems were immediately eliminated. To further increase compatibility we use the popular *WordStar* program to edit text. However, when we receive files created on another word processing program, we run the WS-DOS program (see *.*, Vol. 1, No. 1) to prepare the text for editing.

> More and more type shops are investing in the future by purchasing modems, word processors, front-end computers, and other exotic interfaces.

WS-DOS has two modes. The DOS-to-*WordStar* converter initiates a DOS file into the eccentricities of *WordStar* and converts hard carriage returns (ASCII 13) into soft returns (ASCII 141), while leaving end-of-paragraph returns intact. The other WS-DOS mode (*WordStar*-to-DOS) strips out the *WordStar* high-bit characters and replaces them with their low-bit equivalents. We use it when we receive a file loaded with *WordStar* special print enhancements such as boldface and underline.

Since the typesetting system at the end of the electronic road will not recognize these commands (nor comprehend the special effects commands of any other word processing program), they have to be replaced. The user has the option of deleting special print enhancement commands or replacing them with our own intermediate codes. These codes were developed as a convenient stepping stone between word processing commands and complex typesetting codes. Underline (italics) can be replaced with << ... >> and boldface is swapped with <<< ... >>>. Program listings, which appear in a different font, are marked with <* ... *> . There are also options to strip superscripts, subscripts, and dot commands. Many of our writers implant these intermediate codes during input, but when they don't, we use the converter.

Once we have received the copy through the mail or by telecommunications, at least two editors review the printout, and it is sent to copy editing. Usually a story will return to a PC two or three times for text editing before it is finally ready to be telecommunicated to the typesetter.

At one point we envisioned copy editing directly on the screen, avoiding paper altogether, but we came to realize there were some good reasons not to go completely electronic. First, there is the problem of eye strain from staring into a screen all day. The intensity of copy editing work requires more visual concentration than other computer applications. Second, it's difficult to reorganize a story and look at several different parts at once when you can only see half a page at a time. Finally, keeping a good audit trail on an electronic story without the benefit of paper is difficult. We use an elaborate system of monitoring editing changes to ensure that the language remains technically and gramatically correct. Once a sentence is erased, it's a pain to have to search through a backup

PC Char	ASCII	Formats & Mnemonic Code
#	35	$NO
+	43	$PL
<	60	$NL
=	61	$EQ
>	62	$NM
@	64	$AF
\	92	<UF41>
^	94	<UF40>
`	96	<UF42>
{	123	$BL
¦	124	<UF47>
}	125	$BR
~	126	$NC

Figure 1: Zap Character Conversions

file to STET (return) the original back to life again. Someday improved viewing-screen technology and advanced split/screen or overlay/window word processing software might solve most of these problems, but paper still has its place and will probably be with us as long as they keep growing trees.

The ZAP Converter

After the final edit we run the electronic copy through a custom conversion program called ZAP (see Figure 1). This tailor-made converter prepares the copy to be read by the typesetter's front-end computer. Originally, the program was meant only to replace our intermediate codes with those used by the typesetters, but then we found that many of the ASCII characters used by the PC keyboard would not translate correctly through the typesetter's software.

We discovered this by telecommunicating a test file consisting of every character available on the PC keyboard alongside its ASCII equivalent. Although all our letters and numbers made it through, about 15 characters didn't translate or were assigned to another character. Although most of these are special symbols that most people don't need, *PC World* uses just about all of them in program listings and even in text.

The problem of variable ASCII assignations is not confined to our particular typesetter. Every typesetting manufacturer and type shop has to make tough decisions as to what characters they will match to the 256 ASCII values available to them. Some might concentrate on mathematical symbols; others might want to include a wide range of foreign language characters. Inevitably, certain characters must be sacrificed. It is generally a good idea to run a character test with several prospective interfacing typesetters before you make your final decision.

Just because your keystrokes don't translate instantly to your typesetter doesn't mean you can't access them. Most shops have special fonts that contain characters that can be accessed through mnemonic codes, short codes with letters that resemble the function or symbol they imitate. Most interface customers are required to implant these codes in their word processing files manually. However, with the volume of copy that *PC World* generates, we'd have to hire an army of full-time coders to handle the job.

To alleviate this burden we wrote a conversion program to access the special characters we needed. And so the ZAP program grew larger, taking on the new chore of replacing our unacceptable keystrokes with mnemonic codes.

There was only one character that wasn't available from the typesetters, the divided vertical bar found at the lower-left corner of the PC keyboard. We considered drawing in the vertical bar in the art department, but when we heard that this symbol would be used frequently in DOS 2.00, we had the typesetters create one for us. They electronically stretched a colon until it could imitate the real thing.

At that point we thought we were done creating the ZAP program, but as the weeks went by, new difficulties began popping up on the galleys. One such problem was that the typesetter's software would not allow a format call to be followed by a space.

This would cause the following space to disappear. So the now burgeoning ZAP program was instructed to search for any situation of a space following a format call and put the space inside the format.

Another problem existed with single quotes. The typesetter's front-end system would not accept the PC's open single quote character. After some testing, however, we discovered that the typesetter's system would automatically change a closed single quote into an open one if there was a space preceding it. It became necessary to instruct ZAP to replace all open single quotes with closed single quotes so that the typesetting software could change them back again.

Some of these problems have since been solved by the typesetters reprogramming their front-end system's software. However, it's usually easier for us to solve the problem on ZAP. It is often a matter of our software meeting their software halfway.

The ZAP program is still in transition. Little problems arise from time to time. Although other interface jobs might require fewer replacements and modifications than are listed on ZAP, certain conversions will always be necessary. Without ZAP the amount of time it would take us to search and replace all the untranslatable characters and nasty situations would be prohibitive.

Indeed, a common method is to leave this sort of trench work to the typographers. Most type shops that cater to telecommunications usually have the technical personnel to deal with these problems. We could have asked our typesetters to write the conversion program for us, but doing it ourselves was faster and cheaper.

Format Code	Result
<UF1>	Running head
<UF2>	Title
<UF3>	Subtitle
<UF4>	By-line
<UF5>	Bold subhead

Compositional Code	Result
<cfsai>	Change font to Sabon italic
<cp8.5>	Change point size to 8.5
<cl12>	Change leading to 12 points
<cc20>	Change column to 20 picas
<el12>	Extra leading of 12 points
<rv24>	Reverse leading 24 points

Figure 2: Sample Typographical Code

Coding Is Our Life

When we first met with the typesetters, they explained that it was up to us how much work we wanted to take upon ourselves. They could provide different levels of service, from handling all the coding themselves to training us to be full-fledged typesetters. We decided on a level of service somewhere in between, although closer to taking on the role of a typesetter.

Doing your own coding can backfire if you attempt too much. Although interfacing can provide a cost savings of 30 percent or more, a series of coding blunders could cost more than if you typeset conventionally. The trick has been to handle as much as possible ourselves without taking on so much responsibility that we risk making costly errors. If you want to take on more of the coding work, you need a type company willing to teach you the fundamentals of typography. One of the keys to our success is that each side is willing to admit its ignorance of the technology of the other.

After the ZAP program has done its best, we enter the file a final time to code the story manually. For most standard story categories the typesetters have provided us with formats, macro codes (usually 6 characters long) that replace strings of compositional code from 12 to 1200 characters in length (see Figure 2). We have more than 80 of these formats to keep track of and to place, and yet not even these cover every possible contingency in the magazine. We have also learned some of the more specific compositional codes to augment or replace formats in rare situations.

Although most font changes and mnemonics have already been handled by ZAP, we manually insert code for the various pica widths, heads, line-for-line material and other spec changes such as captions, pull quotes, and reference material (see Figure 3). To save time on our end we use Advanced Software Interface's *Keynote* program (see Burton Alperson's "The PC in a New Key," *PC World*, Vol. 1, No. 1) to assign many of the more common formats and compositional strings to one or two keystrokes.

Developing the formats and code sequences has been an ongoing process punctuated with tests, meetings, and many phone calls. Although most of our formats were written during the first several weeks of production, new specs keep cropping up. If we plan to use the new specs again, the typesetters write new formats and we add them to our thick notebook of mark-ups.

Some situations are so complex that we leave the coding to our typesetters. During the log-on sequence before telecommunicating we usually send our file straight to composition, not to be viewed by human eyes until it pops out the other end as camera-ready copy. However, if we are unsure of our coding, or if we're so completely befuddled that we have to send uncoded keystrokes for the typesetters to encode, we have the option of sending the copy to be viewed and edited on a typesetting terminal. Sometimes we code as much as we can and then mark the trouble spots for the typesetters to fix. Other times we send over hard copy for the typesetter's reference. It is a flexible system.

Although we telecommunicate about 95 percent of the magazine, there is always some copy that has to be set conventionally from manuscript, such as tables and figures with tabular material. Most typesetting systems will not recognize more than one word processing space. Tabs and indents must be formatted or they disappear, and it's extremely difficult to figure the space necessary to line up tabular material.

Telecommunications

Every afternoon we telecommunicate our zapped and coded stories across town to the type shop. We use the *PC-Talk.III* communications program, a Hayes 1200 Smartmodem, and a PC equipped with an AST ComboCard. Other modems, software, and communications boards should accomplish the same result. We transfer at 1200 baud, space parity, 7 data bits, and 1 stop bit. These parameters happen to be compatible to both our systems. Always coordinate your parameters with your typesetter before attempting any transmittals.

At the type shop the modem uploads the copy to the CCI front-end system or to a terminal for review. The CCI runs the copy through a translation table and performs such conversions as changing two hyphens into an em dash and replacing two carriage returns with a new indented paragraph. It makes line ending decisions according to a built-in dictionary and runs a slave program on the Merganthaler 202N phototypesetter to instruct it how to set the copy. After photocomposition, the copy runs through a processor and turns into the final product of a camera-ready galley.

> Always coordinate your parameters with your typesetter before attempting any transmittals.

The galleys are then sent to the art department at *PC World*. Normally the galley is ready for paste-up the first time (due in part to the increased accuracy of keyboarding and proofing our copy before it is telecommunicated), but sometimes lines or paragraphs need to be reset. This is called the AC (author's correction) cycle.

The standard method is to send these marked-up galleys back to the typesetters and have them reopen the file, correct the errors, and reset the lines. Recently, we found that telecommunicating these corrections can often be less expensive than having the typesetter reopen the file and correct the galley conventionally. This usually involves the tedious chore of writing the problem sections out of a file, concatenating the pieces into a new file, and resending the corrected file. It is still cheaper than paying for the overhead, the messengers, and the cost of reopening an old file.

The Electronic Galley

We are only now beginning to explore a service called bidirectional communications. This process allows the typesetters to telecommunicate a file back to us after it has been prepared for typesetting. This "electronic galley" returns to us with the line lengths and line breaks clearly shown as well as with an indication of the pica depth of the story (how

```
180<mc>PRINT "yields this cursor:";<mc>

190<mc>Z$$EQINPUT$(1)<mc>

<el12><uf8>When you run this program, you will see that the
cursor remains as it was defined by the last LOCATE statement,
whether a program is running or not, until it is redefined. Entering

<ufl1>LOCATE ,,,12,13<mc>
for the monochrome display (or <uf48>LOCATE ,,,7 <mc>for the
color/graphics display) will return the cursor to normal. Or,
because BASIC redefines the cursor when loaded, you may exit
BASIC (with the SYSTEM command) and reload BASIC to normalize the
cursor.<ql>
<el24><cfsab><fi>Bad Vibes<fr><cfsa><ql>
<cfsai>Q.<em>Are cathode ray tubes (CRTs), the screens of video
display terminals (VDTs) and TVs, hazardous to our health?
```

Figure 3: Screendump of final coded text for this issue's "The Help Screen"

much vertical space the story will take up once it is typeset.)

At first we considered using bidirectional communications after every transmission, the idea being that we could help the art department in dummying the magazine by giving them an indication of the line breaks and pica lengths. Although the line break information could be helpful, the pica length is of no great help since we already report our copy length in house by checking the amount of K (kilobytes) found on the DOS disk directory (DIR) and converting it to pica length. Due to the volume and variety of articles we process, we realized that it was not worth the time and expense of telecommunicating every story three times. For larger jobs, however, such as long reports or books, this service might come in handy.

We did find one useful application for this service. Some of our copy, such as indexes and directories, changes little from month to month. Using bidirectional communications, the typesetters can send the latest version back to us. We can then make any additions and/or deletions to this running file and send it back the next month without having to reinput the majority of the codes.

Interfacing without a Modem

You don't necessarily have to telecommunicate to save money on typesetting bills. Some typesetters buy up every word processor and computer on the market so that they can be disk compatible with their customers. Others invest in media readers and multidisk converters that can handle almost every disk configuration on the market. These machines are expensive, however, and are at the mercy of a constantly changing hardware technology.

Another method of typesetting interface is the optical character recognition (OCR) machine, a device that scans a page of printed text and converts the characters into type. The current versions have limitations, however, one of which is the difficulty of scanning dot matrix type.

Whether these other interface methods catch on depends on the marketplace, and right now the marketplace points toward telecommunications—the main reason for this is compatibility. Whereas OCRs are dependent on legible hard copy and disk interface methods are plagued by a myriad of different disk sizes, drives, and sector configurations, telecommunications reduces all data to the same common denominator of ASCII conventions and serial transmission. As computer use spreads and modems drop in price more and more interface clients will send their text over the phone lines.

Telecommunications reduces all data to the same common denominator of ASCII conventions and serial transmission.

According to Lori Small, vice-president of Design & Type, "Customers are finding that the cost of a modem can be recovered through the potential savings of interfacing." Although Design & Type has concentrated on the telecommunications market, the company does use some of the other interface methods. Sometimes they find a customer whose disks are compatible with the Osborne and Victor 9000 computers they use in-house. Occasionally they send out conventional paper text jobs to an OCR service bureau that will scan, convert, and telecommunicate the copy back to them. Labor costs are so high that even buying access to an expensive OCR machine can be cheaper than rekeyboarding.

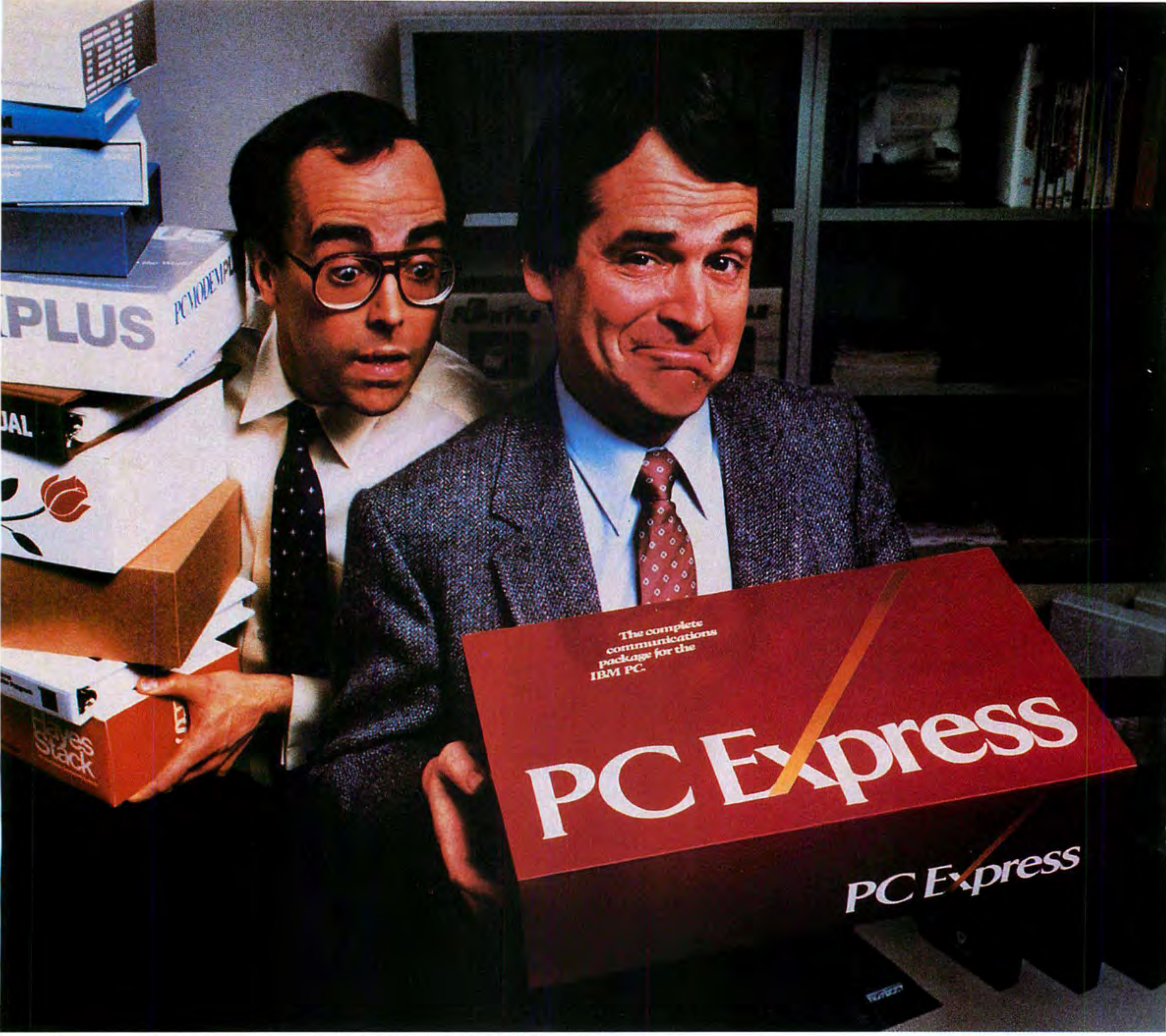
Future Experiments

Although the electronic system we use now has proven to be workable, we are still on the lookout for new processes. We are planning to install an unattended remote access host system so that writers can send files to us at any time, day or night.

We also plan to experiment with a local area network that will connect the editors' PCs to a multimegabyte hard disk data base. Files could be transmitted around the office and returned to the hard disk for storage and further access. Whether this will turn out to be much of an improvement over walking across the room with a disk remains to be seen. If nothing else, a local network might be useful for sending files to a remote printer. An editor could send one file to a high-speed dot matrix printer and the other to a letter quality printer without ever leaving the computer. He or she could then continue to edit another document without waiting for the printer to finish and not be bothered by the aggravating racket of a printer.

All these ideas and more are open to review as we further refine the system. Although advancing technology tends to outpace our understanding of when and how to use it, the only way to improve a system is to experiment. We will continue to report our success or lack of such during the course of experimentation. One thing seems to have been proven: it's cheaper, faster, and more accurate to typeset it yourself.

Eric Brown is Telecommunications Manager at PC World. *He is the author of* The Alvarez Trail, *a travel book on South America.*



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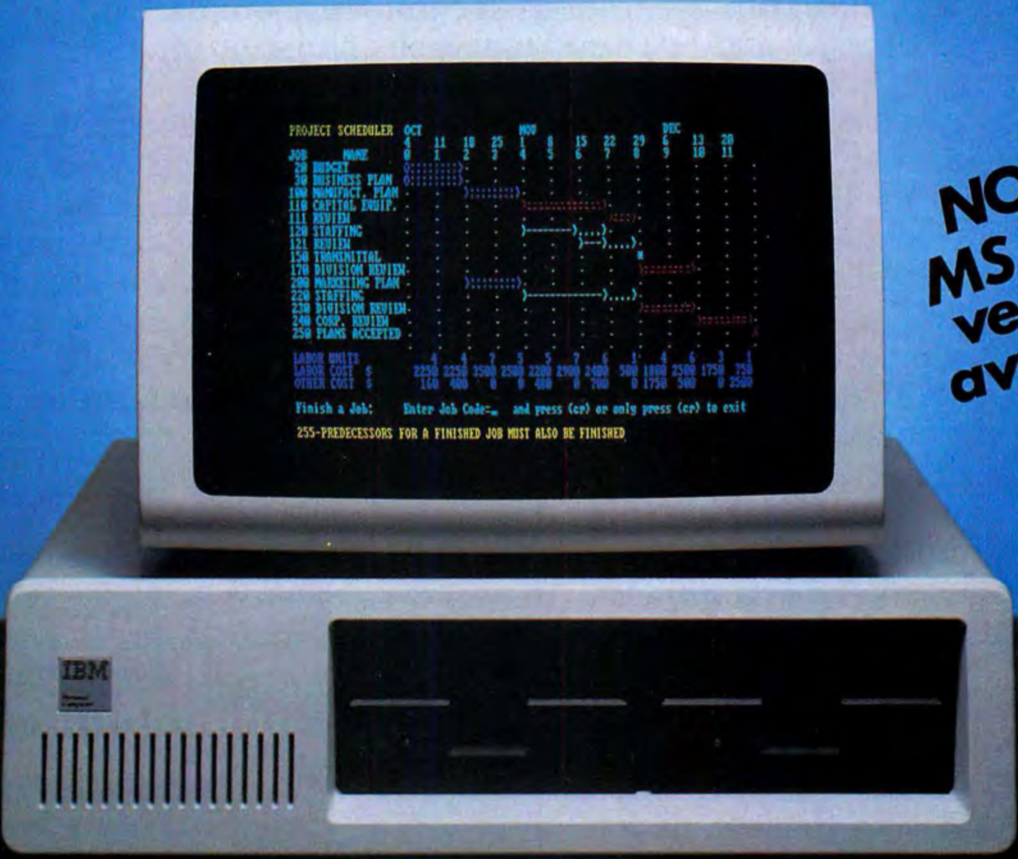

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Screen Shots

Taking distortion-free photos of the PC screen is easier than you think.

Alan J. Fridlund

It's often desirable to photograph images of the PC screen. You may want to make slides for a business talk or school presentation, or prints for documentation or publication. You don't need to be a professional photographer to make picture-perfect prints or slides in color or in black and white; this article will tell you about a way that's nearly error free.

You will need a few common pieces of photo equipment: a 35 mm camera that allows manual control of both lens aperture and shutter speed (most do); a long lens (one with at least a 100 mm focal length); and a tripod (either tabletop or floor mounting).

Setting Up

Secure the camera on the tripod facing the monitor. Try to make the optical axis exactly perpendicular to the faceplate of the monitor. This will ensure that the screen corners are equidistant from the lens so that perspective distortion will be minimized and focus will be sharp across the screen.

Use a lens with at least a 100 mm focal length. A standard 50 mm lens cannot be used because you will have to place the lens very close to the screen to get a full-screen image, and the result will be an image with barrel distortion. Barrel distortion means that straight lines at the screen edge look bowed out (see Figure 1).

A long lens eliminates barrel distortion (see Figure 2). The camera should be set at the distance necessary to focus on the image to be photographed (either a full-screen or partial-screen display). The longer the focal length of the lens, the farther the camera will have to be from the screen. With a 100 mm lens you will need to have the camera 3 to 5 feet from the monitor's faceplate. Focus the lens to get a sharp image of the display.

Some long lenses cannot be focused when placed close enough to the monitor to fill the entire frame. If your lens is too long, you have two options. You can obtain a +1 or +2 diopter close-up lens, which can be purchased for under $20 at a photography store. When screwed on the front of your long lens, the diopter lens allows the display to be brought into focus. Your second option is to buy a 2X converter, typically available for $30 to $40. This extender mounts between a 50 mm lens and the camera body, converting the 50 mm lens into one with a 100 mm effective focal length. A supplementary close-up lens can be used with the 2X and 50 mm lens combination if extra-close shots of portions of the screen are desired.

Setting the exposure can be tricky, but the PC allows a simple, nearly error-free method.

Short of buying a special screen graphics camera (see "Sharp Shooting with VideoSlide 35"), you'll get the best results with a 100 mm macro lens designed for flat-field, distortion-free images.

After you get the image in approximate focus, you can move the tripod closer to or farther away from the monitor to crop the image within the camera's field of view.

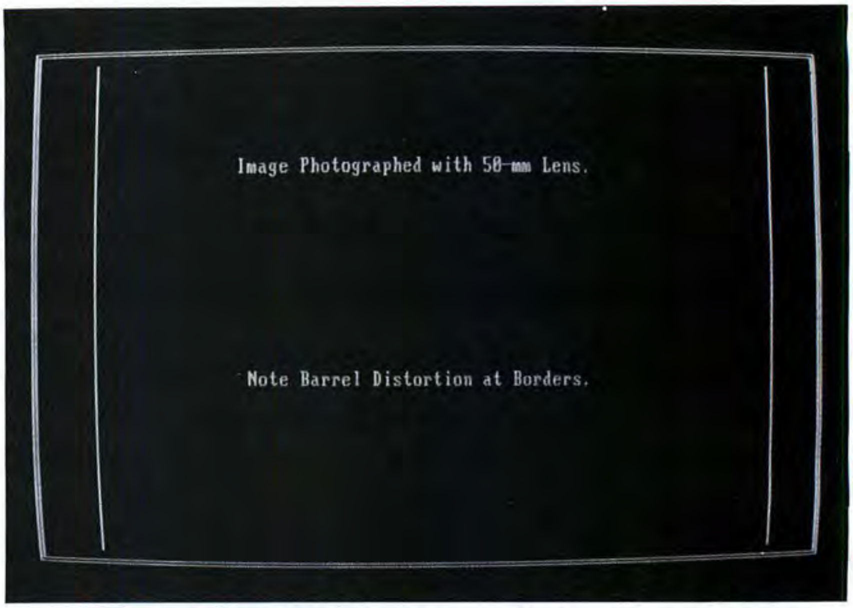


Figure 1: Photograph of IBM Monochrome Display taken with 50 mm lens showing barrel distortion (exposure: 4 seconds at f5.6, lens 18 inches from display)

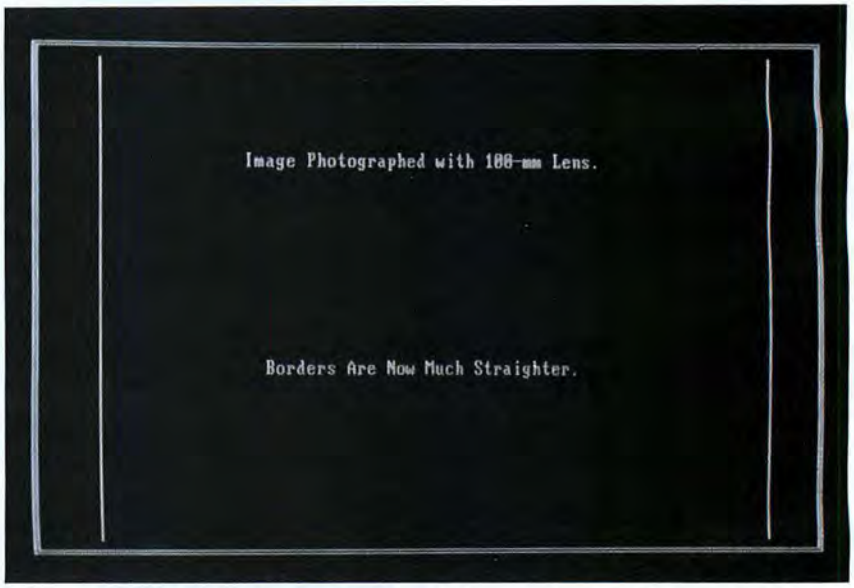


Figure 2: IBM Monochrome Display photographed with 100 mm lens showing correction of barrel distortion (exposure: 8 seconds at f3.5, lens approximately 4 feet from display)

Getting the Right Exposure

Setting the exposure can be tricky, but the PC allows a simple, nearly error-free method. The PC doesn't make the display image all at once. Like a standard TV, the image is scanned across the screen at least 30 times per second (only the retinal persistence of our eyes makes the image appear constant). Because of this, you can't use short exposure times for your photos; these may capture only a partially scanned image.

A simple rule of thumb is to use exposure times (shutter speeds) no shorter than 1/10 second. Ranges from 1/5 to 5 or even 10 seconds are better. For all of these extended exposure times, be sure to use a shutter cable

```
10 REM Program CALSCR.BAS - to establish calibration screen.
20 REM Alan J. Fridlund, 1983.
30 REM Clear screen and set width to 80 columns.
40 KEY OFF: CLS
50 WIDTH 80
60 REM Paint screen.
70 FOR ROW=2 to 23
80 REM Alternate normal- and high-intensity rows.
90 IF ROW MOD 2=0 THEN COLOR 7,0 ELSE COLOR 15,0
100 LOCATE ROW
110 FOR COLUMN = 1 TO 80
120 PRINT CHR$(202);
130 NEXT COLUMN
140 NEXT ROW
150 REM Depress space bar to re-establish cursor.
160 A$=INKEY$: IF A$ = " " THEN END ELSE GOTO 160
```

Listing 1

release or the camera's timer to trip the shutter. This will avoid jarring the camera and blurring the image on the film.

Now for a neat trick. Most exposure meters are averaging meters. This means the meter assumes that the scene it is measuring includes an average mixture of dark and light tones. If you were to set the exposure using a screen on which all pixels were illuminated, any shot of a typical display would look dark. On the other hand, setting exposure time based on a nearly dark screen might overexpose the film on a typical display. So, our task is to take a reading of the PC screen while it displays an image that approximates the average image the metering system assumes.

This process is simpler than you might think; we can easily paint the screen to achieve a calibration standard. The BASIC program (CALSCR.BAS) in Listing 1 will accomplish this. The effect of this program is to paint the screen with the ASCII character whose code is 202—a display that happens to occupy about the right area of screen space. The IBM Monochrome Display version should look like Figure 3. Notice that alternate rows are set for normal and high-intensity characters. This allows for displays that may be composed of a wide range of intensities and saturations. Color screens should be set using CALSCR.BAS to show alternating rows of normal and high-intensity white characters. Calibration of the camera should then hold for the palette of color and intensity options.

Shooting

Load the program in Listing 1 and adjust the PC display for a bright, clear image (avoid excessive brightness and consequent blooming of the image) If your camera has an automatic exposure mode, be sure it is turned off and that you are in the manual mode. Set an approximate shutter speed in the range specified previously and with the room lights out set the lens aperture to the setting indicated by your light meter. The camera will then be set accurately for any display. You may want to bracket the shooting of each image

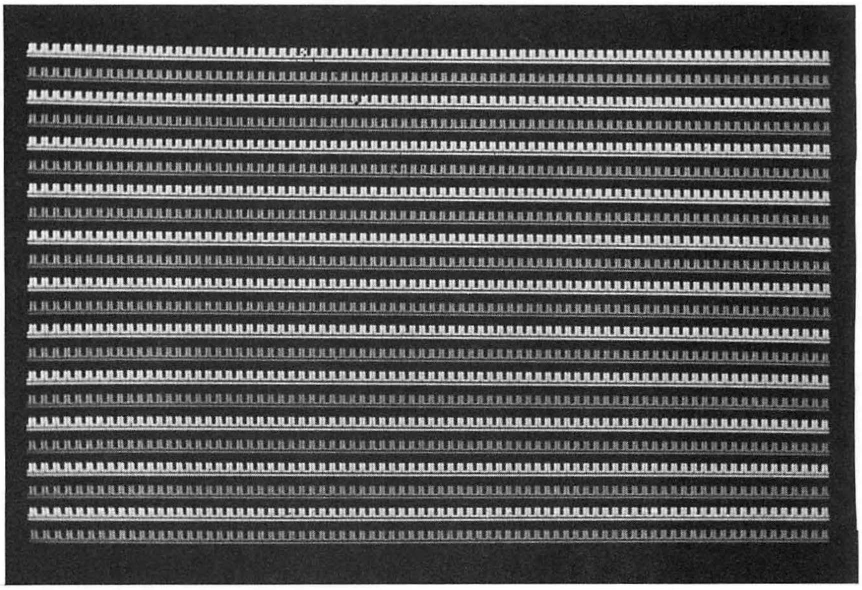


Figure 3: Photograph of screen created by program CALSCR.BAS (see Listing 1), used for calibrating camera exposure parameters (exposure: 100 mm lens, 8 seconds at f3.5, lens approximately 4 feet from display)

Sharp Shooting with VideoSlide 35

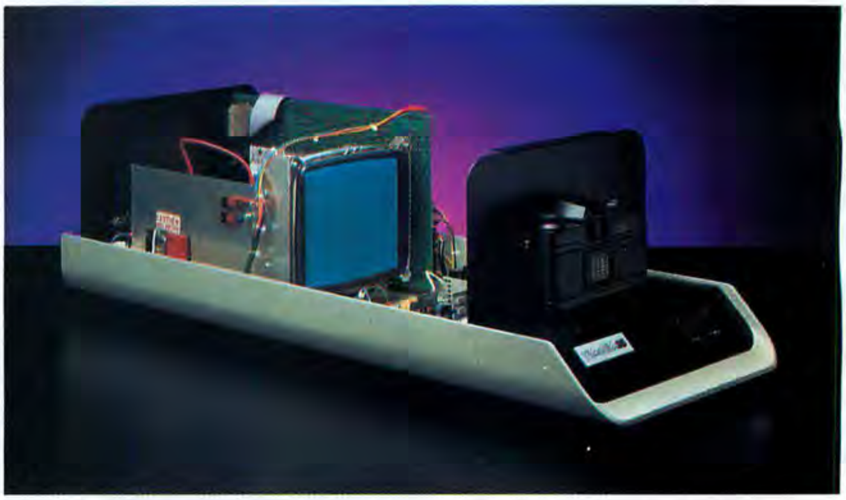
Cindy Hamburger

Packaged in an oblong cream-colored box and weighing a trim 31 pounds, the Lang VideoSlide 35 is a modern commodity: a gourmet gadget for computer and photographic connoisseurs. It is the most fashionable computer accessory since the invention of the executive light pen. An amateur can photograph screen images at the flick of a switch. Seasoned sharp shooters will enjoy the quality workmanship of the camera's design and consistently good results. And anyone who has had the loathsome assignment of photographing a CRT screen will appreciate the absence of cumbersome tripods, lighting, lenses, and exposure meters. Good-bye freelance photographers, messy studio spaces, and darkened rooms. Hello Lang!

The VideoSlide system is light and attractive, easily transportable, and well suited to the desktop. It is assembled and distributed in Menlo Park, California, by Lang Systems and comes complete with a camera, black-and-white monitor, and RGB interface. It is shipped in a packing case of blue styrofoam that one intuitively feels compelled to donate to the garbage collector, but it will occasionally be useful to protect your camera from bad weather and bumps.

Mounted on the front panel of the unit is a Yashica 35mm single-lens reflex camera. The camera is designed so that all functions can be accessed from the top, including motor-driven automatic advance and rewind. The f-stop has been preset by the manufacturer at f-4. For special lighting and exposure problems you can remove the cover of the unit and adjust the aperture.

Also under the lightproof cover (easily accessed by removing four screws) is a red, green, and blue color wheel located between the camera lens and a 7-inch black-and-white monitor. The wheel makes one full revolution for each exposure of the film. Separate exposures of the primary colors (red, blue, and green) are made of the image displayed on the black-and-white screen. You can control the shutter speed and hence the brilliance of your photos by three thumbwheel switches on the outside panel. Moving the thumbwheel one position changes the exposure by ½ f-stop. The flawless accuracy of this mechanism is enough to restore faith in disillusioned photographers who have come to accept their share of bad exposures. I find it difficult to make a bad exposure with the Lang.



A color monitor is not required to operate the Lang, but it is helpful for viewing the image you want to photograph. Lang provides an RGB interface and connector that adapts to any monitor. Simply disconnect the monitor from your system unit and reconnect it to the VideoSlide input terminal. Install the furnished male-female cable connector in the slot previously occupied by the monitor plug.

Realize that using a monitor is a convenience; in no way does it reflect the quality or color of the photos. Finally, if you look through the camera's viewfinder and see a dark, red image, you are ready to shoot.

The shortcomings of the Lang system are similar to those encountered photographing any TV monitor, though the manufacturer has put a lot of effort into minimizing the problems. The black-and-white picture tube is designed with a flat face surface to correct for parallax distortion, and there is little curvature on the final prints. In correcting this one problem, however, Lang seems to have created another. Very often a millimeter of text or graphics from the top of the screen gets cut off on the slide. If you are creating your own graphics, you may want to start low on the screen.

The dot patterns that produce text and graphics on the screen are cause for yet another photographic nightmare: out-of-focus pictures. Using a black-and-white monitor helps because the dots are smaller and closer together, producing a sharper picture than if a color monitor had been used, but even Lang hasn't found a suitable remedy for the fuzz produced by dot images. If all else fails, adjustments to vary the ratio of vertical to horizontal scanning lines are provided and do help clean up the print.

As Robert Frank once said upon hearing about the new hand-held, single-reflex camera, "You can photograph anything now." One last bit of advice for those who opt for this or a comparable camera on the market: don't attempt family portraits and you will undoubtedly have a successful career as a photographer of computer graphics.

VideoSlide 35
Lang Systems, Inc.
1010 O'Brien Dr.
Menlo Park, CA 94025
List Price: $2799

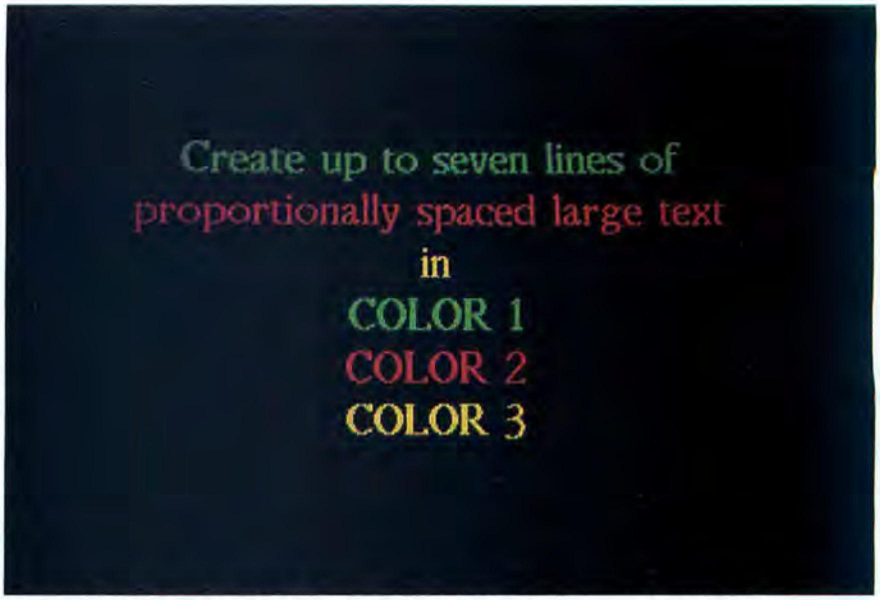


Figure 4: Color title slide made using PC-Title (copyright 1983, PC Solutions)

by also shooting the display at one f-stop above and one f-stop below the correct setting, just to be sure. All shooting should be performed with room lights out.

One complication might be that your camera indicates an exposure with a lens aperture wider than your lens permits. If this happens you have three alternatives. You can increase the display's brightness within its usable bloom-free range. You can increase exposure time (again, times up to 10 seconds are quite acceptable; remember to reset your camera's aperture using CALSCR.BAS). Or you can use a faster film.

Following these procedures should enable you to obtain good-quality prints or slides with a minimum of effort. The technique described here works well with either color or monochrome (green, amber, or black and white) displays.

Users of the IBM Monochrome Display will note a softness in the images they record on film. This is a result of the display's "high-persistence" phosphors which eliminate flicker but are prone to blooming (see Figures 1 to 3). The best pictures of the IBM Monochrome Display are obtained when the display is set at its minimum usable intensity. Other monochrome monitors or RGB color monitors produce sharper images. If you feel particularly adventurous, you can experiment with color filters, gratings, and other accessories to enhance your display shots.

Several companies have entered the market with software specifically designed to produce camera-ready titles and displays in several colors and print fonts. *PC-Title* is an exemplary program (PC Solutions, 620 Hobart Terrace, Santa Clara, CA 95051) that produces letters in a range of fonts and foreground and background colors (see Figure 4). This type of program can reduce the time and money needed to produce handsome lettered graphics for professional publication and presentation.

Alan J. Fridlund is a psychophysiologist who is developing a system that uses the PC to assess brain function. Screen photography is an important part of his work.

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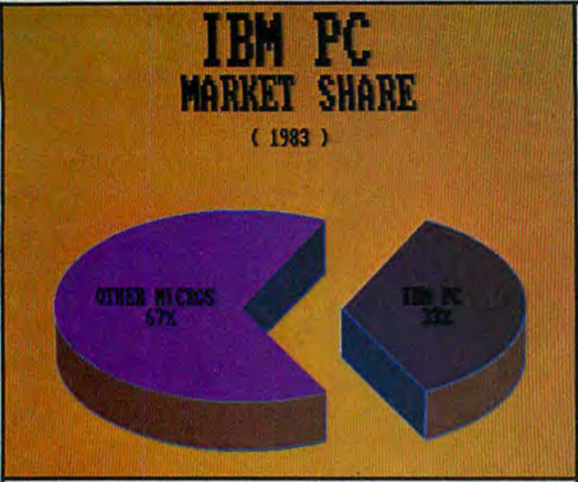

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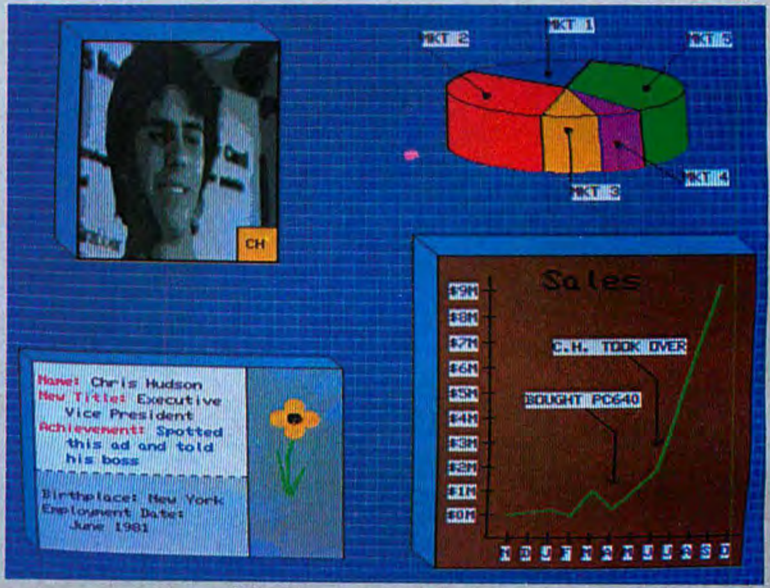

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Reader Service #120

The GIGO Eliminator

Some practical tips for avoiding mistakes and mismatches in computer communications

Alfred Glossbrenner

This guide to communications troubleshooting is excerpted from the Complete Handbook of Personal Computer Communications, *recently published by St. Martin's Press.*

GIGO (*guy-go*) is an old term that stands for "garbage in/garbage out," and while it doesn't apply precisely to data communications, there may be times when you will see garbage on your screen. There may also be times when incoming data does not appear in the desired format, and there may be times when two machines coupled by a crossover, or null modem, cable will apparently refuse to communicate. The GIGO Eliminator is designed to help you quickly identify and correct any of these problems.

Most of the time your communication with data bases and on-line services will be problem free, as long as you are careful to set your system to the baud rate, parity, word length, and other protocols a given system requires. If you do experience problems, the chances are that they are the fault of either the data base's computers or of the packet-switching network you are using. In either case, there is nothing you can do about them.

Problems are much more likely to occur when you are trying to communicate with a friend or associate's computer, either over the telephone or through a direct connection. There are so many systems and so many software packages that it isn't possible to cover all of the variables. But it is possible to present the major ones and the "garbage" they generate.

If you are having problems communicating with another system, the first rule is: Don't overlook the obvious. Is your modem turned on? Is it even plugged in? Is your printer out of paper? Any of these obvious oversights can prevent your system from working properly. And each is much easier to solve than some of the more exquisitely complex possibilities.

So before you automatically assume that you have a real problem, run down the following checklist.

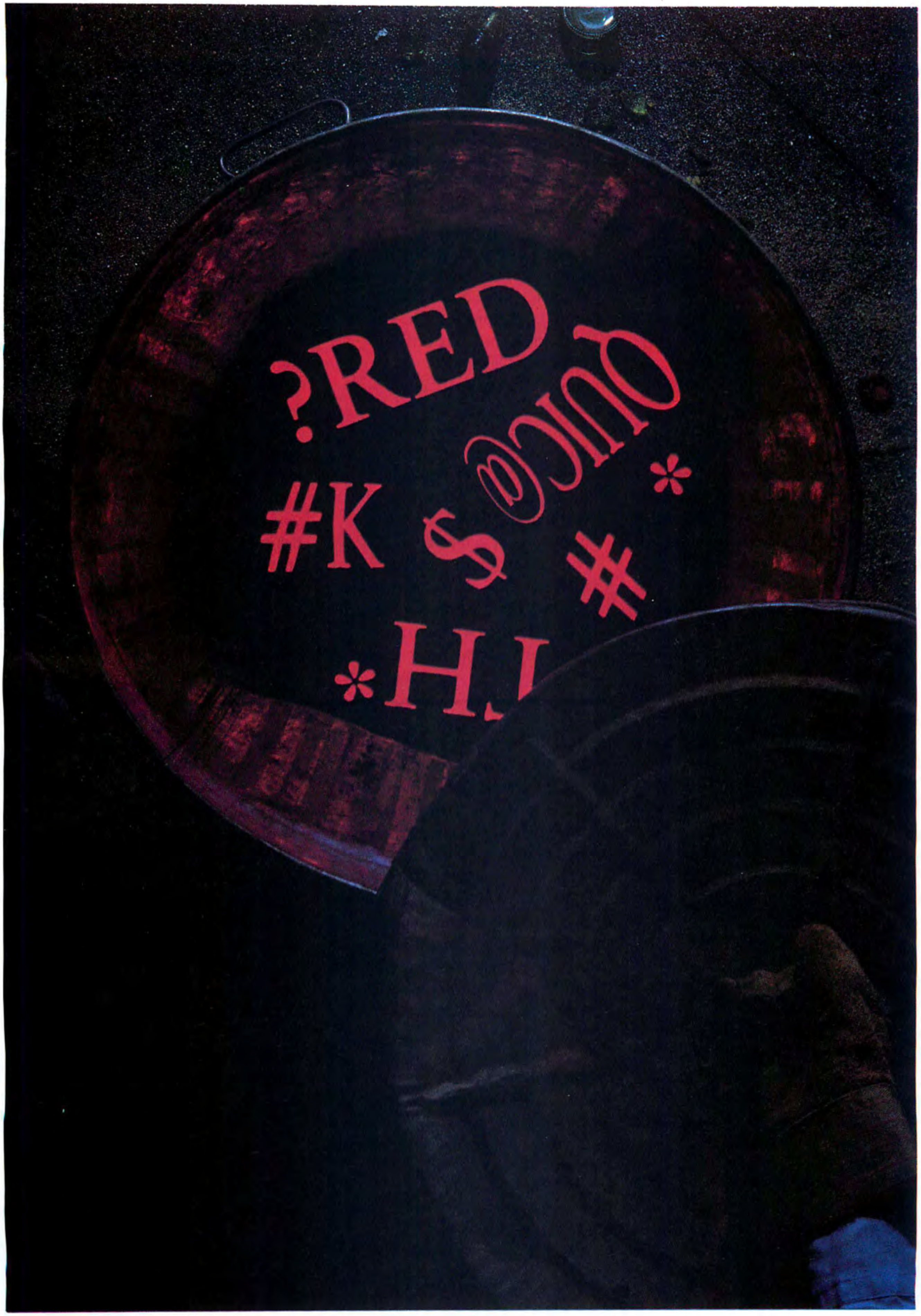
Troubleshooting Checklist

1. Are all cables securely inserted? In your system? In your modem? What about the cable from your modem to the phone jack?
2. Is one modem set to Originate and the other set to Answer?
3. Is the modem turned on?
4. Is the printer cable properly inserted? Is the printer physically on and in its on-line mode? Does it have enough paper?
5. Have you loaded a particular translation table and forgotten that it is in the system?
6. If you are directly connecting two systems, did you remember to use a crossover, or null modem, cable? Does the printout of the other system match that of your own system? Are you sure that each system is receiving a 'Clear to Send' and a 'Data Set Ready' signal? If not, you may have to do a little rewiring of the cable.

If you can answer yes to each of these questions and you still have a problem, go on to the next part of this section and see if you can find an example of what you are seeing on your screen. It's important to be aware, however, that if you do not proceed methodically, you will end up in a labyrinth of communications parameters. This is why we suggest following a few simple rules.

Rules of the Game

1. Write down the communications parameters both you and your correspondent are currently using.
2. Leave plenty of room on the paper for notes on what happens when, such as "when at even parity, this happens...."
3. Hold one system constant. If possible, talk to the other person on the phone and try to get both systems set to the same parameters.
4. Be methodical. Try one setting and make a note of what happens. Then try the next setting, and make a note, and so on.
5. Be patient. There is no substitute for this ancient virtue when trying to beat two systems into perfect communication. When you feel yourself getting frustrated, take a break.


?RED
#K

Communications Problems and Solutions

In each of the following problems, we will assume that the same test sentence is being used either by you or by your correspondent. That sentence is the classical example that includes every letter of the alphabet:

THE QUICK RED FOX JUMPS OVER THE LAZY BROWN DOG.

Problem 1

Your correspondent sends you the test sentence and it appears on your screen like this:

x*xx@<xxxx'xxxx

Your system is probably set at 1200 baud and the other system is set at 300. Make the change and have him retransmit. Generally, any time either of you get garbage characters like this, it is because the two baud rates do not match. This is true regardless of what specific rates are involved.

Problem 2

You send or receive the test sentence and either of you sees some of the correct characters intermingled with garbage characters, like this:

TH* *QUIC@##K$?RED

The problem probably lies with the parity setting. Make sure that you are both using odd, even, or no parity. If you use no parity, be sure to set your word length to eight instead of seven.

Problem 3

Your correspondent sends you the test sentence and any of the following happen:

- Your screen goes blank except for the blinking cursor.
- Question marks separated by spaces appear randomly like this:

```
  ? ?
            ?          ?
                ?
```

- A few of the letters appear but are widely separated on several lines all across the screen and intermingled with block graphic characters. (In the example below, # stands for an undefined graphic character.)

```
  H      #      U##      K#
D#             #     S#
```

This is probably a word length or character length problem. Have your correspondent verify his word length setting (7 or 8 bits) and make sure that the two systems match.

Problem 4

If you are having difficulty communicating at 1200 baud, try the following settings or various combinations thereof:

Baud: 1200
Parity: no parity
Word length: 8
Stop bits: 1 or 2

Different software and systems have different requirements. So in some cases, simply setting your system to 1200 baud and using the standard settings for the other parameters may work quite well. In other cases you may have to fiddle a bit. Sending and receiving files directly from disk at 1200 baud can also cause problems if you don't make some adjustments. The problem has to do with each computer's internal clock speed, but the technicalities need not concern us here. The point to remember is that a given computer may not be fast enough to send and display data at 1200 baud. If you can, you should try to toggle off the video display or disable the echo setting—anything to keep the information from being displayed on a screen while it is being sent or received. If you don't do this, you may find that you are losing data during transmission.

On-Line Tips

1. If you find the sentences you receive from a data base or on-line service are wrapping around and being split up because they are too long for your screen width, or if you find that information is coming into your system in chunks containing more lines than your screen can accommodate, the problem may lie with the terminal specifications "on file" under your name with the particular service.

CompuServe, Dow Jones News/Retrieval, and the PARTI section of The Source, for example, all allow you to specify how many characters per line your screen can accommodate and how many lines per "page." You may have set these parameters long ago and forgotten about them, or you may never have set them in the first place. Check your manuals and call Customer Service to ask about this point.

2. To make a thorough test of the settings you should use when talking to another system, prepare and record a file containing the following:

THE QUICK RED FOX JUMPS OVER THE LAZY BROWN DOG.
the quick red fox jumps over the lazy brown dog.
1 2 3 4 5 6 7 8 9 10

Add any other characters you can generate from your keyboard. This file will thus contain every visible character you can generate. Use it as a test file, sending it to your correspondent after each change you make. When all the characters are received correctly, you will know that you've solved the problem.

Problem 5

If each line you send overwrites the previous line on your correspondent's screen or printer, one of two things must happen. Either he must set his system to generate an internal linefeed after receiving each carriage return (ENTER) from you, or you must send him a linefeed on each carriage return.

This is a function of the software, and most good programs automatically send a linefeed each time they send a carriage return code. If your software does not include this feature, and if you can't add a programming patch yourself, you will have to get new software.

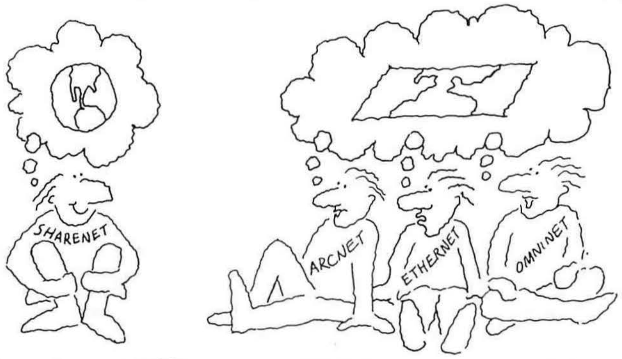
Too many linefeeds can also cause problems. For example, if your system is adding a linefeed each time it sees a carriage return, and if at the same time your correspondent is sending a linefeed on carriage return, you are going to have too many blank lines on your screen. The only solution is for one of you to stop sending an automatic linefeed on carriage return. And again, this is a function of the software. Check your manual to see how to disable this feature.

There is no getting around the fact that computer-to-computer communication is complex. But if you go at it methodically and are careful to take notes at each step, it is probably fair to say that any two computer or computerlike machines can be made to communicate successfully.

Alfred Glossbrenner is a writer and personal computer consultant who went on-line to write this book when he couldn't find the information anywhere else.

Reader Service #89

IN THE FLAT WORLD OF NETWORKING THERE IS A COLUMBUS.



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*3Com Corp. in *March Systems & Software*, pg. 118
**3Com Corp. in *March Systems & Software*, pg. 119

NOVELL

Making networks work.
Our VAST difference.

Reader Service #128

Reader Service #12

Go FORTH

A stack-oriented language for the PC that goes beyond BASIC

Michael Ham

FORTH, a programming language invented in the early '70s by Charles Moore, can give programmers an almost mystical way of communicating with their machines. Once you become accustomed to the power of FORTH and the ease with which it melts problems away, you will have difficulty returning to the crudities and pain of BASIC, where the language itself is part of the problem rather than the solution.

Why are some programmers so attracted to the FORTH language? The answer is in the way the language works. The basic unit of FORTH is the word, an operational entity that does one job, typically a simple job, whenever its name is invoked in a program. In other programming languages this type of entity is called a command. FORTH comes with a variety of predefined words, just as BASIC comes with a variety of predefined commands.

There is, however, an important difference. In FORTH new words are defined by combining previously defined words. If 1COM and 2COM are two FORTH words (whether already in the language or defined previously by the user), you can create a new FORTH word, NEW.WORD, in this way:

```
: NEW.WORD     1COM     2COM
```

When executed NEW.WORD will perform the operation of 1COM followed by the operation of 2COM, and NEW.WORD itself can be used in the definition of other words.

In another example, if you use a color monitor on your PC, you may prefer a display that uses green letters on a black background. Rather than attempt to remember the arbitrary color codes, you could define the FORTH words WHITE, RED, GREEN, BLUE, and YELLOW that would set the background to black and the characters to the color named. If you got tired of one color, a one-word command would reset the screen color.

Although FORTH words superficially resemble the subroutines of other languages, they are quite different, primarily due to the ease with which they are created and invoked. They are easy to define and once defined can be called up merely by using their names (just as for the primitive commands), so you can create words that do very specific jobs. FORTH is interactive, so new words can be tested on the spot, and because the words are simple, errors can be spotted quickly and fixed easily. In other languages subroutines are more cumbersome to define; they tend to have more functions in them that make them more difficult to test and debug. They are also more cumbersome to invoke; compare the FORTH command GREEN with BASIC's GOSUB 1175.

Another difference between words and subroutines is the way in which words may be used in different contexts: a word often becomes part of the definition of another new word, which in turn can be used in the definition of other words, and so on through many levels. Tracing nested subroutines through so many levels would be next to impossible, but each FORTH word is simple, so you can be confident that it will do its job reliably. Each step in a good FORTH program is a small step, and the writer (and reader) can readily verify its correctness.

> FORTH is interactive, so new words can be tested on the spot.

FORTH words are also self-contained. Each word does its own job and is not affected by the words around it. DO loops, IF...THEN statements, and BEGIN...UNTIL statements cannot straddle a word boundary; they must be contained within a word. The word is a little sphere that encloses its own activity.

Stack Work

FORTH words communicate using the stack. The stack is where words get input parameters and where they leave the results of their labors such as true/false flags, numeric results, and address locations.

Technically, the stack is a last-in, first-out (LIFO) structure implemented in software. As in a stack of plates in a cafeteria, the newest entry goes on top, and you can get to the entries beneath it only by removing what is on top of them. To help you move things around on the stack, FORTH provides a collection of words to be used in stack work: SWAP puts the second item on the stack onto the top (it swaps the top two items), ROT puts the third item of the stack on top (it rotates the stack), and DUP duplicates the top item on the stack, so that it becomes the top two items.

Besides the stack work words, FORTH provides words that bring items from memory to the stack (*fetch*, written as @) and a word that moves items from the stack to memory (*store*, written as !). FORTH also provides several ways to derive memory addresses from names. If you define LIMIT as a variable, for example, its job as a new FORTH word is to put its own address on the stack whenever its name is used. The sequence '23 LIMIT !' puts the number 23 at the address that LIMIT placed on the stack. The word NEW.LIMIT could be defined that would set the limit:

```
: NEW.LIMIT     LIMIT  !  ;
```

NEW.LIMIT is easy to test, and in a program it will operate in a clearly predictable way: if a number has been placed on the stack, NEW. LIMIT will set that number as the new limit by storing it in the variable LIMIT.

FORTH words must observe stack etiquette. When FORTH words are invoked and appear to do their jobs, they often expect to find certain items on the stack, and the program must contain earlier words that have left them there, in the correct order. When its work is done, a word may leave items on the stack for subsequent words to use, but the word is expected to tidy up after itself and leave the stack in the appropriate "after" condition.

If a word is supposed to leave one number on the stack, it must leave

```
Block 175 [16 :1]

( The following application moves the cursor, given on the stack
  the code number produced by the IBM PC's cursor-control keys.

  A few words of explanation:  CUR-POS is a byte array that,
  in MMSFORTH, holds a variety of cursor parameters:  the
  character used for the cursor, its location, etc.
  Position 0 of the array holds the current column number,
  position 1 the current row number.

  The FORTH word DUP duplicates the top number on the stack;
  C@ replaces the address on top of the stack with the byte at
  that address.  PTC places the cursor at the position given by
  the top two numbers on the stack:  column on top, row beneath.
  An equal compare replaces the top two numbers on the stack
  with a flag -- 1 for true or 0 for false.  IF removes and
  tests the flag; each IF must have a corresponding THEN.    )


Block 176 [17 :1]

( Bad definition )

: MOVE.CUR     DUP 167 = IF  0 0 PTC

  ELSE DUP 168 = IF CUR-POS 1+ C@ 1- DUP 0< IF DROP 24 THEN
       CUR-POS C@ PTC

  ELSE DUP 173 = IF CUR-POS 1+ C@ 1+ 25 MOD CUR-POS C@ PTC

  ELSE DUP 170 = IF CUR-POS 1+ C@ CUR-POS C@ 1- DUP 0<
       IF DROP 79 THEN PTC

  ELSE      171 = IF CUR-POS 1+ C@ CUR-POS C@ 1+ 80 MOD PTC

  THEN THEN THEN THEN THEN  ;
```

Listing 1

only that number. If it leaves even one extra number that no later word will use or discard, then this careless word could be invoked in a loop that might run a million iterations, building the stack up a million numbers high, enough to push through all the memory and destroy the program. So one important stack work word is DROP. As its name implies, it wipes out the top number on the stack.

In addition to the stack work words, FORTH comes with the usual collection of arithmetic words, logic words, and control words. Any words that you think the language should have can be added at any time. The words you add simply become part of your own version of the FORTH language.

Programming in FORTH

The object of programming, however, is not to learn or create languages, but to produce computer programs that accomplish specific tasks. Why is FORTH any better at this than other languages?

First consider that any computer program satisfies the definition of a FORTH word—it does only one thing, perhaps a complicated thing, but just one thing. *SuperCalc,* for example, does spreadsheets only. Of course, if you look at any program, you'll see that the one thing that it does is actually made up of specific subtasks. Each subtask does one part of the overall job. For example, one subtask might be to initialize arrays, the second to collect the data, the third to calculate the tables, and the fourth to print them. Each subtask could be thought of as a FORTH word, and the program itself as one word defined by using those four words.

Each subtask in turn consists of simpler subtasks, each with its own specific job. Collecting the data, for example, might involve four steps repeated for each datum: present a question, get the response, accept or reject the response according to certain edits, and update the arrays. Each of these could be a FORTH word.

After only a few such steps, you know exactly how to define one of these words in terms of previously defined FORTH words. So you can

```
Block 177 [18 :1]

( Better Definition          Screen 1 of 2)

: COL   CUR-POS C@ ;             : ROW   CUR-POS 1+ C@ ;

 ( The following words add a T/F flag to the stack: n -- n f )
: HOME.KEY?   DUP 167 = ;     : UP.KEY?   DUP 168 = ;
: LEFT.KEY?   DUP 170 = ;     : RT.KEY?   DUP 171 = ;
: DOWN.KEY?   DUP 173 = ;     : NEGATIVE?   DUP  0< ;

 ( The following words move the cursor, with wraparound.   )
: HM    0 0 PTC ;
: UP    ROW 1- NEGATIVE?  IF DROP 24 THEN  COL PTC ;
: RT    ROW COL 1+ 80 MOD PTC ;
: LT    ROW COL 1- NEGATIVE?  IF DROP 79 THEN  PTC ;
: DN    ROW 1+ 25 MOD COL PTC ;                         -->


Block 178 [19 :1]

( Better Definition         Screen 2 of 2)

: HOME?   HOME.KEY?  IF  HM  THEN ;
: UP?        UP.KEY?  IF  UP  THEN ;
: LEFT?   LEFT.KEY?  IF  LT  THEN ;
: RIGHT?     RT.KEY?  IF  RT  THEN ;
: DOWN?   DOWN.KEY?  IF  DN  THEN ;

: MOVE.CUR   HOME?  UP?  LEFT?  RIGHT?  DOWN?  DROP ;
```

define that word and use it as a command that can become part of other words.

A major part of any programming task is testing and debugging. As noted above, the words are easy to test because they are simple. Since FORTH is interactive, you can use a new word as soon as you define it: place the input items that the word expects on the stack, type in the name of the word (which causes it to execute), and then examine what it did (what it left on the stack, what values it stored in memory, and what it printed). FORTH lets you build and test programs one small step at a time. Each bigger word is composed

How to Go FORTH

The best way to understand and appreciate FORTH's power and attraction is to use it. The following are some suppliers of FORTH and FORTH-related materials.

The FORTH Interest Group (P.O. Box 1105, San Carlos, CA 94070) publishes a journal on various aspects of FORTH and its applications. In addition, the group provides some FORTH packages at a modest cost. The editor of the FORTH Interest Group newsletter, Leo Brodie, is also the author of an excellent introductory text, *Starting FORTH,* (Prentice-Hall, Englewood Cliffs, New Jersey, 1982).

Mountain View Press (P.O. Box 4656, Mountain View, CA 94040) publishes a wide variety of FORTH books and materials and also sells a FORTH package for the IBM PC. The package includes two supporting publications, Brodie's *Starting FORTH* and Mountain View Press' invaluable *All About FORTH,* all for $150. This version of FORTH, like the FORTH packages supplied by the FORTH Interest Group, are in the public domain, so you can readily share or sell programs you have written.

MMSFORTH is a powerful and fast FORTH for the IBM PC. It is published by Miller Microcomputer Services (61 Lake Shore Rd., Natick, MA 01760). MMSFORTH ($250) has many words especially defined for the PC that make it easy to take advantage of some of the PC's special capabilities.

All of the above FORTH packages are their own operating system. A different approach was used by Laboratory Microsystems (4147 Beethoven St., Los Angeles, CA 90066). Their version of FORTH, PC/FORTH ($100), operates under PC-DOS.

FORTH 32 from Quest Research, Inc. (P.O. Box 2553, Huntsville, AL 35804) runs under PC-DOS except for the video portions. It makes full use of IBM PC memory by using a 32-bit addressing system. For $200 a complete development system is provided including a 400-page self-teaching manual.

For people who learn better from an instructor than from a book, Inner Access Corporation (517-K Marine View Ave., Belmont, CA 94002) offers 5-day intensive workshops on FORTH fundamentals, FORTH tools and applications, and advanced FORTH.

of parts already tested and known to be correct; a program is built at each level on the solid foundation of the previous level.

When a new word is defined, FORTH compiles it on the spot. This feature allows immediate testing, and it means that FORTH programs run fast: they are compiled, not interpreted, and thus they are also compact.

Words are named and called by name, so you can pick names that make the program easy to read and easy to follow. Of course, FORTH code can be written that is unreadable. Block 176 in Listing 1 was written by a programmer who was still thinking in terms of traditional programming, trying to do the entire job in one long series of steps to be executed sequentially. One big word does the whole job.

However, it is also possible to write FORTH code that is easy to read. The second programmer tackled the job in better FORTH style by defining useful little words and naming them so that the program will be easy to read and maintain (see Block 177 and Block 178 in Listing 1).

No article can give you the feeling for FORTH that you will get by actually writing a few FORTH programs. There's a strange sensation that comes over you when you realize that you have written an entire program before you thought you were even started. It's like breaking a piece of china—it's in your hands and then, before you know what's happened, it's on the floor in tiny pieces. But the FORTH programming experience is the exact opposite: before you know what's happening, the tiny pieces come together to make a functioning whole. Get a FORTH package and write a few programs in FORTH. You may never go back to BASIC.

Michael Ham is an experienced programmer who is currently investigating microcomputer applications for educational support services.

Enjoy the RAMific

PDI464

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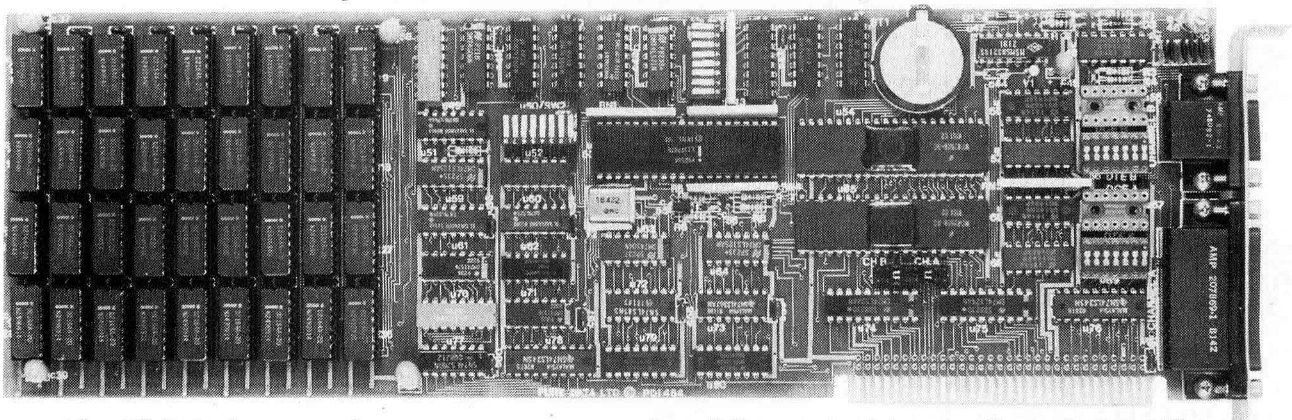

The PDI464 features six separate functions — expansion memory, two asynchronous serial channels, a real-time clock, a disk emulator, and a print spooler. Together with its high quality, the PDI464 offers a price-performance ratio that is tough to beat.

The memory section of the PDI464 provides up to 256KB of fully socketed expansion memory with parity generation and checking. Four memory sizes are available from 64 up to 256KB to meet a variety of needs. Regardless of memory size ordered, each PDI464 is tested with a full compliment of 256KB of memory to ensure trouble-free future expansion. Disk-based memory diagnostics are included which can test memory integrity and report problems down to the chip level.

Two asynchronous serial channels are provided which are completely compatible with IBM serial channels. Each channel can be selected to reside at one of four addresses to allow for future expansion. A unique feature is provided which allows simple selection of data terminal or data communication equipment [DTE/DCE] configurations, thus eliminating the need for special cables or null modems. Each channel comes complete with a 6 foot RS-232 cable.

The Real-Time Clock section features quartz-crystal control and lithium battery back-up to ensure years of trouble-free operation. The RTC features hours, minutes, seconds, day-of-the-week, date, month, and year with automatic leap year adjustment. Software is provided to initialize system time and date information automatically upon power-up.

p-Disk™, a disk-emulation package provided with the PDI464 allows memory to be treated as an ultra-fast disk drive. p-Disk™ can be configured as a single or double-sided drive and can appear as drive B, C, or D. p-Disk™ does not require modification or patching of the BIOS or DOS files on system diskettes and is fully compatible with IBM software and diagnostics.

A background printer spooler is included with the PDI464 which allows files to be printed on a printer while other software is being used in the foreground. The spooler offers features such as menu-selectable configuration, multiple copies, and upper case options.

Comprehensive documentation is provided with numerous illustrations to simplify installation procedures. All documentation fits neatly into existing 3-ring binders provided with the Personal Computer.

Each PDI464 is "burnt-in" at elevated temperatures and fully tested. Packaging material provides protection from static and mechanical shock during shipment to further ensure reliability. The PDI464 is covered by a one year limited warranty.

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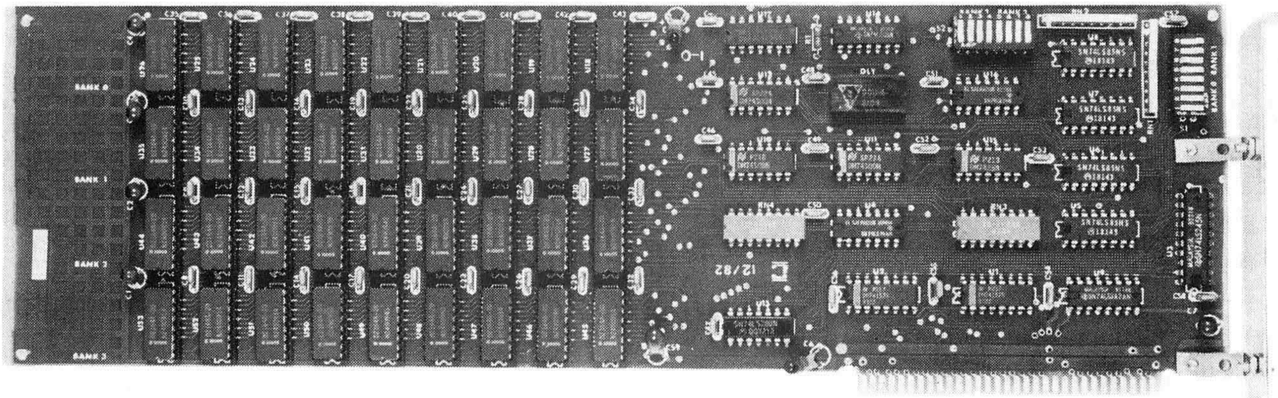

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One from Column A, One from Column B

Tom Sheldon

You can learn how to use some of DOS 2.00's new features while you build a simple but useful menu system. The extended batch and tree-structured directory features open the door to a whole new range of possibilities for utilities that you can create.

```
IBM PERSONAL COMPUTER MAIN MENU
DOS 2.0 OPERATING SYSTEM

 1. DISK STATUS [d:]
 2. SORT DIRECTORY IN ALPHABETICALLY [d:]
 3. SORT DIRECTORY BY DATE [d:]
 4. SORT DIRECTORY FOR GIVEN DATE [d: mm-dd-yy]
 5. LIST MAIL FILES
 6. READ MAIL [filename]
 7. WRITE MAIL
 8. DELETE MAIL [filename]
 9. FIND PHONE NUMBER [NAME]
10. ADD PHONE NUMBER
11. Available for applications program
12. EXIT MENU/RETURN CONTROL TO DOS
```

Figure 1: Screen Image of Main Menu

One of the most useful features of the latest version of IBM's operating system, DOS 2.00, is the extended batch file facility. The procedure outlined in this article shows how the batch facility can be combined with the new tree-structured directory to create a menu-driven system that will help organize message and phone list processing. DOS 2.00 is generally oriented toward a hard disk system such as the new IBM Personal Computer XT. The procedures described here, however, assume a system with dual floppy drives, since that is still the most common arrangement.

In general, the tree-structured directory system that is part of DOS 2.00 will be less useful to the person who uses a dual floppy system. This type of system is excellent for hard disk users, however, because it provides a means to group files stored on a disk. A root directory is the starting point from which several subdirectories are created. If several people are using the system, each user may store files in his or her own subdirectory. Applications programs and related data files could also be kept in separate directories.

The usefulness of the tree structure on a floppy-based system is limited. It's easier to keep track of different types of data and programs by simply using a different floppy disk for each application. A floppy disk may, however, be divided into several subdirectories if necessary. In creating the menu system described here, you will use one directory for programs and another for data files. All programs and data will be stored on the default drive (A).

A DOS Help Menu

If you've ever been confused or unimpressed by the simple system prompt (A>) that appears when you start your system, you'll appreciate the value of the following menu system. It is designed to make it easier to use the operating system. The objective is to create the screen shown in Figure 1. The menu system leaves enough room on the disk for one or more applications programs of your choice.

Hands On

Create the Menu Display

The first step in setting up the menu system is to "draw" the menu on the screen as you want it to appear and save the image as a text file. Figure 2 shows a chart of the graphics characters that can be used to create the menu. Also shown are the ASCII character codes used to represent the graphic characters.

You can use any text editor (e.g., the IBM *Personal Editor* or the *EDLIN* line editor that comes with DOS) to create the text file. Figure 1 contains the text file for the menu screen. The top line can be formed by using an Alt-201 character for the left corner bracket, the Alt-205 character for the double horizontal line, and the Alt-187 character for the upper-right corner. The double vertical lines are created by the Alt-186 character. Alt-204 is the left end of the fifth line, and Alt-185 is the right end. Alt-200 is the bottom-left corner, and the Alt-188 is the bottom-right corner.

ASCII Character Value			
179	│	199	╟
180	┤	200	╚
181	╡	201	╔
182	╢	202	╩
183	╖	203	╦
184	╕	204	╠
185	╣	205	═
186	║	206	╬
187	╗	207	╧
188	╝	208	╨
189	╜	209	╤
190	╛	210	╥
191	┐	211	╙
192	└	212	╘
193	┴	213	╒
194	┬	214	╓
195	├	215	╫
196	─	216	╪
197	┼	217	┘
198	╞	218	┌

Figure 2: Extended ASCII Graphics Characters

Metastring Command	Produces This Prompt
prompt $g	>
prompt $$	$
prompt $t (time)	3:51:47.29
prompt $d (date)	Tue 30183
prompt $p (current directory)	A:\MAIL
prompt ng (default drive & >)	A>
prompt tg (time & >)	3:55:23.58>
prompt d_tg (two line prompt)	Tue 3011983 3:58:34.30>
prompt WAITING$g	WAITING>

Figure 3: Metastrings in Prompt Command

A Batchwork Quilt

Format a new system disk and copy the following DOS 2.00 files onto it: CHKDSK.COM, EDLIN.COM, MORE.COM, TREE.COM, FIND.EXE, and SORT.EXE.

If you are using a hard disk system such as the XT, make a directory called MENU by typing `MD MENU`. MD means make directory. After creating MENU, move into the new directory by typing `CD MENU`. You may type in all of the following batch files as they are shown here, but you must substitute the command CD\MENU for CD\ wherever it occurs. Be sure you are in the MENU directory before proceeding.

Copy the MENU.SCR screen file from the scratch disk to your new DOS disk and create a subdirectory called MAIL. Type `MD MAIL` at the system prompt. The first batch file you should create is AUTOEXEC.BAT. This is the file that the system looks for and executes each time it starts up. Type in the commands as shown in Listing 1. Make sure you press F6 and ENTER at the end of the file. Do not type in the comments shown in parentheses.

This file needs some explanation. The command CD/MAIL moves to the directory called MAIL, which holds all the mail files as they are created. You can write notes to yourself or anyone else who uses the system by selecting number 7 from the menu. The line that reads 'if not exist *.mal' looks in the mail subdirectory to see if any mail files are present. If there is mail, processing continues with the next line, and the 'You have mail' message is displayed. If no mail files are found, processing jumps to the label :A which goes back to the directory that contains the menu and changes the prompt.

```
copy con:autoexec.bat

echo off
date
cls
type menu.scr
cd\mail
if not exist *.mal goto a
echo         YOU HAVE MAIL
:a
echo off
cd\
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 1

```
copy con:menu.bat

echo off
prompt ENTER SELECTION NUMBER [and criteria if required] $g
cls
type menu.scr
<F6>
```

Listing 2

```
copy con:1.bat

echo off
cls
echo USING THE STAT COMMAND
echo ----------------------
echo REQUIRED:  You MUST specify a drive; a colon is not required.
echo OPTIONAL:  Enter a file extension in CAPS to display particular files.
echo EXAMPLE:   stat a BAT would display the status of all batch files on A:

copy con:stat.bat

echo off
prompt $n$g
cls
echo STATUS OF DISK IN DRIVE %1
echo -------------------------
vol %1:
chkdsk %1:
pause
cls
echo TREE STRUCTURE FOR DISK IN DRIVE %1
echo ----------------------------------
echo NOTE: <Ctrl><NumLock> will stop scroll during this listing.
tree %1:
pause
cls
echo DIRECTORY LISTING FOR DISK IN DRIVE %1 WITH EXTENSION OF %2
echo -----------------------------------------------------------
dir %1:*.%2/P
pause
echo off
cls
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 3

Hands On

Prompting Change, Changing Prompts

The last line of the AUTOEXEC.BAT file contains the new prompt command included in DOS 2.00. PROMPT allows you to change the system prompt (normally A>) to anything you want. In this example, the prompt is a comment. Special "metastrings" can be embedded in the prompt command in the form *$c* where *c* is one of the strings listed in Figure 3.

To try the AUTOEXEC.BAT file, reboot the system and watch it go through its paces. The menu is displayed on the screen, and the new prompt appears at the bottom. The prompt can be changed back to A> (showing the default disk drive) by typing `PROMPT $n$g`. At this point you can create the batch file for selection 12 on the menu by typing the following commands. Then you can use it to stay out of trouble as you create the rest of the menu system.

```
copy con:12.bat
echo off
prompt $n$g
cls
<F6>
```

Now any strange prompts you create may be immediately returned to normal by typing 12. This batch file returns control to DOS and doesn't display a menu. You may want to see the menu again later, so you should create a batch file called MENU.BAT (see Listing 2) that will clear the screen and display the menu at any time.

Selection 1 on the menu will require two batch files. File 1.BAT will explain the use of the STAT.BAT batch file. The STAT.BAT file will run the CHKDSK (check disk) program on the designated drive, display the TREE structure, if any, and then display files with the specified extension. Listing 3 contains the commands that will create these two batch files.

Several familiar commands and some new ones are used in the STAT.BAT file. The VOL command simply displays the volume label of the disk, if any. TREE will display the tree structures of any subdirectories on the disk.

Run the file by typing `STAT A BAT`. The screen display should indicate that the disk contains a directory called MAIL and batch files called AUTOEXEC, 1, 12, and STAT.

```
copy con:5.bat

echo off
prompt $p$g
cls
cd\mail
path \
echo        CURRENT MAIL ON THIS DISK
for %%a in (*.mal) do find "SUBJECT" %%a
echo --------------END OF LIST--------------
echo To return to main menu:
pause
echo off
cls
cd\
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 4

```
copy con:6.bat

echo off
cls
prompt $p$g
cd\mail
dir %1.mal
more < %1.mal
pause
echo off
cls
cd\
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 5

Type the following commands to create the file for selection 2:

```
copy con:2.bat
echo off
prompt $n$g
cls
echo PLEASE WAIT
dir %1: ¦ sort >sort.dir
more < sort.dir
pause
echo off
cls
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

File 2.BAT uses a set of commands
DIR ¦ SORT >SORT.DIR
that sorts the directory and pipes the result into the file SORT.DIR. The MORE command then gets its data from SORT.DIR. MORE is a new DOS command that displays one full screen of information and waits until any key is pressed to display more. The MORE command is similar to TYPE, except that MORE causes the screen display to pause.

Note that you may choose either drive A or B. Typing B would execute the command for drive B. A space must be included after the B, but a trailing colon is not required. The selection 2 file can be edited to create files for selection 3 and selection 4. Simply copy the file A:2.BAT to A:3.BAT using the copy command. Then use EDLIN to go in and change line number 5. Add /+25 after the SORT command (as shown in the following set of commands) so that the sort will be based on the date column, which starts with the 25th character.

The following commands and computer responses will be displayed on the screen as you create the 3.BAT file.

```
copy 2.bat 3.bat
1 File(s) copied
edlin 3.bat
End of input file *5
5:*dir %1: ¦ sort > sort.dir
5:*dir %1: ¦ sort /+25 > sort.dir
*e
```

The selection 4 batch file is exactly like 2 and 3 except for line 5. Copy file 3.BAT to file 4.BAT and use EDLIN to change line 5 to
dir %1: ¦ find "%2" ¦ sort > sort.dir
The syntax for using this batch file command is '4 d:3-01-83'. Any drive or date may be specified.

Selection 5 is the first file in the MAIL section of the system. The file 5.BAT will move into the MAIL subdirectory and search for all files with the extension of MAL. It will search for a line of text containing the word SUBJECT in each file and display that line once it's found. When writing a mail file (selection 7), the user is prompted to type the word SUBJECT in uppercase letters on the first line of the file. This insures a proper match when the batch file searches for the word. The SUBJECT line will provide a brief summary of each file.

```
copy con:7.bat

echo off
prompt $n$g
cls
echo WRITE MAIL
echo ----------
echo REQUIRED:  The first line of every mail file must start with the
echo            word SUBJECT.  SUBJECT must be in all caps, and may
echo            be followed by a description of the file.
echo
echo TYPE:  "write filename" to begin.
<F6>


copy con:write.bat

echo off
cls
cd\mail
echo off
echo -----Press <F6> then <Enter> to end and save the file.-----
echo --------------------CURRENTLY WRITING FILE--------------------
COPY CON:%1.MAL
echo FILE WRITTEN TO DISK
cd\
echo off
cls
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 6

Listing 4 details the contents of the batch file for selection 5 (List Mail Files).

To let the user read mail in the mail files, file 6.BAT (see Listing 5) changes the prompt to display the current directory, then changes directories to mail, displays the directory entry for the specified mail file, and sends the file to the screen by way of the MORE command, one screenful at a time.

The file 7.BAT (Listing 6) contains the instructions for WRITE.BAT, the mail-writing routine. WRITE.BAT moves to the mail directory and opens a file with the specified name using the COPY command. It then returns to the main directory and displays the menu.

> PROMPT allows you to change the system prompt (normally A>) to anything you want.

Listing 7 is the 8.BAT file that provides a facility for deleting mail files once they've been read. It simply moves into the mail directory, deletes the specified file, and returns to the main directory and the menu system.

A Handy Phone Directory

Selections 9 and 10 combine to make up a simple phone list system. Names (in uppercase) and phone numbers may be entered in the phone list file in no particular order. When you need a number, the FIND command searches for the name and displays the number (see Listing 8).

The 10.BAT file (Listing 9) lets you append names and phone numbers to the phone list by opening the PHONE.LST file under the EDLIN line editor. You start adding names

```
copy con:8.bat

echo off
cls
cd\mail
erase %1.mal
echo FILE DELETED
cd\
echo off
cls
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 7

```
copy con:9.bat

echo off
cls
echo LOOKING IN PHONE LIST FOR: %1
find "%1" phone.lst
pause
echo off
cls
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 8

```
copy con:10.bat

echo off
cls
echo APPEND PHONE NUMBERS
echo --------------------
echo **PRESS THE CAPS LOCK KEY!**
echo off
echo INSTRUCTIONS: Type "L" to list the file.  Add 1 to the last line number
echo               and type the resulting number and "I" (for insert).
echo               Add all the names and numbers you want. Then press
echo               <Ctrl><Break> and "E" to end and save the file.
edlin phone.lst
echo PHONE NUMBER(S) APPENDED
echo off
cls
type menu.scr
prompt ENTER SELECTION NUMBER [and criteria if required] $g
<F6>
```

Listing 9

by giving the command insert text on the line just past the last entry in the file. The file then displays a message to confirm that the phone numbers have been added and returns to the menu.

10.BAT is the last of the files in the menu system. The system should now be ready to go if everything has been typed in correctly. You may add one or more applications programs, depending on available disk space. The batch files you've just created and the utility programs they require take up about 64K of disk space.

> The simple principles and sophisticated new DOS facilities described here can provide the basis for other customized menu systems you might want to create.

The menu system will be of varying usefulness depending on how you use your computer, but the simple principles and sophisticated new DOS facilities described here can provide the basis for other customized menu systems you might want to create. Use an editor to create a menu display. Include some graphic symbols to make the display more attractive. Then develop batch files using the extended batch facility of DOS 2.00 to carry out the commands listed on the menu. Experiment and enjoy.

Tom Sheldon is a technical consultant for ComputerLand stores in Santa Barbara and San Luis Obispo, California.

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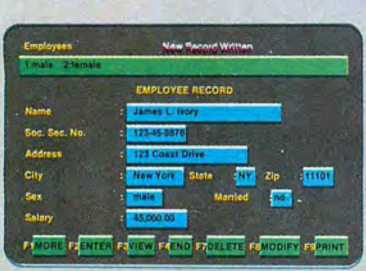

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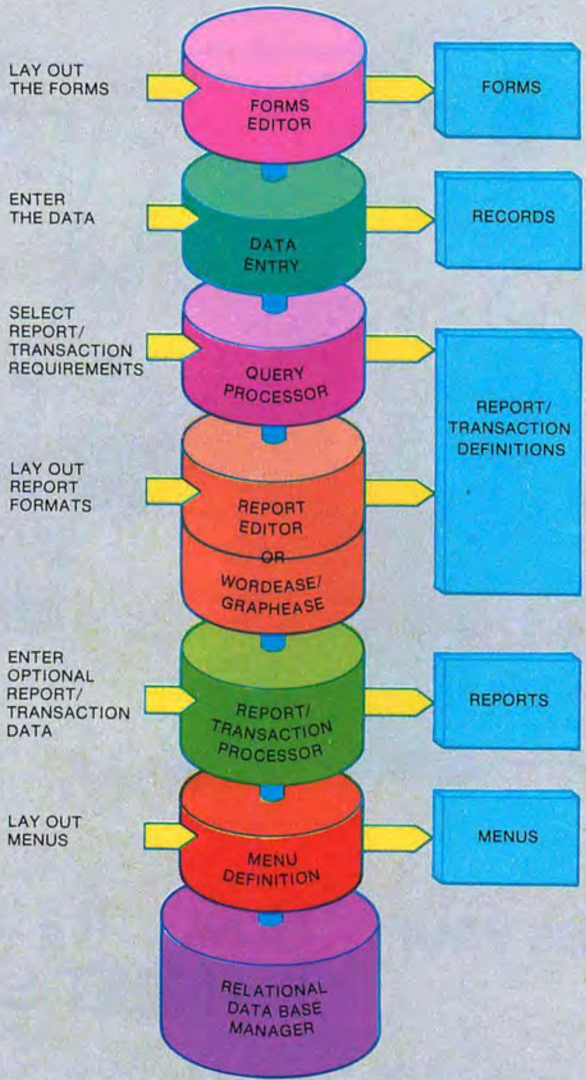

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Going to Bat with FORTRAN

An introductory look at the language and structure of FORTRAN 77

Robert Rouse and Thomas Bugnitz

The following excerpt is a chapter from Programming the IBM Personal Computer: FORTRAN 77 *(CBS College Publishing, New York, 1983). FORTRAN is a popular programming language often used by scientists and engineers. The most recent version of the language, FORTRAN 77, has greater character manipulation capabilities than previous versions.*

The book encourages programming by presenting problems and well-explained program solutions. It builds upon the information and in the final chapters describes advanced programming concepts and practices.

Chapter 2 "Structured FORTRAN 77 Style Guide," part of which is excerpted here, takes a simple example and develops it through a number of evolutionary steps or versions. The problem is to analyze a set of baseball statistics and present the results. The basic data includes a player's batting record, name, and number. Each incremental addition to the basic program illustrates a feature of the language.

The sample problem we will build on is the analysis of the baseball statistics for a player. You are asked to display the data and perform other calculations and data manipulations. The data for the programs is shown in Figure 1. The data includes the player's name, times at bat, hits, doubles, triples, homers, and uniform number. Figure 1 is the listing of a file named bbstat. The first column of numbers (those followed by a colon) are line numbers provided by the IBM Personal Computer line editor, EDLIN. The data on each line begins with the first letter of the player's name and ends with the last digit of the player's uniform number.

The first program we will consider reads the first record in the data file, bbstat, and writes some of the data for that player on the display. It is a very simple program; the only processing we have to specify is the reading of data and the writing of that very same data. The FORTRAN 77 program to accomplish this is shown in Example 1 and the Personal Computer commands to run the program and the resultant output is shown in Figure 2. Take a few moments to "read" the program and get a sense of its contents.

Each FORTRAN 77 program consists of a sequence of lines that defines the data used in the program, the files required or accessed, and the processing logic or sequence (which can be different from the physical sequence of lines). These lines are referred to as program statements. The statements have a prescribed format, which includes a keyword plus other information to make the statement unambiguous. Statements are usually identified and referred to by their primary purpose. In Example 1 there are COMMENT(C), PROGRAM, CHARACTER, REAL, OPEN, READ, FORMAT, WRITE, CLOSE, STOP, and END statements. The keywords in each statement are shown in capital letters for emphasis; they need not be capitalized for the program to run successfully. The detailed structure of each of these statements is described in later chapters of this book and in the IBM Personal Computer DOS FORTRAN manual.

```
     edlin   bbstat
End of input file
*1,991
          1:*Iorg        111.       36.        .324       7 0  0 19
          2: L. Smith    229.       68.        .297      17 2  5 27
          3: Porter      135.       36.        .267       7 2  5 15
          4: Brummer      47.       12.        .255       4 0  0 11
          5: Herr        148.       36.        .243       7 3  0 28
          6: Heranadez   236.       70.        .297      10 1  1 37
          7: Forsch       37.        9.        .243       2 0  0 31
          8: Gonzalez     53.       13.        .245       2 2  0 14
          9: Hendrick    190.       49.        .258       3 1 11 25
         10: Oberkfell   168.       48.        .286       6 1  0 10
         11: Ramsey      113.       37.        .327       5 2  0  5
         12: O. Smith    226.       59.        .261      16 1  7  1
         13: Tenace       31.       13.        .419       4 0  4 13
         14: McGee        94.       23.        .297       1 3  0 51
         15: Landrum      51.       15.        .294       1 0  2 21
```

Figure 1: Data File bbstat with Baseball Statistics

```
 edlin fort4.fort
End of input file
*1,991
      1:*c****************************************************
      2: c  program example 1                                *
      3: c                                                   *
      4: c  This program reads baseball statistics and prints *
      5: c  them to screen                                   *
      6: c                                                   *
      7: c  Data Definitions                                 *
      8: c                                                   *
      9: c   name    name of the player--20 characters long  *
     10: c   atbats  the number of times at bat              *
     11: c   hits    number of hits                          *
     12: c   avg     batting average                         *
     13: c                                                   *
     14: c  Input File is bbstat                             *
     15: c                                                   *
     16: c****************************************************
     17:          PROGRAM stat1
     18: c
     19:          CHARACTER*20 name
     20:          REAL atbats,hits,avg
     21: c
     22: c        OPEN(2,file='bbstat')
     23: c
     24:          READ(2,200)  name,atbats,hits,avg
     25: 200      FORMAT(a20,3f10.2)
     26:          WRITE(*,210)
     27: 210       FORMAT(1x,'name',21x,'atbats',5x,'hits',7x,
                 'avg'/1x)
     28:          WRITE(*,220) name,atbats,hits,avg
     29: 220      FORMAT(1x,a20,2f10.0,f10.3)
     30:          STOP
     31:          CLOSE(2)
     32:          END

A>
```

Example 1: Single FORTRAN 77 Program with Input and Output

```
A>fort4

name                                atbats          hits      avg

Iorg                                 111.            36.     .324
Stop - Program terminated.

A>
```

Figure 2: Output from Execution of Example 1

Each individual FORTRAN 77 statement has a few simple layout rules. The first five columns of characters are reserved for a FORTRAN 77 program statement number. Statement numbers are usually optional and omitted; however, if you wish to refer to that statement somewhere else in the program, the statement number must be used to label the statement. Note that each FORMAT statement has its own statement number. Statement numbers can be entered anywhere in the first five columns of a line. They must be unique; the same statement number cannot be used for two or more different statements in a FORTRAN 77 program.

Let's get rid of the confusion between statement numbers and line numbers. The line numbers are the sequential numbers, starting at 1, which appear to the left of the listing of the program. They are always followed by a colon. They are supplied by the IBM Personal Computer line editor (EDLIN) and are not part of the program at all. They are there to make the editing process for the file easier. The editing process is required for the initial entry and subsequent changes for your program. They are used by the line editor, EDLIN, only.

Another way of viewing statement numbers is that they are labels which permit other statements in the program to refer to the labeled statement. In Example 1 the READ statement in line number 24 references FORMAT statement 200 (line number 25) and uses information in the FORMAT statement to correctly read data into the program.

In addition to the optional statement number in columns 1-5, each line in the program contains a statement of the FORTRAN 77 language. The statement itself appears in columns 7-72 of each line; the statement may begin in any column in the range 7-72. This permits you to indent statements and improve the readability of your program. One other point: blanks have no meaning in the FORTRAN statement; one or more blanks may appear anywhere in the columns 7-72 and they will have no effect on the statement.

If a FORTRAN statement does not fit on one line, it may be continued by placing a continuation indicator in column 6 of the line on which the statement is continued. An example of this will appear later in the chapter.

Now let us look at the specific sequence and purpose of the statements that appear in Example 1. The first 16 lines of the program are COMMENT statements, signified by a *c* in column 1. These statements allow you to document your program with any messages you think might be helpful in using the program now or in the future. Comment statements have no effect on the processing of the program; they may appear anywhere within the program. They are used here to give a brief description of the program, to identify variable names and meanings, and to indicate the input file. Good programming practice demands that documentation be included for future use of the program. You will find them used throughout the programming examples here to make the program itself as self-explanatory as possible.

The first required statement is the PROGRAM statement. It is used to name the program—in this case, stat. It is necessary to include this statement at the beginning of each program. Programs do not have to be unique; in fact, I have used the same program name throughout this chapter. Only COMMENTs may precede the PROGRAM statement. The PROGRAM statement appears on line number 17.

The next two statements, the CHARACTER and REAL statements, declare the names we are going to use to represent data in this program. The statement 'CHARACTER*20 name' establishes a data item called 'name' (for player's name) and tells the computer that this name can contain up to 20 alphanumeric characters. I made the assumption that no player's name would be longer than 20 letters. When the variable 'name' is referred to in the program, the program will assume that it contains 20 letters and/or numbers. The REAL statement establishes or declares that the variables called atbats, hits, and avg will contain numbers and that those numbers may be noninteger, i.e., they may contain or be assigned a number with a fractional part. When the REAL variables are referred to in the program, the program assumes they are numbers and hence arithmetic operations can be performed with them.

```
A>edlin fort5.fort
End of input file
*1,991
      1:*c*************************************************************
      2: c  program example 2                                         *
      3: c                                                            *
      4: c  This program reads baseball statistics, calculates       *
      5: c  batting averages, and prints the results.                 *
      6: c                                                            *
      7: c  Data Definitions                                          *
      8: c                                                            *
      9: c   name    name of the player--20 characters long           *
     10: c   atbats  the number of times at bat                       *
     11: c   hits    number of hits                                   *
     12: c   avg     batting average                                  *
     13: c                                                            *
     14: c  Input file is bbstat                                      *
     15: c                                                            *
     16: c*************************************************************
     17.:             PROGRAM statl
     18: c
     19:              CHARACTER*20 name
     20:              REAL atbats,hits,avg
     21: c
     22:              OPEN(2,file='bbstat')
     23: c
     24:              READ(2,200) name, atbats, hits
     25: 200          FORMAT(a20,3f10.2)
     26:              avg = hits/atbats
     27:              WRITE(*,210)
     28: 210           FORMAT(1x, 'name', 21x, 'atbats', 5x, 'hits',
                     7x, 'avg'/1x
     29:              WRITE(*,220) name,atbats,hits,avg
     30: 220          FORMAT(1x,a20,2f10.0,f10.3)
     31:              STOP
     32:              CLOSE(2)
     33:              END

A>
```

Example 2: A Simple Calculation

The OPEN statement instructs the computer to make a file, named bbstat, to be prepared for reading or writing. This file will contain the raw statistics for the players. The OPEN statement assigns the unit number 2 to the file bbstat. Unit numbers, not the file's name, are used to refer to files in FORTRAN 77. Hence reading of bbstat will be done by a READ statement that refers to unit 2. You do not need to open the output file in this case, because the output file is the display and is automatically opened when the program begins execution. The OPEN statement is the first executable statement in this program.

The COMMON, PROGRAM, CHARACTER, and REAL statements are called nonexecutable—they specify information or declare variables, but they are not part of the processing logic of the program; they may not be referred to by any statement in the program.

The next six statements are the heart of this simple example. The READ and WRITE statements cause input and output to occur; data is read in from the file, bbstat, and lines of data are written to the Personal Computer's display device (and, optionally, the printer).

The first READ, line number 24, instructs the computer to read data from unit 2 (bbstat). The data is specified by an *iolist;* in this case the iolist is composed of four data elements or variables: name, atbats, hits, and avg. The READ statement also refers to a FORMAT statment 200; this FORMAT statement contains information about the location of the four data elements on the lines of the file, bbstat, associated with unit 2. This FORMAT information is required for DOS FORTRAN; it is the only way the program will be able to locate the data on the input file lines. FORMAT

```
A>fort5

name                        atbats          hits       avg

Iorg                         111.            36.      .324
Stop - Program terminated.

A>
```

Figure 3: Sample Run for Example 2

```
*c******************************************************
 c   program example 3                                  *
 c                                                      *
 c   This program reads baseball statistics, calculates *
 c   batting and slugging averages, and prints results. *
 c                                                      *
 c   Data Definitions                                   *
 c                                                      *
 c    name    name of the player--20 characters long    *
 c    atbats  the number of times at bat                *
 c    hits    number of hits                            *
 c    avg     batting average                           *
 c    sing    number of singles                         *
 c    doub    number of doubles                         *
 c    trip    number of triples                         *
 c    home    number of homers                          *
 c    slug    slugging average                          *
 c                                                      *
 c   Input File is bbstat                               *
 c                                                      *
 c*******************************************************
             PROGRAM statl
 c
             CHARACTER*20 name
             REAL atbats,hits,avg,slug
             INTEGER sing,doub,trip,home
 c
             OPEN(2,file='bbstat')
 c
             READ(2,200) name,atbats,hits,doub,trip,home
  200        FORMAT (a20,2f10.2,10x,3i2)
             avg = hits/atbats
             sing = hits-doub-trip-home
             slug =(sing + 2*doub + 3*trip + 4*home)/atbats
             WRITE(*,210)
  210         FORMAT(1x,'name',21x,'atbats',5x,'hits',3x,'
             sss/dd/tt/hh',
          1   5x,'avg',4x,'slug'/1x)
             WRITE(*,220) name,atbats,hits,sing,doub,trip,home,
             avg,slug
  220        FORMAT(1x,a20,2f10.0,3x,i3,3(1x,i2),3x,f5.3,3x,f5.3)
             CLOSE(2)
             STOP
             END

A>
```

Example 3: A More Complex Calculation

```
  edlin fort7.for
End of input file
*1,991
      1:*c****************************************************
      2: c  program example 4                                 *
      3: c                                                    *
      4: c  This program reads baseball statistics,calculates *
      5: c  batting and slugging averages, and prints results *
      6: c  for a group of 15 players.                        *
      7: c                                                    *
      8: c  Data Definitions                                  *
      9: c                                                    *
     10: c   name    name of the player--20 characters long   *
     11: c   atbats  the number of times at bat               *
     12: c   hits    number of hits                           *
     13: c   avg     batting average                          *
     14: c   sing    number of singles                        *
     15: c   doub    number of doubles                        *
     16: c   trip    number of triples                        *
     17: c   home    number of homers                         *
     18: c   slug    slugging average                         *
     19: c                                                    *
     20: c  Input File is bbstat                              *
     21: c                                                    *
     22: c****************************************************
     23:          PROGRAM stat1
     24: c
     25:          CHARACTER*20 name
     26:          real atbats,hits,avg,slug
     27:          INTEGER sing,doub,trip,home
     28: c
     29:          OPEN(2,file='bbstat')
     30: c
     31:          WRITE(*,210)
     32:          DO 20   i = 1,15
     33:               REAL(2,200,end=100) name,atbats,hits,DOub,
                  trip,home
     34: 200          FORMAT(a20,2f10.2,10x,3i2)
     35:              avg = hits/atbats
     36:              sing = hits-DOub-trip-home
     37:              slug =(sing + 2*DOub + 3*trip + 4*home)/atbats
     38: 210           FORMAT(1x,'name',21x,'atbats',5x,'hits',3x,'
                  sss/dd/tt/hh',
     39:      1       5x,'avg',4x,'slug'/1x)
     40:              WRITE(*,220) name,atbats,hits,sing,DOoub,trip,
                  home,avg,slug
     41: 220           FORMAT(1x,a20,2f10.0,3x,i3,3(1x,i2),3x,f5.3,
                  3x,f5.3)
     42: 20       CONTINUE
     43: 100      CLOSE(2)
     44:          STOP
     45:          END

A>
```

Example 4: Repetition by Count

```
A>fort6

name       atbats     hits       sss/dd/tt/hh    avg        slug

Iorg        111.       36.        29  7  0  0  .324        .387
Stop - Program terminated

A>
```

Figure 4: Sample Run for Example 3

200 specifies that the four items will be found as shown in Table 1.

The a20 item in the FORMAT statement indicates that the 'name' data element will contain 20 alphanumeric characters; note the consistency with the declaration of name in the CHARACTER statement. The 3f10.2 item in the FORMAT statement describes three data areas or fields on the input line, each 10 columns long and containing numeric data.

The first WRITE statement causes a line of output to be written to the Personal Computer's display; this is indicated by the * in the WRITE statement. Note that there is no iolist for this WRITE. The only items to be written are described in the accompanying FORMAT 210. The WRITE results in a heading line being put on the display. The items in the FORMAT statement specify the headings (those items in quotes) and the spacing of the headings (the x items). The second WRITE causes the iolist to be displayed on the display under the appropriate heading; some thought and planning had to be done to get the headings and data just right. The items in FORMAT 220 format or "typeset" the position of the output data element on the output line.

In this program only the first line in the file, bbstat, is read and written to the display. The other lines in bbstat are not read at all. In addition, not all the data in each record is read; the data on the details of the hits (doubles, triples, etc.) and the uniform number is ignored. This is acceptable. The fields to read are listed in the iolist and location on the input line is defined by the FORMAT statement. The other fields on the bbstat lines are not affected or read in at all. When the program is done (after the second WRITE), it is necessary to stop the program in an orderly fashion. In this case the file, bbstat, is closed with the CLOSE(2) statement. The program is then stopped with the STOP statement. The END statement only indicates the last statement in the program, stat; it is not executable (it cannot be given a statement number and referenced). It serves to signal the end of the FORTRAN 77 language statements.

Data Name	Found in Columns
name	1–20
atbats	21–30
hits	31–40
avg	41–50

Table 1

Note that Example 1 also contains the command calling EDLIN and listing the program, which was stored in a file FORT4.FOR. The execution of this program can be requested only after the program has been compiled; see the next section for a few hints. Once compiled, the program is executed by entering the execution module's name. The execution of Example 1 is shown in Figure 2. If you have not attempted a FORTRAN program on the Personal Computer, this example will be a good starting point.

A Simple Calculation

Example 2 contains a small modification to the first example. Since the batting average (avg) can be calculated by dividing hits by atbats, there is no need to read it in; in a real situation such a derived result would usually not be made part of the data base, but would be calculated when needed.

One of the strengths of FORTRAN 77 as a programming language is its natural expression of arithmetic formulas. In line number 26 of Example 2, there is a FORTRAN 77 statement that looks very much like the formula we might write algebraically to describe the calculation of avg. This statement is called an ASSIGNMENT statement; it causes the calculation to the right of the equal sign to be performed and then stores the numeric results of the calculation in the data element to the left of the equal sign. The equal sign carries a different meaning in FORTRAN 77 than it does in algebra. In FORTRAN 77 it merely represents another operation—the assignment operation; here the value of the data

```
  edlin fort8.for
End of input file
*1,99l
      1:*c*****************************************************
      2: c  program example 5                                 *
      3: c                                                    *
      4: c  This program reads baseball statistics, calculates *
      5: c  batting and slugging averages, and prints results  *
      6: c  for a group of 15 players.                         *
      7: c                                                    *
      8: c  Data Definitions                                   *
      9: c                                                    *
     10: c   name    name of the player--20 characters long    *
     11: c   atbats  the number of times at bat                *
     12: c   hits    number of hits                            *
     13: c   avg     batting average                           *
     14: c   sing    number of singles                         *
     15: c   doub    number of doubles                         *
     16: c   trip    number of triples                         *
     17: c   home    number of homers                          *
     18: c   slug    slugging average                          *
     19: c   nplay   number of players--entered interactively  *
     20: c                                                    *
     21: c  Input File is bbstat                               *
     22: c                                                    *
     23: c*****************************************************
     24:          PROGRAM statl
     25: c
     26:          CHARACTER*20 name
     27:          REAL atbats,hts,avg,slug
     28:          INTEGER sing,doub,trip,home,nplay
     29: c
     30:          OPEN(2,file='bbstat')
     31: c
     32:          WRITE(*,230)
     33:  230      FORMAT(lx,'enter number of players-2 digit integer...'\)
     34:          READ(*,240)  nplay
     35: 240      FORMAT(i2)
     36:          WRITE(*,210)
     37:          DO 20  i = 1,nplay
     38:              READ(2,200,end=100) name,atbats,hits,doub,trip,home
     39: 200          FORMAT(a20,2f10.2,10x,3i2)
     40:              avg = hits/atbats
     41:              sing = hits-doub-trip-home
     42:              slug =(sing + 2*doub + 3*trip + 4*home)/atbats
     43: 210         FORMAT(lx,'name',21x,'atbats',5x,'hits',3x,'sss/dd/tt/hh',
     44:      1       5x,'avg',4x,'slug'/lx)
     45:              WRITE(*,220) name,atbats,hits,sing,doub,trip,home,avg,slug
     46: 220          FORMAT(lx,a20,2f10.0,3x,i3,3(lx,i2),3x,f5.3,3x,f5.3)
     47: 20       CONTINUE
     48: 100      CLOSE(2)
     49:          STOP
     50:          END

A>
```

Example 5: Interactive Input

element to the left of the equal sign has its value changed. The sample run of Example 2 is shown in Figure 3; it is identical to the output of Example 1.

More Calculations and Input/Output

In Example 3 we see two enhancements. Let's assume we want to have both the batting average and the slugging average. The latter is calculated by dividing the total number of bases a player has hit for by the times at bat; here a single counts for one base, a double for two, a triple for three, and a homer for four bases. To carry out the calculation of the slugging average, we need additional data, i.e., the number of doubles, triples, and homers. We can calculate the number of singles and the total number of hits from this data.

Take a moment to review Example 3. Note that the comments at the beginning of the program have been modified to reflect the additional function of the program and to define the new data elements or variables which are required to complete the calculation. In line number 26 the INTEGER statement is used to declare variables that will be integers. The variables cannot have a fractional part; they must be whole numbers. In lines numbered 33 and 34 the number of singles and the slugging averages are calculated. In line number 34, the * is used to represent the algebraic operation of multiplication; hence 2*doub means take the value doub and multiply it by 2. No change occurs to doub; its value is just used for that part of the calculation.

In lines numbered 36 and 37, there is a FORMAT statement which is longer than one line in the program. The continuation line is identified by a 1 in column 6; actually any letter or number would have worked, but good practice is to label continuation lines successively with 1, 2, 3, 4, etc. In this FORMAT the labels for an expanded output line are described.

Variable	Columns	Field	Definition
name	1–20	a20,	20 alphanumeric characters
atbats	21–30	f10.2	a numeric value
hits	31–40	f10.2	a numeric value
doub	51–51	i2	an integer value
trip	53–54	i2	an integer value
homer	55–56	i2	an integer value

Table 2

The READ and associated FORMAT, statement number 200, have been modified to include the additional variables in the iolist. The FORMAT statement indicates that the layout of the input line is as shown in Table 2.

Note that the FORMAT item 10x is used to skip over the place on the line where avg appears in the file bbstat; we don't need avg, but we have to indicate that 10 spaces appear between hits and doub. Note also that we do not have to write i2 three times (one time each for the three integers); instead we can enter 3i2.

Figure 4 shows the simple execution of Example 3.

There is one other item to discuss in Example 3. The calculation of sing and slug requires mixing integer and real variables in the same numeric expression. In the calculation of slug you find integer variables (sing, doub, trip, and home), integer constants (2,3,4), and a real divisor, atbats. These expressions are called mixed-mode expressions. They work correctly, but there are very specific rules about how to mix them.

Repetition by Count

Suppose we wish to analyze all the data in bbstat, not just the first line. To do this we need to read in a player's data, perform the necessary computations, then print out the results and read the next player's data and repeat the steps. Example 4 demonstrates the technique for repeating a number of FORTRAN 77 statements.

The repetition by count logical construct is a special case of the DO-WHILE construct. It permits the repetitive performance or execution of a sequence of FORTRAN 77 statements a specific number of times. In FORTRAN 77 this construct is called a DO loop. It is defined by a DO statement at the beginning of the loop and a CONTINUE statement at the end of the loop. In Example 4 the loop begins at line number 32 and ends at line number 42.

The beginning of the loop is defined by the DO statement that specifies the statement number of the FORTRAN 77 statement at the end of the loop and an index that determines the number of times the loop will be executed. In this example the end of the DO loop is statement number 2 and the index runs from 1 to 15 and is incremented by 1 each time through the loop. The DO loop is terminated by the CONTINUE statement, statement number 20, in line number 42. This FORTRAN 77 statement causes no processing to occur; it holds the place at the end of the loop.

The execution of Example 4 is shown in Figure 5. Compare the output with the input file bbstat and you will see the repetitive processing of the statements in the DO loop.

There is another modification in Example 4. The READ statement has been changed to include an END clause. This END clause allows you to automatically specify the processing you want done when the READ operation indicates that there is no more data in the input file; this condition is called an end-of-file condi-

```
  edlin fort9.for
End of input file
*1,991
 *c************************************************************
  c  program example 6                                         *
  c                                                            *
  c  This program reads baseball statistics, calculates        *
  c  batting average and prints results.                       *
  c  Player stats are read in and stored in arrays and         *
  c  printed from arrays.                                      *
  c                                                            *
  c  Data Definitions                                          *
  c                                                            *
  c   name    name of the player--20 characters long           *
  c   atbats  the number of times at bat                       *
  c   hits    number of hits                                   *
  c   avg     batting average                                  *
  c       these variables are arrays with dimension 15.        *
  c   nplay   the number of players in the file..15 maximum    *
  c                                                            *
  c  Input File is bbstat                                      *
  c                                                            *
  c************************************************************
            PROGRAM statl
  c
            CHARACTER*20 name(15)
            REAL atbats(15),hits(15),avg(15)
            INTEGER nplay,i
  c
            OPEN(2,file='bbstat')
  c
            WRITE(*,230)
  230       FORMAT(lx,'enter number of players-2 digits,15 max..'\)
            READ(*,240) nplay
  240       FORMAT(i2)
            IF (nplay .le. 15)    THEN
                DO 20 i = 1,nplay
                    READ(2,200,end=80) name(i),atbats(i),hits(i)
  200               FORMAT(a20,3f10.2)
                    avg(i) = hits(i)/atbats(i)
  20            CONTINUE
                    WRITE(*,210)
  210               FORMAT(lx,'name',21x,'atbats',5x,'hits',7x,'avg'/lx)
                DO 30 i = 1,nplay
                    WRITE(*,220)  name(i),atbats(i),hits(i),avg(i)
                    FORMAT(lx,a20,2f10.0,f10.3)
  30            CONTINUE
            ELSE
                WRITE(*,250)
  250       FORMAT(lx,'number of players is too large--program stopped')
            ENDIF
  80        CLOSE(2)
            STOP
            END
```

Example 6: IF-THEN-ELSE and Arrays

```
A>fort7

name        atbats     hits        sss/dd/tt/hh    avg         slug

Iorg         111.       36.         29  7  0  0   .324        .387
L. Smith     229.       68.         44 17  2  5   .297        .454
Porter       135.       36.         22  7  2  5   .267        .459
Brummer       47.       12.          8  4  0  0   .255        .340
Herr         148.       36.         26  7  3  0   .243        .331
Heranadez    236.       70.         58 10  1  1   .297        .360
Forsch        37.        9.          7  2  0  0   .243        .297
Gonzalez      53.       13.          9  2  2  0   .245        .358
Hendrick     190.       49.         34  3  1 11   .258        .458
Oberkfell    168.       48.         41  6  1  0   .286        .333
Ramsey       113.       37.         30  5  2  0   .327        .407
O. Smith     226.       59.         35 16  1  7   .261        .434
Tenace        31.       13.          5  4  0  4   .419        .935
McGee         94.       23.         19  1  3  0   .245        .319
Landrum       51.       15.         12  1  0  2   .294        .431
Stop - Program terminated.

A>
```

Figure 5: Sample Run for Example 4

```
A>fort8

enter number of players-2 digit integer...100

name        atbats     hits        sss/dd/tt/hh    avg        slug

Iorg         111.       36.         29  7  0  0    .324    .387
L. Smith     229.       68.         44 17  2  5    .297    .454
Porter       135.       36.         22  7  2  5    .267    .459
Brummer       47.       12.          8  4  0  0    .255    .340
Herr         148.       36.         26  7  3  0    .243    .331
Heranadez    236.       70.         58 10  1  1    .297    .360
Forsch        37.        9.          7  2  0  0    .243    .297
Gonzalez      53.       13.          9  2  2  0    .245    .358
Hendrick     190.       49.         34  3  1 11    .258    .458
Oberkfell    168.       48.         41  6  1  0    .286    .333
Stop - Program terminated.

A>
```

Figure 6: Sample Run for Example 5

tion. When the end-of-file condition is found on the input file (unit number 2, in this case), the program will automatically branch to the statement indicated in the END clause, statement number 100. Without this check, the program would stop execution when the end-of-file condition occurs, preventing the orderly closing of the input file, bbstat. It is always good programming practice to build in the checking feature.

Interactive Input

You will find it very convenient to communicate interactively with a program while it is executing. The examples used to this point read all the data required from a file, bbstat, on the diskette. Now we see an example where the program asks us for information while it is executing.

Suppose we want to specify the number of players we wish to analyze; we could want 5 or 10, instead of 1 or 15, as the previous examples had presented. In fact, we want to be able to change the number of players each time we run the program. The facility is built into Example 5.

The approach illustrated here prompts the user of the program for the number of players desired and then uses this number to define the upper limit of the index of the DO loop and hence the number of repetitions that occur. The prompt is written to the display in line number 32; this statement causes a message to be printed to the display requesting that the user enter the number of players. The message also gives the user the required number of digits expected for that number—in this case, a two-digit number. The backslash (/) also appears in the FORMAT statement (number 230); this backslash allows you to enter the number of players at the end of the message line, not on the next line. The READ statment in line number 34 reads in the two-digit number (i2), which is called nplay; the unit in this READ is the keyboard, which is indicated in READ by the unit number, *. The integer variable nplay is then used as the upper limit on the index of the DO statement.

The execution of Example 5 is shown in Figure 6. The execution of the program is begun by entering the load module name, FORT8. Once execution begins, the prompt requesting the number of players is printed and my response (10) entered; I typed 10 and hit ENTER. The program reads 10 into nplay and continues execution, reading and printing the first 10 entries or records in bbstat. The program is then terminated. You must enter a two-digit number or the program will end on an error. This is a built-in constraint of the FORTRAN 77 compiler. If you want to print a number of players less than 10, you must type in a blank and the one-digit number you want. So your response to the prompt to analyze the first five players would be to hit the space bar, then the number 5, and finally the ENTER key. If I merely typed 5 and hit ENTER, the program would terminate on an error.

```
  edlin fort10.for
End of input file
*1,pp  991
 1:*c**************************************************************
 2: c  program example 7                                            *
 3: c                                                               *
 4: c  This program reads baseball statistics,calculates            *
 5: c  batting average and prints results.                          *
 6: c  Player stats are read in and stored in arrays and            *
 7: c  sorted in descending order by average.  The sorted list is   *
 8: c  printed from arrays.                                         *
 9: c                                                               *
10: c  Data Definitions                                             *
11: c                                                               *
12: c   name    name of the player--20 characters long              *
13: c   atbats  the number of times at bat                          *
14: c   hits    number of hits                                      *
15: c   avg     batting average                                     *
16: c        these variables are arrays with dimension 15.          *
17: c   nplay   the number of players in the file..15 maximum       *
18: c   tn,tatbat,thit and tavg are temporary variables used during *
19: c   the sort.                                                   *
20: c                                                               *
21: c  Input File is bbstat                                         *
22: c                                                               *
23: c***************************************************************
24:         PROGRAM statl
25: c
26:         CHARACTER*20 name(15),tn
27:         REAL atbats(15),hits(15),avg(15),tatbat,thit,tavg
28:         INTEGER i,j,nplay,m
29: c
30:         OPEN(2,file='bbstat')
31: c
32: c       read player data
33: c
34:         WRITE(*,230)
35: 230     FORMAT(1x,'enter number of players-2 digits,15 max..'\)
36:         READ(*,240) nplay
37: 240     FORMAT(i2)
38:         IF (nplay .gt. 15)     THEN
39:         DO 20 i = 1,nplay
40:         READ(2,200,end=80) name(i),atbats(i),hits(i)
41: 200     FORMAT(a20,3f10.2)
42:         avg(i) = hits(i)/atbats(i)
43: 20      CONTINUE
```

This does present a problem for interactive computing, but if you are careful to input the prescribed number of digits or characters, the program will perform correctly.

The IF-THEN-ELSE Construct and Arrays

Suppose we wanted to read all or a portion of the data in bbstat into our program at one time; this would mean declaring enough variables to hold player data for more than one player. The examples used so far have operated on one player's data at a time; now we wish to bring in data on more than one player at the same time. This is accomplished by declaring arrays; arrays can be compared with tables of data—all the data in a given column refer to the same data item and rows refer to different occurrences of the data.

To be specific, refer to the declaration of 'name' in Example 6. Here, following the declaration of name is the number 15 in parentheses, indicating that there can be 15 occurrences of name, one for each of the players in bbstat. The specific occurrences are referred to by a number or subscript for the array. Hence name(1) would contain the first player's name (Iorg) and name(15) would contain Landrum. We can read all the player data in at once and then process it. The declaration of atbats and hits shows the same pattern; atbats(1) and hits(1) would contain the atbats and hits data for Iorg. The data item avg(1) would contain Iorg's batting average calculated by dividing hits(1) by atbats(1); this calculation is shown in line number 36.

```
44: c
45: c        sort algorithm is bubble sort
46: c
47:          DO 26 m = 1,nplay-1
48:          i = nplay-m
49:          DO 25 j = 1,i
50:          IF (avg(j) .lt. avg(j+1))   THEN
51:                  tn = name(j)
52:                  name(j) = name(j+1)
53:                  name(j+1) = tn
54:                  tatbat = atbats(j)
55:                  atbats(j) = atbats(j+1)
56:                  atbats(j+1) = tatbat
57:                  thit = hits(j)
58:                  hits(j) = hits(j+1)
59:                  hits(j+1) = thit
60:                  tavg = avg(j)
61:                  avg(j) = avg(j+1)
62:                  avg(j+1) = tavg
63:          ENDIF
64: 25       CONTINUE
65: 26       CONTINUE
66: c
67: c        end of sort
68: c
69: c
70: c        print sorted player data
71: c
72:          WRITE(*,210)
73: 210      FORMAT(1x,'name',21x,'atbats',5x,'hits',7x,'avg'/1x)
74:          DO 30 i = 1,nplay
75:          WRITE(*,220) name(i),atbats(i),hits(i),avg(i)
76: 220      FORMAT(1x,a20,2f10.0,f10.3)
77: 30       CONTINUE
78:          ELSE
79:          WRITE(*,250)
80: 250      FORMAT(1x,'number of players is too large--program terminated')
81:          CLOSE(2)
82:          STOP
83:          ENDIF
84: 80       WRITE(8,255)
85: 255      FORMAT(1x,'end of file on bbstat--program stopped')
86:          CLOSE(2)
87:          STOP
88:          END
```

Example 7: SORTing Data

Note that in Example 6 all the data is read and then the headings printed to the display, after which all the data is written to the display. All input and output operations refer explicitly to the arrays. These arrays are sometimes referred to as subscripted variables.

The output for one run of Example 6 is shown in Figure 7. It is the same basic data as used in Figure 6, if you wish to make comparison. For simplicity I have not included the slugging analysis in this example.

In Example 6 the IF-THEN-ELSE construct is used to guarantee that the size of the arrays will not be exceeded; if we attempted to use name(16), processing errors would result. As long as nplay is less than or equal to 15, we can process the data correctly and the THEN portion of the construct allows for this. On the other hand, if nplay is greater than 15, we want to bypass processing; this is handled by the statements following the ELSE statement. The ENDIF defines the boundary for the IF-THEN-ELSE construct and is a required part of it. The indentation of the statements in the IF-THEN-ELSE construct is optional, but good practice; it emphasizes the two alternative processing directions of the IF clause.

```
A>fort9

enter number of players-2 digits,15 max..10

name                     atbats     hits      avg

Iorg                       111.      36.     .324
L. Smith                   229.      68.     .297
Porter                     135.      36.     .267
Brummer                     47.      12.     .255
Herr                       148.      36.     .243
Heranadez                  236.      70.     .297
Forsch                      37.       9.     .243
Gonzalez                    53.      13.     .245
Hendrick                   190.      49.     .258
Oberkfell                  168.      48.     .286
Stop - Program terminated.

A>
```

Figure 7: Sample Run for Example 6

```
A>fort10

enter number of players-2 digits,15 max..15

name                     atbats     hits      avg

Tenace                      31.      13.     .419
Ramsey                     113.      37.     .327
Iorg                       111.      36.     .324
L. Smith                   229.      68.     .297
Heranadez                  236.      70.     .297
Landrum                     51.      15.     .294
Oberkfell                  168.      48.     .286
Porter                     135.      36.     .267
O. Smith                   226.      59.     .261
Hendrick                   190.      49.     .258
Brummer                     47.      12.     .255
Gonzalez                    53.      13.     .245
McGee                       94.      23.     .245
Herr                       148.      36.     .243
Forsch                      37.       9.     .243
Stop - Program terminated.

A>
```

Figure 8: Sample Run for Example 7

SORTing Player Data

Suppose we wanted to produce a list of players sorted by batting average, with the highest average at the top of the list and the lowest at the bottom. Since Example 6 was designed to hold all the player data internally, all we need to do is add a sort process to the program. This modification is shown in Example 7.

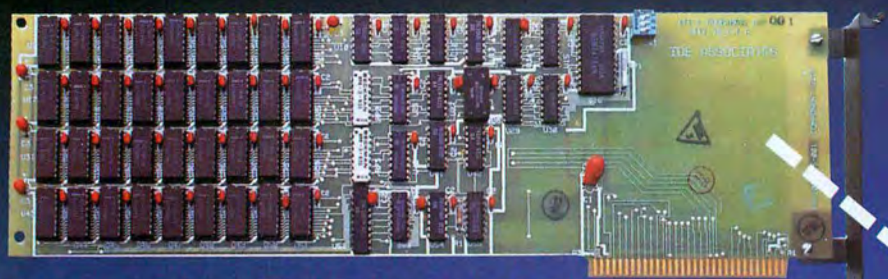
The algorithm for sorting the data is called a *bubble sort*. The averages are compared pairwise and adjacent averages (and other player data) are exchanged in order to move the lowest player average to name(15), atbats(15), and hits(15). The lowest average is bubbled to the bottom of the arrays. So if avg(1) is small than avg(2), all the data for players 1 and 2 are switched: name, atbats, hits, and avg. Then the new avg(2) is compared with avg(3) and the player data switched if avg(2) is less than avg(3). The process continues until the player with the lowest average appears in position 15 in the name, atbats, hits, and avg arrays. The process then proceeds to put the second lowest average into position 14 and so on.

An interesting exercise is to modify Example 7 by adding write statements to the sort and watching the migration of player data during the sort process.

Figure 8 shows the listing for all the players in the bbstat file; it was produced by running Example 7 with the number of players equal to 15.

Robert Rouse and Thomas Bugnitz are affiliate faculty members of the Department of Computer Science at Washington University in St. Louis, Missouri.

Reader Service #280



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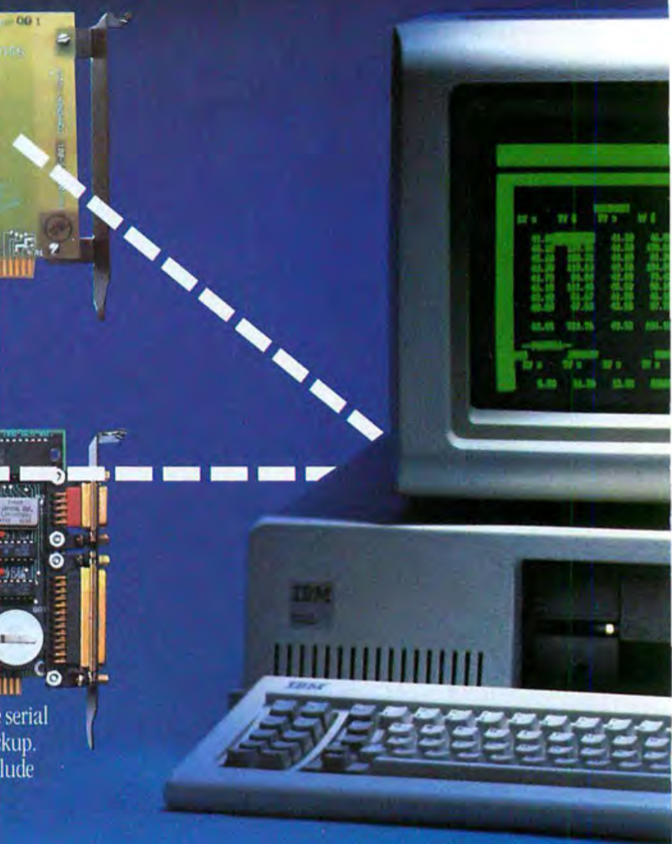

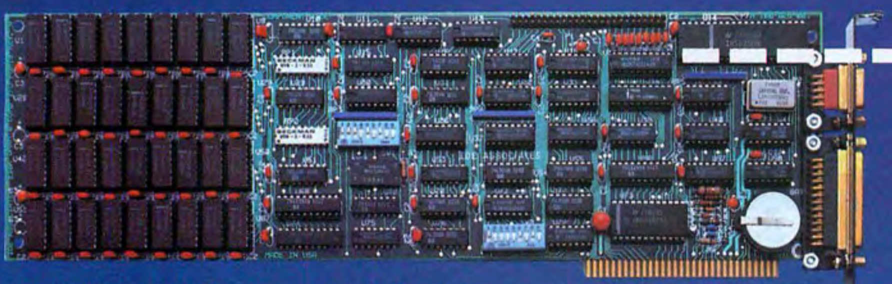

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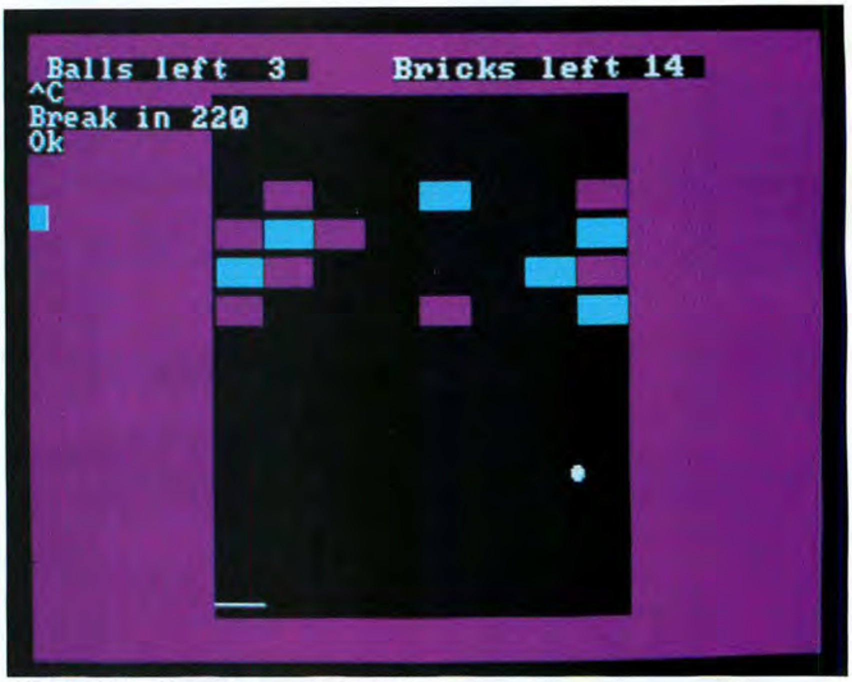
Video Game Graphics

Design and program your own video game using BASIC graphics commands.

Dan Illowsky and Michael Abrash

The graphics commands discussed in our previous articles in *PC World* (see issues 2, 3, and 4) vary in complexity: some are simple to understand and execute, while others are more difficult. In this article many of these commands are used to design and program a video game. If you missed the preceding tutorials, refer to the IBM BASIC manual as you follow the information given here. Thanks to the graphics capabilities of Advanced BASIC, you'll find our *Blockbuster* game surprisingly compact and easy to implement.



The Blockbuster video game in action

Game Design

The most important part of producing a game is creating a good design. The first step in this process is outlining how the program will accomplish each element of the game. Before writing a single line in BASIC, figure out the complete specifications for the playfield and moving objects, and decide how you'll handle the interactions among all components of the game. Once these decisions are made, you can easily write the program from your specifications without worrying about overall program logic.

Improper game design results in frustrating bugs in the program, especially in more complex programs. The "top-down" design we use ensures that each section of the program works well with the others. A good design creates a logically composed program, which makes later additions and changes much easier.

Blockbuster

The game designed here is called *Blockbuster,* a pong-type game in which a ball directed by a player-controlled paddle bounces around a playfield and into a wall of bricks. Each time the ball hits a brick the brick vanishes. The game ends when the player clears the field of bricks or runs out of balls.

There are five sections of the program—the playfield, the bricks, the paddle, the ball, and housekeeping—that must be designed before you can produce the game.

The Playfield

The playfield is closed on three sides and open on the fourth. The paddle is located on the open side, which is at the bottom of the screen. Putting the open side on the bottom replicates a sense of gravity, with the ball falling toward the bottom, where the player will be waiting with the paddle. The playfield is nearly square at 166 rows by 162 columns (all coordinates are measured in pixels). The exact dimensions are changeable, so experiment with them. The playfield is black, as that is the easiest background color on which to follow the action. The area surrounding the playfield is a solid color, the selection of which is always a dilemma when you are programming color graphics on the IBM PC.

In medium-resolution graphics there is a choice of two palettes. Palette 0, with red, green, and brown is vivid on a high-quality monitor, but all three colors look brownish on a TV screen. Palette 1 has magenta, white, and cyan, which are less striking but look better on a TV. For *Blockbuster* we will use palette 0, but feel free to alter the program to use whichever palette and background you prefer. The area surrounding the playfield is supposed to be magenta, but it appears as anything from pink to deep red on the various displays.

The Bricks

Once the playfield is set, the bricks can be placed on it. There are four rows of eight bricks each, arrayed about two-thirds of the way to the top of the playfield. Each brick is 9 rows by 19 columns. There are no rules regarding placement and sizing of objects. The usual approach is to use graph paper, a pencil, and a large eraser to experiment. The upper edge of the top row of bricks begins at row 42, measured from the top of the screen. Each brick is 4 rows below the brick above and 2 columns from each brick to the side. The bricks are alternately magenta and cyan.

The Paddle

The paddle is a horizontal white line 21 columns wide in row 181 of the screen. The paddle's range of movement is the full width of the playfield, from column 80 to 241.

Although a joystick is an ideal paddle controller, not all PC owners have joysticks. Therefore, *Blockbuster* uses the keyboard to control the paddle, even though keyboard control is not as easy as a joystick. One method of keyboard control involves moving the paddle one unit each time a certain key is pressed. Approximately 25 keystrokes are required to move the paddle across the screen. Since the PC keyboard doesn't immediately repeat a key command (i.e., continually send the same key command when that key is held down), this method would leave the player whacking repeatedly at the keyboard.

Handling the ball is the most complex portion of the program.

A better approach to keyboard-controlled movement is to start the paddle moving when a key is pressed and to allow that movement to stop only when another key is pressed or the paddle reaches the edge of the playfield. In *Blockbuster* the z key starts the paddle moving left, the x key stops it, and the c key starts it moving right. Of course, you may select other keys if these don't appeal to you.

The Ball

Handling the ball is the most complex portion of the program, since the ball interacts with all the elements previously discussed. Draw the ball as a white circle of radius 2. The ball starts on the left of the playfield, below the bricks.

To create the impression that the ball is moving, the program erases the ball at its current location, adds the ball's coordinates an increment in each of the x and y directions, and then redraws the ball in the new location. The x and y increments fully describe the movement that the ball makes and can be either positive or negative for motion in all directions.

To determine if the ball has hit any of the edges of the playfield, simply compare coordinates. If the ball is at row 80, for example, and tries to move to the left, it has hit the left edge; you must reverse the x increment of its direction.

Similarly, compare coordinates to check if the ball has hit the paddle or gone off the bottom of the screen. If the ball reaches the paddle row, it either hits the paddle or misses the paddle and is lost. If the ball hits the paddle, the y increment is set to move the ball up, and the x increment is set according to how close to the center of the paddle the ball hit.

There is always the temptation to let the computer carry out the same movement every time, in this case to bounce the ball off the paddle at the same angle every time. Varying the path of the ball as it bounces off the paddle makes the game more interesting and creates the impression that the ball and paddle are real objects. In reality, balls bounce with spin, so we must create the illusion that this is happening in our game as well. Small touches like this make the game feel right to players, even though they may not know why they have that feeling.

If the ball misses the paddle, restart it the same way you did at the beginning of the game. The remaining number of balls will be handled in the program's housekeeping section.

Use the POINT function to check whether the ball has hit a brick. If the ball hasn't hit any of the playfield's edges or the paddle, and if the point where the center of the ball is about to move is not black, then a brick must have been hit. Disposing of the brick is simple; PAINT it out, starting at the point you just checked with POINT.

In understanding the ball's motion and the collision checks, it's important to understand the nature of program execution. While you, the game designer, are trying to create the impression of continuous action, you're actually dealing with discrete, sequential events. Hence, in *Blockbus-*

```
100 DEFINT A-Z:CLS:SCREEN 1,0:COLOR 0,1
130 LINE(0,0)-(319,199),2,BF:LINE(80,20)-(241,185),0,BF
```

Listing 1: Drawing the Playfield for Blockbuster

```
100 DEFINT A-Z:CLS:SCREEN 1,0:COLOR 0,1
130 LINE(0,0)-(319,199),2,BF:LINE(80,20)-(241,185),0,BF
140 FOR I=0 TO 7:FOR J=0 TO 3:LINE(82+20*I,48+J*12)-STEP(18,8),
    ((I+J) MOD 2)+1,BF:NEXT J:NEXT I
```

Listing 2: Drawing the Bricks

```
100 DEFINT A-Z:CLS:SCREEN 1,0:COLOR 0,1
130 LINE(0,0)-(319,199),2,BF:LINE(80,20)-(241,185),0,BF
140 FOR I=0 TO 7:FOR J=0 TO 3:LINE(82+20*I,48+J*12)-STEP(18,8),
    ((I+J) MOD 2)+1,BF:NEXT J:NEXT I
160 PX=150:PXINC=0
190 A$=INKEY$:IF A$="c" THEN PXINC=5 ELSE IF A$="z" THEN PXINC=-5
    ELSE IF A$="x" THEN PXINC=0
200 OLDPX=PX:PX=PX+PXINC:IF PX<80 OR PX>221 THEN PX=OLDPX
210 LINE(OLDPX,181)-(OLDPX+20,181),0:LINE (PX,181)-(PX+20,181),3:OLDPX=PX
270 GOTO 190
```

Listing 3: Moving the Paddle

```
100 DEFINT A-Z:CLS:SCREEN 1,0:COLOR 0,1
110 CIRCLE(3,3),2,3:PAINT STEP(0,0),3
120 DIM BALL(10):GET(0,0)-(5,5),BALL
130 LINE(0,0)-(319,199),2,BF:LINE(80,20)-(241,185),0,BF
140 FOR I=0 TO 7:FOR J=0 TO 3:LINE(82+20*I,48+J*12)-STEP(18,8),
    ((I+J) MOD 2)+1,BF:NEXT J:NEXT I
160 PX=150:PXINC=0
170 REM *placekeeping line*
180 BX=80:BY=100:BXINC=4:BYINC=4:PUT(BX,BY),BALL
190 A$=INKEY$:IF A$="c" THEN PXINC=5 ELSE IF A$="z" THEN PXINC=-5
    ELSE IF A$="x" THEN PXINC=0
200 OLDPX=PX:PX=PX+PXINC:IF PX<80 OR PX>221 THEN PX=OLDPX
210 LINE(OLDPX,181)-(OLDPX+20,181),0:LINE (PX,181)-(PX+20,181),3:OLDPX=PX
220 OLDBX=BX:BX=BX+BXINC:IF BX<80 OR BX>234 THEN BXINC=-BXINC:BX=BX+2*BXINC
230 OLDBY=BY:BY=BY+BYINC:IF BY<24 THEN BYINC=-BYINC:BY=BY+2*BYINC
240 IF BY>175 THEN IF BX<PX-5 OR BX>PX+20 THEN 280 ELSE BYINC=-BYINC:
    BY=BY+2*BYINC:BXINC=(BX-PX)\2-4
250 PUT(OLDBX,OLDBY),BALL:IF POINT(BX+2,BY+2)=0 THEN GOTO 260 ELSE
    PAINT(BX+2,BY+2),0:BYINC=-BYINC:BY=BY+2*BYINC
260 PUT(BX,BY),BALL
270 GOTO 190
280 REM *placekeeping line*
290 PUT (OLDBX,OLDBY),BALL:GOTO 170
```

Listing 4: Moving the Ball

ter you know that any point not black is a brick because you have already eliminated the possibility that the point is the edge of the playfield or the paddle. If the order of the checks is reversed, the program won't work. Again, you must PAINT over the brick after the ball is taken off screen at the old location and before the ball is drawn at the new location, or you may PAINT the ball off as well.

The discrete nature of video game programming is one reason for doing extensive game design before programming; the events must be sequenced so that they interact properly and without interference. It's impossible to replicate real-world action perfectly, so use good design to produce good illusion. Fortunately, fast action and the impressionable eye often cover for a good deal of imprecision.

Housekeeping
A game must have a beginning, an end, and a scoring method. In *Blockbuster* the score is the number of bricks hit, and the end comes when three balls are lost or when all the bricks are gone. You must keep track of the number of bricks and balls.

The beginning of the game consists of initializing and drawing the playfield, bricks, paddle, and ball. Initializing the paddle and ball by starting the ball aimed right at the paddle makes the game easier to play. If a player is confused or unprepared, for example, the ball won't be lost immediately. Also, the ball bouncing off the paddle makes the basic idea of the game more readily apparent to the novice.

Programming the Game
Now that *Blockbuster* is designed, you can program it in BASIC. You could just sit down with your specifications and start writing, but it's more productive to program a game in modules (i.e., to write each section in turn, thoroughly testing and debugging it before proceeding to the next section). Modular programming, especially important with large programs, is easier to do with compiled languages or in assembly language, but it can be applied in Interpretive BASIC.

This game is programmed in five steps, with a pause after each step to test your progress to that stage. These five steps correspond to the five sections of the program: playfield, bricks, paddle, ball, and housekeeping. Before starting, note that the program listings shown seem to have gaps in the line numbering. For example, the line numbers run 100, 130, 140, skipping 110 and 120. The missing numbers are reserved for lines dealing with later steps, such as housekeeping. Also note that there are many statements on each line, which can make the program difficult to read. As an interpreted language, BASIC is not as fast as some other languages, but it can run statements faster if they're on the same line. *Blockbuster* uses multistatement lines for greater speed. Similarly, there are no comments in the listings because BASIC wastes a surprising amount of time when it encounters REM statements and single-quote comments. In general, however, commenting is a very desirable programming practice.

Programming the Playfield
The program in Listing 1 sets up the playfield. Line 100 clears the screen and selects medium-resolution color mode and palette 1 on a black background. Notice that the DEFINT statement makes all variables integers. This is important in programming games because BASIC works with integers much more quickly than with real numbers, particularly for arithmetic operations. The first LINE statement on line 130 colors the entire screen magenta, while the second LINE statement makes the playfield area black. Run the program to see the constructed playfield.

Programming the Bricks
Listing 2 draws the playfield and sets up the bricks. In line 140 the FOR...NEXT loop with the I variable runs through the eight columns of bricks, and the FOR...NEXT loop with the J variable runs through the four rows of bricks. The heart of line 140 is the LINE statement: the coordinates for the upper-left corner of each brick are calculated based on the upper-left brick, which is at coordinates 82,48. Each column is 20 dots wide, so the x coordinate of any brick is $82 + I*20$, where I is the column number of that brick. Similarly, each row is 12 dots high, so the y coordinate is $48 + J*12$, where J is the column number of the brick.

For each brick the rectangle drawn with the LINE statement is 19 columns by 9 rows and is created with the STEP command relative to the upper-left corner of the brick. The rectangle is filled in with alternating blocks of magenta and cyan using the MOD operator. The MOD function finds the necessary values for the LINE statement's color parameter to color in the bricks. If the formula $(I+J)$ produces an even number, then the MOD 2 function, for example, returns the value 0; if the formula $(I+J)$ produces an odd number, then MOD 2 returns the value 1. Cyan and magenta, however, are given the values 1 and 2, respectively. To make the MOD values 0 and 1 correspond to the color values 1 and 2, the value 1 is added to the MOD value. In this case the MOD 2 value of 0 indicates the color cyan (color 1) and the MOD 2 value of 1 indicates magenta (color 2).

Run the program in Listing 2. Notice that it simply adds line 140 to the program in Listing 1.

Programming the Paddle
Now comes the action. The program in Listing 3 initializes the paddle and lets you move it back and forth. The program also sets up the playfield and the bricks.

Line 160 initializes the paddle's x coordinate, the variable PX. The paddle's y coordinate never changes, so a constant is used. To move the paddle you need a loop that repeatedly executes the paddle movement commands. If line 160 were inside this loop, the paddle would constantly be returned to its initial position. Lines 190, 200, and 210 are the paddle movement commands. Line 190 uses the INKEY$ command to get keyboard input, if any, without disturbing the screen. (Keystrokes obtained with INKEY$ are not shown on the screen.) If there is no input, INKEY$ returns an empty string. If the input is one of the three movement keys—z, x, or c (the keys must be lowercase)—then action is taken. The action is to set the variable PXINC (the increment by which the paddle moves) to -5 to move left, 0 to stop, or 5 to move right. Moving the paddle at fewer than five dots at a time produces slower motion, while moving it at more than five dots produces jerky motion that's difficult to control.

Line 200 guards against the paddle moving off the edge of the screen by saving the current location in OLDPX and then performing a trial move of the paddle by adding the paddle movement increment PXINC to the current *x* coordinate. If the new location is off either edge, it is set back to the old location and no move takes place.

Line 210 moves the paddle. (If PX equals OLDPX, either because PXINC is 0 or because the edge has been reached, then no move occurs. Instead, the paddle is erased and drawn again in precisely the same spot.) The first LINE statement uses OLDPX to erase the paddle at its old location, and the second LINE statement uses PX to draw the paddle at its new location.

Line 270 loops back to perform the paddle movement commands again. The initialization in line 160 is not reexecuted.

Run the program in Listing 3. Notice that the paddle moves very rapidly. This is to be expected, because the lines dealing with the ball's movement are not being executed yet. These lines slow the action down considerably. Also remember that this program is an endless loop, so use Crtl-Break to stop it.

Programming the Ball

The program in Listing 4 adds the ball to what you've already created. To program the ball, draw and initialize it, check for collisions with the edges, paddle, and bricks, and then move and redraw the ball.

The ball must first be drawn so that it can be saved for future use. Line 110 creates a white circle of radius 2, and line 120 uses the graphics GET command to save the form of the ball into the array variable BALL.

Line 180 sets the ball's coordinates (BX and BY) and motion (BXINC and BYINC). BX and BY are set to start the ball on the left side below the bricks. BXINC and BYINC are set initially to move the ball down and to the right to intersect the pad-

```
100 DEFINT A-Z:CLS:SCREEN 1,0:COLOR 0,1
110 CIRCLE(3,3),2,3:PAINT STEP(0,0),3
120 DIM BALL(10):GET(0,0)-(5,5),BALL
130 LINE(0,0)-(319,199),2,BF:LINE(80,20)-(241,185),0,BF
140 FOR I=0 TO 7:FOR J=0 TO 3:LINE(82+20*I,48+J*12)-STEP(18,8),
    ((I+J) MOD 2)+1,BF:NEXT J:NEXT I
150 NBALLS=3:NBRKS=32
160 PX=150:PXINC=0
170 LOCATE 2,2:PRINT "Balls left ";NBALLS:IF NBALLS=0 THEN LOCATE 15,13:
    PRINT "YOU LOST!!!!!":END
180 BX=80:BY=100:BXINC=4:BYINC=4:PUT(BX,BY),BALL
190 A$=INKEY$:IF A$="c" THEN PXINC=5 ELSE IF A$="z" THEN PXINC=-5
    ELSE IF A$="x" THEN PXINC=0
200 OLDPX=PX:PX=PX+PXINC:IF PX<80 OR PX>221 THEN PX=OLDPX
210 LINE(OLDPX,181)-(OLDPX+20,181),0:LINE (PX,181)-(PX+20,181),3:OLDPX=PX
220 OLDBX=BX:BX=BX+BXINC:IF BX<80 OR BX>234 THEN BXINC=-BXINC:BX=BX+2*BXINC
230 OLDBY=BY:BY=BY+BYINC:IF BY<24 THEN BYINC=-BYINC:BY=BY+2*BYINC
240 IF BY>175 THEN IF BX<PX-5 OR BX>PX+20 THEN 280 ELSE BYINC=-BYINC:
    BY=BY+2*BYINC:BXINC=(BX-PX)\2-4
250 PUT(OLDBX,OLDBY),BALL:IF POINT(BX+2,BY+2)=0 THEN GOTO 260 ELSE
    PAINT(BX+2,BY+2),0:BYINC=-BYINC:BY=BY+2*BYINC:LOCATE 2,20:
    NBRKS=NBRKS-1:PRINT "Bricks left";NBRKS:IF NBRKS=0 THEN LOCATE 15,13:
    PRINT "YOU WON!!!!":END
260 PUT(BX,BY),BALL
270 GOTO 190
280 NBALLS=NBALLS-1
290 PUT (OLDBX,OLDBY),BALL:GOTO 170
```

Listing 5: Housekeeping (finished program)

```
95  rem Block Buster-- A pong-type video game
100 DEFINT A-Z:CLS:SCREEN 1,0:COLOR 0,1
105 rem draw the ball and fill it in
110 CIRCLE(3,3),2,3:PAINT STEP(0,0),3
115 rem save the ball in array called BALL
120 DIM BALL(10):GET(0,0)-(5,5),BALL
125 rem draw the playfield
130 LINE(0,0)-(319,199),2,BF:LINE(80,20)-(241,185),0,BF
135 rem draw the bricks in the playfield
140 FOR I=0 TO 7:FOR J=0 TO 3:LINE(82+20*I,48+J*12)-STEP(18,8),
    ((I+J) MOD 2)+1,BF:NEXT J:NEXT I
145 rem initialize the number of balls and number of bricks
150 NBALLS=3:NBRKS=32
155 rem set initial paddle position and movement
160 PX=150:PXINC=0
165 rem keep track of number of balls left, if none then end game
170 LOCATE 2,2:PRINT "Balls left ";NBALLS:IF NBALLS=0 THEN LOCATE 15,13:
    PRINT "YOU LOST!!!!!":END
175 rem start new ball and direction
180 BX=80:BY=100:BXINC=4:BYINC=4:PUT(BX,BY),BALL
185 rem set paddle direction according to what key is pressed
190 A$=INKEY$:IF A$="c" THEN PXINC=5 ELSE IF A$="z" THEN PXINC=-5
    ELSE IF A$="x" THEN PXINC=0
195 rem find new paddle location--do not let it go off playing field
200 OLDPX=PX:PX=PX+PXINC:IF PX<80 OR PX>221 THEN PX=OLDPX
202 rem draw the paddle at its new location which then becomes the
204 rem   old location
210 LINE(OLDPX,181)-(OLDPX+20,181),0:LINE (PX,181)-(PX+20,181),3:OLDPX=PX
215 rem find new horizontal ball location-- if it would hit a wall then
    go in other direction
220 OLDBX=BX:BX=BX+BXINC:IF BX<80 OR BX>234 THEN BXINC=-BXINC:BX=BX+2*BXINC
225 rem find new vertical ball location-- if it hits the top then go down
230 OLDBY=BY:BY=BY+BYINC:IF BY<24 THEN BYINC=-BYINC:BY=BY+2*BYINC
232 rem if ball is at paddle row and missed the paddle then goto line 280
234 rem if ball is at paddle line and hit the paddle then set ball to go up
236 rem   and set the horizontal movement according to where the paddle was
238 rem   hit
240 IF BY>175 THEN IF BX<PX-5 OR BX>PX+20 THEN 280 ELSE BYINC=-BYINC:
    BY=BY+2*BYINC:BXINC=(BX-PX)\2-4
242 rem erase the ball, restoring the background. if the dot at the center
244 rem   of where the ball is to be put next is black then go to 260. if
246 rem   not, then a brick has been hit, so erase the brick by PAINTing it
248 rem   the background color, then reverse the direction of the ball and
249 rem   reduce the brick count by one. if no bricks left, you won!!!
250 PUT(OLDBX,OLDBY),BALL:IF POINT(BX+2,BY+2)=0 THEN GOTO 260 ELSE
    PAINT(BX+2,BY+2),0:BYINC=-BYINC:BY=BY+2*BYINC:LOCATE 2,20:
    NBRKS=NBRKS-1:PRINT "Bricks left";NBRKS:IF NBRKS=0 THEN LOCATE 15,13:
    PRINT "YOU WON!!!!":END
252 rem draw the ball at its new location
260 PUT(BX,BY),BALL
265 rem loop back and do it all again
270 GOTO 190
275 rem the ball went past the paddle, so there is one less ball
280 NBALLS=NBALLS-1
285 rem erase the old ball and goto where a new ball will be started
290 PUT (OLDBX,OLDBY),BALL:GOTO 170
```

Listing 6: Complete Blockbuster Game with Comments dle's starting position. The PUT graphics statement at the end of the line draws the ball on the screen at its starting spot. Remember that the PUT statement is a rapid way to draw an image previously saved with the GET statement.

Line 220 moves the ball horizontally and checks for collision with the sides. The current location is saved in OLDBX for later reference. BXINC (the horizontal motion) is then added to the current *x* coordinate. If this new location is off either edge, the horizontal motion variable BXINC is negated (that is, multiplied by -1) and twice the new motion is added to the *x* coordinate. This cancels the move made at the beginning of line 220 and moves the ball one normal distance. After this line executes, the ball's *x* coordinate is moved by BXINC. When checks are made for collisions, remember that BX and BY are

> Decide how you'll handle the interactions among all components of the game.

the coordinates of the upper-left corner of the ball. Since the ball is five dots wide, its right edge is at BX+4. The same is true for the paddle, the right edge of which is at PX+20.

Line 230 is similar to line 220, except that it handles vertical motion. Only the top edge is checked for in this line. If the ball has reached the top, BYINC (the vertical motion) is negated.

Line 240 checks whether the ball hits the paddle. If the ball hasn't reached the paddle row, no check is necessary. If the ball has reached the paddle row, the ball has either hit the paddle and bounced or hasn't hit the paddle and has gone off the screen. If the ball hits the paddle, the ball's vertical motion is reversed just as when the ball hits the top edge of the playfield. The horizontal motion varies, depending on how close to the center the ball hits, thereby creating the impression of spin. The last statement on line 240 sets this variable horizontal motion.

If the ball misses the paddle, it must be taken off the screen and restarted. This is done in line 290. Note that line 170 (where the ball is restarted) is a REM statement. This line, like line 280, is used in the housekeeping section, so the REM statement is merely a placekeeper for now.

If the ball hasn't gone off the bottom edge of the screen, it must be erased so it can be moved. Line 250 erases the ball from its old location by exclusive ORing it out of the screen. Line 250 uses the POINT function to see if there is anything on the screen where the ball's center is to go. Since the ball is not allowed to hit the boundary or the paddle, if any color but black is there, the ball must be hitting a brick. Because the brick is surrounded by black, it is PAINTED off the screen, and the ball reverses direction as if it hit the top edge of the screen.

With line 260 the ball is redrawn in its new location. The program loops to line 190 to execute the whole sequence of ball and paddle movements.

When you run the program in Listing 4, remember to terminate it with Ctrl-Break.

Programming the Housekeeping

Only a few details remain to make *Blockbuster* a working game. The program must check to see if any bricks remain and count the balls as they're lost. Line 150 sets the initial number of balls and bricks. Line 280 reduces the number of balls after each ball is lost and then loops to line 170, which indicates on the screen how many balls remain and terminates the game with the message 'YOU LOST!!!!!' if no balls remain.

In line 250 the number of bricks is reduced each time a brick is hit. If there are no bricks left, the game is terminated with the message 'YOU WON!!!!'. Line 250 also indicates on the screen how many bricks remain.

The program in Listing 5 is *Blockbuster* in its entirety. Review the listing and relate each line to its function as you play. You might also find it worthwhile to follow the program through a few loops by printing variables such as BXINC and BYINC on an unused portion of the screen or on your printer as the game is playing.

You Win!

That's all there is to programming a video game. *Blockbuster* isn't as polished as it might be; we left some rough edges for you to smooth out. The best way to acquire game-making skills is to experiment with the program and redesign the game. You also might want to review the commented version of the program in Listing 6; it may be of use to you in working with the program.

If you graduate to programming games in assembly language, you'll find that the basic principles of game design and implementation are the same. So fool around with *Blockbuster*, or better yet, write your own video game. Using the graphics commands you've learned here, you may be amazed at what you can make your PC do.

Dan Illowsky and Michael Abrash coauthored the Snack Attack II *video game for the IBM PC. Illowsky, author of the original* Snack Attack *for the Apple II, is president of Funtastic, Inc. of Drexel Hill, Pennsylvania. Abrash has written several video games and is an energy consultant with Delphi Energy Group of Philadelphia. The authors are planning to adapt the information in this article for a future book.*

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A Global Exchange of Computer Discoveries

Edited by Andrew Fluegelman

This month's discoveries include an elusive AST command, a *VisiCalc* hybrid, and the rarest BASIC bug ever found. We hope you take advantage of our Star-Dot-Star Disk Incentive Plan introduced in last month's issue. Remember, if you submit your *.* item to us on a PC-DOS disk in standard ASCII or *WordStar*-readable form, we'll return your disk plus an additional free disk as thanks for making our editing job a bit easier.

The Secret AST Switch

I have an AST MegaPlus board with 512K and, of course, make liberal use of RAM drive operation. I have been unable to figure out how to access more than 544K out of the memory installed, as the switch combinations do not go beyond that capacity. This, plus the need to have a certain program install itself in memory below the 512K point, presented a real problem because the AST *Superdrive* program installs its drives in low core. Although the documentation says that core above the switch settings can be used for RAM drives, there is no way to do it.

A call to AST, however, revealed some new information that I want to pass on to all AST owners. Although not mentioned in AST's documentation, a switch in both the *Superdrive* and *Superspool* programs allows you to specify that the drive or spooler be installed only in memory above the switch-set memory capacity. This feature is obtained by adding '/H' to the *Superdrive* or *Superspool* define commands.

'/H' has solved all my problems. I need a 320K drive, a 96K drive, and a 16K spooler, and I need my applications programs to load into core below 512K. So I have set my switches at 480K, and I define the 96K D drive with '/H' so that it is installed beginning at 480K. This leaves room below 512K for the applications programs and also makes full use of the last 32K of previously inaccessible memory. AST's only mistake was not documenting this powerful switch feature.

Bruce Jacobs
Dallas, Texas

dBASE Video

dBASE II displays data being edited in reverse video. A few hours of data entry in this black-on-white mode and you're assured "monitor eyes." Many users avoid the eyestrain by using the SET INTENSITY OFF command. However, there are times when you want some screen enhancement.

Listing 1 is a short program that allows you to reset the PC's display attributes while in *dBASE II*. The byte that specifies the way your monitor displays fields and GET phrases is at location 417 hexadecimal (1047 decimal). By resetting this byte you can use the IBM monochrome monitor's dual intensity, blinking, and underlining capabilities. The POKE command used in the program is not in the *dBASE II* manual, but it works.

Rick Bernauer
Kansas City, Missouri

@LOOKUP @CHOOSE

Have you ever wished you could look up a value from a table in *VisiCalc* by specifying its column and row? During a class I was teaching on *VisiCalc*'s @LOOKUP function, a student asked me if this could be done. At first my reaction was "No, it can't." After some reflection, however, the solution came to me.

The @LOOKUP function is very similar to the actions you take when using the IRS tax tables. To fill in the amount of tax owed, you make a note of the amount of your income, then move to the table area. In the table you look down the column for a match with your income figure, then slide your finger over to the right to find the tax owed. Finally, you put that figure in the appropriate spot on the form. The @LOOKUP function doesn't provide any method of selecting from a second (or third) list of values at the same time.

The missing link is provided by the @CHOOSE function, which provides this ability. When using @CHOOSE, you specify a reference value and a list of values to be chosen from. Based on the value you provide, the *N*th item from the list is chosen. Here is an example in English: choose the third value from this list: 3, 5, 20, 5, 9. In *VisiCalc* you would express it this way:

```
@CHOOSE (3,3,5,20,5,9)
```

Of course, knowing ahead of time which one you want defeats the purpose of using the function. You are interested in *VisiCalc* choosing on the basis of some changeable condition, so indirect references are usually used.

```
@CHOOSE(A2,E5...E20)
```

means that if the value at cell A2 is *N*, get me the *N*th value in the range of cells E5 through E20. If $N = 3$, then I want the value stored in cell E7.

The solution to the problem involved combining these two functions: first LOOKUP the correct row, and then CHOOSE the correct column. Table 1 is a simple illustration

```
**********************************************************
* PROGRAM NAME: DISPLAY.PRG                              *
**********************************************************
* THIS PROGRAM ALLOWS THE USER TO RESET THE IBM PC'S VIDEO   *
* ATTRIBUTES.                                            *
**********************************************************
ERASE
@ 5,5 SAY "THIS PROGRAM ALLOWS YOU TO RESET THE WAY YOUR IBM PC"
@ 6,5 SAY "DISPLAYS DATA FIELDS, GET PHRASES, ETC.
@ 8,5 SAY "JUST PRESS <ENTER> TO LEAVE DISPLAY ATTRIBUTE AS IT IS."
@ 10,10 SAY "1> REVERSE VIDEO"
@ 12,10 SAY "2> HIGH INTENSITY"
@ 14,10 SAY "3> UNDERLINED"
@ 16,10 SAY "4> HIGH INTENSITY UNDERLINED"
@ 18,10 SAY "5> BLINKING"
@ 20,10 SAY "6> NO ENHANCEMENT"
STORE "   " TO CHOICE
@ 23,5 SAY "PLEASE ENTER YOUR CHOICE"
@ 23,30 GET CHOICE
READ
DO CASE
   CASE CHOICE="1"
   POKE 1047,112
   CASE CHOICE="2"
   POKE 1047,15
   CASE CHOICE="3"
   POKE 1047,01
   CASE CHOICE="4"
   POKE 1047,09
   CASE CHOICE="5"
   POKE 1047,135
   CASE CHOICE "6"
   POKE 1047,07
ENDCASE
RETURN
```

Listing 1

of how the formulas would be written. The value at A1 is an integer pointing to the row desired; the value at A2 is an integer pointing to the column desired. Values of 3 in cell A1 and 2 in A2 would result in a value of 51 being inserted in B1.

Recalculating this model manually by pressing the exclamation mark is necessary as there are forward references.

James F. Bartram
Deerfield, New Hampshire

Ctrl-Break Resume

Here is a way to restart the scrolling of a BASIC listing after stopping it with Ctrl-ScrollLock. It may seem trivial, but it has proven my most-used function key when I am programming.

Redefine one of the function keys (e.g., F6) as follows:

```
KEY 6, "LIST .-" + CHR$(13)
```

When you have stopped scrolling a program, you only have to press F6 to start again where you left off, since the period refers to "last line entered" and the minus sign means "and following."

This may not be the best way to do this, but I haven't seen any other.

Keith R. Knox
Washington Island, Wisconsin

.

BASIC Default Switch

Listing 2 should be a help to anyone who has tried to change the default disk drive from within a BASIC program. It works by loading a small machine language routine that performs a DOS interrupt 21.

Kurt F. Wagner
Deerfield Beach, Florida

Capital Conversion

I created a program (Listing 3) that, although not very elegant, is useful in converting files that are in all capitals to capitals with lowercase. I keep a data base of customer files in all uppercase, which is preferred for lists and reports. But when I need to extract data for a *MailMerge* data file such as a form letter, the data should be in the standard format.

The program works with *WordStar* and other ASCII-formatted data files and retains capitals only if they are the first letter in a string or word.

Day Tooley
Portland, Oregon

Scroll Window

If you have ever plotted a graph using BASIC, you must have been disappointed to find that the graph would scroll and start to disappear from view as soon as the cursor reached the bottom of the screen and a carriage return was entered. This makes using the powerful graphics facilities in an interactive manner difficult. How would you like to build a graph interactively or plot a curve and then change the value of a variable or some lines of your program, rerun the program or part of it, and plot the new curve superimposed on the previous one?

There is a very simple way to do this. The method works with the monochrome display or the color graphics board. It applies to text modes as well as to medium- and high-resolution graphics modes. The screen is effectively divided into two areas: graphics and text. The graphics area remains static and unaffected by scrolling, while the text area scrolls in the usual way. You can enter direct commands or make changes to your program in the text area, leaving the graphics area undisturbed.

The top and bottom lines for the scroll window are stored at offsets 91 and 92 of BASIC's data segment. BASIC initializes the byte at offset 91 to the value 1, and the byte at offset 92 to the value 24. These numbers correspond to the 24 lines in which you can control the cursor from the keyboard or in which you can normally enter commands (line 25 is reserved for function key display). BASIC never changes these values after they have been initialized.

You can redefine the top and bottom lines of the scroll window by poking the desired values into these positions. For example,

```
1000 KEY OFF
1020 DEF SEG : POKE 91,20 : POKE 92,25
1030 LOCATE 20
```

allows you to use the lower 6 lines for text (including line 25), while maintaining your artwork unchanged in lines 1 through 19.

Generally, you should define a scroll window large enough to let you display the longest line in your program, the Ok prompt, and an empty line in which you can enter commands. Minimum and maximum values that can be poked into positions 91 and 92 are 1 and 25. In addition, the value poked into 91 must be smaller than the value poked into 92.

If line 25 is included in the scroll window, a KEY OFF statement is necessary. Otherwise the function key definitions will scroll with the rest.

BASIC does not automatically position the cursor within the scroll window. The cursor must be forced into it with a statement such as line 1030 in the above example. Once the cursor has been placed within the scroll window it will remain there unless you explicitly LOCATE to the graphics area.

The Home key moves the cursor to the upper left corner of the scroll window. The CLS command and Ctrl-Home also position the cursor at the upper left corner of the scroll window, but they also clear the entire screen. A convenient way to clear

	A	B	C	D	E
1	*Row Value*	@LOOKUP (A1,A4...A7)			
2	*Column Value*				
3					
4	1	@CHOOSE (A2,C4...E4)	30	31	32
5	2	@CHOOSE (A2,C5...E5)	40	41	42
6	3	@CHOOSE (A2,C6...E6)	50	51	52
7	4	@CHOOSE (A2,C7...E7)	60	61	62

Table 1: @LOOKUP @CHOOSE

```
5     'THIS PROGRAM ALLOWS USER TO SELECT THE DEFAULT DRIVE
20 FOR X%=0 TO 7
30 READ SELDISK%(X%)
40 NEXT X%
45 DATA &H8B55,&H8BEC,&H0676,&H148a,&HOEB4,&H21CD,&HCA5D,&H0002
1000 '
1020 '
1030 '
1040 '         MAIN BODY OF PROGRAM GOES HERE
1050 '
1060 '         MAKE SURE A% IS SET BEFORE THE
1070 '           ROUTINE AT LINE 6000 IS EXECUTED
1080 '
1090 '
1100 '
1110 '
6000    ' CHANGE DEFAULT DISK DRIVE SUBROUTINE
6005    ' A% CONTAINS DRIVE NUMBER (0 FOR A, 1 FOR B, ETC.)
6010 SUBRT%=VARPTR(SELDISK%(0))
6020 CALL SUBRT%(A%)
6030 RETURN
```

Listing 2

only the text area is to dedicate one of the function keys to this purpose by adding the following line:

1040 C$ = CHR$(5) + CHR$(31) : KEY 9,
CHR$(11) + C$ + C$ + C$ + C$ + C$ = C$

There should be as many *C$* entries assigned to the function key as there are lines in the scroll window. Because the key definition is limited to 15 characters, the maximum number of lines for which this will work is seven. If you are willing to sacrifice some speed, you can increase the number of lines to eight by omitting CHR$(11) in the key definition and at the same time replacing CHR$(31) with CHR$(13) in the definition of C$.

The width of the scroll window can also be controlled. The left margin, however, is fixed to column 1. The right margin is obtained from the byte at offset 41 in BASIC's data

```
90   'ASCII CAPITALS TO CAPITAL/lowercase ROUTINE.
100  DEFINT A: CLS: KEY OFF
110  LOCATE 10,10: PRINT "CAPITALS TO CAPITALS/lowercase ROUTINE"
120  LOCATE 13,10: INPUT "ALL CAPITALS WordStar or ASCII filename
     - ";IFN$
130  LOCATE 14,10: INPUT "Converted CAPITAL/lowercase filename -
     ";OFN$
140  OPEN IFN$ FOR INPUT AS #1: OPEN OFN$ FOR OUTPUT AS #2
150  CLS: LOCATE 13,15: PRINT "Working on word beginning with - "
160  B=O
170  WHILE NOT EOF  (1)
180      A1 = ASC(INPUT$(1,1))
190      IF A1 > 127 THEN A1 = A1 - 128
200      IF B<91 THEN GOTO 210 ELSE GOTO 220
210      IF B<65 THEN GOTO 240
220      IF A1>90 OR A1<65 THEN GOTO 240
230      A1 = A1 + 32
240      B = A1
250      A$ = CHR$(A1): PRINT #2, A$;: LOCATE 13,48:IF B<91 THEN
         PRINT CHR$(B)
260      IF A1 = 26 THEN 290 .
270      WEND
280  CLOSE: CLS: LOCATE 13,30: PRINT "Done ... ": BEEP: SYSTEM
```

Listing 3

```
210 DFNUM=29:DIM DP$(29):DIM D$(29):DIM DT$(29)

5231 FOR I=1 TO DFNUM:DT$(I)=D$(I):NEXT

5260 GOSUB 2500:IF Q$=CHR$(27) THEN GOSUB 2655:GOSUB 2655:ABORT=-1
 ELSE IF Q$<>"" THEN DT$(I)=Q$:IF DT$(I)=" " THEN DT$(I)=""

5271 FOR I=1 TO DFNUM:D$(I)=DT$(I):NEXT

9035 IF ERL=5280 THEN BEEP:GOSUB 5295:PRINT TAB(31)"*** Invalid
 communications parameters. Try again.";:EXIT=0:RESUME 5215

9999 DATA 830424
```

Listing 4

segment. This memory position is modified by the WIDTH and SCREEN statements. It normally contains either the value 40 or the value 80, depending on the display mode.

If you wish to modify the width of the scroll window, you can use statements such as

```
DEF SEG : POKE 41,30
```

which would set a width of 30 characters without changing the size of the characters being displayed. The value you poke into 41 must be consistent with the maximum possible number of characters that can be displayed in the display mode active at the time. Before executing a WIDTH or SCREEN statement the byte at offset 41 must be restored to its original value, as there is some interaction between it, the way a statement such as WIDTH 40 is interpreted, and the status of the character generator.

You can enter direct commands or make changes to your program in the text area, leaving the graphics area undisturbed.

Please note that the memory locations given for control of the scroll window are specific to the IBM PC.

O. B. Canobie
Peabody, Massachusetts

```
To create the DOS 1.10 version:

-n kilcolor.com

-e ds:0100  EB 1E 90 00 00 00 00 80  FC 00 75 06 3C 04 74 07

-e ds:0110  24 FE 2E FF 2E 03 01 FE  C0 EB F7 00 00 00 00 00

-e ds:0120  BE 03 01 33 DB 8E C3 8A  1E 4A 01 D1 E3 D1 E3 26

-e ds:0130  8B 07 89 04 26 8B 47 02  89 44 02 A0 4A 01 B4 25

-e ds:0140  BA 07 01 CD 21 BA 20 01  CD 27 10 00

-u 100 14b

XXXX:0100 EB1E          JMP     0120
XXXX:0102 90            NOP
XXXX:0103 0000          ADD     [BX+SI],AL
XXXX:0105 0000          ADD     [BX+SI],AL
XXXX:0107 80FC00        CMP     AH,00
XXXX:010A 7506          JNZ     0112
XXXX:010C 3C04          CMP     AL,04
XXXX:010E 7407          JZ      0117
XXXX:0110 24FE          AND     AL,FE
XXXX:0112 2E            SEG     CS
XXXX:0113 FF2E0301      JMP     L,[0103]
XXXX:0117 FEC0          INC     AL
XXXX:0119 EBF7          JMP     0112
XXXX:011B 0000          ADD     [BX+SI],AL
XXXX:011D 0000          ADD     [BX+SI],AL
XXXX:011F 00BE0301      ADD     [BP+0103],BH
```

Listing 5

PC Stutter

There have been two reported bugs in the first release of *PC-Talk III* (program files dated 3-26-83). Both of them might occur when you are making changes to the program defaults with the Alt-F command.

If you specify changes and then decide that they're not okay, the default menu will display your specified values, even though they have not been put into effect. Also, if you enter an erroneous communications parameter (such as 1300 baud) in the default menu, the program will trap the error, but you will not be able to reenter a new value.

If you're familiar with BASIC, you can make the fix easily yourself, as shown in Listing 4. Four lines should be revised and two lines added. (All new code is represented with underlining.)

All Freeware contributors have been notified of this revision. Thank you to Steve Manes of *PC Magazine* for making and reporting this discovery.

A.F.

Rarest Bug

The following has got to be the most obscure BASIC bug ever reported. There must be some explanation for it; readers are invited to submit their speculations. Our only question is, why put CHR$(217) in a REM statement?

I recently found a bug in IBM BASIC that kept me guessing for a few minutes. While commenting a program, using a single quote instead of REM, I found that my computer gets confused if a '┘' symbol (CHR$(217)) appears in that line.

```
XXXX:0123 33DB         XOR    BX,BX
XXXX:0125 8EC3         MOV    ES,BX
XXXX:0127 8A1E4A01     MOV    BL,[014A]
XXXX:012B D1E3         SHL    BX
XXXX:012D D1E3         SHL    BX
XXXX:012F 26           SEG    ES
XXXX:0130 8B07         MOV    AX,[BX]
XXXX:0132 8904         MOV    [SI],AX
XXXX:0134 26           SEG    ES
XXXX:0135 8B4702       MOV    AX,[BX+02]
XXXX:0138 894402       MOV    [SI+02],AX
XXXX:013B A04A01       MOV    AL,[014A]
XXXX:013E B425         MOV    AH,25
XXXX:0140 BA0701       MOV    DX,0107
XXXX:0143 CD21         INT    21
XXXX:0145 BA2001       MOV    DX,0120
XXXX:0148 CD27         INT    27
XXXX:014A 1000         ADC    [BX+SI],AL

-r bx
BX 0000
:0

-r cx
CX 0000
:4b

-w
Writing 004B bytes

-q
```

When the line is entered, the computer seems to treat anything following that character as BASIC code. Although this bug does not affect execution, a LIST reveals the following points: lowercase letters following a '┘' symbol will be changed to uppercase; if a nonstandard ASCII character (CHR$(128) through CHR$(255)) follows a '┘' symbol, it will disappear; and BASIC key words are converted to single characters.

Ken Nelson
Rancho Cordova, California

Kill Color

This program is for those people who are using a black-and-white monitor with the IBM Color/Graphics Adapter. The problem is that many of the software packages assume that if you have the Color/Graphics Adapter, you have a color monitor connected to it. Therefore the software automatically set the mode to color, causing a terrible display with unreadable text.

Reader Service #108

.

```
To create the DOS 2.00 version:

-n kilcolor.com

-e ds:0100  EB 1E 90 00 00 00 00 80 FC 00 75 06 3C 04 74 07

-e ds:0110  24 FE 2E FF 2E 03 01 FE C0 EB F7 00 00 00 00 00

-e ds:0120  BE 03 01 A0 42 01 B4 35 CD 21 8B C3 89 04 8C C0

-e ds:0130  89 44 02 A0 42 01 B4 25 BA 07 01 CD 21 BA 20 01

-e ds:0140  CD 27 10 00

-u 100 143

XXXX:0100 EB1E          JMP     0120
XXXX:0102 90            NOP
XXXX:0103 0000          ADD     [BX+SI],AL
XXXX:0105 0000          ADD     [BX+SI],AL
XXXX:0107 80FC00        CMP     AH,00
XXXX:010A 7506          JNZ     0112
XXXX:010C 3C04          CMP     AL,04
XXXX:010E 7407          JZ      0117
XXXX:0110 24FE          AND     AL,FE
XXXX:0112 2E            CS:
XXXX:0113 FF2E0301      JMP     FAR [0103]
XXXX:0117 FEC0          INC     AL
XXXX:0119 EBF7          JMP     0112
XXXX:011B 0000          ADD     [BX+SI],AL
XXXX:011D 0000          ADD     [BX+SI],AL
```

Listing 6

Fortunately, many packages ask whether you want color or at least provide a method of changing the default. However, to defend myself from the sloppier programmers who make their programs almost useless by giving me an unreadable display, I wrote the following program to disable color entirely. Even if the program sets the mode to color, the request is changed to black and white.

The program is an interrupt routine that intercepts and modifies calls to the set mode routine of the video I/O package in ROM. When executed, it replaces the current video I/O vector with itself. When the applications program issues a video set mode interrupt, the intercept routine receives it and changes any requests for color to the equivalent black-and-white mode. After modifying the mode, the program branches to the original interrupt vector address, which it has saved. For set-modes to black and white, or for functions other than set-mode, the routine branches to the original routine without changing anything.

This technique causes no permanent damage. The intercept routine goes away the next time the system is booted. If and when you get a color monitor, just stop using the program. It can be added to AUTOEXEC.BAT so that it is always active.

I have written two versions of the program, one for DOS 1.10 and another for DOS 2.00. Logically they are identical, but the 2.00 version is slightly smaller, utilizing a new func-

```
XXXX:011F 00BE0301      ADD     [BP+0103],BH
XXXX:0123 A04201        MOV     AL,[0142]
XXXX:0126 B435          MOV     AH,35
XXXX:0128 CD21          INT     21
XXXX:012A 8BC3          MOV     AX,BX
XXXX:012C 8904          MOV     [SI],AX
XXXX:012E 8CC0          MOV     AX,ES
XXXX:0130 894402        MOV     [SI+02],AX
XXXX:0133 A04201        MOV     AL,[0142]
XXXX:0136 B425          MOV     AH,25
XXXX:0138 BA0701        MOV     DX,0107
XXXX:013B CD21          INT     21
XXXX:013D BA2001        MOV     DX,0120
XXXX:0140 CD27          INT     27
XXXX:0142 1000          ADC     [BX+SI],AL

-r bx
BX 0000
:0

-r cx
CX 0000
:43

-w
Writing 0043 bytes

-q
```

tion call to get the current interrupt vector. This function call didn't exist under 1.10, so it has to be done manually. Microsoft recommends using this new function call. If you have 2.00, use that version.

You can type in the program by hand using the debugger. Put the DOS disk (with the debugger) into drive A and the disk to receive the program into drive B. Make B the default drive and type a:debug. Listings 5 and 6 give instructions for creating the two versions of the program. In each of the listings the lines starting with a dash are the entries you make; the other lines are the responses by the debugger. The output should match. The 'XXXX' can be any hexadecimal number. To run the program type kilcolor <ENTER>.

Wayne Sewell
Garland, Texas

---

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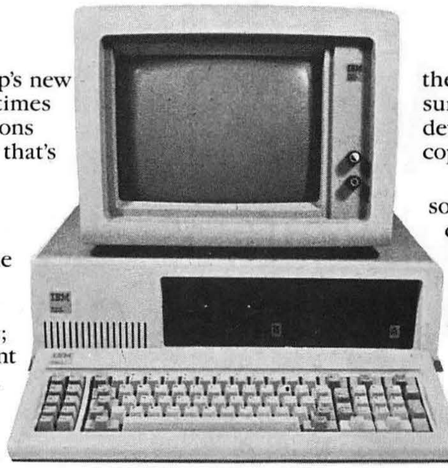

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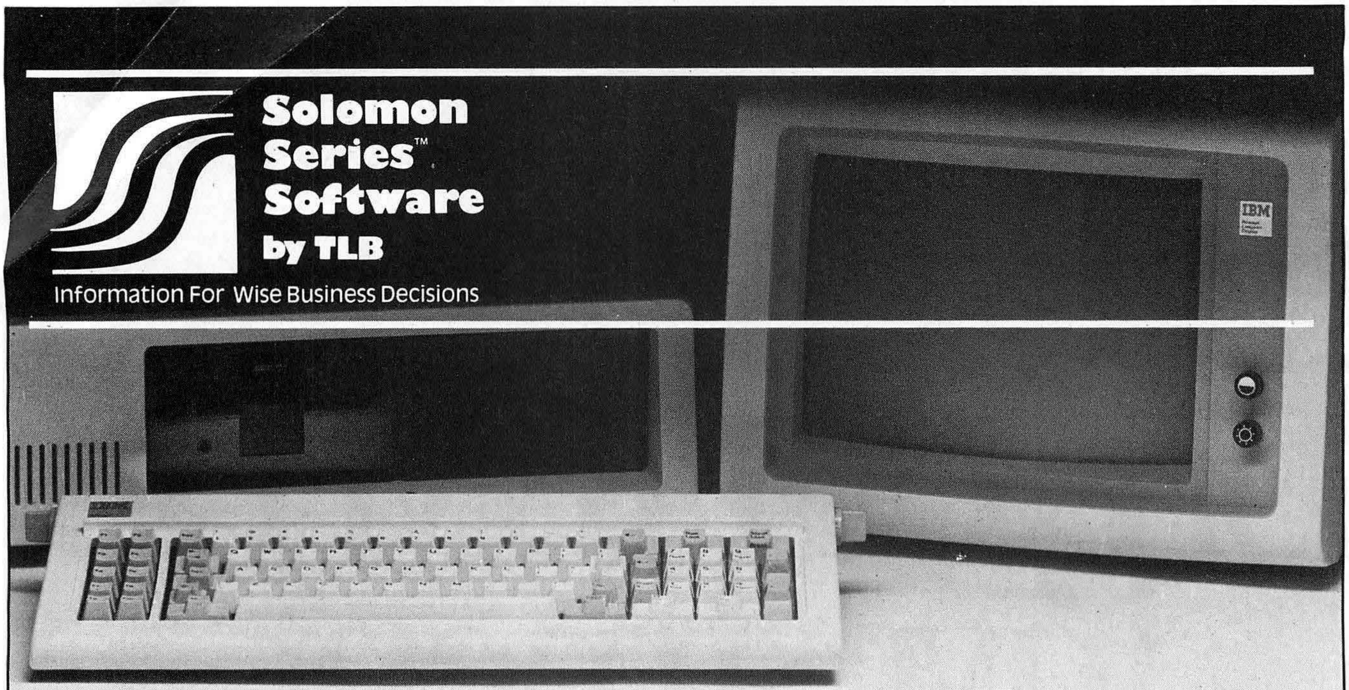

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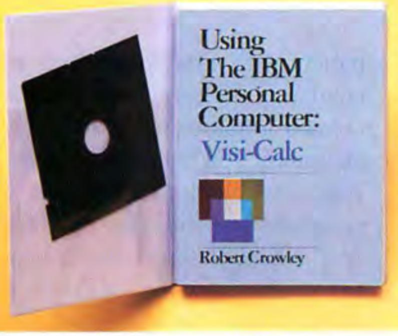

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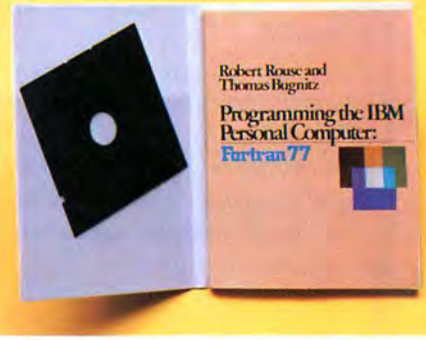

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Psychology and the PC

Edited by Stuart R. Schwartz, M.D.

Psychologists have resisted using computers, particularly if an application appeared to diminish the personal contact that is at the center of their work. Nevertheless, computers are now being used extensively in several areas of the mental health field, including diagnosis, basic psychological research, and the evaluation of health care delivery.

Diagnostic testing in psychology is an arduous and expensive procedure. It takes a psychologist up to six hours to administer the complete battery of psychological tests that may be necessary to clarify a diagnostic issue. Many of these tests, however, such as the Minnesota Multiphasic Inventory (MMPI), are easily given by computer. The machine can provide instantaneous scoring and graphic representation of results. Using decision trees based on an experienced clinician's reasoning, several excellent programs can also interpret these results and generate a narrative summary.

A project instituted at the University of Wisconsin uses a computer to collect information from adolescent patients as a means to augment an initial interview. Some observers have expressed concern about whether patients would be willing to divulge personal and sensitive information to a computer.

One study based on the Wisconsin project revealed, however, that teenagers were quite willing to "talk" to the machine about their use of alcohol and drugs and that this method of interviewing culled as much or more useful information as traditional methods. Another study demonstrated that people readily disclosed problems to the computer. These patients reported that they found being interviewed by the computer less embarrassing than talking to a psychiatrist, even one of the same sex.

A great deal of effort has been put into creating software that can emulate disordered thinking. Dr. Kenneth Colby, a psychoanalyst and psychiatrist working with SRI International in Palo Alto, California, attempted to develop a program that would respond like a patient with a paranoid thinking disorder. A program emulating the responses of a trained psychotherapist was created simultaneously and an effort was made to evaluate interaction between the two programs. The primary stumbling block to the project was the inability of the programs to handle the complexities of natural language. As the field of artificial intelligence brings more linguistics within its scope, advances can be expected. This project, however, succeeded in raising many ethical issues regarding the construction of an "automated psychotherapist."

With the advent of the community mental health center, delivery of mental health services to the population at large has become a complex undertaking. The computer has become central to gathering information that is useful in determining what kinds of services to provide for the diversity of mental health needs in the community.

The following two accounts, one by a psychologist doing research in emotion and brain injuries and the other by a specialist in health care program evaluation, reveal how the personal computer is making its presence felt in the mental health field.

The Damaged Brain

Alan J. Fridlund, Ph.D.

As a staff psychologist at the Martinez Veterans Administration Medical Center in Martinez, California, and as an assistant professor at the California School of Professional Psychology in Berkeley, I maintain a clinical practice while also doing psychological research. My IBM PC has been an integral part of both efforts since I got it over a year ago; its special features, including the 8087 co-processor, have allowed me to take some interesting new directions in my research.

Although a good portion of my PC use is in manuscript writing and editing, I also use the computer for clinical applications. For example, several of the psychological tests I normally administer to patients have been set up for administration and scoring on the PC. Allowing patients to take these tests with a PC gives me more time to analyze the results. The success of these computer tests has led some of my co-workers and me to develop an administration and scoring package for the MMPI. The owners of the MMPI are now evaluating our package for publication.

Of the many advantages of an IBM PC, its fast number-crunching ability using the 8087 co-processor chip was the deciding factor leading me to incorporate the machine in my work. Much of my research involves rapid data collection followed by multivariate statistical analysis. Both of these functions require extensive matrix manipulations that cannot be done by machines less powerful than the 16-bit PC.

Unmasking Emotion

To many people my research work at the Martinez V.A. on the subject of human emotion seems far removed from the world of computers. The PC, however, is an important part of my study. My longstanding interest is in emotion and, more specifically, the detection of the minute physiological changes that occur when we react emotionally or even think of an emotional event. By understanding how we change physiologically in an emotional state, we can learn about the cause and progression of diseases, particularly psychosomatic disorders. For example, at the V.A. we have shown that the detection of tiny electrical discharges from the facial muscles (using a technique known as electromyography) during emotional imagery enables accurate decoding of an emotional state, even though no overt facial expression is recognizable.

> With the CNS we can observe second-by-second where the person's mental strategies work and where they break down.

We now plan to use the PC to collect electromyographic data from patients who have affective disorders such as mania and depression to discover what physiological distortions they might have. Then, using mathematical techniques borrowed from artificial intelligence research, we do "pattern-classification" of the emotional states of these individuals. We began this research using a DEC PDP-11/03 at Yale University, but the 8087-equipped PC should be superior even to the minicomputer. We'll also construct a high-resolution graphics model of the face using the PC graphics capabilities which will enable us to amplify the emotional states of our patients for display on a color monitor.

As our research at the V.A. progresses, we'll add electroencephalographic (brain wave) and autonomic nervous system measures (e.g., sweat gland production, blood flow, heart rate) to the research. For data collection we acquired the Tecmar Lab-Tender card for the analog-to-digital conversions, and we designed and constructed the electrophysiological amplifiers, filters, and integrators required to convert the physiological signals into usable data.

This project has stringent demands for high-resolution graphics, but we're investigating graphics options for the PC that approximate the best medical imaging technologies. Our leading candidate is the Tecmar Graphics Master, which gives a 480- by 640-pixel screen.

Brain Injuries

Outside the V.A. I am beginning a private project in brain damage diagnosis for which the PC will be used extensively. The public is not aware of how great a toll brain injury takes on an individual, his or her family, and society. Brain injury is often the result of an accident, a stroke, or another disease. The recovery process is difficult and is complicated by the lack of good rehabilitation techniques for the intellectual and emotional problems that sometimes result from brain injury. The first step in aiding recovery is knowing precisely what mental strengths and abilities the individual has retained. This creates the need for neuropsychological testing.

In the past psychologists gave verbal functioning and visual-motor coordination tests with pencil and paper to localize areas of brain injury in the central nervous system. Now with CATSCANs, PETSCANs, and other medical imaging technologies used in coordination with neuropsychological tests we can specify exactly what mental (cognitive) and behavioral deficits a patient demonstrates. Knowing this may indicate the person's chance for recovery and the amount of retraining required on the deficient areas.

The CNS

This is where the PC fits in. Our group—which includes two colleagues, Dr. Dean Delis and Dr. Joel Kramer; our consultant, Dr. Edith Kaplan of the Boston V.A.; and I—is working with Life Science Associates of New York to construct a new battery of PC-oriented neuropsychological tests. We call the battery the California Neuropsychological System (CNS).

The CNS is the first neuropsychological assessment tool designed explicitly for the computer. Moreover, it's the first neuropsychological battery to exploit fully the "process" approach to neuropsychology, which emphasizes not only whether an individual can or cannot do a particular task, but also how he or she does it (and people are quite creative in figuring out ways to to compensate for a deficit). So a continual challenge has been to include within the CNS software the capability to analyze the strategies that an individual uses when asked to deal with a particular task.

Integral to the CNS is a custom, color graphics work station. The examinee sits at this assessment console and is presented with a variety of tasks, some verbally oriented and others visually oriented (the latter look much like video games). The examinee communicates with the computer using a light pen. The computer in turn provides continual speech feedback to the patient. The examiner has a console as well, which at any point can provide tallies and percentages regarding the examinee's performance.

To implement certain features of the CNS our group has had to look to state-of-the-art technology. For example, we are currently working closely with a San Diego company on a custom light pen that will allow extremely high-resolution detection of the point on the screen at which the patient is drawing, without any of the false detections and with limited sensitivity to prior pen designs. Also, for our many patients who have limited movement, we're using alternative input devices, including the mouse.

Saving Time with the PC

The development of the CNS has taken us beyond the limits of traditional neuropsychological tests. In the past we had the examinee respond to photographs, drawings, and printed words, but this testing simulated real-world conditions poorly. With the CNS, however, we can produce many kinds of graphics—moving points of light and colored paths for the examinee to track and simulated three-dimensional figures that rotate in space—all with the aim of presenting the examinee with realistic and demanding situations.

A thorough neuropsychological assessment once took hours or even days, since it was necessary to administer a battery of neuropsychological tests and then pore over the results looking for broad deficits. With the CNS we can rapidly administer a wide range of tests and let the PC make the complex analyses the clinician used to do by hand. By making the testing less time consuming (and thus less expensive), we can make this kind of assessment available to patients who couldn't otherwise afford it.

With the CNS we can observe second-by-second the individual's responses to the tasks offered, showing us where the person's mental strategies work and where they break down. And even here the CNS makes the work easy for the clinician; the detailed response data is stored for later retrieval, enabling the responses to be more close analyzed.

Components of the CNS are now being field tested in medical centers nationwide. We soon hope to validate these components as usable tests for assessing brain injuries or dysfunctions. With our colleague, Dr. Matt Blusewicz, we expect to provide within the CNS a variety of rehabilitation tasks that directly follow the system's fundamental assessment tasks. This complete CNS will help people relearn skills and extend their level of functioning.

We hope our system will help confirm that computer-aided neurodiagnosis and psychodiagnosis, along with computer-implemented programs of cognitive rehabilitation, are the wave of the future.

More Efficient Mental Health Care

Michael Glish, Ph.D.

Keeping good records at a mental health center is crucial to evaluating treatment effectiveness. The center administrators must know how many patients are being treated, how long these patients have been in treatment, how many are getting better or worse, and how much it costs to provide various levels of care. The program evaluators must analyze these records as the comptroller of a corporation might to see if the center is well managed and effective.

Knowing patient conditions and the impact of treatment is not the only aspect that requires evaluation. The resources of a mental health center must be carefully managed to provide care to the greatest number in need of its services. This means that therapist productivity must be monitored, bills must be sent out and collected, and the cost of services must be calculated. If revenues are too low, the decision has to be made to increase billing rates or cut back services.

MIS

Computerized management information systems (MIS) have been used for years by program evaluators to perform these functions. As part of my postdoctoral training in program evaluation I designed an MIS that was used by a mental health center and by the psychiatry department of a local hospital. Each place had a caseload of several thousand patients and delivered millions of dollars of services annually. The total cost of data entry and time-sharing was high but was considered reasonable given the increase in efficiency over manual data collection methods and the increased timeliness of evaluation reports.

On Smaller Systems

Only after a chance encounter on the commuter train did I consider using microcomputers in my work. A woman sitting next to me was reading a familiar book on program evaluation. She was the director of a local social service agency and her budget was up for renewal. She was researching program evaluation techniques that would demonstrate her agency's effectiveness and thereby increase the odds that her budget would be renewed.

After telling her about the success of my MIS, I suggested that such a system might meet her needs. But when she heard how much its time-sharing charges were, she immediately ruled it out. We discussed the possibility of using a personal computer for her small program, and I suggested she visit a computer store for the appropriate prepackaged software.

Mental health centers are, in effect, small businesses; their product is the treatment of mental disorders, their customer the patient.

Confident that I had steered a colleague down the Yellow Brick Road of increased efficiency and productivity, I became curious about those software packages that I was sure were available for social service agencies. After visiting a few local computer stores and reading numerous computer and psychology magazines, I found the answer: there weren't any.

Close, but No Cigar

There were billing programs, data base management systems, and even a few psychological testing programs. But there was no single integrated system that could replace the mainframe MIS I'd developed.

My trip to the store did show me that the hardware capacity of the smaller computers was not as limited as I had thought. For instance, the total disk storage requirements of each agency using my system were less than 10 megabytes, something easily handled by hard disk drives.

My effort to find an information system for mental health programs was not a complete failure. In fact, it was this search that caused me to reorient my work toward microcomputers.

The Business

Mental health centers are, in effect, small businesses; their product is the treatment of mental disorders, their customer the patient. Like any other business, a center has a staff to be paid, facilities to be managed, and a charge for services rendered. Terms such as accounts receivable and payable, payroll, and billing are as familiar to a mental health program manager as they are to a hardware store manager.

Although most centers operate on a nonprofit basis, revenue collection is a very important aspect of the business. Some government funding is added to the operating budgets of most centers, but the bulk of the funds that pay the rent and the staff come from fee-for-service charges billed directly to patients or their insurance companies. Money must be collected for all services rendered or else the business slides into the red.

But the nature of the mental health center's product and the state of the art of psychological treatment are such that business-oriented software is not easily adapted for the mental health setting. Unlike a business run for profit, a mental health program can't be judged effective solely by its balance sheet.

There are specific techniques for assessing psychological problems, evaluating treatment outcomes, and determining overall program effectiveness. Need assessments determine the level of need in a community for mental health services. Continuity-of-care studies look at whether patients are moving from a high level of care, such as a psychiatric hospital, to lower levels of care in outpatient clinics. Close watch is kept on the recidivism rate, or the number of patients who have a relapse and must return to the hospital. And age, sex, ethnicity, and patient diagnosis data are compared with the corresponding data of others in the service area to assure that all groups of people are being adequately served.

Business software products are suitable for the business aspects of running a mental health center, but they do not adequately address program evaluation techniques. Products are needed that specifically incorporate these program evaluation techniques. But even if this kind of software were readily available, it probably would not be sold at your friendly neighborhood computer store; the potential market is too small for such products to compete for shelf space with word processing, business, and entertainment software.

System Support

The lack of industry-specific software is not the only unmet need: support is often more important than the product itself. Most mental health professionals don't know the first thing about computers and are unwilling to convert their manual billing and information systems until they are sure that expert help is available. The expertise they need must include an intimate knowledge of how mental health centers are run, as well as the ability to translate the human service business approach into a computer solution that works.

Why the PC?

As someone who speaks both mental health and computer languages, I was confident I could make an important contribution. I chose the IBM Personal Computer to support me in my new venture. My clients can afford to purchase and maintain the PC, and it has the capacity to handle the workloads of small- to medium-size agencies. It also has a hard disk available. Finally, I chose the PC because it has a large software base from which my clients could easily find prepackaged solutions for their needs. The IBM fit all these requirements better than any computer I considered.

As my primary application development tool I chose *dBASE II* by Ashton-Tate for its power, flexibility, and ease of use. Ashton-Tate sells a run-time version of *dBASE II* for only $100, so it's easy for me to package a system at a reasonable cost without having to pass along the expense of the entire package. "On time and under budget" is an important goal in system development, especially when your client has a limited budget, as is often the case with social service agencies.

I became a psychologist because I wanted to help people. My colleagues, however, wonder why I sit in front of a computer screen most of the day. But I am helping people as surely as if I were sitting in front of a patient or a classroom of students. With my help, agencies are now delivering better mental health care services to more of the people who need those services. And we couldn't do it without the PC.

Alan J. Fridlund is a clinical psychophysiologist at the Martinez Veterans Administration Medical Center in Martinez, California, and an assistant professor of psychology at the California School of Professional Psychology in Berkeley. Michael Glish is the director of program evaluation at Northeast Mental Health Center in San Francisco and a program evaluation consultant.

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First Debugging

A novice programmer immerses himself in the microworld.

David Sudnow

I bought my IBM Personal Computer to do word processing. Awarded a contract to write a book on video games, my deadline was tight and the time ripe. Addicted to the IBM Selectric for years, its keyboard as intimate a part of my bodily space as the piano's (I play jazz and write about the acquisition of skill), there was no question that I'd get an IBM PC. And

When a novice copies a listing, it's like typing foreign language text.

it was only a matter of days after I'd unpacked the machine before I was quite at ease with it and the *Volkswriter* word processing program.

Now, one year and a book later, determined not to let this ergonomic masterpiece go unused between writing projects, I've decided to learn about programming and to keep track of the nature of that experience at the same time. My first evening at the task gave me a glimpse of what computer programming entails and the fascination that the process obviously holds.

With a book in hand on how to program the IBM PC, I spent a couple of hours working over a few primitive BASIC functions such as displaying characters at certain locations on the screen, working with elementary equations, and learning how to have 1 through 100 squared by writing 'For A = 1 TO 100; PRINT A^2; NEXT A'. Kid's stuff (although computers make using this phrase obsolete). Playing around with numbers, I got a certain kick out of watching thousands of figures fly by and seeing how quickly exponents get large.

After a short while, however, that sort of electronic magic lost its appeal, and then, while browsing through the BASIC manual, I came upon the SOUND statement. I knew of the little speaker on the PC from those annoying bleeps accompanying warning messages in my word processing program, but I didn't know you could program it. Here I'm told that this SOUND statement, followed by two numbers, produces a tone—my first chance at computer music.

SOUND and Sense

The statement takes the form

```
SOUND X, Y
```

in which *X* assumes values in cycles per second to define a tone's frequency (e.g., concert A = 440), while *Y* is expressed in "clock ticks" to define duration. A table in the BASIC manual made sense of these clock ticks (18.2 of them per second), which are related to some built-in timing device or cycle within the computer. In any case, if you type

```
SOUND 440, 18.2
```

you get a second's worth of concert A. If you type

```
SOUND 1500, 1.5
```

for example, you get a much faster high tone. I spent a few minutes generating different notes with these one liners and then noticed how a sample program in the manual said to produce a glissando:

```
10   FOR X = 440 TO 1000 STEP 5
20   SOUND X, 0.5
30   NEXT X
40   FOR X = 1000 TO 440 STEP -5
50   SOUND X, 0.5
60   NEXT X
```

I copied it with care, ran it (you're speaking the lingo in one night), and sure enough, a glissando. How neat. Statements combine to produce widening possibilities. I could envision all the need for complexity you'd ever want. For about half an hour I experimented with the rising half, lines 10 through 30, writing dozens of three-statement programs, assigning different values for *X*, different incremental steps for ascending a sequence, and different durations. I tried to generate a chromatic scale from 440 to 880 with 12 equal intervals. I played around with long, low tones and especially enjoyed one mistake I made by typing RUN on a numbered program line, rather than on its own line, so that the sequence kept repeating.

After a while I took a break, had some dinner, and then came back to the machine. At some point during the course of the next hour I wrote:

```
10   FOR X = 1000 TO 300 STEP 10
20   SOUND X, 4.0
30   NEXT X
```

I typed RUN and the computer responded Ok, the BASIC prompt, ready for the next instruction. Ok, my hat. It wasn't Ok, so I typed it again. Again that insistent Ok—no tone, no sound, let alone the descending scale it should have produced. Maybe I punctuated incorrectly, so I did it again, and yet again.

> Languages are really systems of movements to be grasped by eyes and hands.

How odd to repeat the self-same entry several times—a carry over from the machine age. Try the starter once more. Wait a minute, give things a chance to settle down, and then give it another go. You figure something hasn't registered, the connection is weak, needs better contact. Maybe you didn't strike the ENTER key with the right force. There's my perfectly good statement, can't see a thing wrong with it, so it's got to be in the mechanism. Fat chance. I couldn't tell what was wrong. It worked fine before dinner. Perhaps 4.0 was an inappropriate duration, so I tried out a plain 'SOUND 1000,4.0', and sure enough got a high-pitched tone. The 4.0 part was acceptable. Try the whole thing again, with the FOR...NEXT. Still nothing. I hadn't the slightest clue.

You can sit in front of the console and go nuts on such occasions. Things look fine. You break down some of the elements and they work, even break down things you know perfectly well are proper, but put it together and you've still got that insolent, instantaneous Ok. I stared at the screen like an idiot. It's times like this that you start talking to your machine.

In a few minutes I came upon it. Vacantly perusing the manual, I was befuddled and peeved, looking with a nondirected, transfixed gaze at the whole thing, not line by line, but with that gaze that never feels like problem solving and turns out to solve many nonetheless. Looking at the problem in that unmotivated way, my eyes fell on the sample listing again. The minus sign in 'STEP -5' on line 40 suddenly made an appearance, popped out at me as though a spotlight had hit it. Of course, the numbers are decrementing, so you've got to have the minus. That the computer doesn't read 1000 to 100 and know to step backward probably has to do with organizational considerations at some programming level. Decrementing sequences in FOR...NEXT statements must be negatively signed, and that's that—a rule, a convention, how things must look. Yes, that's the best way to put it.

I retyped 'FOR X = 1000 TO 300 STEP -10', and naturally got my descending scale.

Landscape of Signs

Many first-time users try out a few programs that are beyond their understanding just so they can get something sophisticated happening on their new machines. I'd copied the glissando listing a few hours before to hear my computer do its music thing, not to understand the logical structure of the operations. And when copying it, I wasn't taking action with symbols whose use I understood or speaking the lines; I was just reproducing a string of sights, character by character. The first time through the listing that minus sign was merely arbitrary punctuation, a figure to be accurately copied, a little dash on the page. When a novice copies a listing, it's like typing foreign language text.

This time I was ready to see it, not because I searched around with a question that a minus sign might answer, though in the instant I spotted it I naturally knew just how its logic fit the meaning of a decrementing progression. I hadn't the faintest idea what I was looking for, wasn't really looking for anything, and there it was, a little piece of paper quivering with relevance, an incongruous fragment against a background of growing familiarity with the correct look of those FOR, NEXT, STEP, and SOUND statements.

Seeing that minus sign, I didn't discover a rule so much as a detail of how things must look, now waiting there to show itself to me. The "pointless" repetitions, mindless copying of a sample program, and experimental routines with changing values established a microcontext of sights and moves, a perceptual ground that yielded up that missing sign, spotlighting it on the page. The little strips of programming action take on increasing specificity through repeated play, and handling expressions at the keyboard with growing fluidity lets you see their form with deeper refinement. What at first was no more than a series of seemingly senseless marks gets slowly integrated into a connected gesture of movements and sights.

As trivial as such discovery procedures may seem, their implications for learning are important. In the days to follow my first BASIC evening, I've encountered many similar situations, coming to competently see and use commands through a mixture of systematic and haphazard experimentation, moving back and forth between direct, problem-solving research and diffuse searching, with many repetitions at the keyboard and browsing through the landscape of signs and their consequences.

At first I figured there was little point in copying someone else's programs. After all, you want to understand, but understanding means more than grasping the logical structure of a command—it means immersing oneself in a world of new perceptual events. I keep coming upon new details as much by wandering up an alleyway till I get stuck, as by moving through a strict problem-solving exercise. Perhaps different styles of programming emerge out of different paths in this respect, and with them different kinds of programs.

Exploring the Microworld

The computer, the manuals, and the program listings make up a little *Umwelt,* as animal ethologists put it, an environment, a surrounding of connected sights, movements, and sounds in which our human bodies must look and feel. Computer languages and command routines are presented in manuals as logically structured expressions to be acquired by way of definition and assembled according to the rules of a formal syntax.

While that's one valid description, in the course of that often mentioned, yet seldom discussed hands-on experience, these languages are really systems of movements to be grasped by eyes and hands. Their sense and competent use of them is a problem for the entire body, not just the so-called thinking parts. I'm waiting for the programming manual that bypasses formal definitions altogether, that trains by successive scale such as repetitions, gradually increasing possibilities without announcing the rule, so that you can just watch new things happen on the screen while you go over and over routines with minor variations and expansions. Maybe I'll write that one myself someday.

Meanwhile, I'll play with SOUND, manuals in hand, and try lots of free-form experimentation. Why not learn about the machine and the language in the context of an already established interest? Most guidebooks would have me do elementary business problems or freshman-level sociological tables. Surely the complex ways one can concisely manipulate sequences of numerically described sounds must in principle invite extensive use of different programming structures.

> Why not learn about the machine and the language in the context of an already established interest?

Perhaps I could work my way through BASIC just staying with SOUND, making melodies whose nature grows out of and reflects that of BASIC and the PC. As I practice my scales, improvise, learn how to see and grasp possibilities while composing by number, I'll try to deepen my understanding of the mysterious learning process by keeping an eye on it as I go along.

David Sudnow is a former sociology professor and Guggenheim Fellow and the author of numerous articles and books including Ways of the Hand: The Organization of Improvised Conduct *and* Pilgrim in the Microworld. *He is currently writing a book based on his programming experiences with the IBM PC.*

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BASIC Boggler

Test your BASIC knowledge.

Steven P. d'Adolf

Wordfind puzzles can be entertaining and educational. The following puzzle was generated on an IBM PC using a program written in BASIC. The program uses an algorithmic approach for part of its operations and then a brute force trial-and-error method to fit as many words into the puzzle as possible.

See if you can find the 51 IBM PC BASIC functions, statements, and commands hidden in this puzzle. Only words of four or more letters are to be considered. Words may read up, down, forward, backward, or diagonally.

If your memory needs jogging, check the list of the 51 BASIC words used in the puzzle. The complete solution to the puzzle is on page 327.

Steven P. d'Adolf is a freelance writer, electronic engineer, and computer hobbyist. He is in the process of moving from El Paso to San Diego.

D	D	C	L	P	T	I	A	W	N	N	Y	K	D	T
D	K	R	O	I	E	H	H	E	S	O	L	C	S	A
A	I	T	A	N	N	T	E	W	S	H	I	I	U	T
E	L	I	H	W	T	E	S	L	G	P	L	T	B	N
R	L	G	K	E	E	P	L	D	A	N	O	S	P	I
V	E	N	R	R	N	P	E	I	A	J	S	D	Y	O
S	F	S	M	S	Y	F	N	M	P	D	A	F	P	P
O	Q	C	E	E	S	T	E	P	L	T	E	I	E	E
P	P	S	E	T	L	F	L	L	A	C	M	N	B	D
L	R	L	R	O	I	K	K	Z	Y	W	U	P	U	I
V	R	O	C	E	N	R	U	T	E	R	S	U	S	T
O	O	A	L	J	N	P	R	M	X	G	E	T	O	P
H	T	D	N	E	P	O	M	U	N	E	R	V	G	O
E	O	O	G	P	F	K	R	R	T	I	N	E	A	T
Z	M	N	G	F	P	E	V	T	G	Q	F	Z	M	S

Basic Boggler help words:

AUTO	OPEN
CALL	OPTION
CLOSE	PAINT
CONT	PEEK
CSNG	PLAY
DATA	POINT
DEFSNG	POKE
DEFSTR	PSET
DRAW	READ
EDIT	RENUM
ELSE	RESET
FIELD	RESUME
GOSUB	RETURN
GOTO	RSET
INPUT	SAVE
KILL	STEP
LINE	STICK
LIST	STOP
LOAD	STRIG
LOCATE	SWAP
LPOS	THEN
LSET	TROFF
MERGE	TRON
MOTOR	WAIT
NAME	WHILE
NEXT	

The BASIC Boggler Solution is on page 327.

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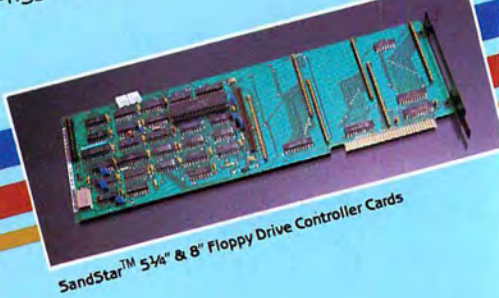

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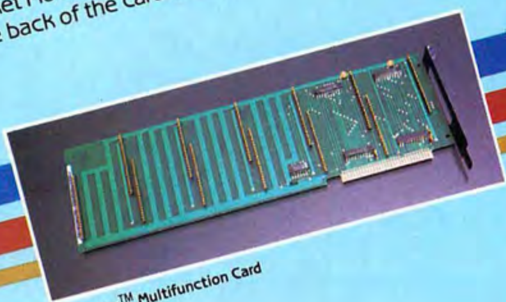

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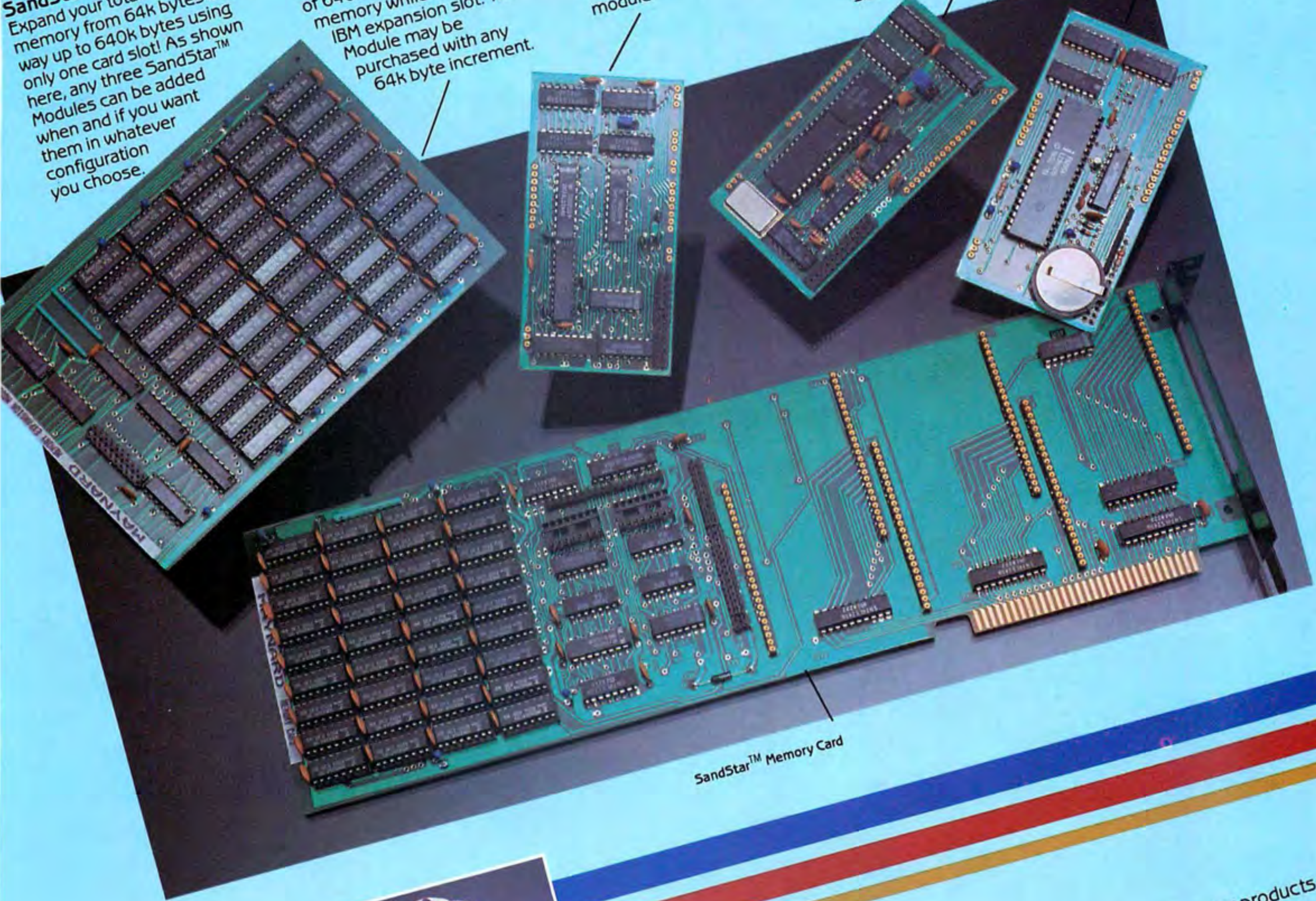

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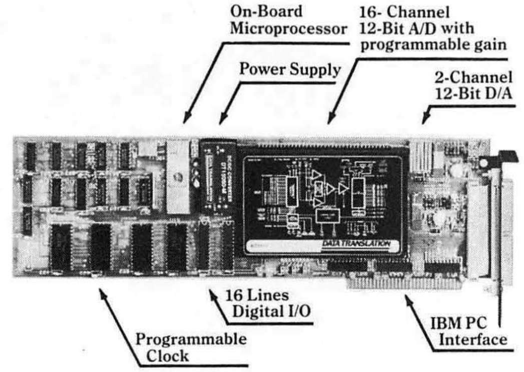

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BBS Watch

CompuServe's Newest Bulletin Board

Gene Plantz

"Your bulletin board is always busy!" Most Systems Operators (SYSOPs) are used to hearing this complaint. The major disadvantage of a single-line bulletin board is that only one caller at a time can access the system.

As an example, an average telephone call to my bulletin board lasts 25 minutes, so my system can serve only about 57 callers a day. I am sure that more than 57 people try to access my BBS every day, but I imagine that they give up in frustration after hearing repeated busy signals.

Frustrated BBS callers take heart! This time *BBS Watch* examines a bulletin board for IBM PC users that handles hundreds of callers simultaneously. This bulletin board has been on-line since January but is already a very popular system. In its first two months of operation it had almost 11,000 callers and accumulated more than 200 program files for transfer. This ever-ready IBM PC bulletin board is found on CompuServe.

Time-Sharing Computers

CompuServe and other time-sharing services maintain hundreds of data bases that subscribers can access with telephones and modems. CompuServe offers subscribers features such as electronic editions of four major United States newspapers, stories from international wire services, updated stock market quotations, home shopping, and games. The service charges customers a one-time membership fee of $20 to $40, depending on which starter kit is purchased. Subscribers are issued identification numbers and passwords that they use each time they access the service.

CompuServe may be used during prime time (8 a.m. to 6 p.m. weekdays) or standard time (6 p.m. to 5 a.m. weekdays and 24 hours weekends). Prime-time usage is by contract only; subscribers using 300 baud modems are charged $22.50 per hour, while subscribers using 1200 baud modems are charged $35 per hour. Prime-time users pay a $45 monthly minimum charge. Standard-time subscribers using 300 baud modems pay $5 per hour, while users with 1200 baud modems pay $17.50 per hour. Standard-time users pay no monthly minimum. All rates exclude local telephone charges.

> File transferring is one of the most popular features of any BBS.

Because CompuServe maintains its own phone network, most people can dial a local phone number to connect with the service. If you live in the continental United States and are in an area not covered by CompuServe's network, you can use another telephone network called TYMNET. CompuServe charges $2 per hour for using TYMNET.

Special-Interest BBSs

When you dial CompuServe you are asked to enter your identification number and password. After a short pause the main service menu is displayed. If you want to go directly to the bulletin board menu, type `GO PCS50` after the prompt at the bottom of the service menu. Your computer then displays the following menu of special-interest groups (SIGs):

Personal Computing SIGS

1	CP/M SIG	11	ST-80 Users
2	HUG (Heath)	12	TeleComm Now
3	MAUG (Apple)	13	CEM SIG
4	MNET-11(H11)	14	Author Forum
5	MUSUS = Pascal	15	Commodore
6	RCA p-System	16	Atari SIG
7	TRS80 COCO	17	IBM PC SIG
8	Panasonic	18	OSI SIG
9	MNET80 TRS80	19	Instructions
10	LDOS TRS80	20	Descriptions

Input a number or key
<ENTER> for more choices

These SIG bulletin boards are used by people who have the same personal computer or share a common interest in a computer-related topic.

MAUG, the MicroNet Apple Users' Group, shares information on Apple computers and Apple-compatible programs. Members of the HUG bulletin board swap tales about their Heath computers. The CP/M SIG is made up of people interested in this popular operating system. They discuss CP/M-based software and the use of computers that support the system. TeleComm callers keep up to date on telecommunications for personal computers.

If you need more information about these groups, option 20 provides a complete description of the subjects covered by the 18 special-interest bulletin boards. Option 19 gives information about joining one or more groups.

The IBM PC BBS

Menu option 17 connects you to the IBM PC bulletin board. The first time you call this BBS the system asks your name and whether you want to be added to the membership list. A yes reply gives you full access to the program library and other files on the bulletin board. A negative response allows you to read messages but prohibits you from transferring files.

When you log on the IBM PC BBS, the welcome message looks like this:

```
Welcome to IBM PC SIG, V. 1A(46)
Name:        Gene Plantz 70040,245
Last on:     11-Apr-83   22:34:40
High msg#: 4321
You are user number 10412
System contains messages
4033 to   4377
You have a message waiting:
  #: 4341        Sec. 8 - Ask the SYSOPs
 Sb: #4309-big xfer
     12-Apr-83   01:02:25
 Fm: Bill Harts   70315,201
```

The information indicates the date and time of your last call to the BBS, the highest message number on the system during that call, the system's current low and high message numbers, and the number, subject, and sender of any messages addressed to you. The message alert is a welcome feature; such a notice saves you from having to search through all the messages to find your own.

After reading your welcome message, press ENTER to display the main SIG function menu:

```
IBM PC SIG
Function menu:
1  (L)     Leave a message
2  (R)     Read messages
3  (RN)    Read new messages
4  (RM)    Read waiting messages
5  (B)     Read bulletins
6  (CO)    Online conference
9  (OP)    Change your SIG options
0  (E)     Exit from this SIG
Enter selection or H for help:
```

The function menu isn't always the same, because it displays only features that pertain to each caller. For example, if you did not have a message addressed to you on the system, option 4 (RM) would not appear on the menu.

The first five options on this function menu are common to most bulletin board systems, but numbers 6 and 9 are unique to multiline bulletin boards. This BBS has been designed to prompt you for any information it requires to complete the commands.

Option 1 (L) allows you to write and leave a message on the system. The system permits user-to-user messages, messages to the SYSOPs (four SYSOPs maintain this BBS), for sale notices, and general information messages and requests.

Option 2 (R) permits you to read all but confidential messages on the system. With this option you can request to see one specific message or all messages on the system.

Option 3 (RN) displays only messages placed on the system since your last telephone call.

Option 4 (RM) displays messages addressed to you. If you are notified of a message when you log on the system, this is the first option you should choose.

Option 5 (B) displays the BBS bulletins, which are messages created by the SYSOPs. These bulletins inform callers about such things as new features on the BBS or changes in program files.

Option 6 (CO) allows you to explore the communications capabilities of a multiline BBS. This feature permits direct communications with other on-line users who have also chosen the CO option. Messages that you type are immediately received by the other conference option users. The SYSOPs periodically hold on-line conferences in which they answer questions from BBS users. These conferences can be "attended" by hundreds of users. The date and time of a conference are usually posted in a system bulletin well in advance.

Option 9 (OP) changes the display settings of the data sent to your terminal. For example, you can use this option to tell the BBS how much data your terminal displays on one line of your monitor.

File Transfers

File transferring is one of the most popular features of any BBS. The CompuServe IBM PC bulletin board has an extensive list of program files (see "BBS of the Month"). Since this BBS is available to many more people than single-line bulletin boards, the programs found on this system are usually not available on local, single-line BBSs. Programs using PC-DOS 2.00 are already a common sight on the CompuServe system. One SYSOP said that he expects to see more of these programs on the BBS as well as information about changes required to make other programs work properly with DOS 2.00.

The file transfer process begins at the function menu. Instead of choosing one of the options, type XA. This command takes you into the file transfer section of the BBS and displays the following file transfer menu.

```
SIG Database Access System
Use ? for help
SIG/Access:
Valid commands:
PUB  -  retrieve from public ACCESS
NOR  -  normal SIG access
XA   -  change to new database
CAT  -  catalog
TYP  -  type a file
DOW  -  download a file
KEY  -  search keyword list
SUB  -  submit a file
DEL  -  delete a file
EXI  -  exit from ACCESS
HEL  -  explains ACCESS
? xxx   -  explain command xxx
SIG/Access:
```

The transfer files are divided into nine data bases that must be viewed one at a time. The files for downloading are in data bases 0 through 7. Data base 8 is reserved for uploading programs. To get a catalog of the contents of data base 0, type in the command CAT. The list that appears shows the sizes of the files, the upload dates, the number of accesses, and the dates files were last accessed. To get a more complete description of the files, type the command CAT/DES. This command gives you a description of the programs and an explanation of how to use them.

If you want to view other data bases, issue the XA command. When the system asks you which data base you want to see, type the data base number, and the list you want will appear on the screen.

To transfer a program to your computer, prepare your communications program to receive an ASCII file and then issue the command

TYP filename.filetype

This command starts the file transfer; you can see the program on your screen as it is transmitted.

Currently, the CompuServe BBS sends and receives files in ASCII format only. However, one SYSOP said that he hopes the system will soon support full binary file transfer.

CompuServe's bulletin board is a bargain.

When you want to log off the system, use Option 0 (E) from the function menu to leave the IBM PC BBS and return to the Personal Computing SIGs menu. Once you have returned to that menu, you can log off the system by typing the command OFF. Unless you properly log off CompuServe, you can be charged for extra hookup time by the service.

CompuServe's bulletin board is a bargain for the PC user who wants to keep up to date on the latest PC news and build a library of interesting programs. And to top it off you don't have to put up with a busy signal.

Send correspondence to Gene Plantz, P.O. Box 95638, Hoffman Estates, IL 60195. CompuServe: EMAIL 70040,245; Source: SMAIL STG476.

IBM PC Bulletin Boards

Following is a partial listing of the IBM PC bulletin boards on-line in the United States. The list is updated as the author receives information about new bulletin boards.

213/649-1489
Culver City, California
SYSOP: George Peck
24 hrs, download & upload, messages

213/390-3239
Source: TCG147
Santa Monica, California
SYSOP: Marc Schoenberg
24 hrs, download & upload, 10 M disk, 300/1200

215/250-0173
Easton, Pennsylvania
SYSOP: Jerry Lotto
24 hrs, download & upload, 300

301/949-8848
Rockville, Maryland
SYSOP: Rich Schinnell
24 hrs, download & upload
(Passwd = IBMPC)

301/251-6293
Gaithersburg, Maryland
SYSOP: Larry Jordan
24 hrs, communications info
(Passwd = IBMPC)

301/460-0538
Bethesda, Maryland
SYSOP: Ramona Landberg
24 hrs, upload newsletter articles

301/937-4339
Beltsville, Maryland
Small People Software
SYSOP: Chet Rhodes
24 hrs, games, messages

312/259-8086
Chicago, Illinois
SYSOP: Gene Plantz
(PCMODEM)
24 hrs, download & upload,
messages, 300/1200

312/376-7598
Chicago, Illinois
SYSOP: Pete Coniceak
24 hrs, download & upload,
messages, 300

416/499-7023
Toronto, Canada
SYSOP: Doug Peel
24hrs, download & upload,
messages, 300/1200

608/262-4939
Madison, Wisconsin
PC Users Group
SYSOP: Read Gilgen
5 p.m. to 8 a.m. weekdays,
5 p.m. Fri. to 8 a.m. Mon.,
download & upload,
messages

703/680-5220
Dale City, Virginia
Dale City Info Exchange
SYSOP: Tim Mullins
24 hrs, news, new product
review—all PCs

703/560-7803
Vienna, Virginia
ABBS with IBM PC
Conference
24 hrs, download & upload,
messages

703/978-0921
Fairfax, Virginia
SYSOP: Bruce Churchill
(Hostcomm)
24 hrs, software eval/purchase
(Passwd = IBMPC)

703/978-9592
Fairfax, Virginia
SYSOP: Don Withrow
(Hostcomm)
24 hrs, download & upload,
tips
(Passwd = IBMPC)

716/836-6964
Buffalo, New York
SYSOP: Bob Taylor

913/842-5749
Lawrence, Kansas
24 hrs, download & upload,
messages

800/848-8199
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BBS of the Month

The CompuServe IBM PC bulletin board offers subscribers a variety of programs for file transfer. This month's listing is a sample of some of the utility programs available for downloading from the CompuServe files.

Name of File	Date Uploaded	Size in Bytes	Comments
TIMEON.BAS	02–Feb–83	1410	Sets the time and date from the Hayes Chronograph through a serial port.
WORDY.BAS	15–Feb–83	1280	BASIC program that allows creation of text files (25 lines) that may be edited using EDLIN or any other ASCII text processor. Allows you to use the BASIC editing functions on a small text file.
SDIR.ASM	24–Mar–83	15680	A disassembled (and commented) version of the sorted directory program for DOS 1.10. This version downloaded from Rich Schinnell's Capital PC Software Exchange BBS.
SDIR.ERR	04–Apr–83	475	Describes an error in the SDIR.ASM file relating to properly handled "hidden" files.
SDIR22.ASM	10–Apr–83	17960	An updated version of the unassembler Sorted Directory program that includes support for DOS 2.00.
UNSQ11.PAS	30–Jan–83	5080	Version 1.10 of the UNSQUEEZE utility for the IBM PC. This IBM Pascal program allows you to download squeezed files from the many remote CP/M systems around the country and then unsqueeze them on your PC. Save $$$ in connect time and long-distance charges! Cannot be used with CompuServe files. Written and contributed by Scott Loftesness.

CAPTUR.ASM	03–Feb–83	5185	Source for trivial print-to-disk routine. Installs itself; requires reboot after use; must be reassembled to change buffer size.
CLOCKC.BAS	01–Feb–83	6005	BASIC program to modify COMMAND.COM for residency. See RESCMD.DOC.
DEBUG.TXT	01–Feb–83	2425	Description of DEBUG change to fix HEX file bug.
INT10.ASM	03–Feb–83	1310	Sample assembly routine to allow high-level programs to invoke the video functions (interrupt 10 is the video service).
MODEM.DOC	01–Feb–83	7660	Documentation of MODEM 3.0 and Christensen protocol.
ONEFOR.BAS	01–Feb–83	2990	BASIC program to modify FORMAT for single execution. See ONEFOR.DOC.
ONEFOR.DOC	01–Feb–83	4510	Documentation of FORMAT command modulations.
RAM160.ASM	26–Apr–83	8505	Electronic disk for DOS 2.00—160K version.
RAM180.ASM	26–Apr–83	8510	Electronic disk for DOS 2.00—180K version.
RAM320.ASM	26–Apr–83	8520	Electronic disk for DOS 2.00—320K version.
RAM360.ASM	26–Apr–83	8510	Electronic disk for DOS 2.00—360K version.
RESCMD.DOC	01–Feb–83	5170	Description of resident mods for COMMAND.COM 1.10.
RESVCM.BAS	01–Feb–83	2875	BASIC program to modify COMMAND.COM for residency. See RESCMD.DOC.

SDHEX.IBM	01–Feb–83	2785	Sorted directory program.
TWOFOR.BAT	01–Feb–83	40	Sample batch file for ONEFOR (format) command. See ONEFOR.DOC.
VDISK.ASM	30–Mar–83	8725	Source for RAM drive device driver; similar to example in DOS 2.00 manual.
VOLSER.DOC	16–Mar–83	2360	Documentation for volume labeler VOLSER.HEX.
VOLSER.HEX	16–Mar–83	2400	Volume labeler (DOS 2.00); see VOLSER.DOC.
CLOCK.BAS	28–Jan–83	7430	A fun novelty program to turn your PC into a very expensive digital alarm clock. Requires the color/graphics card and BASICA.
DIR.BAS	29–Mar–83	19570	A program to aid in cataloging your disk files. Entries may be made via keyboard or direct reading of a disk's directory. Stores up to 1000 entries. Sorted output is available. Program is (and should be) directly compilable. Was written for 128K, two (160K) drives, printer, and color (80-column) monitor, but should run OK on the monochrome.
DIR.DOC	29–Mar–83	910	Documentation for DIR.BAS.
GRAFGE.BAS	28–Jan–83	8330	An IBM utility program that allows the definition and saving of the top 128 characters accessed by the CHR$(X) function in BASIC. The program only works in screen 1 or screen 2, and therefore requires the color/graphics card.
GRAFGE.DOC	30–Jan–83	1860	Documentation for GRAFGE.BAS and a BASIC program for loading character sets created and saved by GRAFGE.BAS.

TIMER.BAS	26–Apr–83	2520	A simple BASIC file to demonstrate the BASIC 2.00 function TIMER. The program will sound an alarm after either a given time has been reached or a given amount of time has elapsed. Requires DOS 2.00.
SOUNDS.BAS	10–Feb–83	4695	Introductory program to using the 8253 timer chip for better sound generation on the IBM PC.
STAR3D.ASM	02–Feb–83	2340	Source listing for three-dimensional starplot program in assembly language.
STAR3D.HEX	02–Feb–83	5300	Hex format for three-dimensional starplot program. Must be converted to .EXE format to run.
STAR3D.TXT	02–Feb–83	925	Instructions on how to run the three-dimensional starplot program.

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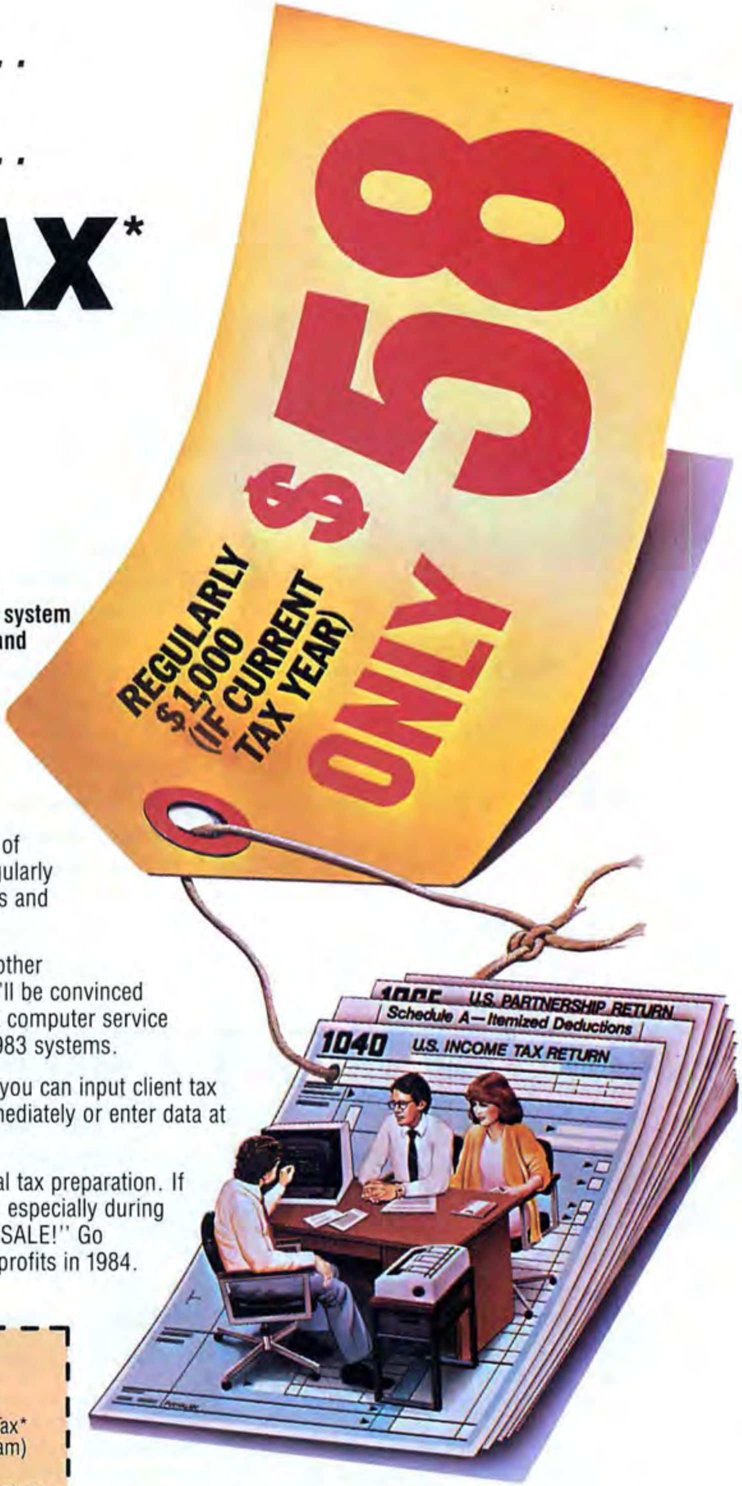

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Reader Service #36

User Group Dispatch

Raise Your Hand Please

Harry J. Foxwell

When a user group grows too large to determine the composition and interests of the membership by a simple show of hands, it might be time to conduct a survey.

It's the third Monday of the month, the day I go directly from work to the Capital PC User Group monthly meeting. I want to arrive early so I can purchase this month's Software Exchange disk before a big line forms at the sales table outside the meeting room. In the latest issue of Capital PC's newsletter, the *Monitor,* the software librarian announced that this month's disk contains some new DOS utility programs contributed by other groups.

I arrive at 6:30 p.m., a full hour before the meeting is scheduled to start, and there are already 30 or 40 people in line for disks. A crowd of 100 or more is noisily milling around at the Buying Group tables, waiting to pick up the software, memory boards, and blank disks they ordered at last month's meeting. By the doorway to the auditorium Ramona Landberg, our newsletter editor, is signing up new members and selling back issues. So much for coming early.

At 7 p.m., my disk finally in hand, I enter the auditorium. Almost all of the 350 seats are taken. Mike Todd, president of Capital PC, is standing up front trailing a microphone cable, congenially fielding questions from the attentive audience.

"How do I get *WordStar* to do subscripts and superscripts on my Diablo printer?" asks a grey-haired man from the back of the room. Mike responds by repeating the question and asking if any other members have this combination of hardware and software and can offer a solution. A few people raise their hands in answer, and Mike tells the questioner to seek them out after the meeting.

A boy in his teens asks, "What are null characters, and why does the electronic bulletin board program ask me how many nulls I want to use?" Mike carefully explains how nulls are used to control the timing of characters sent by the program to the receiving computer. I find a seat and casually reread my newsletter, half listening for some useful tidbit of information or a question of interest.

> When the group was small, each member knew all the other members by name and knew their special interests.

At 8 p.m. Mike firmly terminates the question period and introduces the topics for tonight's formal presentation. For the next hour or so I listen to Larry Jordan explain his *HostComm* program for the PC and to Wes Merchant reviewing the SPS/BBS telecommunications software package. This is followed by a big-screen demonstration of Microsoft's now-famous *Flight Simulator* program.

It's now well after 9 p.m. and Mike adjourns the meeting, announcing the gathering places for the special interest groups (SIGs). "The Games SIG will meet in the left rear of the auditorium. The Advanced SIG will meet in the cafeteria. The Pascal SIG..." His voice fades into the post-meeting commotion. My Statistics SIG doesn't meet tonight, so I head for the door, talking with other members as we work our way through the crowd.

Although it's late when I finally arrive home, I can't resist the urge to look at the new addition to my growing library of programs from Capital PC's Software Exchange. My fellow members are almost certainly at their PCs right now with their new disks in the drives.

Capital PC's Survey

The Capital PC User Group is a fortuitous combination of talented volunteers and PC owners who have insatiable appetites for information about their computers. The organization grew from about two dozen pioneering IBM PC owners in early 1982 to a membership that will probably exceed 2000 before the end of 1983.

When the group was small, each member knew all the other members by name and knew their special interests. When the membership topped 1000 in January 1983, the club officers resorted to a survey to find out who members were and what kinds of information they were seeking. The four-page survey questionnaire was designed to gather demographic information, to determine members' interests, to ascertain the types of software and hardware used by members, and to seek presentation suggestions for future meetings. (See the "Capital PC User Group Survey" and results on the following right-hand pages.)

About 270 of the 400 members who attended the January 1983

Capital PC User Group Survey

At the January 17, 1983 general meeting of the Capital PC User Group 400 survey questionnaires were distributed to the attendees. At the end of the meeting 268 completed questionnaires were returned. The questionnaire was also available on the PCUG electronic bulletin board. Five members obtained copies by this method and returned them by mail.

Twenty-five percent of the 1100 PCUG members responded to the survey. The questionnaire data was tabulated using an IBM Personal Computer and the Survtab *survey analysis package. The tables included with this article represent data from some of the survey questions.*

If you own an IBM Personal Computer or use one at work, please complete this survey form. The results of this survey are to be used by the Capital PC User Group for information purposes only. The information collected will be analyzed by the Statistics Special Interest Group of Capital PC, and the results will be reported in the Capital PC *Monitor.*

Please be as accurate as possible in answering the following questions. More than one answer may be appropriate for some questions.

1. **Are you a member of Capital PC?** yes [ ] no [ ]

2. **How many IBM Personal Computers do you (or your family) own?** 2[ ]

3. **How many IBM Personal Computers does your employer own (that you are aware of)?** 3[ ]

4. **For what purposes do you use your IBM PC? (Check all that apply.)**
   Business that existed before the PC ..... 4.1[ ]
   Business that exists because of or since I got the PC .... 4.2[ ]
   Entertainment (games) (of kids 3a[ ], adults 3b[ ]) .... 4.3[ ]
   Household (checkbook, budget, files, etc.) .... 4.4[ ]
   Software development .... 4.5[ ]
   Education (of kids 6a[ ], adults 6b[ ]) .... 4.6[ ]
   Other. Please describe briefly:
   ______________________________ 4.7[ ]

5. **Of the time you spend on the PC, approximately what proportion do you spend on the following applications?**
   Word processing .... 5.1[ ]%
   Data base management .... 5.2[ ]%
   Education .... 5.3[ ]%
   Programming .... 5.4[ ]%
   Spreadsheet .... 5.5[ ]%
   Communications .... 5.6[ ]%
   Games .... 5.7[ ]%
   Other .... 5.8[ ]%

6. **What other microcomputers did you own before buying the IBM PC? (Check all that apply.)**

Apple	6.01[ ]	DEC	6.08[ ]
Commodore	6.02[ ]	TRS	6.09[ ]
Atari	6.03[ ]	H/P	6.10[ ]
Xerox	6.04[ ]	TI	6.11[ ]
Sinclair	6.05[ ]	Other	6.12[ ]
Heath	6.06[ ]	None	6.13[ ]
Osborne	6.07[ ]		

7. **Where did you buy your IBM PC?**____________
   ____
   (If from a chain, please include location.)

8. **From what dealer have you gotten the best service?**
   ComputerLand .... 8.1[ ]
   Math Box .... 8.2[ ]
   Learning Tree .... 8.3[ ]
   Sears .... 8.4[ ]
   Entre .... 8.5[ ]

meeting completed and returned the questionnaire. The respondents represented about one-quarter of the membership at the time of the survey.

The results of the survey show that Capital PC members are a well-educated and affluent group. Over half the respondents have advanced university degrees, and 60 percent reported annual family incomes of $50,000 or more. One out of eight respondents is a woman, a ratio that will bear watching as the membership grows. More than half the respondents are over 40.

Most of the respondents had not owned a personal computer before they bought an IBM PC; about 80 percent already knew how to program before purchasing their machines, and about half said their employers had one or more IBM PCs.

At the time of the survey over 40 percent of the respondents had monochrome monitors, over 30 percent had color monitors, and 20 percent had both. While less than half had telecommunications equipment for their PCs, nearly all who did not planned to add it to their systems. Members are upgrading their systems so rapidly, however, that information about their PCs gathered by the survey will soon be out of date.

About 60 percent of the respondents have more than 64K of main memory in their computers. A few have computers with almost a full megabyte of memory. Most of the memory upgrades were accomplished with the Quadram Quadboard or the AST ComboPlus, both of which were available to members through the club's Buying Group.

Less than 5 percent of the group uses the CP/M-86 operating system. Digital Research has recently cut the price of this software, however, so PC owners who don't like PC-DOS now have a reasonably priced alternative.

There are, apparently, quite a few entrepreneurs within the Capital PC User Group. In reply to the question, "For what purpose do you use your IBM PC?" more than 40 percent checked the box beside the response, "Business that exists because of or since I got the PC." Members do not limit the use of their computers to business, however. Other frequently mentioned uses were entertainment, household, and education.

Members Want Education

The survey included questions on the kind of activities members wanted the group to sponsor. The most popular choice was instruction in assembly language programming. Classes and meeting presentations on communications, graphics, and data base software were also frequently mentioned.

The Capital PC User Group continues to draw 400 to 500 people to its regular meetings and is growing by nearly 100 new members each month. How has it accomplished so much in little more than a year? The answer seems to be quality meeting presentations, sharing of public domain software, an active Buying Group, and lots of hard work by knowledgeable volunteers.

Harry Foxwell is a statistician for the American Chemical Society in Washington, D.C. He is chairman of the Capital PC Statistics SIG and the author of several statistical programs for the IBM PC.

In future issues of PC World, User Group Dispatch *will feature articles by user group members on software libraries, buying clubs, special interest groups, and other user group activities. If you are interested in contributing, write to Anna Bunker,* User Group Dispatch, PC World, *555 De Haro St., San Francisco, CA 94107.*

User Group Directory

PC World publishes a User Group Directory every month. If your group is not in this list but would like to be, send the group's name, address, contact, and other information to *User Group Dispatch, PC World,* 555 De Haro St., San Francisco, CA 94107.

Alabama
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Birmingham, AL 35209
205/942-8085

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Lisa May
United Systems Corporation
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Tempe, AZ 85283
602/831-9363

IBM PC User Group
Theresa Baudier
711 E. River Front Dr.
Tucson, AZ 85719
602/622-4751

IBM Product Center .... 8.6[ ]
Frederick Computer .... 8.7[ ]
Systems International .... 8.8[ ]
Other .... 8.9[ ]
No preference .... 8.10[ ]

9. **What characteristics of the IBM PC most influenced your decision to buy that computer? (Check all that apply.)**
Cost .... 9.01[ ]
The IBM name .... 9.02[ ]
Color graphics .... 9.03[ ]
User group support .... 9.04[ ]
Available software .... 9.05[ ]
Quality of design .... 9.06[ ]
Eye appeal .... 9.07[ ]
Memory capacity .... 9.08[ ]
Raw computing power .... 9.09[ ]
Languages available .... 9.10[ ]
Mass storage capacity .... 9.11[ ]
Availability of compatible equipment ... 9.12[ ]
Microprocessor used (Intel 8088, 16 bit) .... 9.13[ ]
Keyboard (function keys, numeric keypad, feel) .... 9.14[ ]
Quality of the monochrome display .... 9.15[ ]
Perception that this was a "business" machine .... 9.16[ ]
Other (explain briefly) .... 9.17[ ]

10. **What kind of display adapter do you have on your PC?**
Monochrome .... 10.1[ ]
Color graphics .... 10.2[ ]
Both monochrome and color .... 10.3[ ]
Other (please describe) .... 10.4[ ]

11. **Please indicate the type of monitor that you use (U) with your IBM PC, and what type of monitor you plan to purchase (P) for use with your PC in the next year. (Mark all that apply).**
Black-and-white composite .... 11.1[ ]
Green-and-black composite .... 11.2[ ]
Television set .... 11.3[ ]
IBM monochrome .... 11.4[ ]
Other monochrome .... 11.5[ ]
Composite color .... 11.6[ ]
RGB color .... 11.7[ ]
Other .... 11.8[ ]

12. **Which operating systems do you use with your IBM PC? (Check all that apply.)**
PC-DOS 1.0 or 1.05 .... 12.1[ ]
PC-DOS 1.10 .... 12.2[ ]
MS-DOS .... 12.3[ ]
CP/M-86 .... 12.4[ ]
UCSD-p .... 12.5[ ]
Other .... 12.6[ ]

13. **What type of printer do you use with your IBM PC? (Check all that apply.)**
Letter quality .... 13.1[ ]
Epson MX-80 .... 13.2[ ]
IBM PC printer .... 13.3[ ]
Epson MX-100 .... 13.4[ ]
Other dot matrix .... 13.5[ ]

14. **How many expansion slots in your IBM PC are empty?** 14[ ]

15. **What type of memory expansion board do you have in your IBM PC?**
IBM 64K .... 15.01[ ]
IBM 256K .... 15.02[ ]
IBM 512K .... 15.03[ ]
Microsoft .... 15.04[ ]
Tecmar .... 15.05[ ]
Tall Tree .... 15.06[ ]
Davong .... 15.07[ ]
APSTEK .... 15.08[ ]
Quadram Quadboard .... 15.09[ ]
Quadram memory only .... 15.10[ ]
Seattle Computer .... 15.11[ ]
AST Research .... 15.12[ ]
Memory Technology .... 15.13[ ]
MBI MEGRAM .... 15.14[ ]
Other .... 15.15[ ]
None .... 15.16[ ]

16. **How much random access memory:**
was in your IBM PC when you bought it? .... 16.1[ ]K

Phoenix Personal Computer Club
Fred Lynch
P.O. Box 44218
Phoenix, AZ 85064
602/266-6634

California
Diablo Valley PC
Al Hunt
1415 Oakland Blvd. #101
Walnut Creek, CA 94596
415/687-8037

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San Francisco IBM PC Users Group
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Santa Barbara City College Computer Science Department
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Silicon Valley Computer Society
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Rich Paterson
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IBM PC User Club of Stamford
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Southeastern Connecticut IBM PC Users Group
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Wilmington, DE 19899

District of Columbia
Capital PC
Janet Withrow
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IBMICRO
Mike Todd
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202/433-4380

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Manasota IBM PC User's Group
Richard Reynolds
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Bradenton, FL 33529
813/792-5400

Hawaii
Hawaii IBM PC User Group
Doug Long
P.O. Box 22967
Honolulu, HI 96822
808/735-5769

do you have in your IBM PC now? . 16.2[ ]K
do you eventually plan to have in
your IBM PC? .... 16.3[ ]K

17. Do you have a hard disk with your IBM PC?
yes 17.1[ ]
no 17.2[ ]
What type?____________________
Megabyte capacity .... 17.3[ ]
Are you happy with it? .... yes 17.4[ ]
no 17.5[ ]

18. Did you know a programming language before buying the PC? yes 18.1[ ]
no 18.2[ ]

19. Would you be interested in attending one of the following courses taught by a qualified instructor at a cost of $75 or less? Please check those that you might attend.
Word processing .... 19.01[ ]
Accounting .... 19.02[ ]
Communications .... 19.03[ ]
BASIC programming .... 19.04[ ]
Macro Assembler .... 19.05[ ]
Graphics .... 19.06[ ]
Combination of above .... 19.07[ ]
Spreadsheet .... 19.08[ ]
Data base .... 19.09[ ]
Pascal .... 19.10[ ]
FORTRAN .... 19.11[ ]
COBOL .... 19.12[ ]
None of the above .... 19.13[ ]

20. Please indicate the types of programs you would like to see at Capital PC monthly meetings. (Check all that apply.)
Spreadsheet .... 20.1[ ]
Word processing .... 20.2[ ]
Communications .... 20.3[ ]
Software marketing .... 20.4[ ]
Programming .... 20.5[ ]
Games .... 20.6[ ]
Graphics .... 20.7[ ]
Other (specify)________________20.8[ ]

21. Please indicate below the status of your use of asynchronous communications:
Do you presently use communications?
yes 21.1[ ]
no 21.2[ ]
Do you plan to use communications eventually?
yes 21.3[ ]
no 21.4[ ]

22. What is your age?

Under 20	22.1[ ]	40–49	22.4[ ]
20–29	22.2[ ]	50–59	22.5[ ]
30–39	22.3[ ]	60 & over	22.6[ ]

23. Your sex? Male 23.1[ ]
Female 23.2[ ]

24. What is your education level?
Some high school without diploma .... 24.1[ ]
High school diploma or equivalent .... 24.2[ ]
Some college .... 24.3[ ]
Bachelor's degree .... 24.4[ ]
Master's degree .... 24.5[ ]
Ph.D. .... 24.6[ ]

25. How many people are in the organization in which you work?
Federal agency .... 25.1[ ]
Self-employed .... 25.2[ ]
Less than 10 .... 25.3[ ]
11–100 .... 25.4[ ]
101–1000 .... 25.5[ ]
Over 1000 .... 25.6[ ]
Don't know .... 25.7[ ]

26. What is your annual family income?
Less than $20,000 .... 26.1[ ]
$21,000–$30,000 .... 26.2[ ]
$31,000–$40,000 .... 26.3[ ]
$41,000–$50,000 .... 26.4[ ]
$51,000–$60,000 .... 26.5[ ]
$61,000–$70,000 .... 26.6[ ]
Over $70,000 .... 26.7[ ]

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IBM PC User Group
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515/967-5880

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Topeka Library User Group
Becky Hinton
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Miller Microcomputer Services
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Shrewsbury, MA 01545

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IBM PC Users' Group—Minneapolis
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Minneapolis, MN 55403

New Jersey
North Jersey IBM PC Club
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New York, NY 10036
212/869-5066

Personna Computer Association
The Int'l Association for the PC
Paul Cowan
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Point Pleasant, NJ 08742
201/840-0300

New York

Long Island Computer Association
Marvin Freifeld
3 Lindron Ave.
Smithtown, NY 11787
516/724-0574

Manhattan IBM Micro Club
Helaine Head
360 Central Park West
New York, NY 10025
212/222-9027

Course Interest (question 19, all respondents):

Course Interest	Percentage	No. of Respondents
Word Processing	9.9%	27
Accounting	5.9%	16
Communications	20.1%	55
BASIC	12.5%	34
Macro	33.7%	92
Graphics	24.2%	66
Spreadsheets	9.9%	27
Data Base	19.0%	52
Pascal	13.9%	38
FORTRAN	2.6%	7
COBOL	3.3%	9
None	18.7%	51

Desired Meeting Programs (questions 20, all respondents):

Desired Meeting Programs	Percentage	No. of Respondents
Spreadsheet	41.8%	114
Word Processing	41.0%	112
Communications	57.1%	156
Software Marketing	34.1%	93
Programming	53.1%	145
Games	27.5%	75
Graphics	53.1%	145
Other	5.5%	15

Individual PCs by Employer PCs (questions 2 and 3, all respondents):

	Member Owned							
Employer Owned	One	Two	Three	Four	Five+	No Resp	Row Total	
One	38	0	0	0	0	5	43	Count
	88.4%	0.0%	0.0%	0.0%	0.0%	11.6%	100.0%	% of Row
	15.8%	0.0%	0.0%	0.0%	0.0%	26.3%	15.8%	% of Column
Two	12	1	0	0	0	1	14	
	85.7%	7.1%	0.0%	0.0%	0.0%	7.1%	100.0%	
	5.0%	10.0%	0.0%	0.0%	0.0%	5.3%	5.1%	
Three	6	0	0	0	0	3	9	
	66.7%	0.0%	0.0%	0.0%	0.0%	33.3%	100.0%	
	2.5%	0.0%	0.0%	0.0%	0.0%	15.8%	3.3%	
Four	5	1	0	0	0	2	8	
	62.5%	12.5%	0.0%	0.0%	0.0%	25.0%	100.0%	
	2.1%	10.0%	0.0%	0.0%	0.0%	10.5%	2.9%	
Five+	46	3	0	1	0	4	54	
	85.2%	5.6%	0.0%	1.9%	0.0%	7.4%	100.0%	
	19.1%	30.0%	0.0%	100.0%	0.0%	21.1%	19.8%	
No Response	134	5	1	0	1	4	145	
	92.4%	3.4%	0.7%	0.0%	0.7%	2.8%	100.0%	
	55.6%	50.0%	100.0%	0.0%	100.0%	21.1%	53.1%	
Column Total	241	10	1	1	1	19	273	
	88.3%	3.7%	0.4%	0.4%	0.4%	7.0%	100.0%	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

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Communications Use and Planned Communications Use (question 21, all respondents):

Use Communications	Count	Percentage of Respondents	Plan to Use Communications	Count	Percentage of Respondents
Yes	111	40.7%	Yes	139	90.8%
No	153	56.0%	No	7	4.6%
No Response	9	3.3%	No Response	7	4.6%
Total	273	100.0%	Total	153	100.0%

Education by Income (questions 24 and 26, members only):

Income	HS	Some Coll	Bach	Mast	PhD	No Resp	Row Total	
<$20k	0	0	4	0	2	0	6	Count
	0.0%	0.0%	66.7%	0.0%	33.3%	0.0%	100.0%	% of Row
	0.0%	0.0%	5.3%	0.0%	4.3%	0.0%	2.4%	% of Column
$21–30k	0	2	6	2	2	0	12	
	0.0%	16.7%	50.0%	16.7%	16.7%	0.0%	100.0%	
	0.0%	7.1%	7.9%	2.1%	4.3%	0.0%	4.7%	
$31–40k	0	3	11	8	5	0	27	
	0.0%	11.1%	40.7%	29.6%	18.5%	0.0%	100.0%	
	0.0%	10.7%	14.5%	8.5%	10.6%	0.0%	10.7%	
$41–50k	1	6	8	22	7	0	44	
	2.3%	13.6%	18.2%	50.0%	15.9%	0.0%	100.0%	
	50.0%	21.4%	10.5%	23.4%	14.9%	0.0%	17.4%	
$51–60k	1	9	18	16	10	0	54	
	1.9%	16.7%	33.3%	29.6%	18.5%	0.0%	100.0%	
	50.0%	32.1%	23.7%	17.0%	21.3%	0.0%	21.3%	
$61–70k	0	2	9	15	2	0	28	
	0.0%	7.1%	32.1%	53.6%	7.1%	0.0%	100.0%	
	0.0%	7.1%	11.8%	16.0%	4.3%	0.0%	11.1%	
$71+	0	4	13	27	17	0	61	
	0.0%	6.6%	21.3%	44.3%	27.9%	0.0%	100.0%	
	0.0%	14.3%	17.1%	28.7%	36.2%	0.0%	24.1%	
No Response	0	2	7	4	2	6	21	
	0.0%	9.5%	33.3%	19.0%	9.5%	28.6%	100.0%	
	0.0%	7.1%	9.2%	4.3%	4.3%	100.0%	8.3%	
Column Total	2	28	76	94	47	6	253	
	0.8%	11.1%	30.0%	37.2%	18.6%	2.4%	100.0%	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

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Membership by Know How to Program (questions 1 and 18):

	Know Programming				
Member	Yes	No	No Resp	Row Total	
Yes	195	51	7	253	Count
	77.1%	20.2%	2.8%	100.0%	% of Row
	92.9%	92.7%	87.5%	92.7%	% of Column
No	15	4	1	20	
	75.0%	20.0%	5.0%	100.0%	
	7.1%	7.3%	12.5%	7.3%	
Column Total	210	55	8	273	
	76.9%	20.1%	2.9%	100.0%	
	100.0%	100.0%	100.0%	100.0%	

Age by Sex (question 23, members only):

Age	Men	Women	No Resp	Row Total	
<20	1	0	0	1	Count
	100.0%	0.0%	0.0%	100.0%	% of Row
	0.5%	0.0%	0.0%	0.4%	% of Column
20–29	17	4	1	22	
	77.3%	18.2%	4.5%	100.0%	
	8.1%	12.5%	8.3%	8.7%	
30–39	84	14	1	99	
	84.8%	14.1%	1.0%	100.0%	
	40.2%	43.8%	8.3%	39.1%	
40–49	69	8	5	82	
	84.1%	9.8%	6.1%	100.0%	
	33.0%	25.0%	41.7%	32.4%	
50–59	26	5	1	32	
	81.3%	15.6%	3.1%	100.0%	
	12.4%	15.6%	8.3%	12.6%	
60+	11	1	0	12	
	91.7%	8.3%	0.0%	100.0%	
	5.3%	3.1%	0.0%	4.7%	
No Resp	1	0	4	5	
	20.0%	0.0%	80.0%	100.0%	
	0.5%	0.0%	33.3%	2.0%	
Column Total	209	32	12	253	
	82.6%	12.6%	4.7%	100.0%	
	100.0%	100.0%	100.0%	100.0%	

Operating Systems (question 12, all respondents):

Operating System	Percentage	No. of Respondents
PC-DOS 1.0	8.1%	22
PC-DOS 1.10	83.9%	229
MS-DOS	5.1%	14
CP/M-86	3.7%	10
UCSD p-System	5.1%	14
Other	1.1%	3

Printers (question 13, all respondents):

Printer	Percentage	No. of Respondents
Letter Quality	19.8%	54
Epson MX-80	25.6%	70
IBM PC	17.9%	49
Epson MX-100	19.8%	54
Other Dot Matrix	13.6%	37

IBM PC Uses (question 4, all respondents):

Purpose	Percentage	No. of Respondents
Business	53.8%	147
PC Business	42.9%	117
Fun	41.0%	112
House	49.5%	135
Software Development	57.1%	156
Education	32.6%	89
Other	15.8%	43

Display Adapters (question 10, all respondents):

Display Adapter	Percentage	No. of Respondents
Mono	43.2%	118
Color	31.5%	86
Both	20.5%	56
Other	0.7%	2
No Response	4.0%	11

BASIC Boggler Solution from page 293.

D	D	C	L	P	T	I	A	W	N	N	Y	K	D	T
D	K	R	O	I	E	H	H	E	S	O	L	C	S	A
A	I	T	A	N	N	T	E	W	S	H	I	I	U	T
E	L	I	H	W	T	E	S	L	G	P	L	T	B	N
R	L	G	K	E	E	P	L	D	A	N	O	S	P	I
V	E	N	R	R	N	P	E	I	A	J	S	D	Y	O
S	F	S	M	S	Y	F	N	M	P	D	A	F	P	P
O	Q	C	E	E	S	T	E	P	L	T	E	I	E	E
P	P	S	E	T	L	F	L	L	A	C	M	N	B	D
L	R	L	R	O	I	K	K	Z	Y	W	U	P	U	I
V	R	O	C	E	N	R	U	T	E	R	S	U	S	T
O	O	A	L	J	N	P	R	M	X	G	E	T	O	P
H	T	D	N	E	P	O	M	U	N	E	R	V	G	O
E	O	O	G	P	F	K	R	R	T	I	N	E	A	T
Z	M	N	G	F	P	E	V	T	G	Q	F	Z	M	S

PC World Day on Tape

If you missed PC World Day at the West Coast Computer Faire, you're not out of luck! These five symposiums featuring 26 of the most highly respected professionals in the personal computing field were audio taped . . . and are available now.

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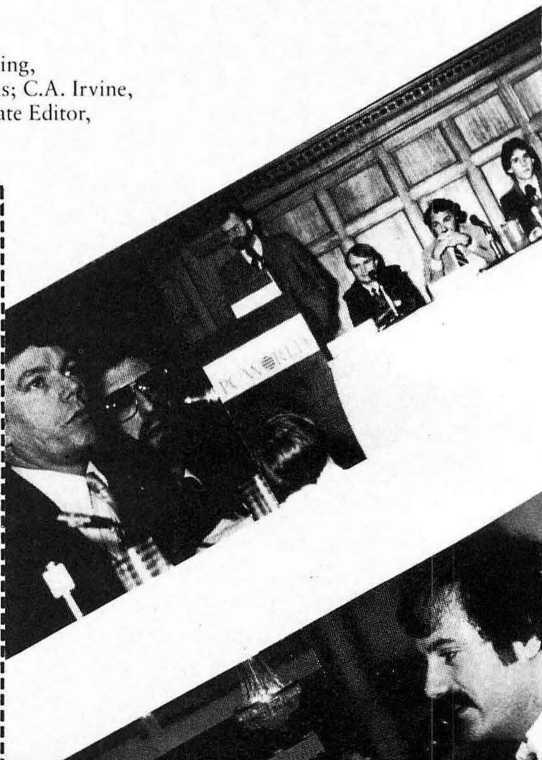

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The Help Screen

PC World Offers Answers and Advice at Every Level.

Karl Koessel

In this month's column we discuss keeping the expanded IBM PC cool, DOS 2.00 graphics screen dumps on Epson printers, cursor control in BASIC via the LOCATE statement, and possible radiation risks for CRT users.

Too Hot to Handle

Q. *I recently upgraded our PC by adding an AST Research ComboPlus multifunction card (256K additional memory; clock calendar, and asynchronous serial port) and an IBM Color/Graphics Adapter. Now I notice a significant temperature increase on the cabinet top of the computer. I have heard some talk about the limited expansion capabilities of the PC because of the number of slots available, but are there any restrictions because of the increased heat produced by additional cards? Should I be concerned?*

We also purchased the IBM 5¼-inch Disk Drive Adapter with our PC. The card supports two 320K drives and a large connector on its mounting bracket. What is the purpose of this connector? The local IBM Business Products Center in Chicago doesn't seem to know.

Joseph Schumacher
Evanston, Illinois

A. Most PCs are completely filled with cards, and although the tops of their system units get warm, we have never had problems due to heat. Remember the following three points of preventive maintenance:

○ Keep the system unit cover on the PC, and be sure all the expansion card port holes on the rear panel of the PC (where you connect the monitor's cable, etc.) are covered so that the air for cooling can properly enter and flow through the PC.

○ Be sure all air intake ports are able to breathe. They are located on the left-front face, on the bottom along most of the left side, and on the bottom along the full length of the front of the system unit. This last intake draws the most air; slip your fingers under the front and you can feel the flow of entering air.

○ Be sure the air exhaust port, located near the center of the rear panel, is not blocked and that the hot air can escape from the PC so that heat doesn't build up behind the system unit.

The connector on the outside of the IBM Disk Drive Adapter contains the signal lines for two additional external disk drives (not supplied by IBM). This connector performs the same function as the primary disk drive connector (which is located at the other end of the card and connects the card to the internal disk drives via the internal flat ribbon cable). Thus, the IBM Disk Drive Adapter will support four 5¼-inch disk drives—two internal and two external.

White Lines

Q. *I just purchased DOS 2.00 for my IBM PC and have found many interesting enhancements. The $80 price seems excessive, even though it does include a packet of pages to update the BASIC manual. My PC has a Seattle Computer RAM+ board (it*

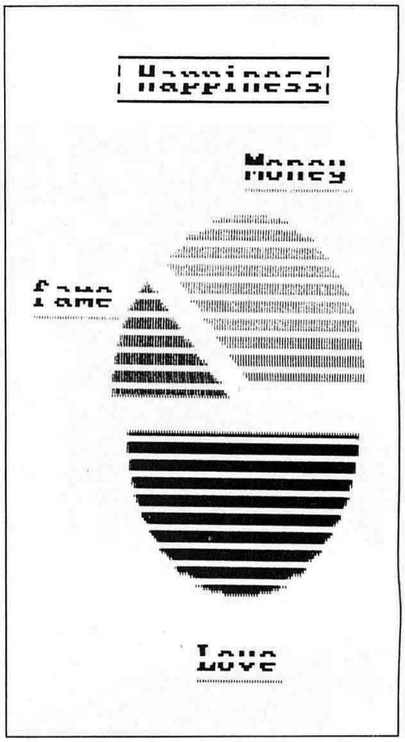

Figure 1

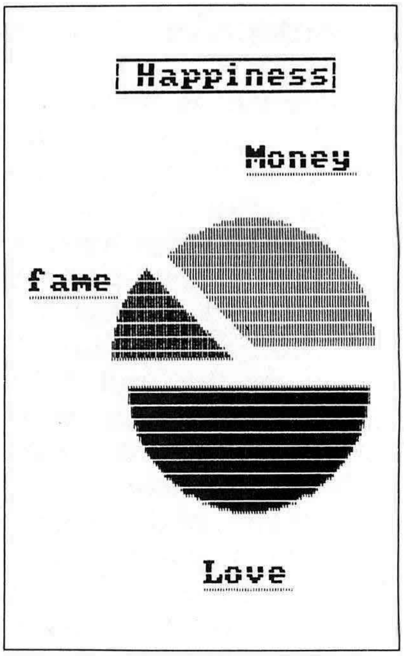

Figure 2

comes with an asynchronous serial port and is filled with half the 256K of memory it can support), an Amdek Color II monitor, a game control adapter, two single-sided disk drives, and an Epson MX-100 dot matrix printer.

DOS 2.00 now has a graphics dump utility. My problem involves the white lines that occur between consecutive passes of the printhead (see Figure 1). The printer seems to default to 6-line-per-inch spacing, and the only way I can minimize the white lines is to set the printer for 8 lines per inch. This still leaves a space in the graphics dump (see Figure 2). Can you help me resolve this problem?

Herman A. Goetz
Levittown, New York

A. The IBM suggested retail price for DOS 2.00 is $60, but dealers may charge any price they wish. As for your graphics printout problem, you have an Epson printer with older ROM chips. Opening the printer and replacing the two ROM chips with the newest version, Epson's Graphtrax Plus for the MX-100, isn't difficult. Be careful, Graphtrax Plus for the MX-100 is not the same as Graphtrax Plus for the MX-80, and both are different from the older version called Graphtrax.

The current model of the Epson MX-100 (excluding those that are old stock) and the IBM Graphics Printer come with the upgraded ROMs installed, and they do a fair job of replicating the color/graphics screen (see Figure 3). People who have bought the Epson MX-80 and want to add the graphics ROM chips should make sure that they are buying Graphtrax Plus—not the older version (called Graphtrax)—and that the chip set is for the MX-80.

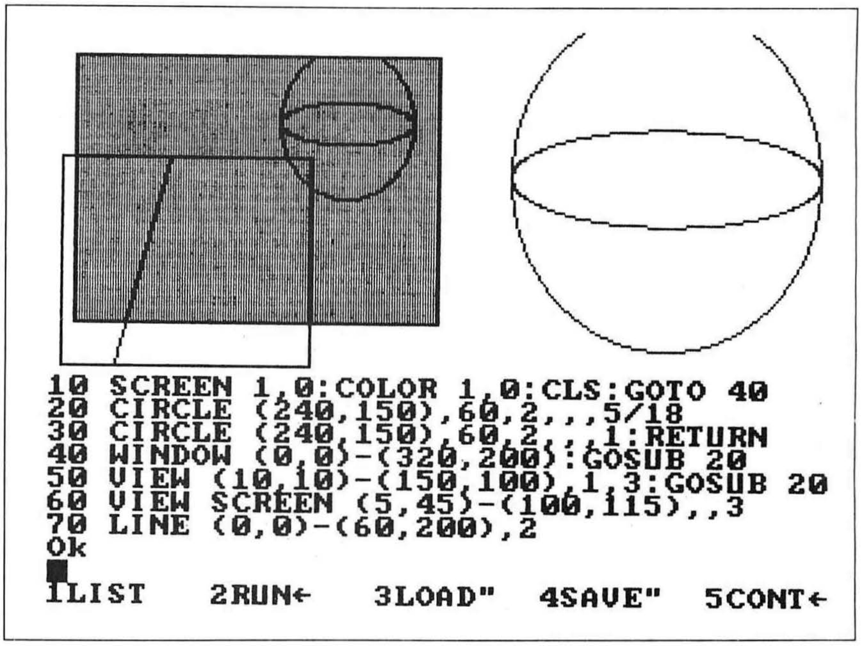

Figure 3

Cursor Control

Q. *When I run the programs I've written by typing* BASIC FILENAME, *the cursor stays on, but if I first load BASIC and type* RUN "FILENAME", *the cursor goes off. How can I (or a program) turn the cursor on or off as needed?*

John Kersiry
Berkeley, California

A. This frequently asked question has stumped many people, including those who have turned to the index of the IBM BASIC manual. The answer is tucked away in the second reference listed for the index entry *cursor position,* which contains information about the LOCATE statement.

The LOCATE statement may be followed by up to five optional parameters. Those of you who have been programming the PC in BASIC know that the first two parameters position the cursor at a desired row and column on the screen. For example, executing the statements

```
LOCATE 4,5 : PRINT "Hello";
```

prints the word *Hello* with the *H* located on row 4 in column 5, and moves the cursor to the column following the last displayed character (in this case, *o*).

The third parameter controls the display of the blinking cursor in text mode; it has no effect in graphics modes. If the third parameter is 1, the cursor is on; if it is 0, the cursor is not displayed. This short program demonstrates the first three parameters of the LOCATE statement.

```
10  CLS
20  PRINT "Press <ENTER> to continue"
30  LOCATE 4,5,0
40  Z$=INPUT$(1)
50  PRINT "This cursor is off:";
60  Z$=INPUT$(1)
70  LOCATE 4,5,1
80  PRINT "This cursor is on :";
90  Z$=INPUT$(1)
```

The last two parameters are a bit more complicated and, like the third parameter, have no effect in graphics modes. They define which scan lines will be lit when the cursor blinks on. Before we go any further, let's see just what scan lines are. First load BASIC. Hold down the Alt key and type 219 using the numeric keypad on the right side of the keyboard. Then let the Alt key up. The block that appears is a character cell with all its horizontal scan lines lit. Look closely. On the monochrome display you should be able to see 14 scan lines; the top line is scan line 0, and the bottom line is scan line 13. On the color/graphics display you can easily see 8 scan lines, each one composed of a string of dots called pixels; the top line is scan line 0, and the bottom line is scan line 7. Now look at the cursor. On the monochrome display the two bottom scan lines (12 and 13) are flashing; on the color/graphics display the cursor is just the bottom scan line (7).

BASIC allows you to redefine the cursor to be any set of sequential scan lines. The fourth parameter of the LOCATE statement specifies which scan line will begin the set, and the fifth parameter specifies which scan line will end the set. For example, when the cursor defined by

```
LOCATE ,,,4,7
```

flashes on, scan lines 4, 5, 6, and 7 will be lit. If the fifth parameter is not included, BASIC will assume you want the cursor to be the single scan line indicated by the fourth parameter. If the fourth parameter is not included, the cursor will not be redefined. If the fourth parameter is greater than the fifth, the cursor wraps from the bottom scan line back to the top, yielding a two-part cursor that flashes on both the top and bottom portions of the character cell.

The cursor defined by

```
LOCATE ,,,7,3
```

for example, will blink scan lines 7, 0, 1, 2, and 3 on the color graphics display (7 through 13, and 0 through 3 on the monochrome display). Add the following lines to the program above and you can see the different cursors available from BASIC.

```
100 LOCATE 4,1:SCREEN 0,0,0,0
110 PRINT SPC(39):PRINT SPC(39)
120 LOCATE 4,1
130 INPUT "Beginning scan line";BEGIN
140 INPUT "    Ending scan line";ENDING
150 LOCATE 7,1,1,BEGIN,ENDING
160 PRINT "LOCATE ,,1,";
170 PRINT USING "##_,##
      ";BEGIN;ENDING;
180 PRINT "yields this cursor:";
190 Z$=INPUT$(1)
```

When you run this program you will see that the cursor remains as it was defined by the last LOCATE statement, whether a program is running or not, until it is redefined. Entering

```
LOCATE ,,,12,13
```

for the monochrome display (or LOCATE ,,,7 for the color/graphics display) will return the cursor to normal. Or, because BASIC redefines the cursor when loaded, you may exit BASIC (with the SYSTEM command) and reload BASIC to normalize the cursor.

Bad Vibes

Q. *Are cathode ray tubes (CRTs), the screens of video display terminals (VDTs) and TVs, hazardous to our health? Please describe any studies or articles regarding the health effects of working with CRTs. I've seen brief mention in various publications describing Canadian studies that link birth defects to working with CRTs, and I understand that in certain European countries amber screens are the standard because they are easier on the eyes. Are there any United States governmental agencies or private institutions investigating these concerns?*

Helen Harvey
Oakland, California

A. The December 1982 issue of *BYTE* magazine carried a letter to the editor from John C. Villforth, director of the Bureau of Radiological Health (BRH), Department of Health & Human Services, Food and Drug Administration, stating that VDT radiation studies have been performed by the FDA and the NIOSH (National Institute for Occupational Safety and Health). Furthermore, he states that these studies have never measured "X-ray emissions significantly above the natural radiation level to which we are all exposed," and that the BRH does "not believe that VDTs should pose a radiation risk to those who operate them."

Taking objection to the spirit of this letter and its omission of actual measurements, Edward M. Gogol responded with a letter carried in the April 1983 issue of *BYTE* stating that "exposures, no matter how low, carry with them some additional risk" (of disease and damage) and that studies "should be carried out by truly independent scientists....Federal cover-ups of the cancers...from atomic-bomb tests show clearly that no federal agency...can be trusted to tell us the truth about radiation." Gogol also suggests that CRT users can immediately decrease radiation exposure by sitting farther from the screen and turning down its brightness. He recommends two books: *Radiation and Human Health* by John W. Gofman, M.D. and Ph.D. (Sierra Club Books, San Francisco, 1981) and *The Zapping of America* by Paul Brodeur (W. W. Norton and Company, New York, 1977).

Also, the April 1983 issue of *Computers & Electronics* magazine has an article entitled "Maximize Your Computing Comfort & Efficiency" by Les Solomon and Al Burawa on computer environment ergonomics. A major portion of this article is devoted to the discussion of the human eye and the color of VDTs.

Do you have any questions concerning the PC or the new compatibles? This column provides help and advice to PC World *readers by sharing solutions to the variety of problems encountered by PC users. If you have questions, send them to* The Help Screen, PC World, *555 De Haro St., San Francisco, CA 94107.*

After $50,000.00 and 7 months of programming ... I chose PLAN80™

In 1979, I was the President of a small but fast growing manufacturing company, producing a new recreational product. To tell you that our sales increased over 100 times in five years gives you a picture of how volatile things were.

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In sheer desperation, I bought a microcomputer and started to teach myself how to program. At that time, there were no financial planning packages available. And the prospect of teaching a programmer about financial models seemed more awesome than learning to program myself.

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When Calc programs became available, I bought one and quickly realized the time and money that would have been saved had they been available sooner. But I soon appreciated that a computerized spread sheet program also had very major limitations for financial modelling.

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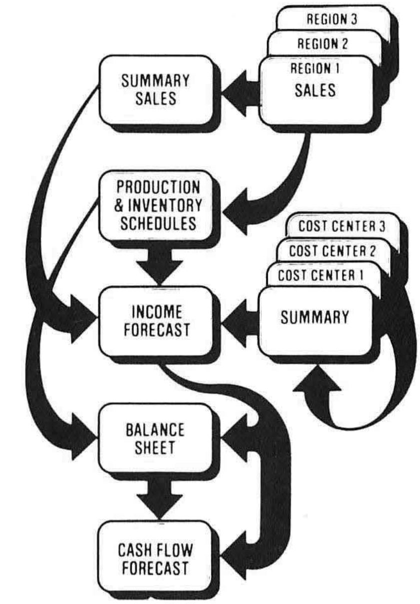

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These command files are created on your own computer with your own familiar word processor.

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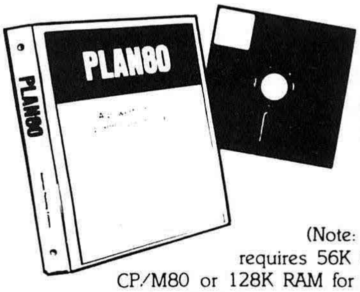

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World Events

A Calendar of Regional, National, and International Events

Edited by Patricia Navone

World Events lists computer-related conferences, conventions, workshops, camps, symposiums, trade fairs, and shows. If you know of an upcoming event, we'd like to hear from you.

June 26-August 7
Computer Tutor Camps at Stanford University
Four 2-week sessions for children 11-17. Five hours of computer instruction balanced with recreational activities.
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980 Magnolia
Larkspur, CA 94939
415/461-7533

June 27-July 29
International Institute on Microcomputers in Education
Stanford University
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Stanford University
Stanford, CA 94305
415/497-2102

July 5-8
Software Development Workshop
TERC offices
Cambridge, Massachusetts
Hands-on workshop to train teachers and administrators at all levels, elementary through college.
Technical Education Research Centers
8 Eliot St.
Cambridge, MA 02138
617/547-3890

July 6-19
Antioch College Computer Camp
Yellow Springs, Ohio
For children 9-17. Hands-on learning in Pascal, BASIC, and LOGO. Tennis, swimming, and field trips.
Antioch College
Yellow Springs, OH 45387
513/767-7331

July 11-22
Summer Institute in Math, Science, and Computer Literacy
Trinity College
Vermont
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Technical Education Research Centers
8 Eliot St.
Cambridge, MA 02138
617/547-3890

July 11-22
Camp CompuQuest
Asbury College
Lexington, Kentucky
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Camp CompuQuest
P.O. Box 8161
Lexington, KY 40533
606/278-9933

July 17-20
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Moscone Center
San Francisco
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Marilyn Jenader
National Grocers Association
1825 Samuel Morse Dr.
Reston, VA 22090
703/437-5300

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For children 8-14. BASIC programming, hiking, astronomy, field sports, and tennis.
Arizona Computer Camp
2946 Darca Dr.
Prescott, AZ 86301
602/445-3778

July 20-23
National Office Machine Dealers Association Annual Convention and Trade Expo
Georgia World Congress Center
Atlanta
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NOMDA
810 Lively Blvd.
Wood Dale, IL 60191
312/860-9400

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Computer Tutor Camps
980 Magnolia
Larkspur, CA 94939
415/461-7533

July 25-29
Siggraph '83
Cobo Hall
Detroit
A computer graphics conference with special emphasis on CAD/CAM robotics.
Siggraph '83 Conference Office
111 East Wacker Dr.
Chicago, IL 60601
312/644-6610

July 29-31
PRODUX 2000
Los Angeles Convention Center
Los Angeles
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Roger Armstrong
PRODUX 2000
P.O. Box 2000
Bala Cynwyd, PA 19004
215/457-2300

August 13-14
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Microshows
P.O. Box 4323
Foster City, CA 94404
415/571-8041

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Woodside, CA 94062
415/851-7077

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312/782-8597

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Telex 06-986766

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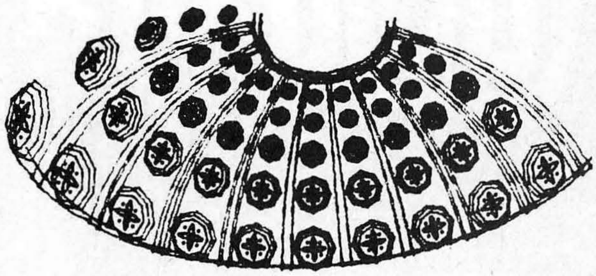

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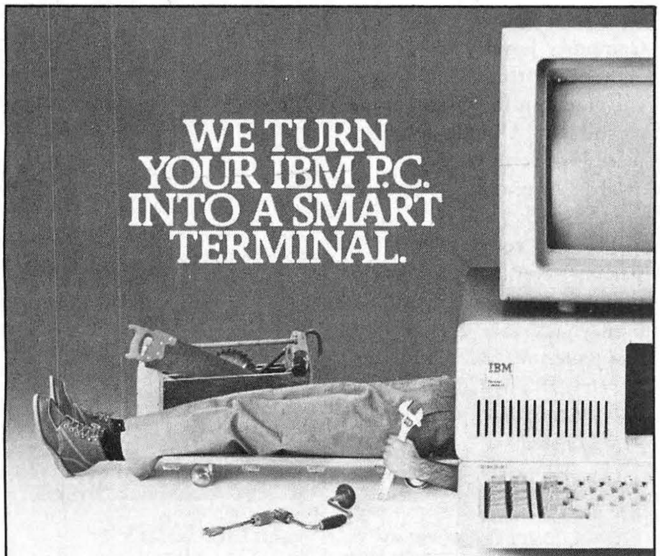

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A totally machine language graphic prints utility. The Prtsc key triggers automatic printing of four color shaded graphics or monochrome characters set. Create variable sizes as well as rotated and inverted images. Also prints pictures from disk files or your own programs. *Windmill Software, Inc., 2209 Leominster Dr., Burlington, Ontario, Canada L7P 3W8, 416/336-3353*

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P-Plot
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HALO-The Complete Graphics Tool
HALO, OEMs choice for graphics applications under MS DOS. HALO, the ad hoc MS DOS standard. Versions for BASIC/PASCAL/"C"/MACRO Assembler & FORTRAN. Complete tool box of optimized subroutines for every graphics application. Custom installations & configurations avail. All major graphics boards supported. *Media Cybernetics, Inc., 36 Columbia Ave., Tacoma Park, MD 20912, 301/270-2272*

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Home Finance provides audit trail of expenditures for 1 yr. and up to 48 categories. Provides % of income spent by category. Search/edit by check no. payee or category. Price $34.95. Apparat Games Disk (64K) color or monochrome monitor. Others are Blackjack, Matches & Spiralgraph $24.95. *Apparat, Inc., 4401 S. Tamarac Pkwy., Denver, CO 80237, 303/741-1778*

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MIS Consultants, Inc., 1065 E. Hillsdale Blvd. # 114, Foster City, CA 94404, 415/345-6000

MRP

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Development System Tools
Operating System Development Tools Universal Development Interface and iRMX86 implementations for PC DOS/ MS-DOS based systems. A complete family of Development Tools. See display ad this issue. *RTCS/Real-Time Computer Science Corp., P.O. Box 3000-886, Camarillo, CA 93010, 805/482-0333*

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DSS Real Estate Analyzer
Designed for real estate professionals involved in analyzing sales or purchases of properties, syndications, or complex limited partnerships. Provides operating statements, cash flow & tax analysis, IRR, partnership investor analysis, loan and depreciation schedules. *Decision Support Systems, 3234 Prospect Street, N.W., Washington, DC 20007, 202/342-8172*

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Opt-Tech•Sort/Merge
Extremely fast Sort/Merge program for the IBM-PC. Can sort or merge multiple files containing fixed or variable length records. Run as a DOS

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Calculates many statistics frequently used by scientists, business researchers, engineers, statisticians, and others who need to analyze survey and experiment data. Possibly the only program that performs the Hodges-Lehman aligned ranks test. Requires 128K. Introductory price $145. *Mace, Inc. 2313 Center Ave., Madison, WI 53704, 608/241-4566*

Stock Market

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Provides up to the minute information on key parts of investor's stock account. Market price updates by DOW JONES; easy link to Hayes Smartmodem. Sort by P/E, gain/loss, yield or any item in SPR's 8 useful reports. Friendly menu displays & manual. Requires 128K, 2dd. Demo disk avail. $179. VISA/ MC welcome. *Micro Investment Systems, Inc., P.O. Box 8599, Atlanta, Georgia 30306, 404/892-3194*

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Systems

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MultiLink turns PC-DOS into an efficient multi-user multitasking operating system. Additional users are supported by attaching inexpensive CRT terminals or modems to serial ports on the PC, and can run normal applications designed for PC-DOS. Includes host communications software for public dial-in. *Software Link, Inc., 6700 23-B Roswell Rd., Atlanta, GA 30328, 404/255-1254*

Tools

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BASIC Programmers. This routine replaces the LIST command and steps through your programs forward, backward, or repeats the same lines. EDIT or RUN the program between steps and continue with only one key stroke. Step parameters can be reset at any time. Includes other features. Diskette, $17. *IRC Associates, 125 Sherrfield Dr., #X9, Saginaw, MI 48603, 517/792-2156*

Utilities

Funkey
Program the function keys to suit your own needs. Funkey makes using word processing, spreadsheet and other applications programs easier and faster. Uses are limited only by the imagination. See display ad. *Bourbaki Inc., 431 Main St., Boise, ID 83702, 208/342-5849*

Alta Link
Alta Link-intelligent communications package allows IBM PC to communicate with other PCs and mainframes across asynchronous telecommunications lines. Menu control using function keys. User control over-baud rate, line control, communications port. 30 user function keys. Many other functions. $97. VISA/ MC. *Alta Systems, Inc., P.O. Box 9802 #181, Austin, TX 78766, 512/836-7351*

Diskette Catalog
DC keeps track of all your files on all your disks. Functions include add, alphabetize, delete, list, and search. Entries are handled by DC, not your typing. Written in machine lang. for speed, DC can hold 3000 files (w/ 96K). For PC Dos (all) 1 drive, 80 col. display, 64 K. $20 plus $1 for MC/VISA. *Creative Programs Unlimited, 16533-37th Avenue NE, Seattle, WA, 98155, 206/367-7949*

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well (even program lines.) *Software Technology for Computers, 430 A Main St., Watertown, MA 02172, 617/923-4334*

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Are your BASIC programs over 100 lines long? Then you need the PrettyPrinter for BASIC. It prints BASIC programs so you can read and understand them: indented and block structured (like PASCAL), keywords in lowercase, remarks highlighted, cross reference. 64K required. Just $39 or write for details. *Personal Computer Things, Inc., P.O. Box 207 - PCW, Centreville, MD 21617*

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PC Disk ID
Eliminate the need under PC-DOS 2.0, to reformat disks in order to add, change or delete volume labels. Prints sorted list of files (including hidden files) from disk directory to labels or to a listing. Also allows recovery of files erased inadvertently. Requires PC-DOS 2.0, 1 disk. $30. *ErgoSoft, P.O. Box 454, Oakhurst, NJ 07755, 201/493-8352*

ARCHIVES V Diskette Backup
Reduces diskette back-up costs by 90 percent. The PCs' built-in cassette interface can save six full diskettes on one ninety minute audio cassette. The utilities process only required information reducing transfer time and tape usage. Specify 64K or 96K version when ordering; $39.95. *Indiana Digital Corporation, P.O. Box 3755, South Bend, IN 46619, 219/288-7280*

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Alta Systems Packages
Super Zap ($47) accesses file/absolute disk sectors. DIR-lift, sector saving, customization. PC Toolbox ($37) EDIR-formatted info about files. List-file printing, total printer control. File Utility-assign/remove "hidden" status, recovers deleted files. Comes with other utilities. VISA/MC. *Alta Systems, Inc., P.O. Box 9802 #181, Austin, TX 78766, 512/836-7351*

640k Memory Access for Old PCs
You don't have to buy a new PC to access more than 544k of memory. With the SETMEM utility, DOS recognizes up to 640k of memory on your current PC. Need to know if your programs run on small PCs? SETMEM can also reduce your DOS-recognized memory without re-setting DIP switches. $35. *Tyler Software, 233 Rodney Circle, Bryn Mawr, PA 19010, 215/525-5478 (after 6)*

PC Padlock
Unique encryption scheme protects EXE-COM programs from running after unauthorized duplication. Copy programs such as COPYPC will not copy after running this easy to use program on your products disk. Protect your software investment & valuable market place. Works with all DOS versions. $99. VISA/MC. *Glenco Engineering, 915 E. Carpenter, Palatine, IL 60067, 312/537-4200*

User Groups

Newsletter/Software Exchange
International PC Owners Inc. This group publishes a newsletter IPCO INFO every other month and runs a software exchange. The software exchange consists of about 160 user developed programs for the PC. Membership in the US is $20/year. Send for free catalog of programs. *International PC Owners, Inc., P.O. Box 10426, Pittsburgh, PA 15234, 412/561-1857*

PC World Directory *is a comprehensive listing, by category, of products and services for the IBM PC, lookalikes, and compatibles. It provides rapid access to the burgeoning PC marketplace for both readers and advertisers.*

FORMAT: The standard format includes a product ID, a 300-character descriptive ad, and company name, address, and telephone number. Use of a company logo is optional.

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DEADLINE: For space reservation and artwork deadlines, contact a PC World Directory *sales representative at 415/861-3861. Please send copy, optional artwork, and prepayment to:* PC World Directory, *555 De Haro Street, San Francisco, CA 94107.*

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Just Announced

The Wide World of PC Products

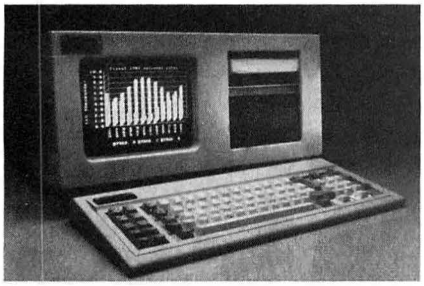
Edited by Adrian Mello

In the fast-paced personal computer marketplace *Just Announced* acts as an alert service to keep you abreast of the latest developments in IBM PC and compatible technology. Information for this department is provided by manufacturers; these write-ups are not reviews. Many of these descriptions will be followed up by reviews in this or future issues.

Hardware

Computers

Columbia VP
An IBM PC-compatible portable computer that uses an 8088 microprocessor, weighs 30 pounds, and includes a large package of bundled software. The base-priced version comes with 128K, two 320K half-height floppy disk drives, a serial



Columbia VP, Columbia Data Products

port, a parallel port, and one expansion slot. Memory can be expanded to 256K. The 9-inch monitor has 640 by 200 resolution and displays either 80 characters or 40 characters horizontally and 25 lines vertically. Buyers are offered a color choice of green or amber for the monochrome monitor at no price difference.

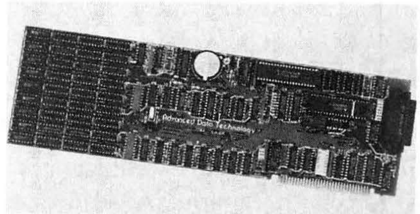
The Columbia VP is bundled with software including *Perfect Writer, Perfect Speller, Perfect Calc, Perfect Filer,* and Perfect Software's asynchronous communications program. The base version of the computer also comes with *Home Accountant Plus* by Continental Software, *Fast Graph* by Innovative Software, the *Space Commanders* game, BASICA, and a macro assembler.

The software is written under MS-DOS although both MS-DOS and CP/M-86 are included with the computer. List price: $2995. Columbia Data Products, Inc., 8990 Route 108, Columbia, MD 21045, 301/992-3400, TWX: 710-862-1891.

Boards

Series 1000
A multifunction board with nine features. Installation of the board requires a system that already has 64K in place. Expanded memory on the board can be purchased with 64K to 256K in 64K increments. The board comes with a serial port, a parallel port, a game port, a clock/calendar, and a user-definable parallel port with 8 bits programmable for either input or output and 4 additional bits dedicated to output.

An unusual feature is the BSR X-10 AC Line Controller Interface that allows users to remotely control lights, appliances, or other AC line components. Users can also purchase the card with a BSR X-10 AS Control System and transducer cable that includes an ultrasonic command console and two lamp modules. Two other features provided on a disk are a print spooler and a disk emulater.



Series 1000, Multifunction Board, Advanced Data Technology

List price: 64K $495, 128K $535, 192K $675, 256K $765, BSR X-10 AC Control System $29. Advanced Data Technology, 13600 Ventura Blvd., Sherman Oaks, CA 91423, 213/986-6835.

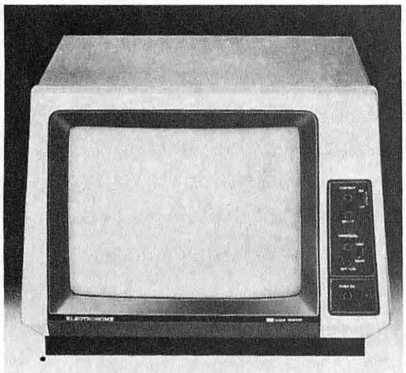
Multi-Display Card
A single board that combines the features of both the IBM Monochrome Adapter with printer adapter and the IBM Color/Graphics Display Adapter. The Multi-Display Card duplicates the performance of the two separate IBM adapters it replaces, so it saves one expansion slot. The board displays either 80 by 25 characters or 40 by 25 characters in the color/graphics mode with flicker-free scrolling.

The 32K of on-board memory provides the ability to switch between two pages of high-resolution graphics. List price: $499. USI International, 71 Park Ln., Brisbane, CA 94005, 415/468-4900.

Display

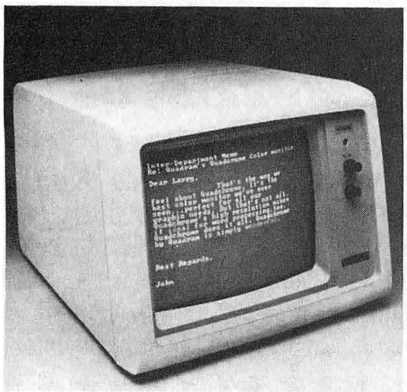
ECM-1301
A 13-inch color monitor intended for commercial and industrial users. The monitor requires a color/graphics adapter. The ECM-1301 has a resolution of 720 by 512 and displays 80 characters horizontally and 40 char-

acters vertically. Controls are included for horizontal and vertical centering. List price: $1795. Electrohome Limited, 809 Wellington St. N, Kitchener, Ontario, N2G4J6 Canada, 519/744-7111.



ECM-1301, Electrohome

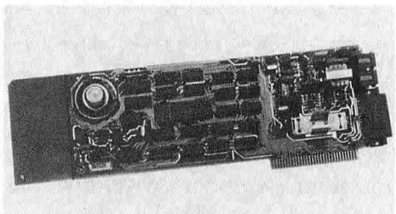
Quadchrome
A 12-inch color monitor that will display up to eight colors in two intensities. The monitor requires a color/graphics adapter. It has a resolution of 690 by 480 and will display 80 characters horizontally and 25 lines vertically using an 8- by 8-character matrix. List price: $795. Quadram Corporation, 4357 Park Dr., Norcross, GA 30093, 404/923-6666, TWX: 810-766-4915.



Quadchrome, Quadram Corporation

Modems

PConnection
A card-type modem that operates at 300 baud and requires a single expansion slot. Features include auto-dial (touch-tone or pulse dialing) and auto-answer. PConnection also comes in a version with a clock/calendar and an additional serial port. List price: $279; with clock/calendar and serial port $375. Microperipheral Corporation, 2565 152nd Ave. NE, Redmond, WA 98052, 206/881-7544.



PConnection, Microperipheral Corporation

PC:IntelliModem
A 1200 baud, card-type modem and software that provides complete data communications capability. The software requires 64K and one disk drive. The modem allows programmable transfer between voice and data communications. An extra jack on the board's mounting bracket permits the attachment of a telephone receiver.

PC:IntelliModem provides immediate telephone-line status detection that positively identifies a dial tone, busy signal, modem answer, voice answer, and ringing without requiring a preset waiting period.

Other features include auto-dial, auto-repeat-dial, and auto-answer. Frequently dialed numbers can be stored and automatically dialed with single-character commands. The modem operates at either 300 or 1200 baud. List price: $499. BIZCOMP Corporation, P.O. Box 7498, Menlo Park, CA 94025, 408/745-1616.

Storage Devices

SCS Mini-Mega Series
A series of disk subsystems that provides 5M of formatted storage capacity on a 3.9-inch removable Winchester cartridge as well as 5, 10, or 15 megabytes of formatted storage on a 5¼-inch hard disk. MiniMega subsystems use one slot in the PC system unit.

The removable cartridge, hard disk combination allows the Mini Mega subsystems to be used for both storage and backup purposes. The removable cartridge allows for media transportability.

List price: SCS-5R $2895, SCS-5/5R $4474, SCS-10/5R $4756, SCS-15/5R $5056. Santa Clara Systems, Inc., 1860 Hartog Dr., San Jose, CA 95131, 408/287-4640, Telex: 176309.

ASI-8000
A Winchester subsystem that provides 6, 12, or 19 megabytes of unformatted storage capacity. It includes a host adapter printed circuit board that uses one expansion slot in the PC system unit. The ASI-8000's Winchester drive has a microprocessor on board that moves the read/write head to the appropriate cylinder.

ASI's controller features automatic error detection and correction. The subsystem includes I/O firmware, cables, a 60-watt power supply, and a menu-driven install program. List price: 6M $2895, 12M $3295, 19M $3695. Almaden Systems, Inc., 6066 McAbee Rd., San Jose, CA 95120, 408/268-1566.

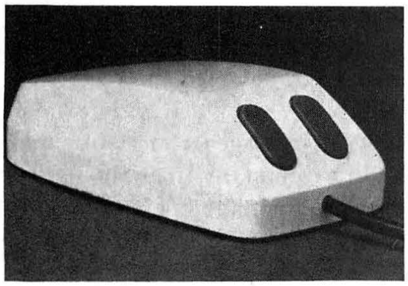
ASI-8000 Series, Almaden Systems

Miscellaneous

Microsoft Mouse
A two-button mechanical mouse that is used as a cursor-positioning and command-selection device to supplement the keyboard. The IBM PC version comes with an interface board, and the version for compatible computers operating under MS-DOS requires a serial interface. As the mouse moves over a flat surface, the cursor tracks across the screen in a corresponding direction and distance. The two buttons select commands.

The Microsoft Mouse can be used with *Multi-Tool Word,* a program from the same manufacturer that has been designed for optional use with the mouse. Three programs are included that train users how to work the mouse: a text editor, a game, and a musical tutorial that produces

sounds when the mouse points to a piano keyboard. List price: $195. Microsoft Corporation, 10700 Northup Way, Bellevue, WA 98004, 206/828-8080, TLX: 328945.



Microsoft Mouse, Microsoft Corporation

EP-101 Graphics Module
A device that allows high-resolution RGB monitors to be used with the PC. The EP-101 changes the standard digital signal to the analog RS-170-compatible signal used by monitors manufactured by Conrac, Hitachi, and Mitsubishi.

The module is a small rectangular box that connects to the 9-pin DIN connector on the PC system unit. The device has three BNC connectors for the attachment of the monitor's RGB cables and includes an external power supply. List price: $69.95. Oryan Engineering, 3325 Plaid Ct., Chino Hills, CA 91710, 714/995-8767.

Systems Software

Operating Systems

FORTH Level 2
A version of the polyFORTH operating system designed for applications development. It requires 32K and two disk drives. It includes the FORTH compiler, assembler, and interpreter. FORTH Level 2 supports multitasking. It includes the 8087 instruction set for numeric applications.

Screen editor functions can be changed to suit individual needs. The ten function keys can be allocated to any system function or user-defined function. FORTH Level 2 includes time and calendar support. It is compatible with the PC-DOS file structure. With FORTH Level 2 the user can develop real-time applications such as process control, data aquisition, mathematical analysis, data

 Reader Service #307

base management, communications, and graphics. List price: $295. Forth Technology, 432 15th St., Santa Monica, CA 90402, 213/372-8493.

Utilities

MAKE

A file conversion utility that converts *EasyWriter 1.1* files into standard ASCII format. It requires 64K and one disk drive and includes a /D switch that automatically deletes old files if the conversion is successful. *MAKE*'s conversion command is similar to the DOS COPY command in that it can perform wild card (* or ?) functions. As a result, an entire disk of files can be converted in less than a minute per side. List price: $15 contribution if the user likes the program. FreeStyle Software, 1109 Greenhill Rd., Flourtown, PA 19031, 215/387-8208.

Basic Development System

An integrated set of tools designed for programmers who use either Disk or Advanced BASIC. It requires 64K and one disk drive. *BDS* includes an installation procedure that allows it to interface with the BASIC interpreter. *BDS* functions include the Single Step Trace, which pauses before executing each new line and displays the line number in the upper-right corner of the screen so as not to interfere with the program display.

Cross-Reference provides a sorted list for each BASIC keyword, numeric and string constant, and line number and variable name used in the program and shows where each item is referenced.

Super Renum allows the user to renumber, move, or duplicate blocks of lines. Variable Dump lists any or all program variables and their current values.

Compress reduces the size of the program to increase execution speed, and Uncompress expands the program to make it legible.

List price: $79. SofTool Systems, 8972 E. Hampden Ave. #179, Denver, CO 80231, 303/793-0145.

BASIC Aids

A utility that provides module extraction and global search and replace of source code saved in ASCII format for programs written in structured BASIC. The program requires 64K, one disk drive, and a printer.

BASIC Aids allows users to identify modules by printing a double-sorted, line cross-reference map. Source listings are shown with page control. The program is written in unprotected BASIC and has over 500 examples of BASIC statements. It also includes a definable file for function key value assignments.

List price: $25. Tulsa Computer Consortium, P.O. Box 14097, Tulsa, OK 74159, 918/747-0151.

Disassembly Cross-Reference System

A tool for the assembly language programmer that requires 64K and one disk drive. *DCRS* is used to decipher unfamiliar programs. It diverts output from the PC-DOS DEBUG utility to a disk file in order to construct a disassembly listing marking each referenced address. *DCRS* also provides a sorted cross-reference of all hexadecimal byte and word values. List price: $49. Softool Systems, 8972 E. Hampden Ave. #179, Denver, CO 80231, 303/793-0145.

Applications Software

Accounting and Inventory

TCS Total Accounting System

A group of six programs that use the same data base file and record structure to provide data transfer between programs. Each program requires 85K and two disk drives. TCS Simple allows users to generate reports that can draw upon information in another program and operates as a filing system.

The *Total Accounting System* also permits users to post information from one program to another without rekeying entries. Programs include Total Ledger, Total Receivables, Total Payables, Total Payroll, Total Inventory, and the Simple Filing System. They may be purchased separately. The manufacturer does not provide a suggested list price. TCS Software, Inc., 3209 Fondren, Houston, TX 77063, 713/977-7505.

Financial Reporting System, Multiplan Spreadsheet Link

A general ledger package that includes six user-defined formats including balance sheets and budget comparisons. It requires 64K and two 320K disk drives. The programs support multiple departments, making departmental accounting possible. With the *Financial Reporting System* the user can compare last year's budget with year-to-date and current-month.

The *Multiplan Spreadsheet Link* integrates the *Financial Reporting System* with *Multiplan*. Financial statements generated in the *Financial Reporting System* can be transferred directly into *Multiplan* for further analysis. Recurring entries in *Multiplan* can be posted as a batch to the general ledger. With the *Financial Reporting System* and the *Multiplan Spreadsheet Link* the user can transfer a financial statement with budget comparisons from the general ledger into the spreadsheet, rework the budget for the following year within the spreadsheet, and then transfer the data back into the general ledger for the following year.

List price: *Financial Reporting System* $825, *Multiplan Spreadsheet Link* $215. Prairie Data Systems, Inc., 626 Broadway Ave. #202, Saskatoon, Saskatchewan, S7N 1A9 Canada 306/384-7110.

Data Management

FileMaster 2.0

A data management system that creates and maintains files and generates reports sorted in ascending or descending order using up to eight fields. It requires 96K, one disk drive, and an 80-column monitor. Each file can hold up to 32,767 records; each record can hold up to 35 fields of up to 65 characters each.

With *Filemaster* the user can load data from a DIF filer into a *FileMaster* file. The file directory displays *FileMaster* file descriptions and data files as well as the remaining space available on the disk. The Select and Find functions enable the user to find all the records that meet a set of selection criteria that include less than, less than or equal to, equal to, greater than or equal to, not equal to, contains, and does not contain. *FileMaster* produces columnar and reference reports as well as labels.

List price: $125. N.F. Systems, Ltd., P.O. Box 76363, Atlanta, GA 30358, 404/252-3302, Source: TCK071.

Notebook
A text-oriented data base that uses *WordStar*-like text editing commands. The program requires 128K and two disk drives. The absence of predefined field lengths permits fields to be as large as storage space allows. Users may choose to search records by field or by specified text within all fields without key words. Storage space is used only up to the entered amount of text in each field.

Other features include the ability to define fields, sort alphabetically, and report textual data. The program doesn't have numeric fields, making it unsuitable for data management requiring calculation of numeric data. Records can be permanently edited during a search or select operation.

List price: $150. Digital Marketing Corporation, 2363 Boulevard Circle, Walnut Creek, CA 94595, 800/826-2222, 415/947-1000, Telex: 171852.

Educational

EDUBAS I and II
Two programs that teach BASIC programming techniques for beginning and advanced users. Both programs individually require 64K, one disk drive, and the IBM Color Graphics Adapter. *EDUBAS I* teaches beginners to write simple programs, create branches and loops, perform flow charting, structure subroutines, and debug programs. The program also introduces users to graphics, input/output functions, and use of the computer as a calculator.

EDUBAS II teaches more advanced functions of BASIC such as string and substring manipulations, sequential and random file manipulations, and advanced graphics and colors. The program also explains instructions such as COMMON, INKEY$, PRINT-USING, ON ERROR-RESUME, and WHILE-WEND. Both *EDUBAS I* and *EDUBAS II* include three disks each.

List price: *EDUBAS I* $95, *EDUBAS II* $105, both programs $170. Europro, Inc., 129 Saratoga, Petaluma, CA 94952, 707/763-9700.

General Business

Computer-Assisted Management System (CAMS)
A project management program that performs time, cost, and resource analysis using the traditional Arrow Diagraming Method (*CAMS-ADM*) and the recently developed Precedence Diagramming Method (*CAMS-PDM*). Both *CAMS-ADM* and *CAMS-PDM* require 128K, two 320K disk drives, an 80-column monitor, and a 132-column printer. (A color monitor is supported for color graphics reports.)

CAMS schedules any project that consists of a number of different activities. The project can run from less than a day to as long as 30 years. *CAMS* prompts the user to describe the general parameters of the project: starting date, finishing date, type of activity, how long each activity will take, the number of days work will progress per week, and the number of hours per day for each activity. With this information *CAMS* provides the user with three sets of dates: early start, early finish, late start and late finish, and the average of the two. *CAMS* also provides a "float value" (the number of days an activity can be delayed without delaying the entire project). With *CAMS* the user can determine how different variables, such as overtime or seven as opposed to five days a week, will affect the targeted finishing date.

Once the project is underway the user can see what impact the late activities will have on the target date. All data is saved for future, similar projects. *CAMS* produces formatted reports with the option of color graphics. List price: $289 for either model. Maxima Systems, 4101 McEwen #550, Dallas, TX 75234, 214/960-0333.

Powerful Business Software
A group of six modules that includes order entry, invoicing, inventory control, accounts receivable, sales analysis, and mailing labels. The floppy disk version requires 64K and two dual 320K disk drives. The hard disk version requires 128K. Both versions require a 132-column graphics printer for hard copy reports.

The package is designed for distributors, wholesalers, retailers, and manufacturers. The sales analysis module produces black-and-white graphic displays of history and forecasting by customer, by item, or by gross sales.

A demo package is available for $50 that is refundable or applicable toward purchase. List price: $495. Distributed Computing Systems, P.O. Box 185, Lombard, IL 60148, 312/495-0121.

Integrated Applications

Textplus
An integrated program that combines list processing, word processing, mail merging, mailing labels, plotting, and information management capacities including sorting and selecting subsets. It requires 64K, one disk drive, and an 80-column monitor.

Textplus is designed to produce short reports and letters rather than long documents. It provides the user with predefined files such as mailing and telephone lists, but also allows the user to define data files to suit a unique need. *Textplus* includes a print spooler and supports subscripting and superscripting. List price: $149. Owl Software Corporation, 6927 Atoll Ave., North Hollywood, CA 91605, 213/982-6243.

Job and Industry Specific

Customer-Info
A software marketing tool for computer retail stores that provides the customer with information describing major hardware and software products. It requires 128K and two disk drives. Product files can be edited to reflect changes in price or inventory.

Supplementary files will be available from Learning Tools as new products become available. *Customer-Info* allows the user to create product files to suit unique needs. List price: $395. Learning Tools, 686 Massachusetts Ave., Cambridge, MA 02139, 617/864-8086.

Commercial Property Management
A real estate program aimed at commercial property managers. The program requires a system with 64K and one hard disk drive. Data can be transferred between the program and Solid Software's General Ledger, Payroll, and Accounts Payable programs. Consolidated financial statements can be produced for all properties managed. The program can report on all leased properties, including lease expiration reports, and rent increase notification reports.

Accounts receivable for tenants is linked with financial reporting. Late fee processing is calculated by tenant, or a fixed fee can be assigned that will automatically be processed monthly instead of manually calculating and entering it every month. Other improvements allow property numbers to be entered only once, and escape functions enable the user to leave data entry screens more quickly. List price: $1495. Solid Software, Inc., 5500 Interstate North Pkwy. #501, Atlanta, GA 30328, 800/554-4078.

Medical Data Management
An accounts receivable program designed for medical offices with from 1 to 50 doctors. A 64K system with a hard disk drive is required. The program maintains patient billing records based on head of household and accommodates commonly accepted medical codes such as ICDA and CPT. *Medical Data Management* provides detail and summary reports and allows patient inquiry by either patient name or record number.

Patient scheduling is handled for up to 50 doctors, up to 6 months in advance, and provides a daily appointment schedule for each doctor. An insurance report writer permits the user to format new and updated forms without professional programming.

Mailing labels can be printed for patient billing. *Medical Data Management* has been enhanced from the earlier version to allow data transfer with Solid Software's Accounts Payable, General Ledger, and Payroll programs. List price: $1495. Solid Software, Inc., 5500 Interstate North Pkwy. #501, Atlanta, GA 30328, 800/554-4078.

Word Processing/ Text Editing

Datatext
A new version of Datatek's word processing package that can merge letters or documents with *dBASE II* files, allowing the user to produce a mass mailing with names and addresses entered in *dBASE II*. It requires 96K and two dual-sided disk drives. It uses imbedded English commands instead of control code commands. *Datatext* can generate footnotes and an alphabetized index. Its formatting capacities include subscripting, superscripting, automatic word wrap, block move and delete, insert, copy, and find and replace.

File space is limited only by the amount of disk storage space available. The horizontal scroll feature allows the user to edit lines up to 255 characters long. It features true proportional spacing with justification. List price: $450. Datatek, 2621 Enterprise Rd., Clearwater, FL 33515, 813/797-6464.

Multi-Tool Word
The second product in Microsoft's line of productivity tools (*Multiplan* being the first) that will have a common user interface and the ability to share data. It requires 128K and one disk drive. The Microsoft Mouse can be used with *Multi-Tool Word* for pointing to and executing commands. *Multi-Tool Word* features multiple windows that allow the user to compare and/or transfer sections of one file or parts of two or more files.

Multi-Tool Word includes an "undo" command that allows the user to undo or erase the last action. It offers the user a number of style formats; the user can either choose a format from those provided or create a format and store it for future use. *Multi-Tool Word* gives the user the ability to abbreviate or code commonly used phrases and store them in the glossary buffer. The glossary is useful for generating boilerplate material and legal documents.

Another feature is a ruler that can be called up to the top of the screen and used for placing tabs and margins. List price: $375. Microsoft Corporation, 10700 Northup Way, Bellevue, WA 98004, 206/828-8080.

ReadiWriter
A word formatter that interfaces with the IBM mainframe text processing software, *Document Composition Facility (DCF)*. It requires 128K and two single-sided disk drives. With *ReadiWriter* the user can format text that has been previously keyed into an input file on a mainframe or a personal computer. It interfaces with standard DOS files. The user can create footnotes, an index, and a table of contents.

ReadiWriter supports proportional spacing and underlining. Printer support can be determined by the user through the device definition file. There is no limit to the size of document *ReadiWriter* can format. Chapters, sections, and subsections can be included. *ReadiWriter* supports logical statements, allowing the user to delete part of a file automatically or substitute variables such as names and addresses or a recurring word or phrase. List price: $125. ReadiWare Systems Inc., P.O. Box 680, West Redding, CT 06896, 203/431-3521.

Accessories

Synergetix Work Station
A cabinet that provides work space and locked storage space for the IBM Personal Computer's central processing unit, keyboard, monitor, and printer. The work station provides an adjustable terminal base, an adjustable chair, a printer stand, a worktable, an optional-locking two-drawer module, and an optional mobile storage cabinet. List price: $850. IBM Corporation, P.O. Box 10, Princeton, NJ 08540, 201/329-7000.

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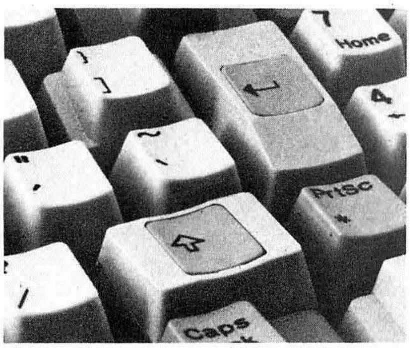
Just Announced

Keyfixer

A set of four plastic collars that fit over the return, left shift, right shift, and tab keys on the PC and XT keyboards. The collars increase the size of the keys and improve typing ease and accuracy. The tab keyfixer also fits on the backspace key. List price: $19.95. Vertex Systems, 7950 W. Fourth St., Los Angeles, CA 90048, 213/938-0857.



Keyfixer, Vertex Systems

Glarefree

An antiglare screen that fixes to the exterior of any monitor used with the PC. The screens come in various sizes and two densities for color or monochrome displays. An antistatic cleaning kit is included with the screen. List price: $39.50 for IBM Monochrome Display, $49.50 for IBM Color Display. Prosoft, Inc., 35 North Main St., Southington, CT 06489, 203/621-9331.

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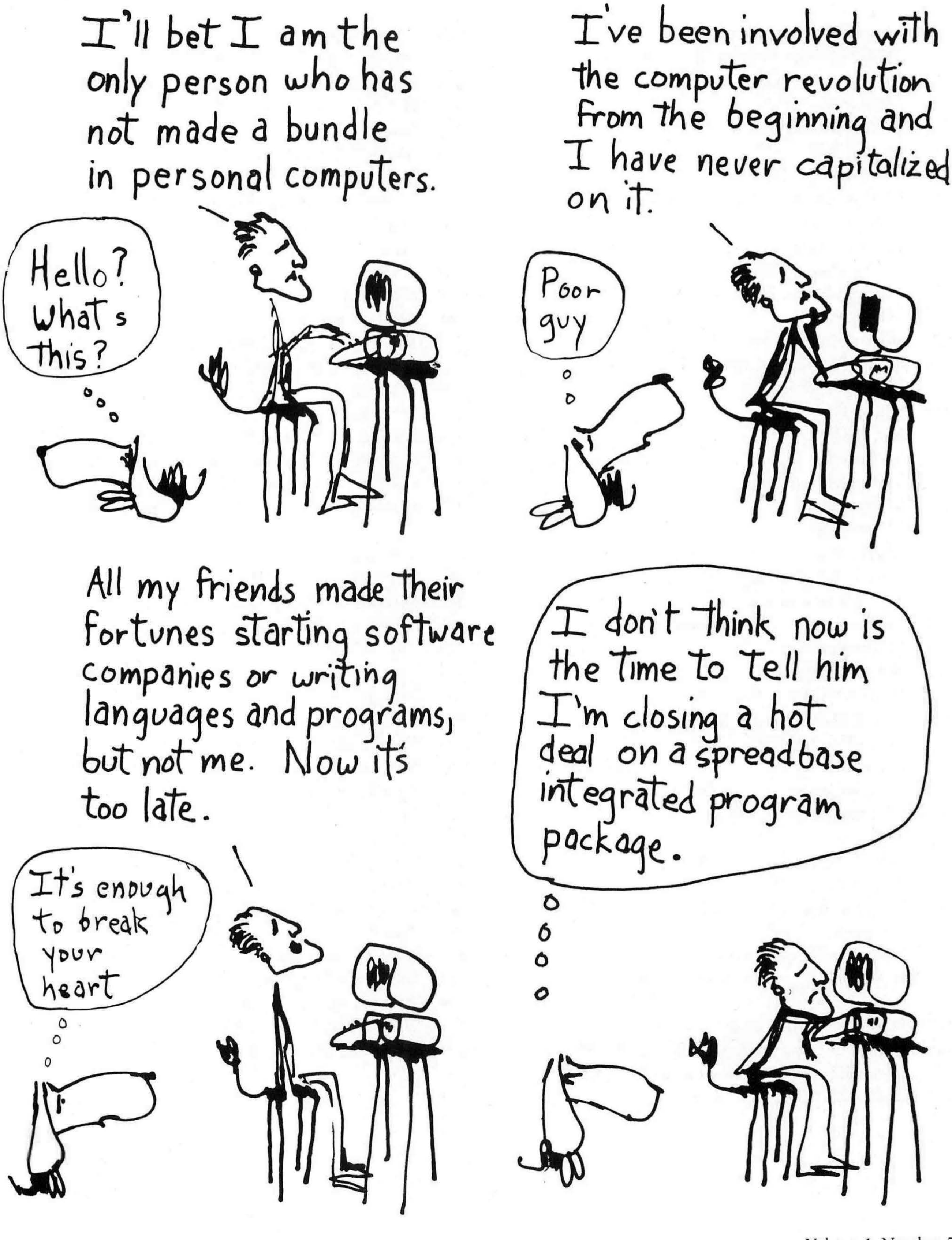

I'll bet I am the only person who has not made a bundle in personal computers.
Hello? What's this?
I've been involved with the computer revolution from the beginning and I have never capitalized on it.
Poor guy
All my friends made their fortunes starting software companies or writing languages and programs, but not me. Now it's too late.
It's enough to break your heart
I don't think now is the time to tell him I'm closing a hot deal on a spreadbase integrated program package.

After $50,000.00 and 7 months of programming ... I chose PLAN80™

In 1979, I was the President of a small but fast growing manufacturing company, producing a new recreational product. To tell you that our sales increased over 100 times in five years gives you a picture of how volatile things were.

Among other problems, our financial and information systems were light-years behind where they should have been. The only financial planning and forecasting for the business was done by myself using pencil and paper. Not only was it an almost impossible task in terms of the time required, but the projections were virtually out-of-date by the time they were typed.

In sheer desperation, I bought a microcomputer and started to teach myself how to program. At that time, there were no financial planning packages available. And the prospect of teaching a programmer about financial models seemed more awesome than learning to program myself.

Seven months of nights and weekends later, I'm pleased to say I had a 30 spreadsheet, inter-related financial model up and working. The estimated cost was about $50,000.00 in time, materials and equipment . . . but it was worth it. Now I could update the company's financial plan in a 10th of the time.

Enter the 'Calc' programs

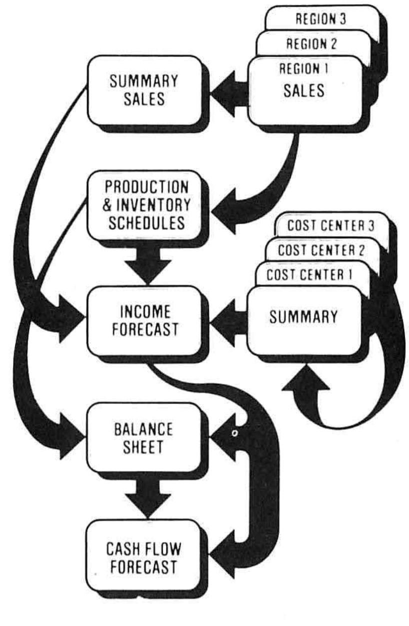
When Calc programs became available, I bought one and quickly realized the time and money that would have been saved had they been available sooner. But I soon appreciated that a computerized spread sheet program also had very major limitations for financial modelling.

The problem of consolidating and running up to 30 inter-related spread sheets, in the correct sequence and without errors, becomes almost insurmountable. And the complexity of thousands of formulas, all using co-ordinates like "A5*C4+B6", would have made the system almost impossible to revise.

PLAN80 — it's worth $50,000.

When I bought PLAN80, I was amazed at the power of this brilliant piece of software. In using PLAN80, I soon realized that the financial model that had taken me months to create, would have taken only a few days to create with PLAN80. The results would have been the same, if not better.

PLAN80 allows you to create simple 'command' (instruction) files that cause ANY NUMBER OF SPREAD SHEETS to be computed IN ANY SEQUENCE. The required data is transferred automatically to/from the appropriate spread sheet.



This is the kind of inter-related model PLAN80 automates with ease

These command files are created on your own computer with your own familiar word processor.

And all the rules (formulas) in the spread sheets use abbreviated English-like words that you create, so you can still understand them 6 months later. You enter initial data values into the spread sheets with simple fast commands e.g., "1200 (*110%)" to create a series of values that increase monthly at 10%.

PLAN80 also has an interactive display mode like the 'calc' programs for quick 'what-if' reruns. It displays results graphically on your screen. It has built-in functions to automatically total rows and columns and accumulate values. Plus special trig, financial, depreciation, amortization, net present value and other time saving functions.

PLAN80 stores it's data in 'packed' format in your computer memory so you can use bigger spreadsheets when necessary. It has the ability to produce perfectly formatted reports with up to 6 decimal places if needed . . . with automatic printing and paging . . . and the ability to store your finished reports on your disks so you can incorporate them into written reports with your word processor.

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Mainframe modeling power at micro prices

PLAN80 was designed by a man with years of experience in mainframe modelling to bring it's best features to the CP/M® or MS-DOS® micro-user.

PLAN80 is an incredible product that does everything described above and a great deal more . . . but it still does virtually everything the 'calc's do. And it's much faster and easier to work with since you create your models with your own word processor or editor . . . just as you would on paper.

INFOWORLD rated the original version of PLAN80 as excellent in all 4 categories: PERFORMANCE . . . DOCUMENTATION . . . EASE OF USE . . . ERROR HANDLING. It has been greatly enhanced since then to provide even more power and features.

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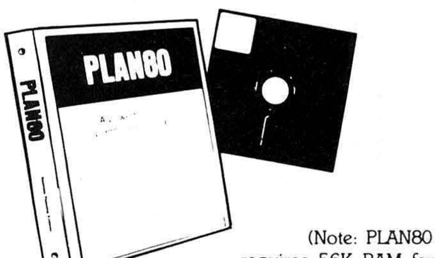
Once you've tried PLAN80 you won't want to use your 'calc' package again for any serious modelling. I should know, I haven't used mine since I got PLAN80. In fact, I'm so enthusiastic about PLAN80 that I've made a special deal with the author to market it.

PLAN80 currently retails at $495. But, for a limited time you can order directly from **Executive Software** at $295. **So order right now**. . . credit card customers, call your order **Collect** to **705-722-3373**. . . . **it might save YOU $50,000.00!**



(Note: PLAN80 requires 56K RAM for CP/M80 or 128K RAM for CP/M86 or MS-DOS operating systems.)

Order Collect 705-722-3373

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P6 Ad# 1011

Reader Service #269

(About Our Gatefold)

The image inside the facing gatefold cover was created by Daniel Cooper, artist, graphic designer, and owner of Perfect Productions in Larkspur, California using an IBM PC and the Plantronics COLORPLUS card and software.

Daniel has a background in mathematics and says he enjoys creating visual expressions of mathematical formulas. This image is from his Sinescape series, in which versions of sine wave forms are used to create abstract landscape patterns.

The images in the Sinescape series are built up in a random process, as successive, overlapping waves of different shapes and colors are generated by the program. "I always incorporate a certain amount of randomness in my programs," Daniel said. "I like never knowing exactly what will happen."

Daniel is marketing limited-edition silkscreen prints from the Sinescape series.

The Plantronics gatefold is a regular feature of *PC World.* Each month we ask a different artist, architect, or designer to experiment with this system and create an image.

At the end of the year a *PC World* blue-ribbon panel will evaluate the series and award a cash prize and a plaque to the artist who makes the most dazzling use of COLORPLUS. If you would like to be considered for the contest, please contact our editorial department.

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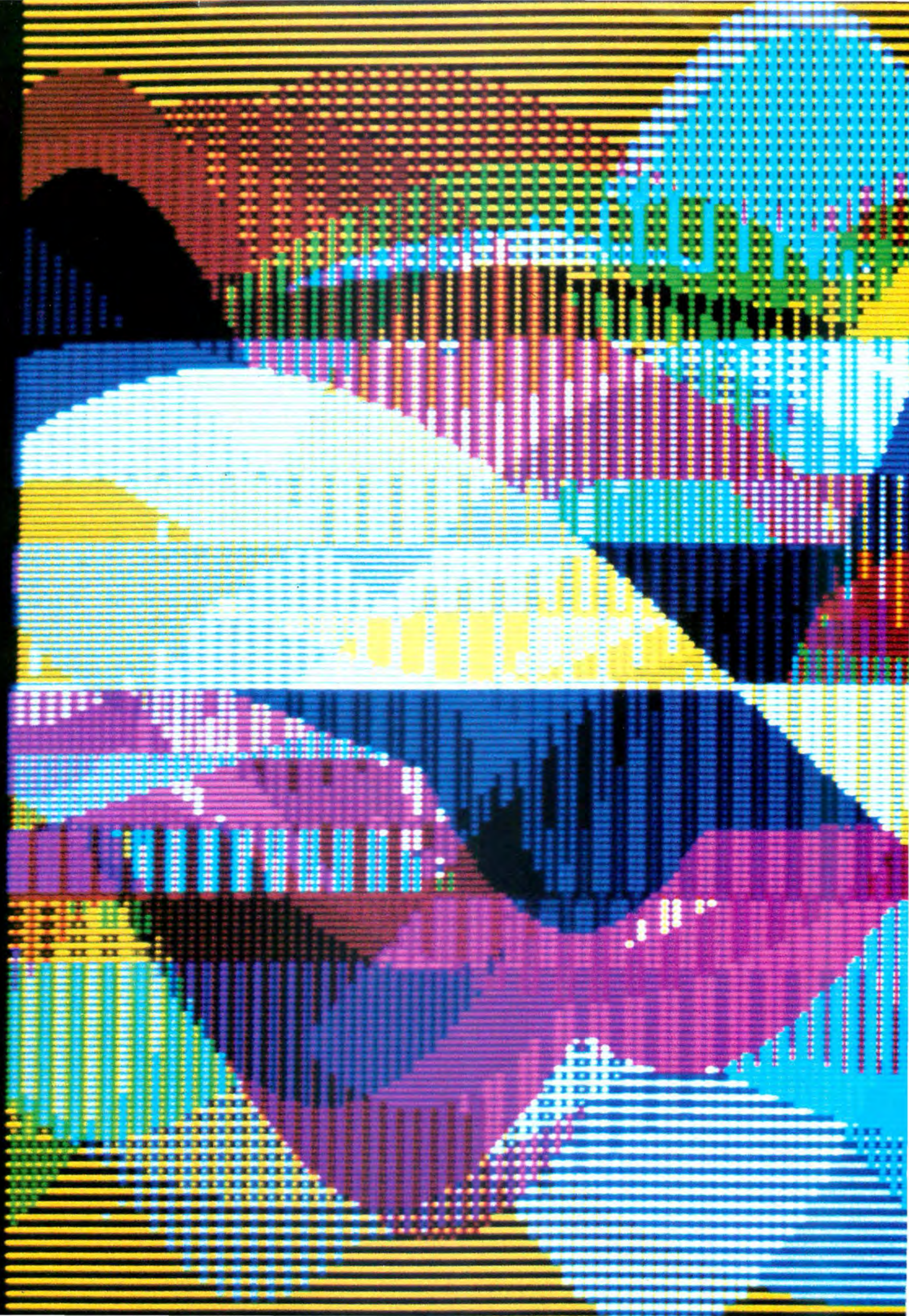

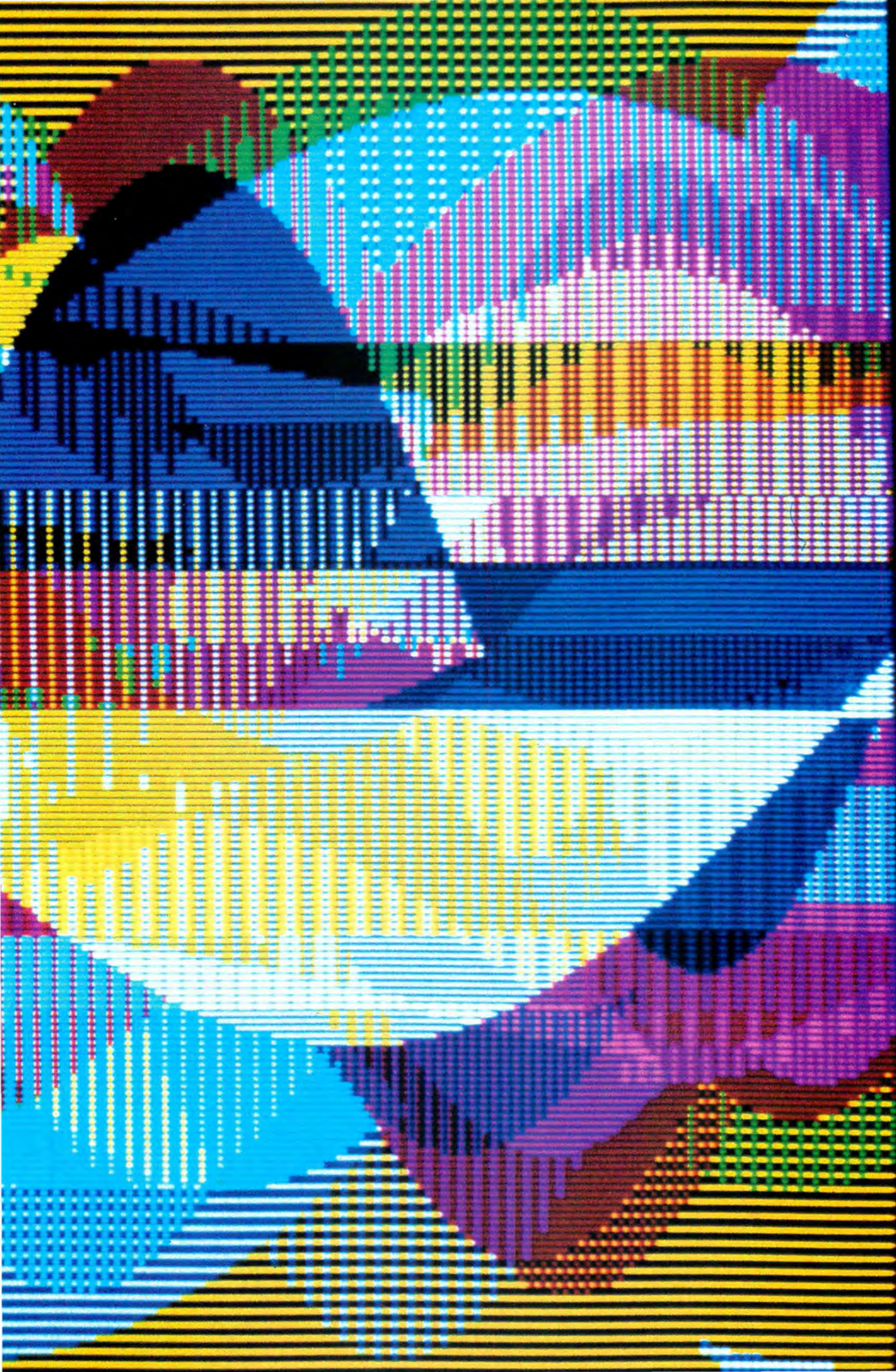

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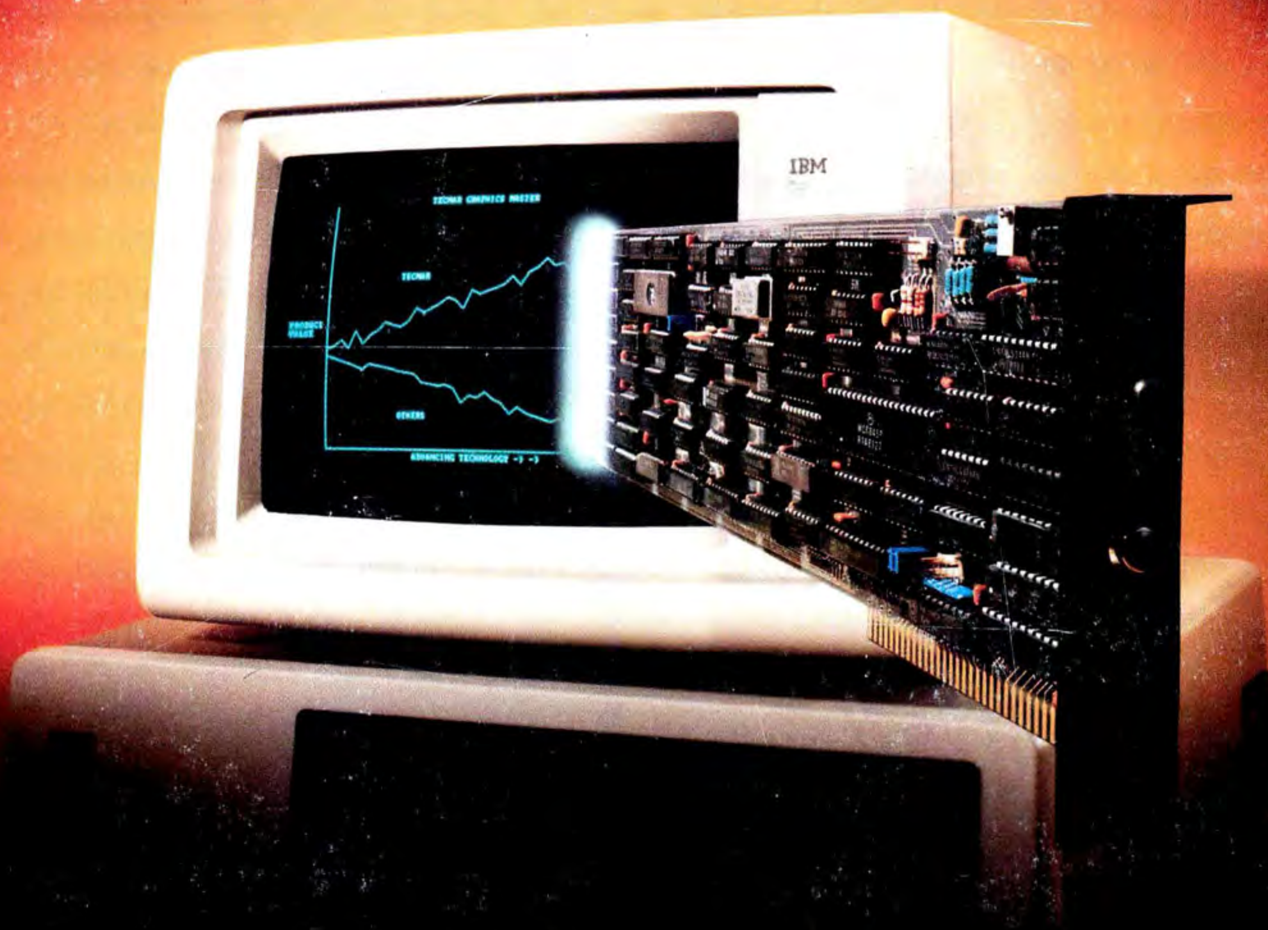

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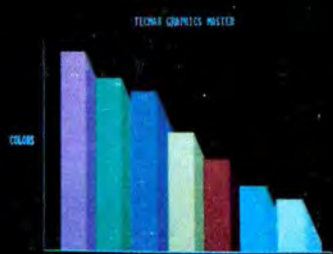

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