

PC WORLD

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*The Personal Computer Magazine for IBM PCs
and Compatibles*

**The New dBASE II:
How Good?**

Ink Jet Printers

IBM PC goes to the
'84 Olympics

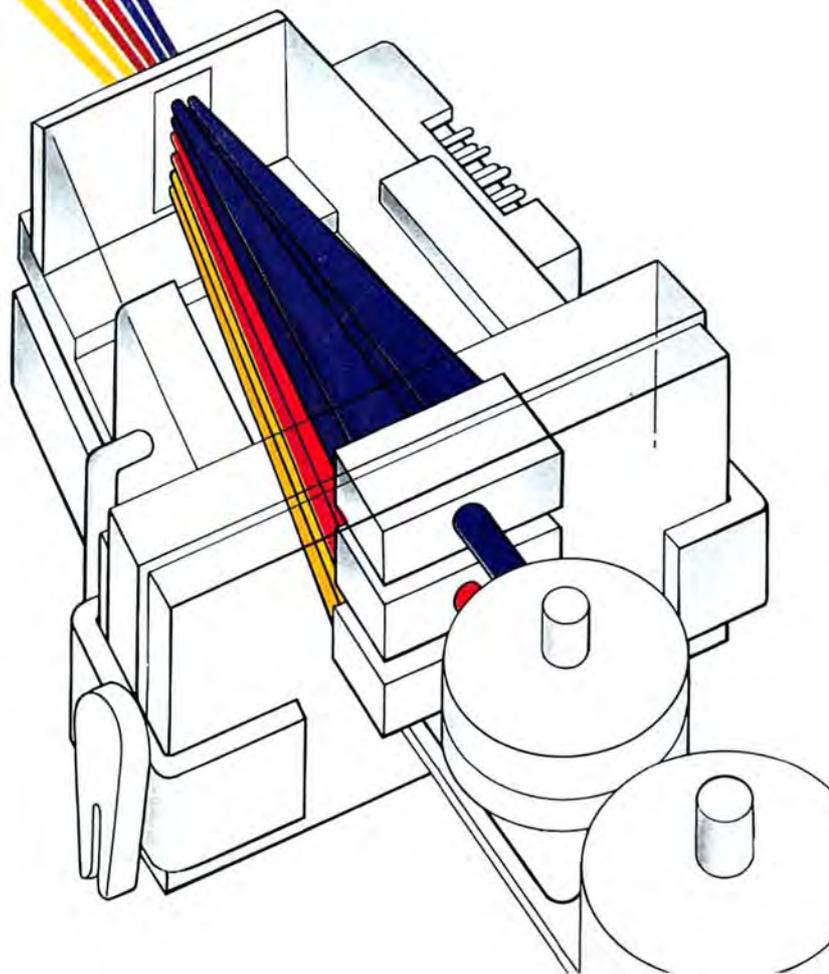
Graphics on Your
Mono Screen

Spelling Checkers

A Better BASIC
Editor

Printing Graphics

Using the 8087



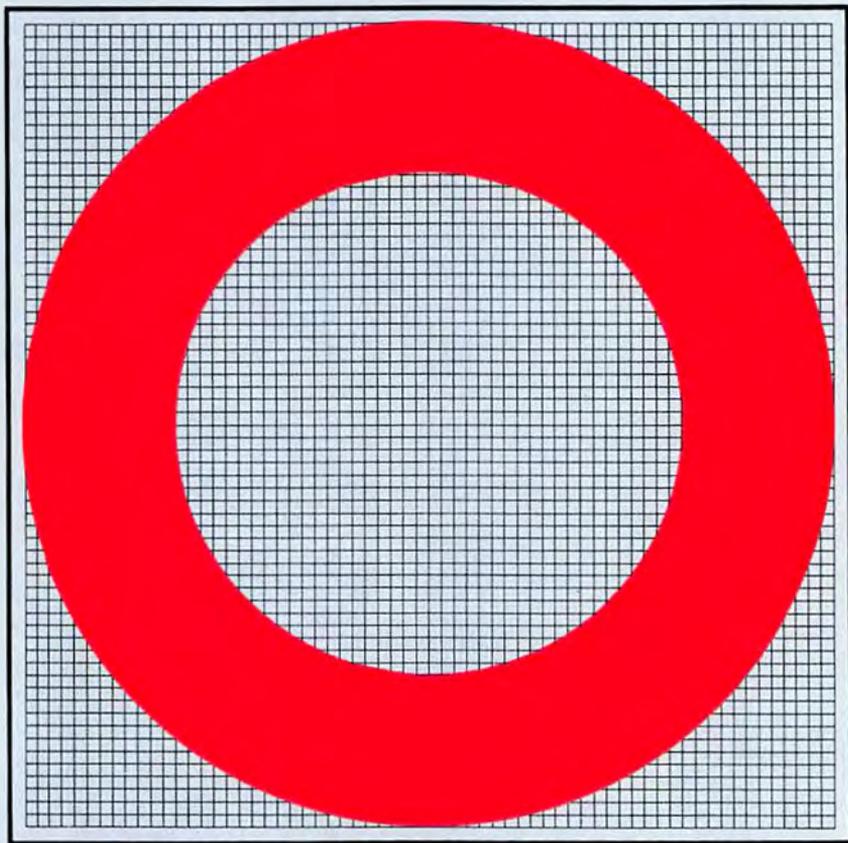
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November 28-December 2, 1983

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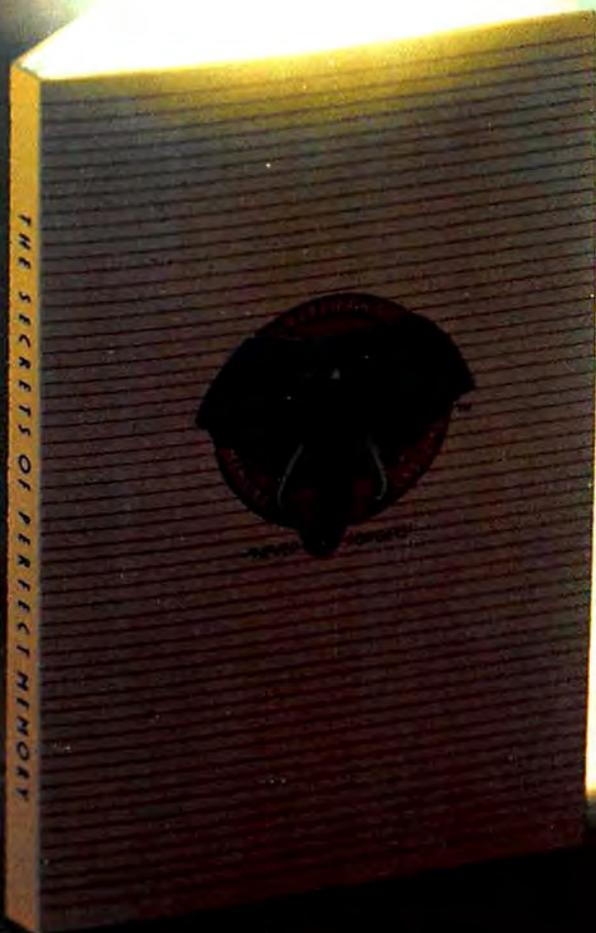
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*DBM II directly reads and writes Lotus 1-2-3 Worksheet (WKS) files. No translating is required.

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We've always said SuperCalc[®] is the world's most useable spreadsheet.

At first, all spreadsheets seem to give you about the same things. Until you put them to work. Then you'll find out if they do everything you expected. Or make you do everything the hard way.

You know what makes the difference? It's not just having the newest, whizziest features, but what those features actually do for you in the real world. And that's the whole idea behind SuperCalc and SuperCalc2. Because they've been designed to work with you in a natural, intuitive way.

What we're really talking about here is useability. When you get right down to it, it's not any one big thing, but a combination of little things. Like the number of keystrokes it takes to get a job done. Or the effort it takes to switch from one function to another. Maybe a few keystrokes here and there doesn't seem like much of a difference. Or having to change disks to plot a graph. But when you multiply those little things by the thousands of times you do them, they make all the difference in the world.

Even the size of the spreadsheet is important. Some programs promise you a huge area to work with. Unfortunately, they can use so much of the computer's available memory just keeping track of all the blank cells that you're left with only a handful. But we've designed SuperCalc to give you the largest useable spreadsheet.

If you look at the printout below, you'll see a lot more examples of what we mean. And we think you'll realize why this is the most useable spreadsheet in the world.

Text can "spill over" into next column

Calendar/Date calculations

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Data management capability

Dictionary sort order (not ASCII)

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Individually variable column widths

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1-12	Boze	\$100	85	89,700	97 50
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MANAGER					
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2-22	Edgar	\$82	72	10,414	127 75
SENIOR					
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3-112	Calaban	\$50	90	6,690	150 85
3-124	Roy	\$48	83	7,008	148 85
STAFF					
4-91	Smith	\$41	99	\$7,134	174 99
4-154	Hollinsky	\$43	99	7,482	174 99
OFFICE TOTAL		80	\$91,162	1401	78
			\$84,517	1309	75
			\$84,744	1,318	77
			\$260,422	4028	

OFFICE SUMMARY STATISTICS:

Lowest Utilization	55%	50%	50%	52%
Highest Utilization	99%	99%	98%	98%

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10

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 Employee Billing by Month

Month	January	February	March
January	\$100,000	\$150,000	\$120,000
February	\$80,000	\$130,000	\$110,000
March	\$90,000	\$140,000	\$130,000

Lowest/Highest Billings

Employee	Lowest	Highest
Employee 1	\$10,000	\$20,000
Employee 2	\$15,000	\$25,000
Employee 3	\$20,000	\$30,000

Billings - Top 3 Employees

Employee	Billings
Employee 1	\$35,513
Employee 2	\$30,832
Employee 3	\$29,848

Billings by Management Level

Management Level	January	February	March
Staff	\$20,000	\$25,000	\$30,000
Senior	\$30,000	\$35,000	\$40,000
Manager	\$40,000	\$45,000	\$50,000
Partner	\$50,000	\$55,000	\$60,000

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PC WORLD

*The Personal Computer Magazine for IBM PCs
and Compatibles*

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Notice to Readers

As a service to our readers, *PC World* features a Reader Service Inquiry card in each issue. This card can be used to get additional information about products advertised in *PC World*. To use the card, simply circle the Reader Service Number of the products you're interested in and mail in the card—no postage is necessary. The information you want will be mailed to you by the product manufacturers. For your convenience, Reader Service Numbers are listed in the Products and Advertisers Indexes, grouped according to type of product and manufacturer.

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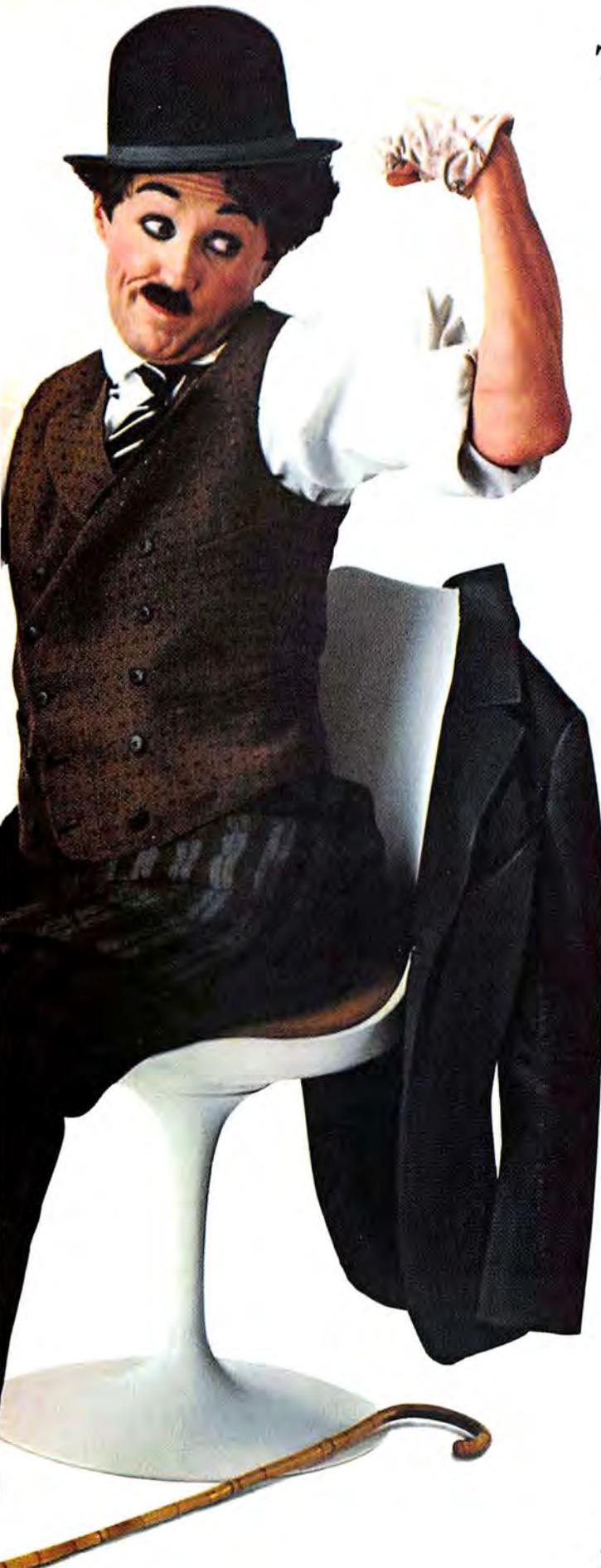
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*An expansion unit can also be added to both 16-bit (8088) systems for 6 more system expansion slots. Added to the IBM Personal Computer, it can house two 10 megabyte fixed disk drives. Added to the IBM Personal Computer XT, it can house one additional fixed disk drive for a total of 20 megabytes.

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I won't go into great technical detail about Friday! because there isn't any. I just follow the English-language instructions on the screen, push a few buttons and—Zap!—I get the job done. With incredible speed because we've turned our paper files into much more efficient "electronic files."

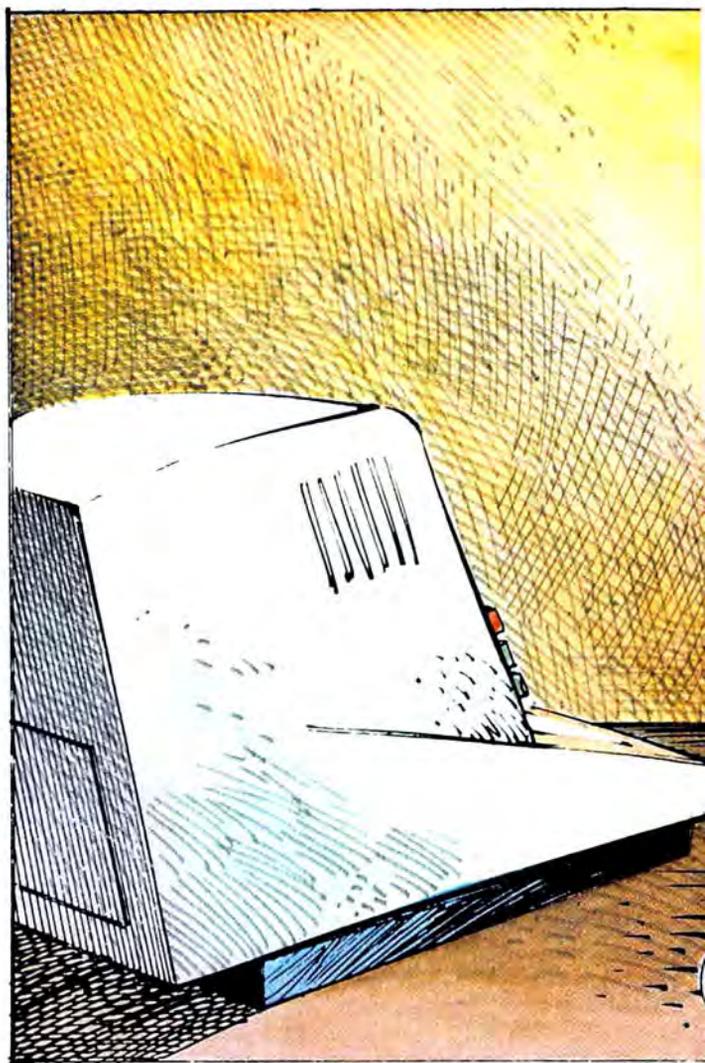
So whatever I need to know, I can find it in seconds.

Sales by product, salesman and territory since the first of the year.

Time billing for work in progress last month.

A quick report on our accounts payable.

Or a custom report that the old man can take to a Board of Directors' meeting. (Friday! and I whipped one out last week and



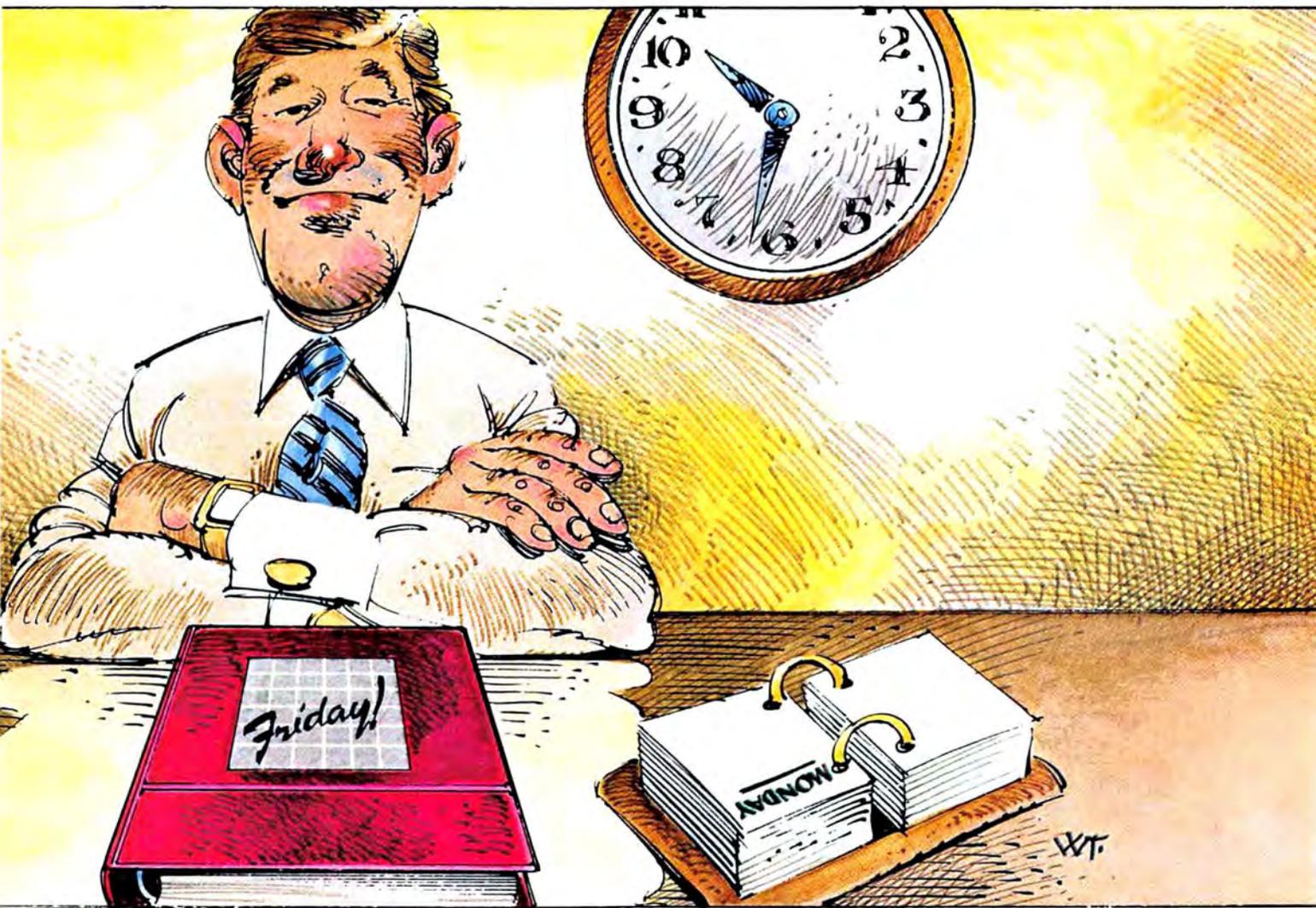
he said it was the best he'd seen since the company opened its doors.)

Very simply—and with blazing speed—Friday! handles just about everything that needs handling around the office.

It's terrific for inventory and invoices and paychecks and input screens and plain or fancy reports. It works with dBASE II and 1-2-3¹ and WordStar² files.

And wait until you see the way it handles mailing lists and labels—it's worth the \$295 (suggested retail) price for that alone!

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If, that is, Dad has cleared off the next rung for me.

For the name and location of the Friday! dealer nearest you, contact Ashton-Tate, 10150 W. Jefferson Blvd., Culver City, CA 90230. (213) 204-5570.

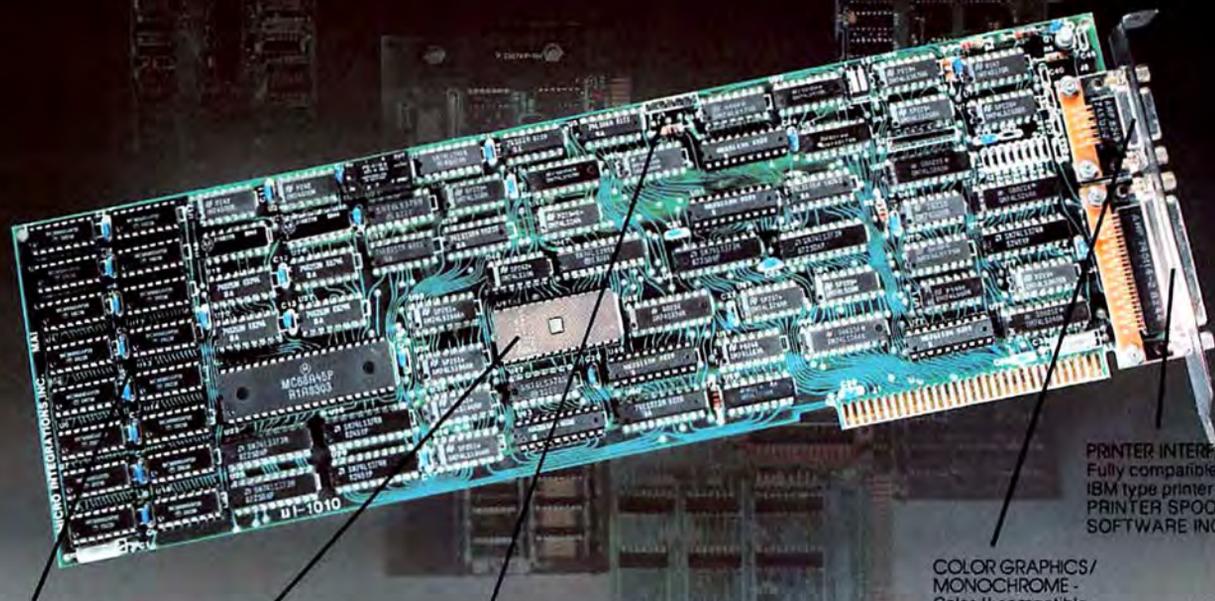
Or better yet, just call today and start getting everything done by Friday!

ASHTON · TATE 

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Friday! runs under CP/M[®]-80, CP/M-86, PC-DOS[®] and MS-DOS[®].
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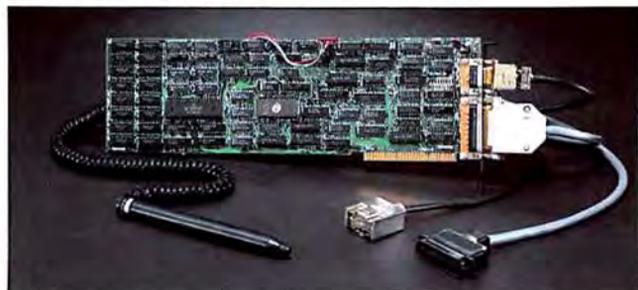
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David Bunnell

A Schizophrenic PC Goes to the Faire

PC Pete, our *PC World* ventriloquist's dummy, drew an excited crowd with his mischievous warm-up for the first World Class PC drawing at the IBM PC Faire in San Francisco on August 26 to 28. As reported in our September issue, the PC system that we were about to give away to a lucky *PC World* reader included some \$14,000 in hardware and software.

The World Class system selected by our readers was an IBM Personal Computer equipped with an AST ComboPlus 256K board, Tallgrass Technologies' 12-megabyte hard disk with tape backup, a Hayes 1200 bps Smartmodem, two printers (a letter quality NEC Spinwriter and an Epson dot matrix), and IBM's color monitor. Software included six games, a disk emulator, a keyboard enhancer, a word processor, a communications package, a spreadsheet, and both major and index-type data management programs. We had it on display in one of Williams and Foltz's oak computer stations. No wonder so many people were drooling.

With PC Pete's encouragement I dug deep into the box and pulled out the winner's name: Alan Klein of Union, New Jersey. Too bad he wasn't in the crowd to see the moment of his enrichment. When contacted on the phone the following week, he said thanks and reported that he plans to use his new PC with



his other PC for a networking project. Mr. Klein also plans to use his new PC for design work.

Thousands of readers voted in this year's contest, and I wouldn't be surprised if over 100,000 people participate next year. As powerful and versatile as this year's World Class PC winning system is, next year's winner will really knock your socks off. The IBM PC has really come a long way. The first ads for it talk about an under-\$1600 system that, with "the addition of one simple device, hooks up to your home TV and uses your audio cassette recorder." In the two years since the PC's introduction, I have run across only one

user who had such a minimal system, and this particular user is a died-in-the-wool hobbyist who just can't afford disk drives at the moment (though his Radio Shack TRS-80 has them).

PC World reader surveys indicate that the typical system has 128K of memory, two disk drives, and a dot matrix printer. However, for each of these systems there are a half dozen others that take off in all directions.

Never was the schizophrenic nature of this hurly-burly market made more clear to me than at the IBM PC Faire, which drew some 20,000 people at \$18 a head to see 300-plus exhibits of IBM PC products. While many of the exhibitors reported that they are scrambling to cash in on the "corporate" market, nearly all of them were also speculating about the IBM home computer and the impact it will have.

I discovered one small software company so confused that it has four products, each targeted for a different market. It has a game for the home market, an accounting package for the small-business market, a foreign language word processor for the overseas market, and a local area network for the corporate market. Selling those packages will require four entirely different marketing strategies.

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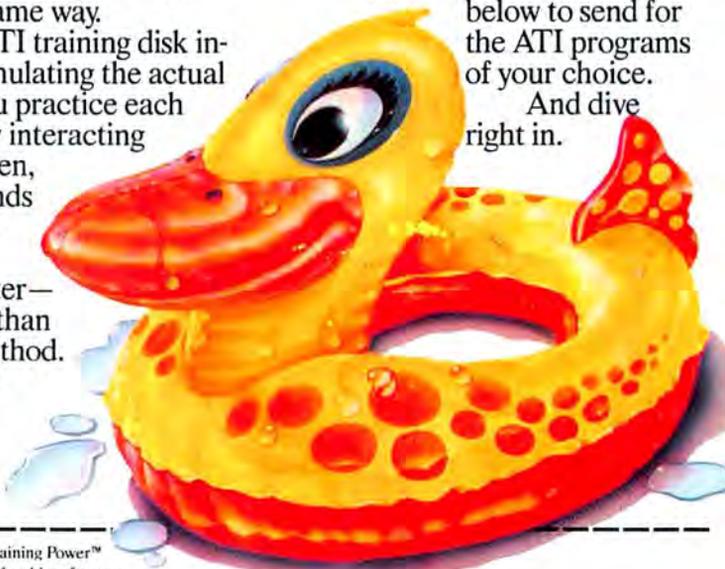
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Circle 7 on reader service card

David Bunnell

The confusion stems partly from the fact that no one is really certain what a personal computer is. Many think that it is the same as a home computer, while others think that it is a business machine. Also, personal computers are so new that they are just now finding their place in the world, which is turning out to be almost everywhere. This only adds to the confusion. We are discovering that, like the telephone, the personal computer is a universal tool that has unlimited applications.

Next year's World Class PC system will really knock your socks off.

The personal computer is usually an open computer system capable of doing many tasks, as distinguished from dedicated systems such as the Wang Word Processor or the IBM Displaywriter.

A typical personal computer is used by one individual and is viewed by that person as his or her personal work tool. However, many personal computers are also shared, particularly in an office or school environment.

Most personal computers can be transported from place to place and fit on a standard desktop. However, by the time you add hard disks, printers, multiple monitors, and modems, they become quite cumbersome. They often require custom furniture. Some personal computers are lap-sized and others can best be described as desktop portables.

No wonder the IBM PC is schizoid—the personal computer phenomenon is totally out of control. I predict that it will take at least 10 years before the dust settles and we finally know what these things really are. ☹

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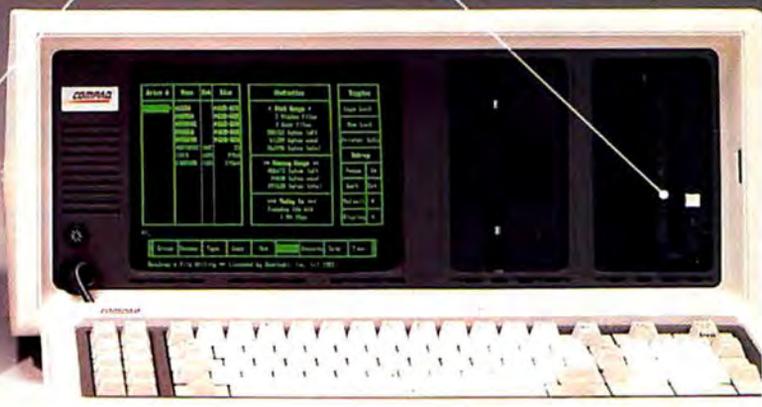
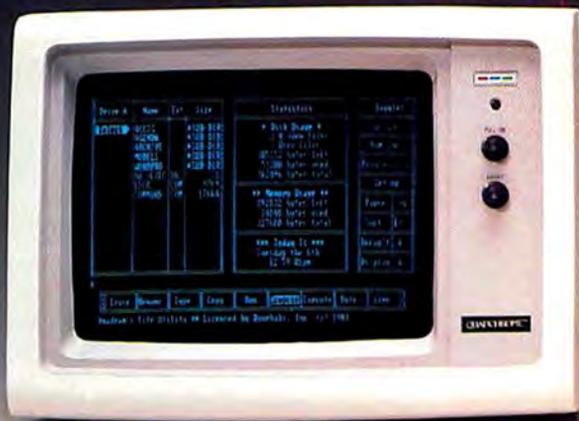
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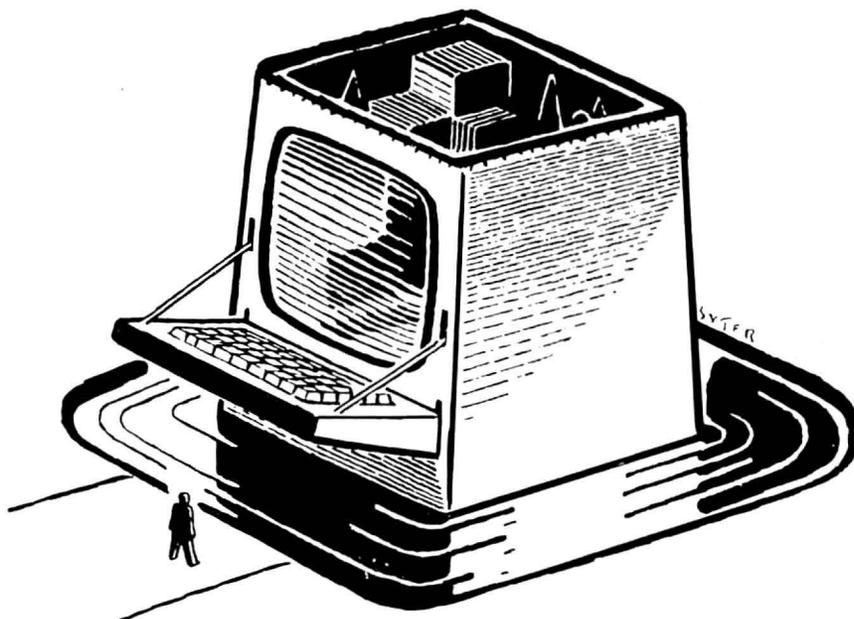
...And PCs for All

Now that IBM has proven that you can teach an elephant to tap-dance, the next question is, can you teach a dinosaur to hustle?

The dinosaur in question is the public education system—and the IBM elephant is a clever and nimble fellow by comparison. Rapid change and intelligent long-range planning do not come easily to a system that moves with all the grace and speed of a brontosaurus. Yet change it must and quickly if the computer revolution of the eighties is not to undo many of the social gains of the sixties.

Though only a few years old, the microcomputer is already an established part of American society. An increasing number of jobs will require computer experience. As microcomputers sprout on the desks of corporate managers, the ability to use a computer will become a prerequisite for advancement in many fields.

Who will be prepared to use those computers? If current trends continue, most of the people behind those desks will be white males from upper middle-class families. They will be comfortable with computers because they grew up in homes that had computers and were encouraged to use them.



That trend is already clear. Visit a computer camp and who do you see? White males with straight teeth and polo shirts. Computer camps tend to be expensive, so they're limited to kids whose parents can afford them and are willing to pay. The more expensive the camp, the fewer girls you'll find there.

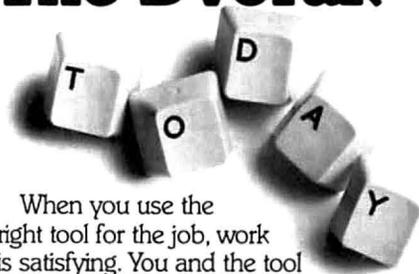
Most kids' first experience with computers is playing games. Because those games are designed to appeal to boys, the boys are more apt to want home computers. And when it comes to buying a computer, upper middle-class families can afford one of the more expensive machines that can be used for programming as well as games. Even if the price of computers falls so that most families can afford them, kids from upper income families will be using them for pro-

gramming and word processing, while kids from lower income families will be playing games.

The availability of educational software for home computers will also widen the gap between the haves and the have-nots. Children from families that provide access to computers and educational software will have a substantial advantage in school.

Children from higher income families already come to school better prepared and get more help at home when they need it, but the microcomputer will multiply their advantage several fold. Their parents will have the money required to purchase programs that can help with math facts, reading, spelling, and even reasoning skills.

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Future Computing Incorporated forecasts that by 1987 the educational software industry will reach \$1 billion, and the home market will account for approximately 70 percent of that figure. If educational software effectively educates children—and many teachers believe it does—the impact on schools and society as a whole could be dramatic.

Teachers will face students who have an increasingly wider range of abilities. They will also face parents who have vastly different expectations and agendas for their children's education. There will be tremendous pressure to separate children by "ability," even in the earliest grades. Ability grouping, or tracking, is a self-fulfilling prophecy. One group of students gets stimulating lessons and the message that they are smart; the other group gets to repeat last year's work and receives the message that they are dumb.

For lower income kids such early tracking will be disastrous. Most girls do fairly well in the early grades, so the tracking won't affect them directly. But overall, the gap between the advantaged and the disadvantaged will grow wider. Achievement will have less to do with ability and more to do with sex and family income. The computer will provide a mechanism for reestablishing the barriers that began to fall in the sixties when overt discrimination became unacceptable.

The schools can go a long way toward rectifying the situation, but it will take more than a required class in computer literacy (and most schools don't even have that yet). Programs must be designed to provide equal access to all students and enough equipment and software to allow the kids who don't have computers at home to master them at school. The situation demands teachers who are capable of tapping the potential of the computer as a teaching machine and adjusting to changes in technology and society.

Unfortunately, the need to make these changes comes at a time when national commitment to both equality of opportunity and education is at a low point. School budgets can barely cover the cost of textbooks, and teaching salaries are so low that bright young people are not attracted to the field. Any teacher who has a knowledge of computers can make more money in private industry than in the schools. RIFs (reductions in force—the current jargon for layoffs) have left teaching staffs with an average age in the 50s.

In computer-conscious California, where corporations can receive tax breaks for donating computer equipment to educational institutions, schools are in such trouble financially that several districts have declared bankruptcy.

If it sounds like a grim situation, that's because it is. And one computer in every school isn't going to do a lot to change it. But the problems are not insurmountable—the same technology that is creating those problems is capable of solving them.

It's not fashionable to talk about issues of social equality in the eighties, but we can't ignore them much longer. A society that is capable of the vitality and creativity evidenced in the computer field is certainly capable of making that technology available to all its citizens.

Schools and libraries are the obvious places to start providing equal access to computers and software, but they need not be our only solution. As with so many problems, the first step is recognizing that a need exists and making a commitment to meet it. Once that is done, solutions have a way of following. ☉

Linda Williams is an educational consultant and the author of Teaching for the Two-Sided Mind (Prentice-Hall, 1983), a book that explores the implications for education of recent brain research. She is currently writing a book on EasyWriter II.

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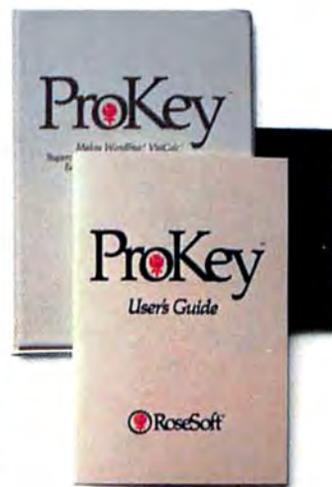
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To run ProKey, you'll need an IBM Personal Computer or workalike, DOS (any version, including 2.0), and 64K of RAM (WordStar requires 96K).

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Letters

Elf Update

Andrew T. Williams' excellent article "The Elves of 'Wall Street Week'" [PCW, Vol. 1, No. 3] has created substantial interest in using spreadsheet programs for computing the Technical Market Index.

Since the article was written, several minor changes have been made in the index due to changes in the data upon which it was based. Readers interested in obtaining an updated explanation and parameters for the indicators may write me at The Asstute Investor, P.O. Box 988, Paoli, PA 19301.

Robert J. Nurock
Paoli, Pennsylvania

Nuclear Madness

I congratulate author Ted Nace and you for the illuminating article "Dr. Strangebyte" in the September issue. I share his concern and feel a responsibility to spend at least some hours each month using my own technical experience in the direction of informing people regarding the current state of worldwide nuclear madness.

It is my hope that networks such as the one described in the article will provide a new means for technically informed persons to use their expertise. Clearly we are needed. Let our word processors, modems, newsletters, and phones create an unprecedented and overdue dialogue aimed at a reduction of the madness daily committed in our names.

Ashton Brown
Kensington, California

Shocked and Amazed

I am shocked and amazed! If there is anything that computer addicts (from the TV/typewriter type to the C-language programmer) agree on, it is that economical and accurate use of language cannot be compromised. Thus it is with much consternation that I continue to see the word *data* misused. The word *data* is the plural of *datum*. Data are, a datum is! One can legitimately say, "The data base is inadequate," but one emphatically cannot say, "The data is not adequate."

This pervasive linguistic bug is all the more surprising given the influx, caused by widespread use of microcomputers, of people who author more than FORTRAN programs. Worse still is the fact that many scientists utter phrases such as, "This data indicates that..." The proper use is, "These data indicate that..."

This is not simply a debate between linguistic purists. To use the plural of this noun without the correct form of the verb *to be* is simply wrong. I do not expect all compheads to know rules of grammar, but editors can make no excuses. Our business is based on accurate syntax and grammar. It is a shame we don't pay more attention to our English.

Chip Clarke
Stony Brook, New York

Computer publishing is notorious for its crimes against the English language. This, however, isn't one of them. Though not unanimously accepted, the use of data as a singular, collective noun is far from being "simply wrong." The relatively con-

servative editors of the American Heritage Dictionary, while they list data as a plural, note that the singular construction is "acceptable to fifty percent of our Usage Panel." The more permissive Webster's Ninth New Collegiate Dictionary (PC World's official dictionary) simply lists data as "pl but sing or pl in constr."—Ed.

RPG-II for the PC

A letter writer in your September issue challenged IBM to develop an RPG-II language and S/34-style screen format generator. That letter rang a bell because I had just read of such a system. This system, *Baby/34*, also provides SEU, DFU, and OCL, and it allows systems developed on the 34 to be downloaded to the PC. The vendor is California Software Products, 525 N. Cabrillo Park Dr. #300, Santa Ana, CA 92701.

Rod A. Flohr
Eustis, Florida

Oh Yeah...

David Bunnell's column [PCW, Vol. 1, No. 6] sets forth his speculations about the possibility of a new IBM "home computer" rumored to sell in the \$600 price range. In the process of doing so he states that the new IBM home computer will be the first 16-bit home computer ever.

Whatever happened to the little TI-99/4a home computer? It is a well-known fact that this machine has utilized the TI-9900 16-bit micro-

Letters

processor from its inception. It also retails in my area for about \$100 as of this writing.

It was through the purchase of a TI-99 for evaluation purposes that I later purchased an IBM PC. I have no regrets about either acquisition but I continue to be surprised by blatant errors in computer-oriented magazines, books, and documentation.

Robert L. Richardson
Woodbridge, Virginia

On the Button

A postscript to and a comment on Douglas Clapp's review of *PC-File* ["For What It's Worth," *PCW*, Vol. 1, No. 6].

Jim Button's support of his program could not be surpassed. He has promptly answered written questions I've put to him, usually by return mail. I called once when he was not in and left a name and number on his answering machine; he called back within the hour.

I recently wrote him about a problem to which he responded by calling me (1) to offer several likely solutions, (2) to advise me that if none worked I should send both my data and my application disks to him and he would do what he could to resolve the problem, and (3) to say that if I did send the disks to him he would not be able to respond for two weeks or so because he and his family were going on vacation for that length of time.

Talk about above and beyond the call of duty! The only other person from whom I've received that kind of support is David Rose, the creator of *ProKey*.

I would also like to make known my feelings of dismay upon learning that so few who use Jim's program send him money. How anyone could spend \$5000 to \$6000 for hardware and then begrudge the creator of a piece of software that permits that hardware to provide a specific service the nominal sum of the suggested \$35 is beyond my ken. In my judgment that such an attitude suggests an appalling lack of grace.

Irving David Shapiro
Oakland, California

Credit Due

I enjoyed your article about the Plantronics Colorplus board and *The Draftsman* ["Color Graphics with a Plus," *PCW*, Vol. 1, No. 5]. As a representative of Starware, the company that wrote *The Draftsman*, I found your description of our graphics software very positive and accurate. We are revising the manual on the basis of the response we have received, and these revisions will offer the kind of changes your article suggested.

I was sorry to note that the article did not mention that Starware holds the trademark on *The Draftsman*, and that we offer a version compatible with the best-selling color board on the market, the IBM Color/Graphics Adapter. That means that your readers can have that same program for use with their IBM equipment. It will also work on any other color board presently available. It offers all the features of the Plantronics version, plus a few extras, including interface with our new series of project management software.

James B. Shapiro
Vice-president
Starware Corporation
Washington, D.C.

MultiMate Tips

I enjoyed the review by Janette Martin of Softword's *MultiMate* word processor ["The PC's Perfect Mate," *PCW*, Vol. 1, No. 6]. I have been using this package for a month now (it came as part of my Corona PC system) and have been quite impressed with its capabilities. Perhaps I can add a few observations of my own.

By inserting format lines here and there in the text, one can drop in and out of half- and quarter-line spacing easily. This allows the creation of multilevel scientific expressions without the need to insert special printer control codes (although that can be done as well). The real advantage is that the automatic line counting keeps track of the size of the expression being constructed. While not as easy to use as the NBI dedicated word processor equation mode, it is as convenient as the approach used on the Micom or Wang systems and better than that used by many microcomputer packages. (Of course, your printer must support nonintegral line spacing. The C. Itoh 8510A and Epson FX-80 do.)

The convenience of *MultiMate's* External Copy feature should be emphasized. Many word processing programs (including the one running on IBM's Displaywriter) do not allow the user to copy a section of text out of an old document and insert it into the current document the way *MultiMate* does.

In my type of work these particular *MultiMate* features are quite important.

Michael W. Schuyler
Corvallis, Oregon

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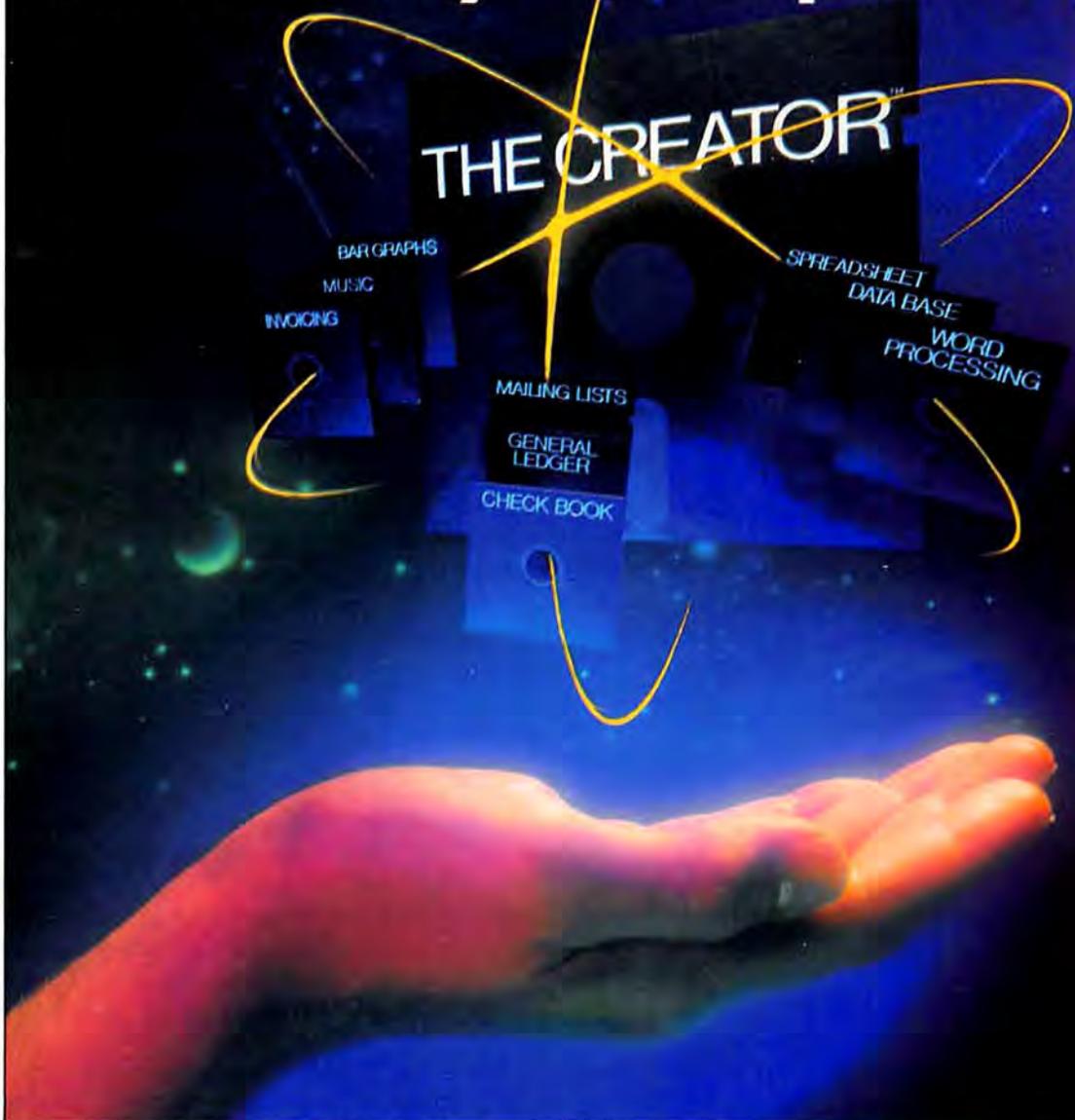


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Circle 249 on reader service card

Letters

Impressed by Interface Inc.

Here's a bit of information about a hard disk drive not evaluated in the MIS project described in Jonathan Sachs' article ["Hard Disk Roundup," *PCW*, Vol. 1, No. 6]. On July 14, 1983, I purchased an Interface, Inc. hard disk system from a mail-order dealer (who arranged to allow me to pick up the product directly from the factory).

Upon returning to my office and attempting to install the product, I encountered a software problem: the diskette provided with the hardware was blank. I phoned the technical representative at Interface and described the problem. By 6 p.m. he was at my office to check out the system. He identified a hardware problem and proceeded to uninstall the unit so he could take it back to the factory. He advised me that I could pick up a brand new one the very next day. On Friday, July 15, I picked up the new unit, installed it, and was able to spend the weekend filling up my 15.9 formatted megabytes.

Monday morning the factory rep phoned me to ask if the unit was operating properly. The system has worked fine since. Needless to say, I am impressed with the quality of the factory support.

*Michael G. Kaplan
Westlake Village, California*

Another Opinion

Jonathan Sachs' experience with Davong Systems as he described it in his article "Hard Disk Roundup" [*PCW*, Vol. 1, No. 6] is absolutely incredible. It contrasts sharply with our

experience at The Boston Company, where we have had seven Davong hard disk drives. We have called Davong on numerous occasions to ask for various kinds of technical help, but we have never talked to anybody that was able to help us. None of us in our most importunate efforts has ever managed to get beyond the message center. Nor have we had a single call returned in spite of the message center's fervent promises. It is our experience that if you buy a Davong, you're on your own. Perhaps they have cleaned up their act, but I think your readers should know the risk.

*Stephen J. Vincent
Boston, Massachusetts*

Davong on Drives

I would like to commend you on your hard disk evaluation ["Hard Disk Roundup," *PCW*, Vol. 1, No. 6]. It seems that you were thorough and took the time to inspect several leading drives. However, I would like to make a correction and add a few comments.

In Table 1 you list the hardware backup facility for our internal drive as "n/a." This is not correct. We do indeed offer an external streaming tape drive backup for our internal drive. Also, your dollars per megabyte figures are misleading. You lumped fixed disk, removable disk, and tape cartridge capacities into one figure. This is comparing apples to oranges and does little to help a novice select the most cost-effective drive. Obviously, dollars per megabyte decreases as installed capacity increases; such a figure is valid only for drives of comparable size.

You did a thorough job of evaluating packaging, documentation, and installation but were a little weak on documenting actual hardware performance. It would be helpful to know for how many hours each system was tested, the number of failures/problems during the test period, and the mean time between failures. To the user, reliability and performance are paramount. Your hardware evaluation rating given in Table 4 should have been broken down into individual categories (installation, performance, reliability, dollars per megabyte, etc.). To have a "very good" for a \$3000 to \$5000 drive compared to a "good" for a \$2000 drive does little to help a user decide what he needs or what to expect.

Some units tested offered backups, but an evaluation of the backup features was not done. I suggest that you do a follow-up review on hard disk backup units as well as a review of local area networks. More reviews of this nature will help make the buyer aware of what's available and help him pick a system that suits his needs.

*John Draut
Engineering Supervisor
Davong Systems
Sunnyvale, California*

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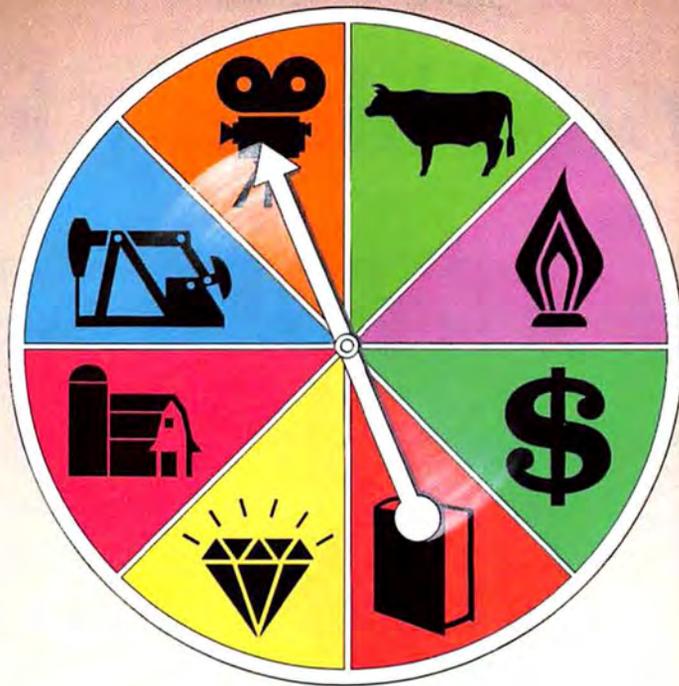
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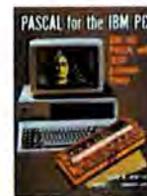
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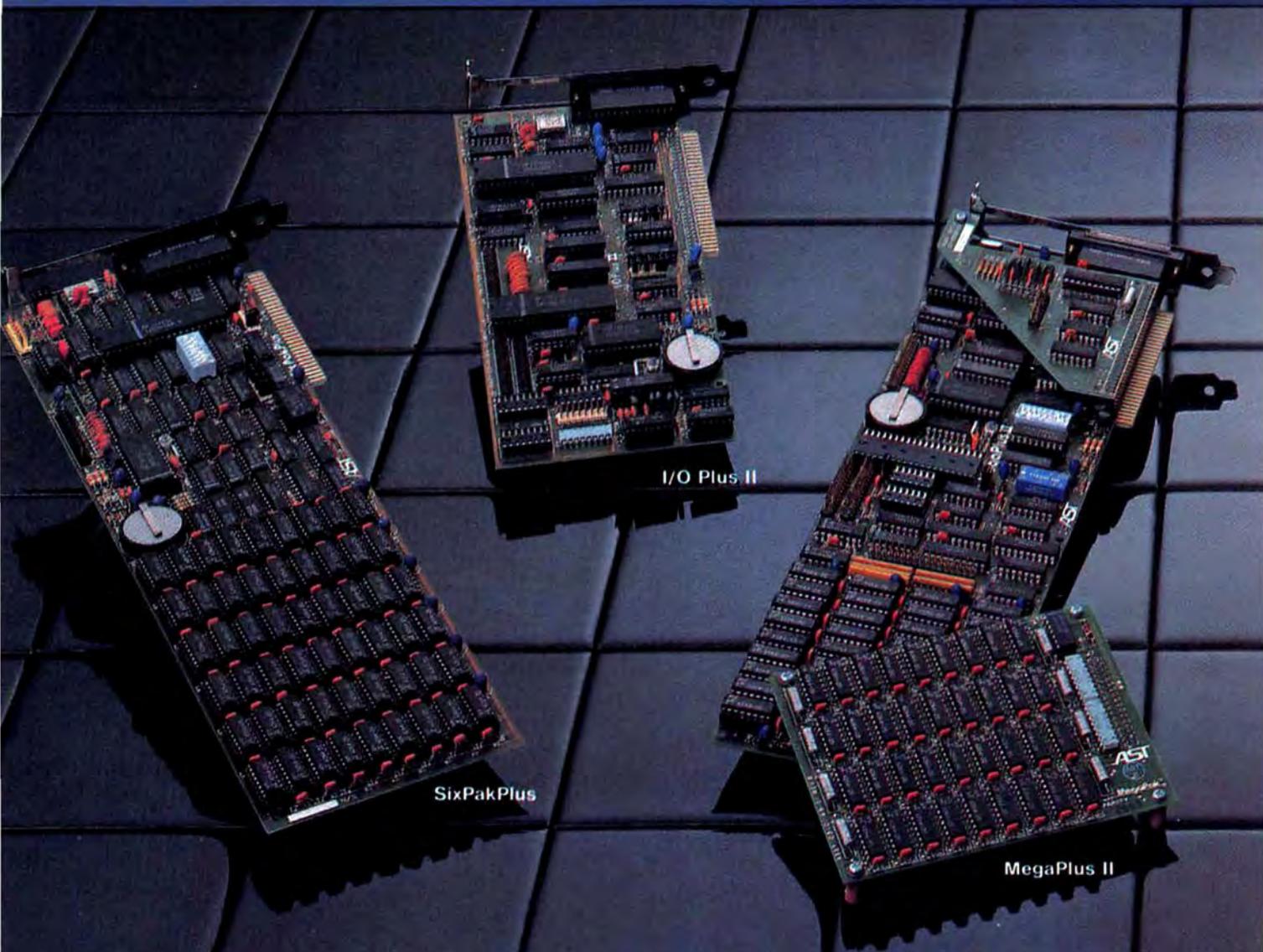
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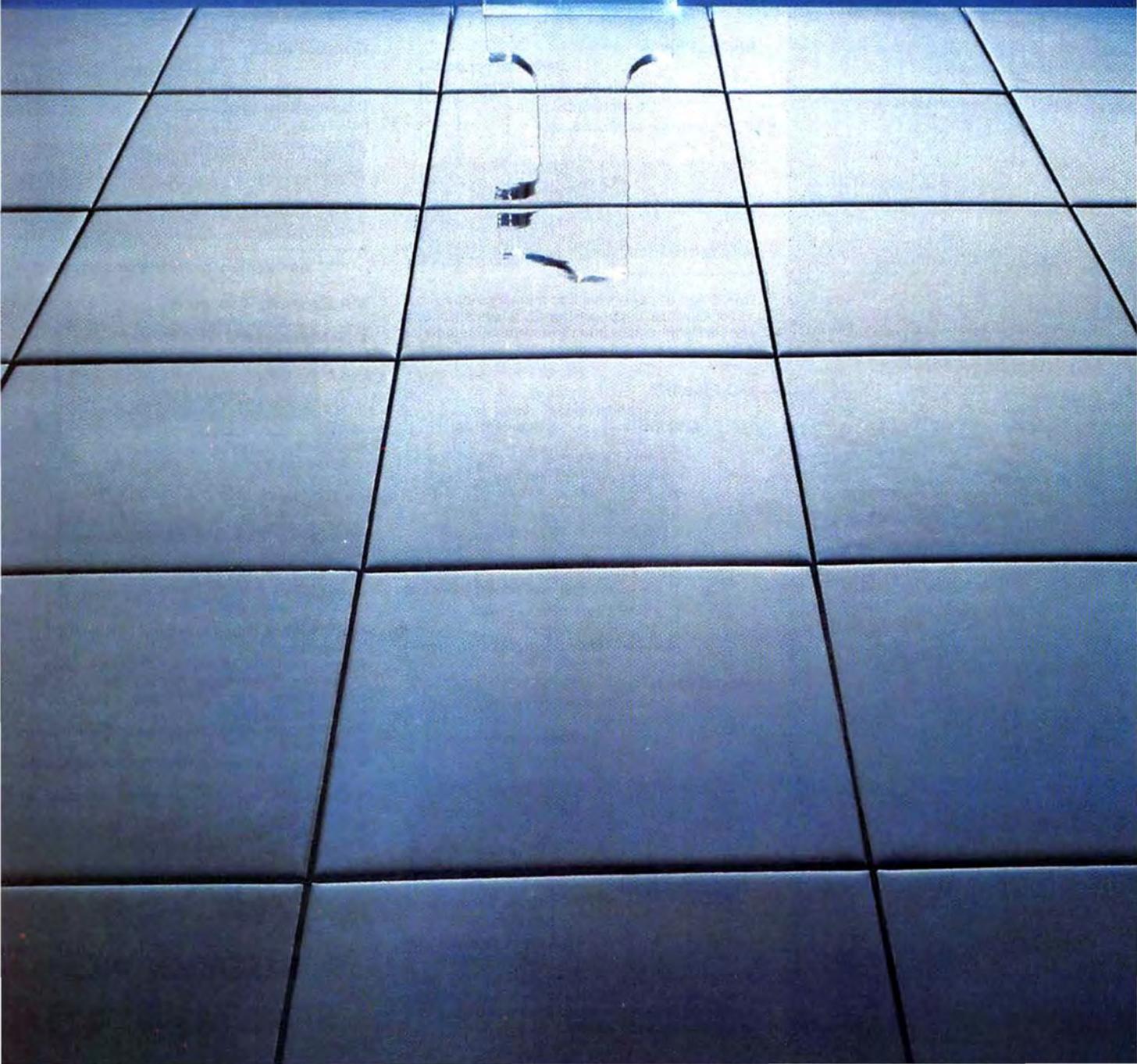
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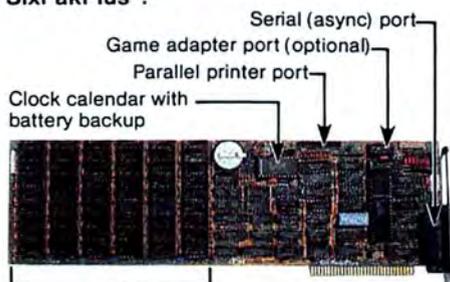
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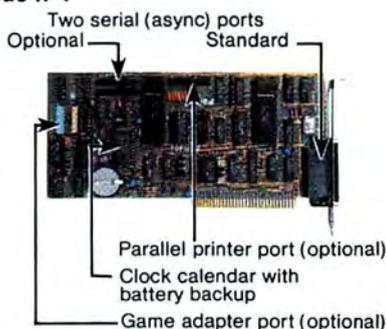


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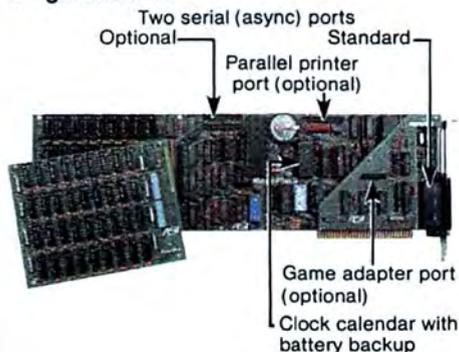


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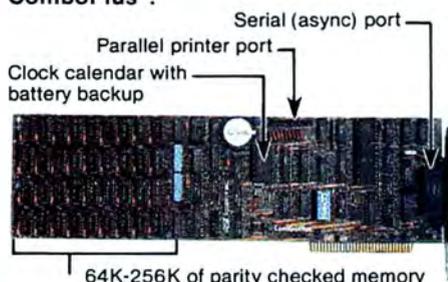


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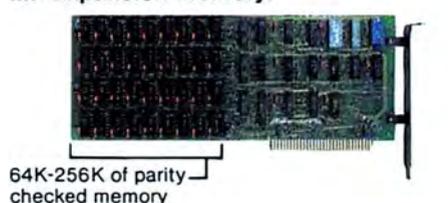
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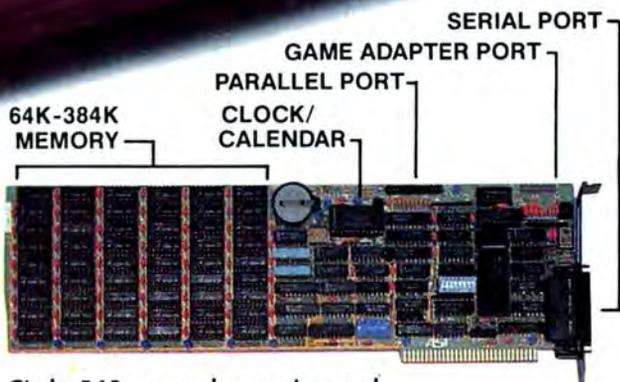
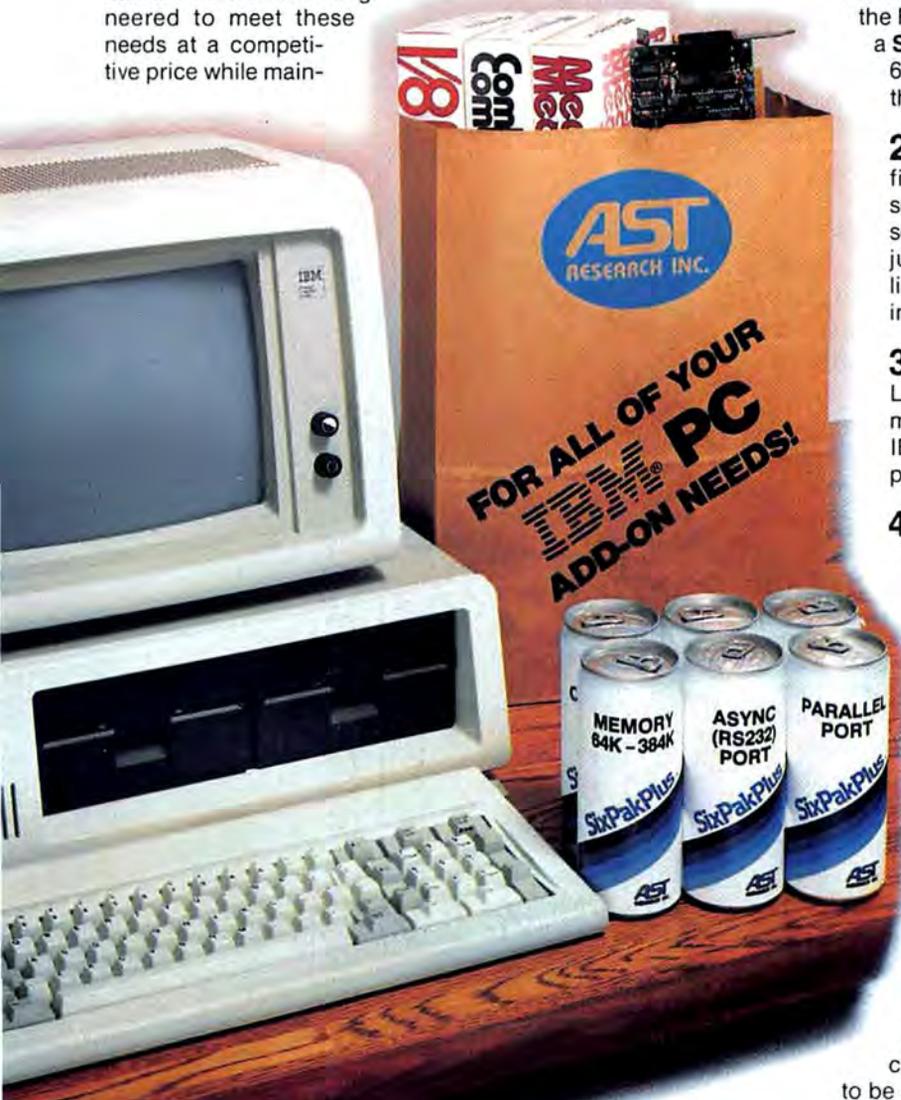
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Its Master's Voice

Danny Goodman

Voice control of computers is more than a matter of hardware or mimicry of keyboard commands. Voice recognition technology hinges on a new breed of software that integrates the concepts and physics of speech into its very fiber—in short, vocally engineered software.

Perhaps it is just a coincidence that Champaign, Illinois, is the home of the fictional speaking, hearing, and thinking computer known as HAL 9000 in Stanley Kubrick's space epic, *2001*. Champaign is also the home of SuperSoft, a company that will probably be the first to offer highly reliable voice recognition software for the IBM PC.

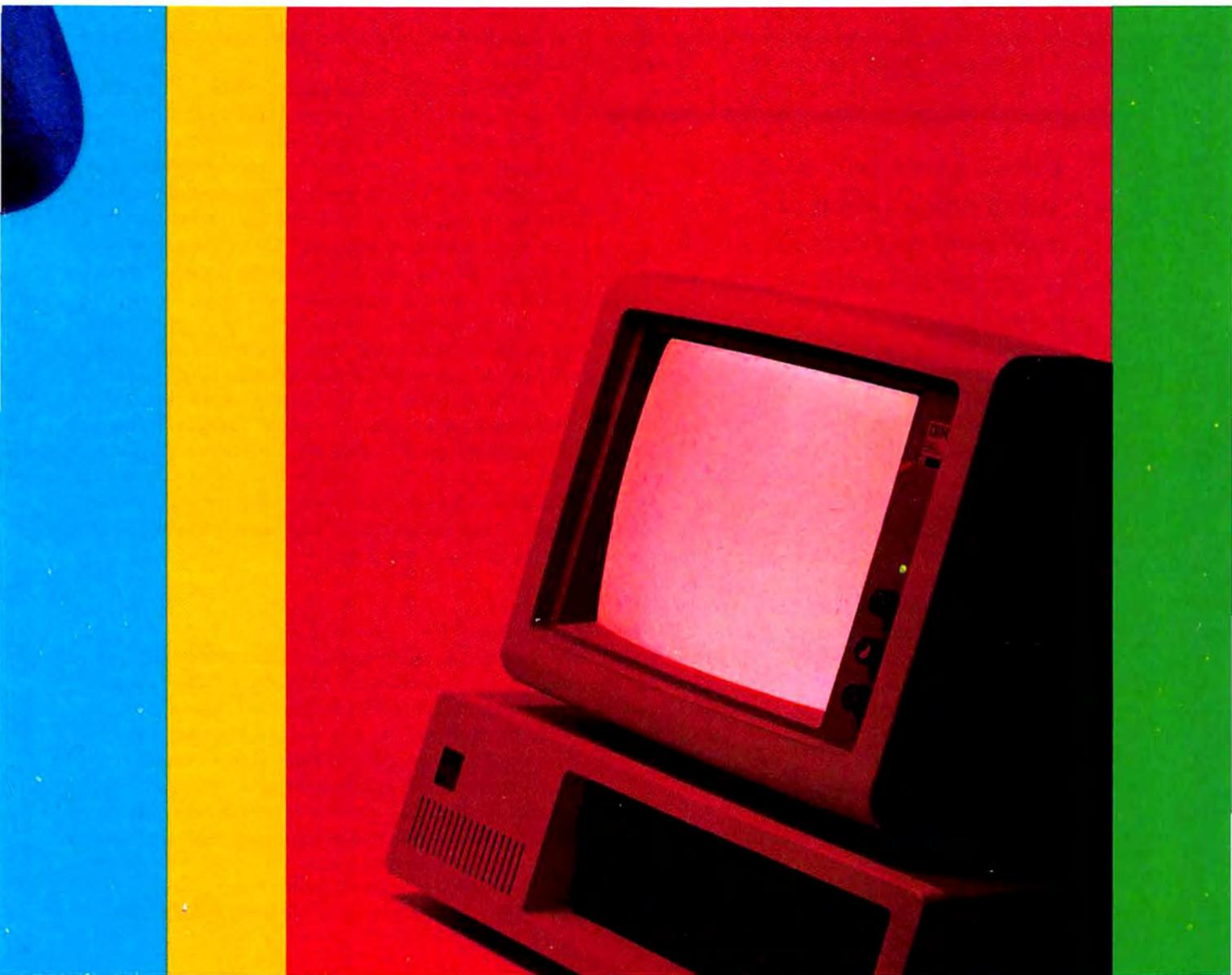
Herb Schildt, president of SuperSoft, is a believer in the potential of voice recognition as an office productivity tool. "Ninety percent of an executive's computer time is spent interrogating data bases," he states. Included in the data base category is any information stored on disk, such as word processing files, financial spreadsheets, and the like. Schildt sees voice as a needed enhancement to

In an office environment speaker dependence has its advantages.

the human-computer connection, but not as a replacement for the keyboard. Voice will be used to supplement keyboard input for communications with the computer.

Approaching voice recognition from this view might lead one to paste the overused term *user-friendly* onto this technology. But Schildt is careful to define what





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voice recognition will mean to the executive or secretary sitting at the electronic work station. *User-friendly* for Schildt means being like a person. "We want computers to be human—to be entities. People talk to other people in the office every day...and they want to talk to computers the same way." But who is willing to talk to a machine? Schildt points out that people talk into a telephone with little trepidation. Talking to a computer, particularly one responsive enough to carry on at least a limited conversation, should not be a jarring experience.

The most important barrier to conquer at this stage in voice recognition technology is enabling the hardware to recognize the natural language of the user, whether it be English, Spanish, or Urdu. It is relatively easy to create a generic voice product capable of understanding the alphabet and a limited set of command words. (In *Word-Star*, for example, you would save a document by saying "Control K D.") It is quite another thing to accomplish the same result in all your applications by telling a program, "I'm finished." In the first case, the voice recogni-

The computer must translate speech into a form it can understand and compare it with the parameters established by the programmer.

tion software is simply paralleling the limited number of keys on the keyboard, one at a time. In the second instance, the voice command set must be much larger because each combination of two-letter commands needs its own matching word in the voice software vocabulary list. And the longer the vocabulary list, the more potential problems for the person talking to the computer.

Common, everyday English should take the place of cryptic program commands. Instead of saying "Replicate," the voice software should be able to accommodate a voice command such as "Copy." "I would never ask my secretary to replicate a letter on the Xerox machine," says Schildt.

Comparing Systems

It is important to know the difference between speaker-independent and speaker-dependent voice recognition systems in use today. In the first, the computer and voice hardware are programmed to accept and respond to a fixed set of words spoken by anyone, male or female, with or without moderate accents. As you might imag-

ine, this is a challenge when you consider the number of voice patterns possible for any spoken word. The computer must translate speech into a form it can understand (digital impulses) and compare it with the parameters established by the programmer. Current systems have vocabularies restricted to numbers and yes/no answers to synthesized speech instructions over the telephone. These systems have acceptable, but not outstanding, records of getting the correct response the first time.

Speaker-dependent systems listen to only one human master at a time. The system must initially be "trained" to match the voice patterns of the user. The user speaks the intended words into a microphone several times. Each time a training word is spoken (called a pass) the computer digitizes it and records the pattern. After four or five passes, the computer has a profile of that speaker's vocal pattern. In running the application, the computer will match the pattern of each utterance with the pattern stored in memory. The size of the program's vocabulary is limited by the amount of available memory and the delay caused by the search through memory for the voice pattern.

While speaker-independent systems are desirable in many commercial environments, such as consumer banking and retailing, in an office environment speaker dependence has its advantages. A voice-only system that recognizes only certain voices offers computer security. A series of vocabulary voice patterns can be stored on disk and activated by each user. Unauthorized access is difficult, and since the user trains the computer to recognize a precise voice pattern for each word, the vocabulary can be different for each user. The computer only cares about the internal codes attached to each word. The words change as the user or language demands.

Consequently, new software does not need to be written for each country or special application, but only the word list that accompanies the training routine. Consider too that an office is noisy. If the voice recognition system is looking for particular voice patterns, an extraneous noise reaching the microphone is less likely to trigger an undesired response.

Error Control

As the number of words in the active vocabulary increases, the possibility for error also increases. Two of the most common errors within the limits of affordable voice recognition hardware are not matching an incoming word even though it's stored in the vocabulary list, and matching two words that sound very much alike. While the first error requires repeating the word (provided it doesn't produce an annoying error condition in the system), the second can be disastrous if the user is not monitoring the action on the screen. No one wants to delete a line of text when the letter *I* was the intended target.

Where SuperSoft's expertise comes in is with its *VoiceDrive* vocally engineered software. Voice control is highly integrated into the applications program in such a way that it momentarily masks those words in the vocabulary list that don't apply at each point during the program. For example, if you are about to open a file to transfer data from the disk to memory, you say, "Open." At that juncture, the program knows that you will next offer either a file name or a "Cancel" command in response to the prompt on the screen. Thus, it can mask all other commands that don't apply at that instant. The net result is a system that offers greater reliability because it's unlikely that a command available at the current juncture will sound like another for a different part of the program. Response time is also improved because fewer patterns need to be searched. Yet the total vocabulary can be quite large.

Another benefit is that the same word or its homonyms can be used throughout the program, provided both sound-alikes are not active at the same time anywhere in the program. The word *done*, for example, could mean that you're through entering data in a data base record and want to return to the main menu. At another point in the program *done* can also mean that you are finished with a file and want it saved on disk before returning to DOS.

ScratchPad and VoiceDrive

SuperSoft's first voice product is a *VoiceDrive*-enhanced version of the electronic spreadsheet program, *ScratchPad*. The program is available with or without a voice recognition board (made by Tecmar), which plugs into any IBM PC or PC XT expansion slots. A highly direc-

Talking to ScratchPad

I've talked to my computer before. But most of what I've said is unfit for publication. Then I found myself in front of an IBM PC trying to make out what I was saying. Even as I spoke with humans in the room, the computer listened carefully, hoping to pick out one of the few dozen words it could match in its memory.

But before I got that far, I had to train the PC, equipped with a prototype of SuperSoft's *ScratchPad* with *VoiceDrive* spreadsheet software and Tecmar's Voice Recognition Board packaged with the program. Training the PC consisted of repeating into the microphone a list of all letters, numbers, punctuation, and program commands that appeared as prompts on the screen. I read the list three times from beginning to end, rather than repeating each word three times in a row. The whole session took less than 10 minutes.

As expected, using voice input exclusively in place of the keyboard proved unproductive. Next, I tried building a sample spreadsheet using a combination of voice and keyboard commands. This was more successful, provided that I was selective with my voice commands, opting for voice only when the response time was faster than making multiple keystrokes. I also found the "up, down, right, left" voice commands for single cell movements somewhat easier than moving my right hand from the keyboard to the cursor/numeric keypad on the PC keyboard. But movement across three or more cells was sluggish.

When stringing commands together, you must wait for the previous command to finish before giving the next. On the Tecmar system there is little buffering of input. As a result, your speech must be distinct, and you must pause between commands. For some this will seem unnatural at first. But by combining voice and keyboard input (usually alternating between the two for any given command), adjustment is quick and painless.

The system demonstrated a high degree of reliability. When I attempted voice data input, however, my patterns for the letter A and the number 8 must have been close, because they were frequently confused. But an erroneous command was never executed. Incidentally, phonetics (Alpha, Bravo, Charlie, etc.) can be assigned to selected letters of the alphabet to increase reliability.

I will admit that I was skeptical about the value of voice recognition. But when I used the system, I found myself using the computer voice commands such as "Cancel" almost subconsciously to proceed through the program. My brief experience with the system showed that using a handful of important vocal commands is easier to learn and more convenient than using the corresponding <Ctrl>-key commands. After all, English is my first language.

● State of the Art

tional microphone rests on the PC system unit. If you already have the voice recognition board, you need only add the enhanced *ScratchPad* program.

ScratchPad uses the same basic screen layout, command structure, and computational features as *VisiCalc* and other spreadsheet programs. "A spreadsheet program is the most demanding in terms of vocabulary size," says Herb Schildt. *ScratchPad* needs 93 of Tecmar's available 100 digitized "words" in storage space. A siz-

Fast typists might prefer to integrate voice and keyboard input, which is easy since both input devices are simultaneously active.

able majority is dedicated to the alphabet (capitals only), numbers, and punctuation characters used in program commands. "We don't recommend data entry by voice," Schildt adds, "but it can be done on our system." Letters and numbers, however, come directly into play in a spreadsheet program that uses cell addresses like A1 and R45.

ScratchPad divides speech into essentially three groups. One group is composed of the letters, numbers, and punctuation used in data or formula entry. Another consists of subcommands used only in conjunction with a third group of more general commands (such as Enter). Yet under control of the *VoiceDrive* software as few as three words may be active at any one time.

Masking Unmasked

ScratchPad allows the user to create multiple spreadsheet windows, pulling together on one screen diverse sections from a very large spreadsheet. When the program is in the "Ready" mode, saying "one" will clear the screen of multiple windows and return to the normal, single window starting at cell A1 in the upper left corner. However, if you first say "Enter," the program expects a number to follow. Following this with "one" will print the numeral 1 on the command line. "OK" will move it to the cell. A similar situation occurs with the word "point," which can mean either "single cell" or "decimal," but never both at any juncture in the program.

Verbal Integration

Several shortcuts are provided to ease entry of verbal and keyboard commands to the program. For example, instead of entering a function like $@SUM(B2..F2)$ by saying "At...Sum...Open...B...2...Point...Point...F...2...Close," all you need to say is "SUM...B...2...Through...F...2...Close." When you say "Sum," the program automatically prints the '@SUM(' function to the screen. Fast typists might prefer to integrate voice and keyboard input, which is easy since both input devices are simultaneously active. Thus, it may be expedient to say "Sum"; type B2; say "Through"; type F2; and say "Close."

The seven words left over from the 100 available can be designated as seven common spreadsheet file names and added to the vocabulary list. A typical verbal command might be "LOAD...YEAR-TO-DATE." Without looking at or touching the computer, the appropriate spreadsheet is retrieved from disk and displayed on screen. This is precisely the kind of data base interrogation Schildt described earlier.

At this point the *VoiceDrive* system cannot support streamed speech (continuous, natural speech) mostly due to the limitations of the Tecmar Voice Recognition Board. But voice recognition technology for personal computers continues to progress. Anticipated voice recognition hardware from Texas Instruments designed for the Professional Computer will be capable of picking out valid words from streamed speech and stacking them in memory, much like a keyboard buffer. A harried executive could say, "Load that year-to-date file for me." The computer would pick out "load" and "year-to-date" as key action words. This approach reduces the amount of command syntax a user must remember. At this point, however, the technology is pricey (at least \$2000) and confined to Texas Instruments products. No doubt streamed speech will find its way to the PC—it's merely a matter of when.

More from SuperSoft

SuperSoft plans to bring out a *VoiceDrive*-enhanced word processor and later a data base, both of which will be fully compatible with the voice recognition hardware supplied with *ScratchPad*. Schildt foresees an easier time of creating the word processor because there are fewer commands to deal with at a given instant. "Word processing commands have fewer decision points. For example, there are only so many things you can delete—a character, word, or sentence. Thus the system is more reliable, and extra room is available on the voice board for additional words."

SuperSoft's future *VoiceDrive* product line will not include an integrated software system. Rather, Schildt prefers the "hub and spokes" approach to linking several

diverse applications. "All programs will interact and be vocally engineered. Eventually there will be a vocal menu to bring them all together."

Not a Better Mousetrap

Rick Bolacca, vice-president of Research and Development, is quick to point out that SuperSoft is not anti-mouse. "Our products will support a mouse. There is room for everything: voice recognition, the mouse, and the touch screen." There are some situations, however, in which voice input may be the best approach.

Schildt admits that very few people need voice recognition. But he sees an avid audience of PC users interested in artificial intelligence who will probably be the vanguard of voice recognition users. Others will follow as soon as productivity gains are measured and word about reliability spreads. "The key point of vocal engineering is finding out where [in a program] people can productively use voice. The fundamental basis of voice recognition is natural ease of use. If it can't work like a human, then it won't work at all."

Which brings us back to the deceptively free-thinking HAL in 2001. HAL could do no more than his programming allowed, just like any IBM PC you may know.

"Open the disk drive bay, PC!"

"I'm sorry, Dave, I can't do that." ☹

Danny Goodman is a Contributing Editor for PC World. He is the author of Word Processing on the IBM PC (Howard W. Sams, 1983) and a commentator on "New Tech Times," a new Public Broadcasting Service TV series.

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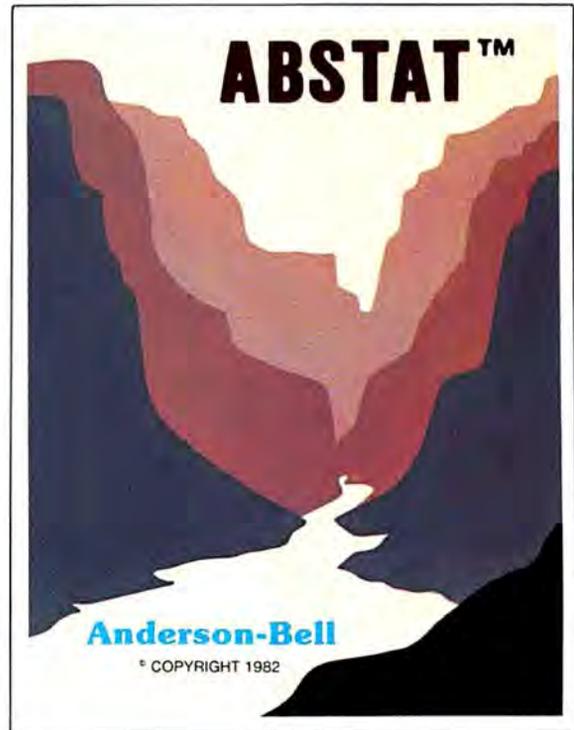
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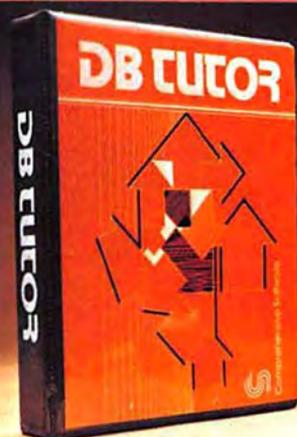
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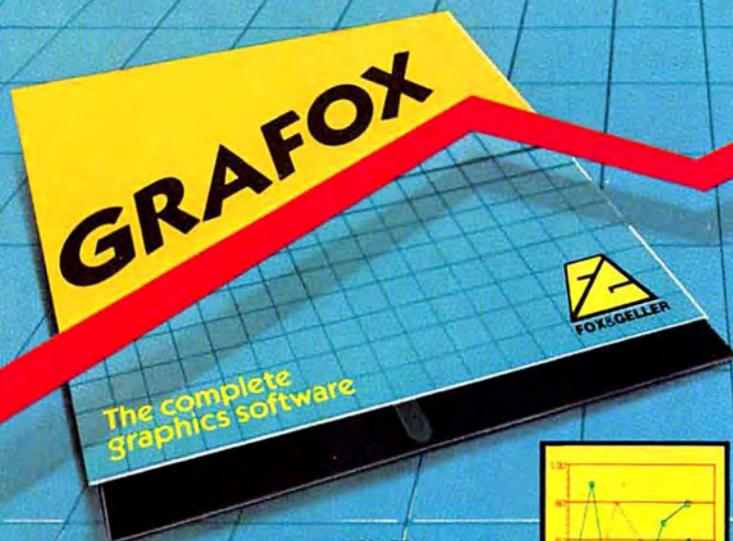
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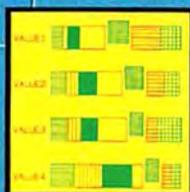
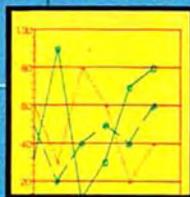
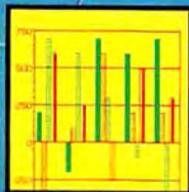
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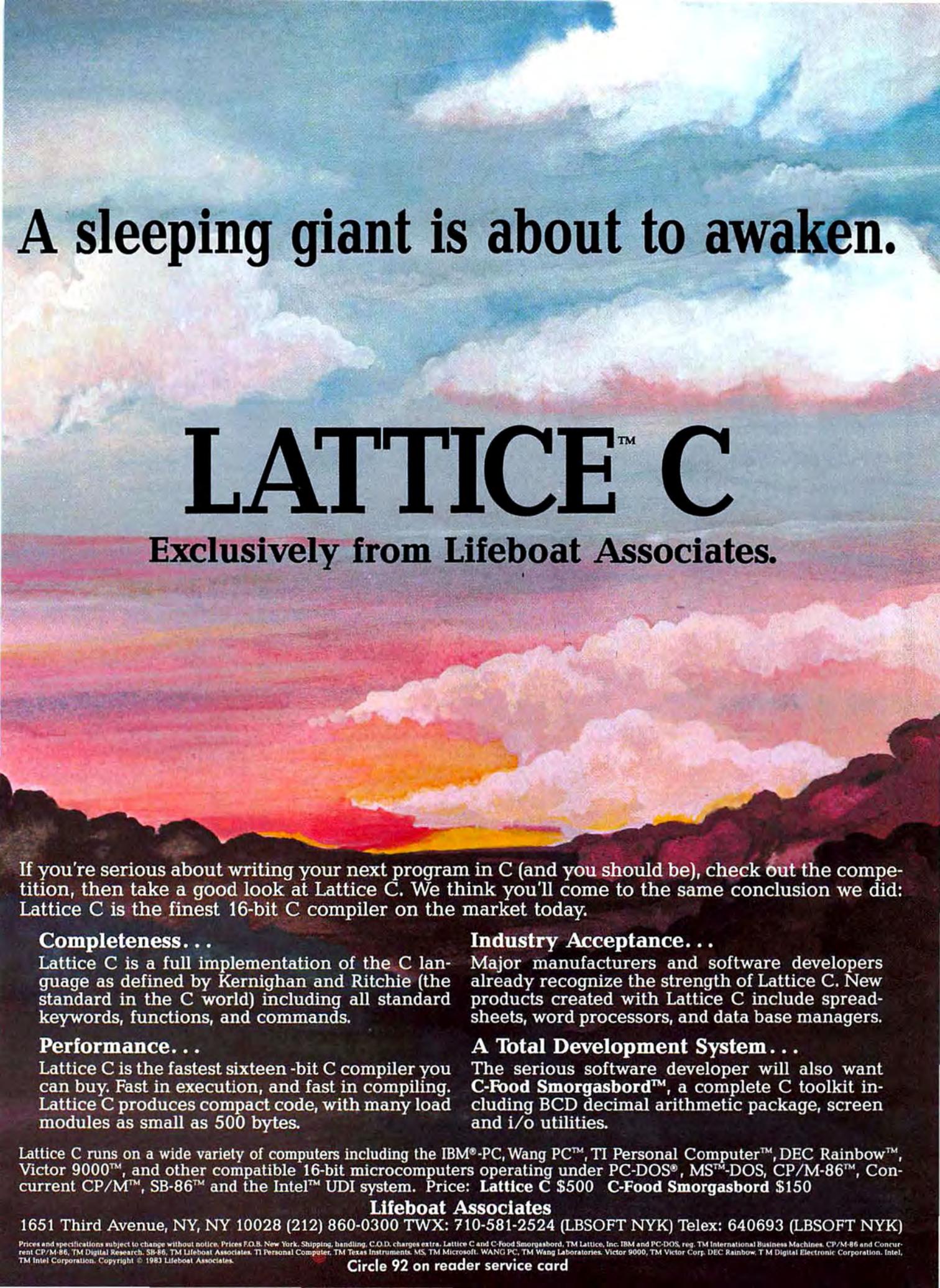
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Circle 92 on reader service card



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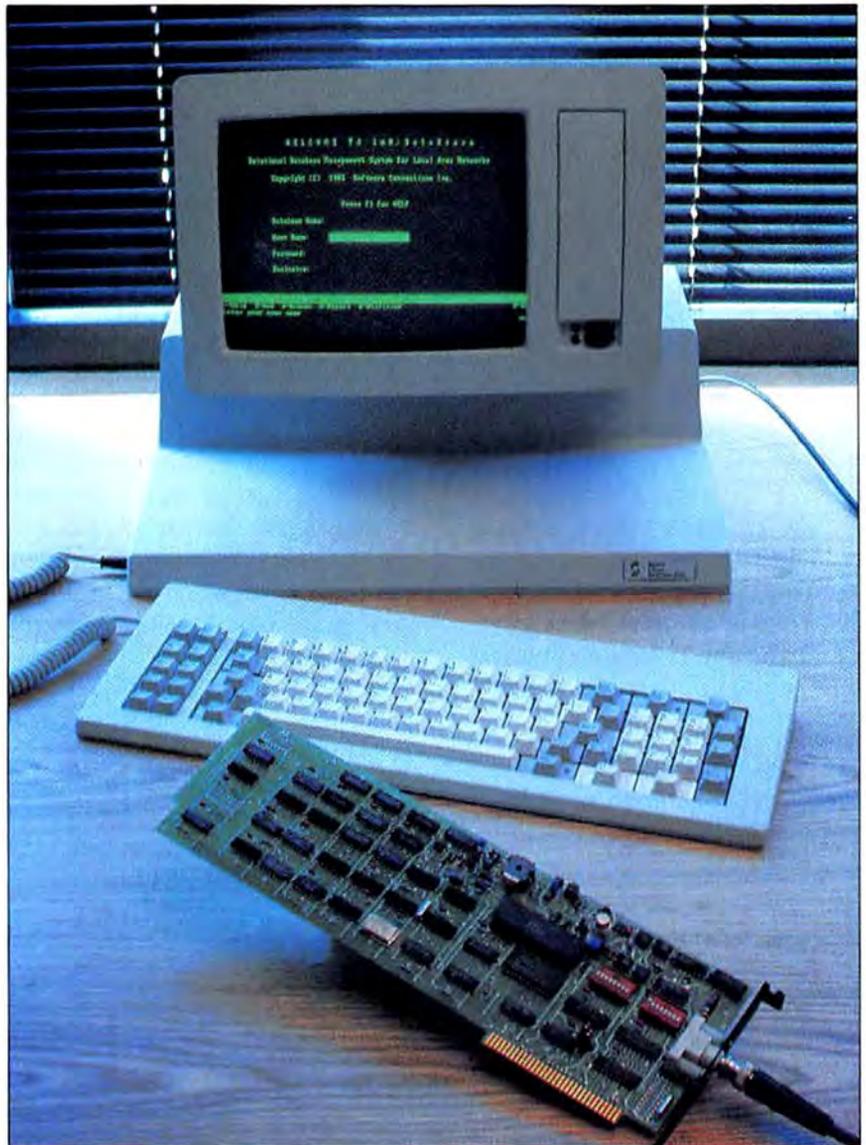
Adding PC power to your local area network may not be as expensive as you think.

Robert Luhn

When *VisiCalc* first appeared in 1978 and skyrocketed to software fame, thousands of programmers probably banged their heads and asked, "Why didn't I think of that?" Adam Osborne similarly flummoxed the industry when he stuck a handle on a computer and called it portable. Neither was a technological breakthrough, but simply the right idea at the right time.

Santa Clara Systems (SCS), a hard disk manufacturer in Silicon Valley, is likely to inspire similar skull rapping with the PC Terminal, a network-based microcomputer that fully emulates the features, speed, and power of the IBM PC—for \$1295. The PC Terminal works on PCnet, a local area network licensed to SCS by Orchid Technology.

PCnet is a popular and relatively inexpensive bus-structured network that links PCs with one another and any number of peripherals. Printers, modems, floppy and hard disks, and even internal memory can be shared among the networked PCs. Adding a PC to PCnet involves buying a network interface board, plugging it into the PC, and turning on the power. The network is compatible with all IBM software—a further convenience and money saver.



Why SCS created the PC Terminal is no mystery. The first step to adding a station to a PCnet is buying another PC. With a base price of \$3000, the expense is considerable, especially if you need a large number of work stations. Much of the expense goes to support disk drives and other peripherals for the PC. But do you need a floppy disk drive or extra internal memory on each work station, particularly when a 10- or 30-megabyte hard disk drive is in the network? Does every work station need a printer or a modem?

Answering these questions is not always easy. The PC Terminal is a handy solution for businesses wanting to cut costs as they add work stations. Thus the cost of the network is kept down as it expands. This is good business for SCS, since they manufacture and sell the hard disk drives as well as market the network. No doubt many more PCnets will be sold to first-time computer users now that an entire network package is more affordable.

The Bare Bones

The PC Terminal doesn't promise high-tech wonders—just low price and functionality. What \$1295 buys is a network interface board (a \$695 value) and a bare-bones computer that is PC compatible. The terminal consists of two pieces: a detachable IBM-style keyboard and a CPU with a 12-inch monochrome monitor secured above on a tiltable pedestal. The CPU is a standard 8088 microprocessor; the unit also has space for Intel's high-speed number-crunching 8087 coprocessor. Internal memory is 64K, expandable to 256K, and an RS-232C serial port and parallel printer port are built into the unit as well.

In keeping with its low-cost profile, the PC Terminal eschews peripheral boards or floppy disk drives. The monitor interface, for example,

is built into the motherboard. If you must have floppy storage, the power supply is capable of supporting a single half-height disk drive, which fits neatly into the side of the monitor.

Part of the PC Terminal's compatibility lies in its bus—the connectors and associated wiring that allow the computer to accept plug-in circuit boards designed for the IBM PC. The PC Terminal has four IBM PC compatible interface slots. One slot is used for the network interface card; the rest can be used for additional memory, a color graphics board, or other devices. The potential for expansion is always there.

Stock in Trade

In a network environment you may never use the expansion potential of the PC Terminal, since resources in the network can always be tapped. As it is, the PC Terminal can be placed on a desk, hooked up to the network with a standard 70 ohm coaxial cable, and used immediately. As SCS President Tom Quinn bluntly put it: "Add-ins are the biggest rip-off for the personal computer user. They're the hidden cost. The low base price hooks you. But then you discover that you need a printer interface card, a CP/M card, a disk drive, or extra memory. It adds up. In essence, we're making a stripped-down IBM PC. We take the peripherals out and reduce the power supply needed. We also put everything on one board, which significantly cuts manufacturing costs."

64K in Search of Itself

The PC Terminal is powerful but not very intelligent. It does have its own BIOS ROM (which, among other things, allows it to function with the network) and the requisite 8088 chip for processing; however, to be fully operational it must find its brains, namely DOS, somewhere in the network.

At power-on, the PC Terminal reaches across the network and searches for a PC that has already loaded DOS into memory. The PC

Terminal then copies the DOS from the other PC's memory. At this time the PC Terminal becomes a member of the network.

The important point to remember is that there must be a PC running DOS in the network from which the PC Terminal can boot. The PC in this case acts as a server, providing the PC Terminal not only the wherewithal to operate but the resources as well. While the PC Terminal can process data on its own, it also supports

'Whatever runs on the PC can be shared on the PC Terminal.'

a remote execution mode, taking control of the server PC's processors, memory, and peripherals. This capability becomes important when the issue of compatibility is considered.

"Whatever runs on the PC can be shared on the PC Terminal," says Quinn. "In a remote execution mode what you type on the keyboard of the terminal is sent over the network to the PC, where the work is actually done."

Thus a user on the PCnet can request to use a program from the disk in the server PC's drive B while others use a different program from the disk in its drive A. The hard disk can be used to store the data generated by both programs. A number of other combinations among PCs, PC Terminals, hard disk drives, and other peripherals is possible.

Compatibility Questions

SCS is sometimes hesitant to come right out and claim 100 percent compatibility with the PC. "Functionally equivalent" is perhaps a better term, for the PC Terminal does not always fit the accepted definitions of compatibility. Compatibility encompasses

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everything from media (can it use PC-formatted disks?) to questions of internal architecture (does it reproduce the PC's internal structure down to the BIOS routines in ROM?)

At the board level the PC Terminal must closely match the wiring and the memory layout of the PC without actually copying it, lest IBM's legal department be aroused. As other IBM PC compatible manufacturers have discovered, this is not an easy job. The location (i.e., address) of memory in the PC Terminal must be the same as the PC's. Otherwise software designed for the IBM PC cannot run on the PC Terminal. For example, programs looking for BIOS instructions in ROM would get lost if the BIOS were moved to a different location; the program would not ex-

'The hard disk drive is the bottleneck in any network.'

ecute and compatibility would not exist.

SCS claims to have reproduced the function of the IBM PC "memory map" and the accompanying circuitry without duplicating it exactly. "As long as the machine responds to addresses in a similar manner as the IBM PC, the machines are map compatible," says Quinn. "The circuitry that manipulates the data can be completely different as long as it gets the same job done." Beyond this, hardware differences are minor. The PC Terminal does not include Cassette BASIC in ROM or offer a cassette interface. This is not surprising considering its network role.

Software compatibility, however, does not rely solely on hardware. PCnet was originally created with only IBM PCs in mind, and thus the

network runs under PC-DOS. Although the PC Terminal is designed to operate under PC-DOS, SCS can supply customers with MS-DOS only, since the PC Terminal is not an IBM product. While MS-DOS and PC-DOS are similar, they are not exactly the same.

"We will be licensing MS-DOS and providing it with the PC Terminal," says Quinn. "But you won't have the level of compatibility that PC-DOS offers. Of course, you can go to a computer store and buy PC-DOS off the shelf and use it. Then you would be 100 percent compatible."

Hedging Bets

If, as SCS claims, the PC Terminal is fully compatible, why is the remote execution mode so desirable? The answer lies in the double-edged nature of compatibility. In the world of PC lookalikes compatibility is never a sure thing. Some programs are created exclusively for the PC. Routines that execute on the PC may not execute on a compatible computer. But 100 percent compatibility (if such a thing truly exists) is also a trap. If IBM decides to change the PC's operating system or make a significant change in PC-DOS or in the IBM PC hardware, a 100 percent compatible computer may suddenly be incompatible with an entire new line of software. This is a position an IBM PC compatible user can hardly afford to be in.

"When a user buys an IBM PC compatible," says Quinn, "he's crossing his fingers and hoping that a program he gets six months later will work. A compatible is strictly by itself. But the PC Terminal is on an extension of the PC's bus. If there's a compatibility problem, you simply operate as a remote terminal off the PC—and you stay 100 percent compatible."

Passing the Byte

Some would say that achieving total compatibility is impossible or a violation of copyright. Either way the issue bears examination. When a PC Terminal reaches across the network, it can boot up DOS, use the server PC's RAM, or run a program in one of the server's drives. But can a PC Terminal get into the heart of a PC—the BIOS in ROM—and use those instructions, thus ensuring 100 percent compatibility? The answer is not clear, obscured as it is by SCS's claims of proprietary information.

Copy is a word that SCS prefers not to use. Tom Quinn stresses that all SCS is selling is a compatible, inexpensive terminal for the PCnet. As far as the PC BIOS is concerned, the PC Terminal "performs operations that are compatible with what exists in the PC [BIOS] ROM...the information does not necessarily have to be taken from the PC." The capability apparently exists, but the choice is the user's.

"The tools are there," adds Quinn. "Anything in the IBM PC can be accessed. It's up to the users. We will give users an MS-DOS operating system, and they'll be pretty compatible with the IBM. But since they have the bus-structured network, they'll do whatever they want."

PCnet, like other local area networks (see Figure 1), can also support unauthorized software duplication of a sort. *WordStar*, for example, is not copy protected, but the documentation and software clearly state that the disk is not to be duplicated. Yet in a network once a program is stored on hard disk it automatically becomes available to a number of work stations. In the past there was some measure of protection because most single-user software could not function in a network environment; copy-protected software could not be copied to a hard disk and thus could not be distributed across the network.

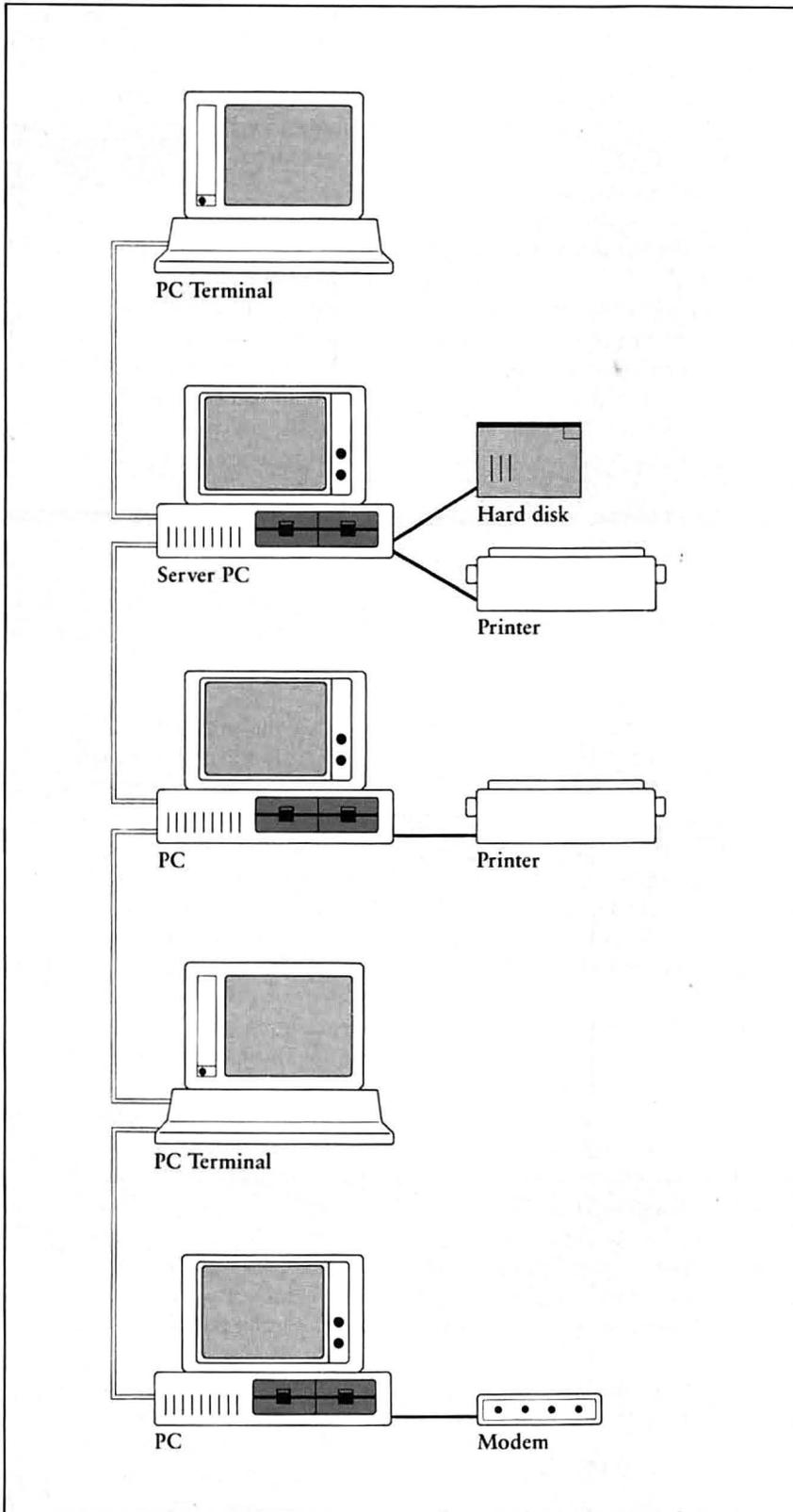


Figure 1: The PCnet

But current local area network operating systems and hardware are capable of multiple processing with single-user software. Using the PC Terminal's remote execution mode, copy-protected software can be run in a server PC and simultaneously accessed by a number of users. Thus copies of one program can be made across a network. The alternatives for software companies are either to ignore the problem or to copy protect their software. With the former, potential income is lost; with the latter, protection may not work anyway.

"People can get around copy protection in a network," says Quinn. "We try to support the software companies because they make the industry work. It's not IBM but Microsoft and all the others who help us sell our products."

Legal Questions

Network manufacturers and suppliers are generally aware of the legal questions raised by their products. Lawyers for the computer industry are closely watching the Sony Betamax case and the lawsuit Apple Computer has filed against Franklin Computer. Both cases could have an effect on SCS. In the former case, a manufacturer's liability in copyright infringement is being tested for the first time. Sony's videotape player is a device essentially dedicated to copying TV programs—privately owned, copyrighted material. The question being debated is whether a manufacturer is liable for making a product the primary purpose of which is to violate copyright.

In the Apple lawsuit the Court of Appeals agreed with the company's contention that BIOS instructions embedded in an Apple ROM were indeed protected under copyright laws and thus could not be copied and used in Franklin's ACE-1000 computer. Franklin is likely to request another hearing on the issue or may even appeal this last ruling to the Supreme Court. The implications for

● State of the Art

SCS could be serious. Sony's loss would establish a manufacturer's role in "aiding and abetting" infringement; Apple's win would secure the legal status of a ROM chip. Of course, these cases have yet to be resolved, and copyright law in this area is vague.

Surprisingly, the software industry has not always been concerned about copyright questions. SCS's own experiences have not been salutary.

"We went to VisiCorp and told them about the network and how we

wanted to cooperate," says Quinn. "Their reaction was, 'Why would we support your network and hard disk? We can't even meet customer demand for our products.' But when the hard disk for the PC came out, IBM made it clear that they wanted software to support it. So now the software companies are being forced to pay attention to that."

Offering network versions of software at a higher price may be the answer. When SCS and other makers of compatibles bite heavily into IBM's share of the market, the questions of copyright, clones, and

compatibility may be settled in the courts. Until then it's up to users to stay within the law. (See "Copyright and Computers" for more on the legal questions confronting the computer industry).

Service for 64,000

PCnet is a relatively sophisticated local area network for the price. It is easy to install, and software programs, hardware, and files can be shared among a number of users. Also, data can be centralized on a hard disk, and you can theoretically add as many as 64,000 stations to the

Copyright and Computers

Jordan Breslow

Technology is always several steps ahead of the law. In the area of copyright law, this is particularly noticeable as lawyers and judges cope with the rapid changes in the software industry. Applying copyright law to software is like using a horse to pull a race car—it gets you there, but not without problems. Nevertheless, software companies rely on copyright law (as well as trade secret and license law) for legal protection of their programs.

A patent gives the developer the exclusive right to manufacture, use, or sell a program, while a copyright gives exclusive right to reproduce and modify a program. Loosely speaking, the patent protects the developer's idea or process as long as the idea is put into some new and useful form. A copyright cannot protect an idea. For example, the author of a copyrighted word processing program cannot prevent a competitor from creating a word processing program; the author can only pre-

vent the competitor from copying that particular program.

The Software Act of 1980 slightly modified United States copyright law by defining the legal status of computer programs. Unfortunately, courts interpreting the copyright law have created more confusion and uncertainty.

Technically (if not for Section 117 of the copyright law, which was amended by the Software Act), you violate copyright every time you load (and thus copy) a program into your machine's internal memory. Section 117 permits a buyer to copy a copyrighted program as long as it is an essential step in using the program with the computer. A buyer can also make changes necessary for machine compatibility. (If the user obtained the program under a licensing agreement, the right to make copies may be restricted.)

But what are the copyright implications of copying a program in a network? For the courts to

answer this question, they must first understand network technology and determine whether a terminal (or similar device) actually copies a program, and if it does, if it uses the copy in a permissible way in accordance with Section 117. If the courts find that a copy is being made, manufacturers may argue that such copying is essential for using the program in conjunction with their machines.

If a network terminal (or related device) is found to violate a copyright, will the courts ban its manufacture and sale? If not, who will bear the legal and financial responsibility for infringement—the manufacturer or the user? Those seeking answers to these questions should pay close attention to the developments in the Sony Betamax case, which is now before the Supreme Court.

In the meantime, Congress is considering a bill that would permit an individual to tape a single, off-the-air recording for private use and would require those sell-

network. SCS is the first to admit that in practice the number is considerably less, though it is probably more than enough for most local area network customers.

Nonetheless, even in a network of 20 users, how do you coordinate all this activity and still maintain the network's speed? Who gets to do what and when? Several terminals might be vying for printer time, needing a server PC to process spreadsheet data, or wanting to move data across the network. Keep in mind that one PC can effectively

ing equipment and blank tape to pay a royalty to the copyright owners. If this approach is adopted for computer networks and terminals, it will no doubt mean higher prices for the consumer.

Building and using computers (particularly IBM PC compatibles) within the bounds of copyright law is not easy in the face of so much uncertainty. Judges face the formidable task of applying a copyright law based on eighteenth-century concepts to a sophisticated and rapidly changing technology. How well they juggle the old and the new will greatly affect the computer industry and, in the end, the people who buy and use computers.

Jordan Breslow is a partner in the Walnut Creek, California, law firm Stewart, Stewart, and Breslow.

serve only a few PC Terminals before the lag in response time becomes a problem.

Disk Factors

Smack in the middle of all this activity is the hard disk drive. Aside from storing data and programs, it acts as a conduit for requests and information going to and fro within the network. It is here that a network encounters its weakest link.

"The hard disk drive is the bottleneck in any network," notes Quinn. "Let's say you have a hard disk with an 80 millisecond 'seek' time and 20 people are trying to get to it. Data is being moved to a printer or a modem, and requests for information are coming in. That disk drive arm is going back and forth trying to find all the data. It slows you down, because it's moving at a fraction of the speed of the data flow."

Thus, faster data flow is not necessarily better. Data transmission rates are sometimes equated with the "horsepower" of a network. Ethernet and 3Com, for example, can transmit data at roughly 10 megabits a second; PCnet at about 1 megabit a second. In benchmark tests PCnet often proves faster. Although the hard disk drive is the limiting factor in the network's speed, there are price considerations as well.

"Ethernet is very expensive," says Quinn. "They thought of serving the market 20 years from now, when you'll have disks that transfer information very quickly. That's a challenge for today's semiconductor house...coming up with chips that can handle that kind of rate. We decided to take some of the more sophisticated Ethernet technologies and combine them with a low-cost network. By cutting the speed we lowered the cost."

Cache and Carry

The data crunch is further lessened in the PCnet by the use of a technique known as caching, in which frequently used information is stored

in RAM for quick access. For example, the disk directories are always referenced when data is stored or retrieved from a hard disk. By keeping directories in cache memory, you can access them quickly without using the disk itself. On the PCnet cached data (which can be as large as 1 megabyte) is held in an optional pe-

Running applications software is a matter of managing simultaneous access to shared files.

ripheral made by SCS called QuickDisk. QuickDisk (which costs anywhere from \$1500 to \$3500) is attached to the server PC and the hard disk.

Cache memory is also handy when data is being routed through the network. Instead of storing incoming data to disk, retrieving it, and then sending it on its way, data can be placed in cache and immediately transmitted to the processor waiting for it.

Bursts and Calls

The speed of local area network communications is also dependent on how data transmission is controlled. Data flow in a local area network is unpredictable. Using the bus structure of the PCnet and the Intel 8274 communications processor on the network interface card, random calls to the network can be dispatched quickly.

A terminal needing to communicate can call out an address it wants to send data to or receive data from. The data in question is collected into a formatted packet and "burst" out to the address. At PCnet's 1-megabit-per-second transmission rate, the user

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seldom notices a lag in response time. Network software coordinates the bursting of the data throughout the network.

Unlocking the Net

Network software is also responsible for determining resource sharing (printers, modems, etc.) and concurrent use of applications software. PCnet boasts a number of main-frame-style features, from query to print spooling. The latter is particularly useful, since requests for printer time are automatically tallied, lined up, and routed to available printers throughout the net. A measure of control is present, since printers can

The PC Terminal
doesn't promise high-
tech wonders—just
low price and
functionality.

be specified and the spooling list can be reordered to reflect changing priorities in the network.

Running applications software is a matter of managing simultaneous access to shared files, particularly for single-user software that does not normally provide for this kind of multitasking.

"A lot of software doesn't have the means of 'locking' a record. We provide the locks and unlocks that let you insulate a record you are working on in the PCnet. We tell the user how to implement the locks on the network, or we get the software company to incorporate locks and multitasking features into their software."

SCS is working with a number of software firms that are converting and creating network software for the PCnet. Among the packages available will be data management

Circle 348 on reader service card

software such as *DataStore*, *Micro-RIM*, and *dBASE II*; accounting and inventory control software such as *Real World Software* and *Micro MRP*; and file-management/menu-driven software such as *Power* and *Menu Power*. 1-2-3 is also expected to join the PCnet roster in the near future.

Mainframe Solutions

With the introduction of the PC Terminal and the burgeoning interest in network software, the future of the PCnet looks promising. Of course, Tom Quinn is bullish on networking. It sells hard disk systems, and that, after all, is his business. Success of the PC Terminal is by no means assured. SCS is doing something that other companies (such as Corvus and COMPAQ) can sit back and watch—and then duplicate. But Quinn feels that the time for the PC Terminal is now.

"We're providing the missing link in local area networks. With a PC Terminal workers have their own computer and memory; the workers are going to be more productive. Yet as part of a network, they have to think in a share mode.

"We're trying to educate people to use a network the right way. There's a mainframe way and a micro way of looking at networking. We want to bring people into the mainframe world...because the problems they're facing now were long ago thought out and solved."

The PC Terminal may bring this about with a minimum of pain—and cost. ☺

Robert Luhn is an Associate Editor at PC World.

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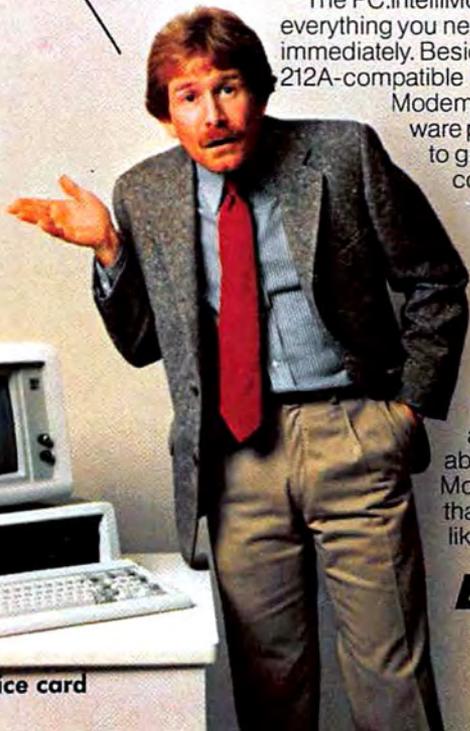
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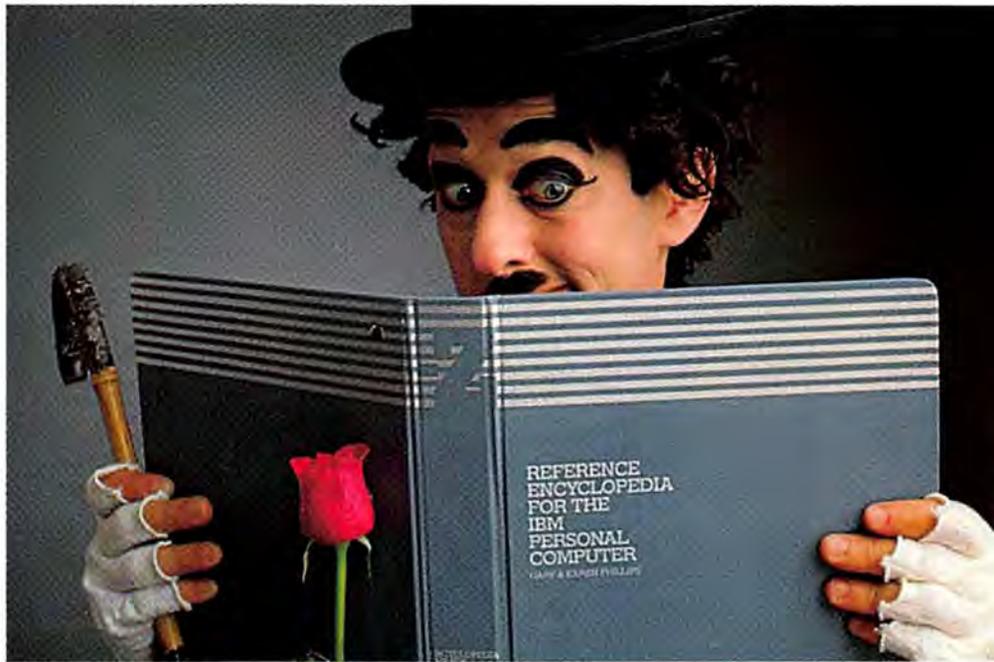
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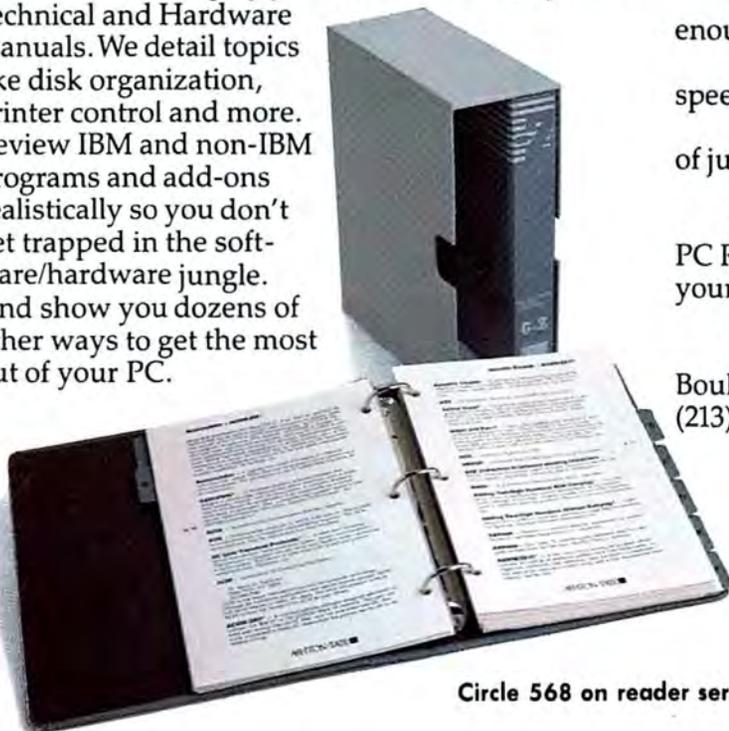
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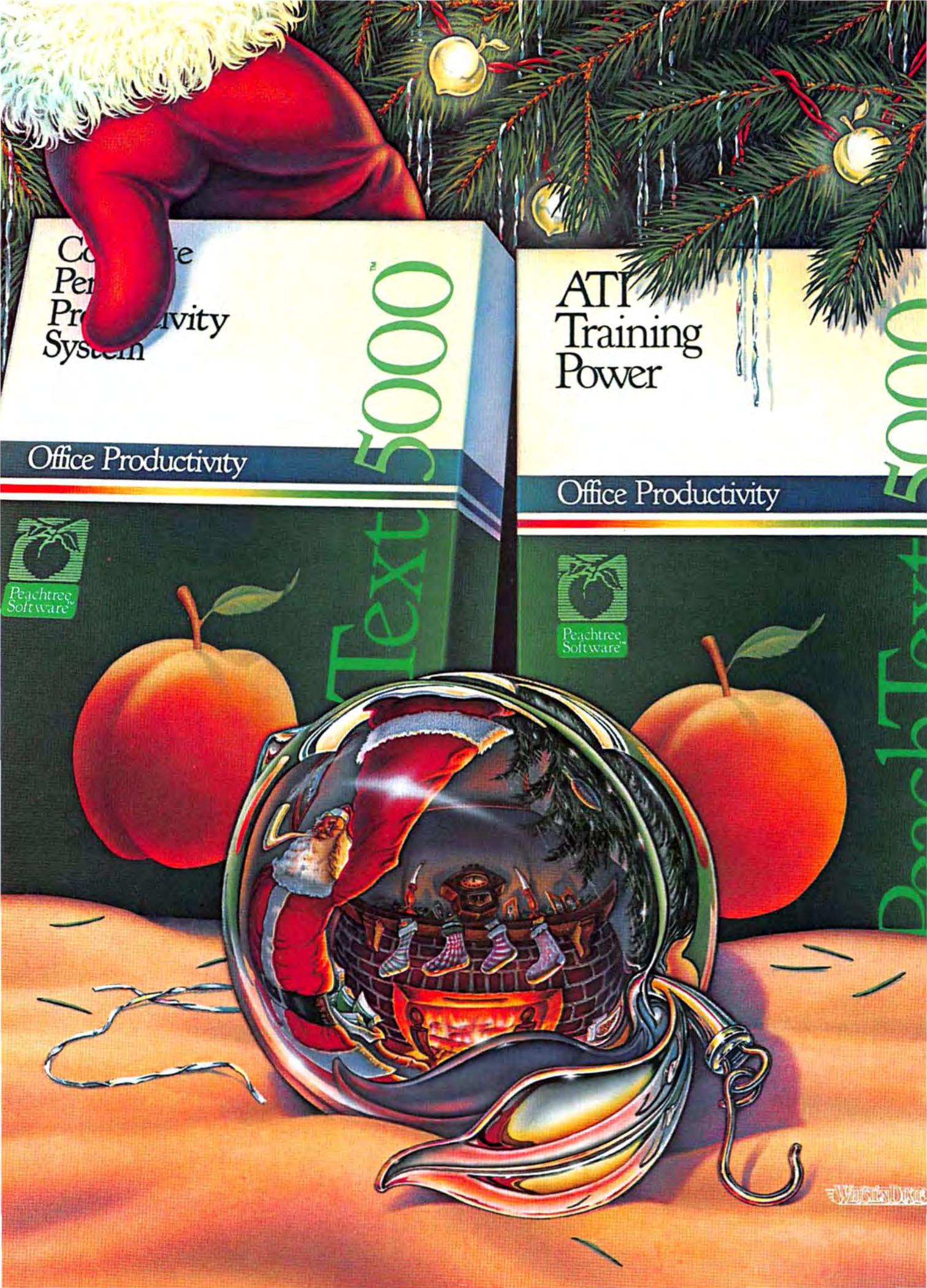
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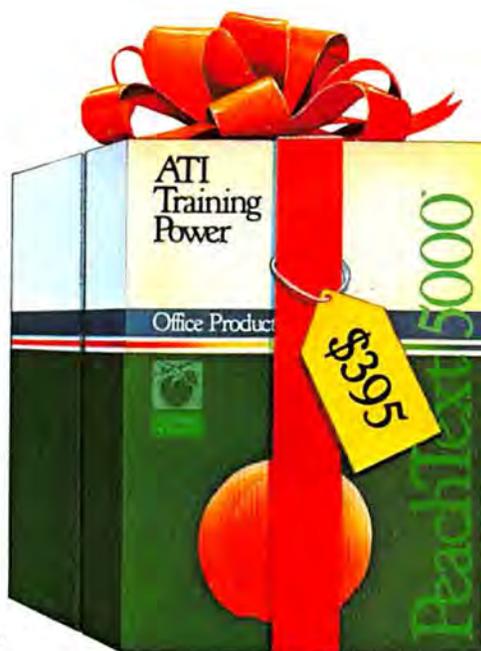
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PC WORLD View

News and notes for the computing community

Miriam Medom

PC World View reports new developments in computer technology, items of interest to all computer enthusiasts, and the most significant and enticing speculation about industry trends and personalities. We've reserved the "Grapevine" section of this column for industry reports that are still at the speculative stage.

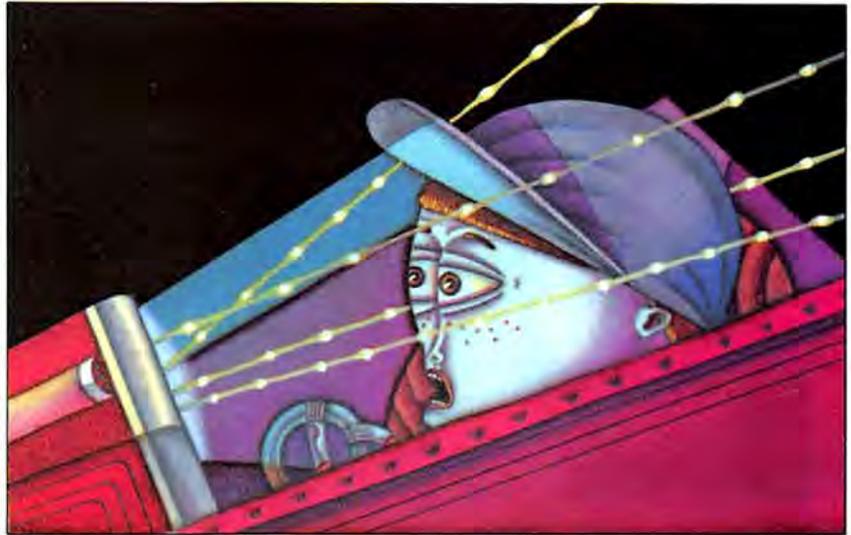
Grapevine

Full-Freight PCs

As the producer of the PC-DOS operating system for the PC and XT, Microsoft should have easy access to these computers for internal use. But a story we've heard from a source very close to the Bellevue, Washington, software firm suggests that Bill Gates and crew apparently don't qualify for special treatment when they are buying PCs. It seems that the company has agreements requiring it to lend some independent contractors a PC for the duration of their project. And where does Microsoft get the PCs to loan? From a local department store, reportedly for the full retail price.

Arcades for One

Arcade games seem to be slumping of late, but a new type of game, which could be called an arcade-in-a-box, may revive this national craze. One of our sources reports that major software, graphics, and special effects designers have created a total environment video game. The player enters a booth about the size of a small sports car; this contraption has



a video screen instead of a windshield and a steering wheel that the player uses to shoot down the enemy before getting shot.

The amazing graphics in these one-person arcades are enhanced by sound effects that seem to boom from all sides, providing a further dose of realism (or a further assault to the senses, depending on your point of view). We think these little arcades might be ideal places to accomplish some of life's peskier tasks, such as getting a 5-year-old boy to submit to a haircut or getting a teenager to relinquish the family telephone.

Hard Driving

Industry sources report that IBM recently added two new suppliers of hard disk drives for the XT and other computers; they are International Memories, Inc., of Medford, Oregon, and Computer Memories, Inc., of Chatsworth, California. International Memories is said to be producing 10-megabyte drives for the XT, and

Computer Memories is supplying larger capacity drives, including 19- and 40-megabyte models, for other products in IBM's existing lines and possibly for an upgraded future XT.

Another intriguing disk drive development, if true, is the rumored alliance between IBM and Seagate Technology. The two firms are reportedly working together to design and produce a tiny hard disk drive less than 3 inches wide. This "micro-platter" would have a storage capacity of 5 megabytes.

Soft Driving

As the prices of hard disks continue to decline and suppliers continue to multiply, software producers will find it increasingly necessary to ensure that their programs can be used with hard disks. At present, most software that is not copy protected operates normally on hard disks, although it must be compatible with the disk

supplier's version of the BIOS (Basic Input Output System—the part of PC-DOS that addresses the hard disk).

Copy-protected programs are another matter, because the encryption that prevents them from being copied to floppy disks likewise prevents their transfer to a hard disk. (In most instances this means that the programs can't be copied to RAM disks either.) Some producers offer a compressor. Lotus Development's *1-2-3*, for example, must be booted from a floppy drive, but its main program and data files can then be operated on a hard disk or RAM disk.

Now VisiCorp has announced hard disk support for its VisiSeries programs for the PC as well as the XT. An upgrade to provide that capability is available from VisiCorp for \$20 per program; new versions of the software will include the enhancement at no extra charge.

Intel Incentive

Chip-maker Intel has established a reward for its employees for writing articles about the business. If an Intel worker has three articles published within a year, he or she wins an IBM PC. As of late summer six employees had won PCs. Obviously Intel figures the publicity is worth the price of a PC, and payment in the form of a \$3000-plus computer is far better than most computer journalists can claim.

Big Blue's News *Intelligent Questions*

IBM obviously made a smart move by encouraging independent software producers to develop programs for the PC. Now the computer giant has gone out of house for the first time in acquiring software for its mainframes. The beneficiary of this un-



usual honor is Artificial Intelligence Corp. of Waltham, Massachusetts; IBM has purchased its *Intellect* program to provide a simple English-language query system for use with large-scale data bases.

Intellect has been called a rudimentary form of artificial intelligence, although it may be described more accurately as a sophisticated query language that allows people who are not familiar with computers to locate and retrieve data from their company's IBM mainframe systems. If this new access to digital information catches on among previously computer-shy managers and executives, IBM is likely to cash in on *Intellect*, and other firms are certain to develop rival software.

There may be one group of losers in this situation, however—the data

processing departments that previously were the only means of interchange between computer novices and electronic data. As microcomputers proliferate on desktops and micro-mainframe links become cheaper and easier to use, the big computers in the basement may need far fewer translators and guardians.

Enter Please

As we speculated in October's "Grapevine," IBM has created a new division that has the PC and the XT as its flagship computers. Called the Entry Systems Division, the new unit is headed by Philip "Don" Estridge, who guided the PC to market. Besides the PC and XT operations based in Boca Raton, Estridge will preside over IBM's other low-end business computers, including the Displaywriter, the Datamaster (also called System/23), the 5520 administrative system, and the 5280 distributed system. Those four computers were previously part of a unit based in Austin, Texas.

Industry sources have predicted that IBM will phase out both the Displaywriter and the Datamaster systems, because sales of both products have declined rapidly as the PC and XT have flourished. An IBM spokesperson would not comment on such reports, stating only that the Entry Systems Division was established to "provide a single management focus" for that group of computers.



The Japan Connection

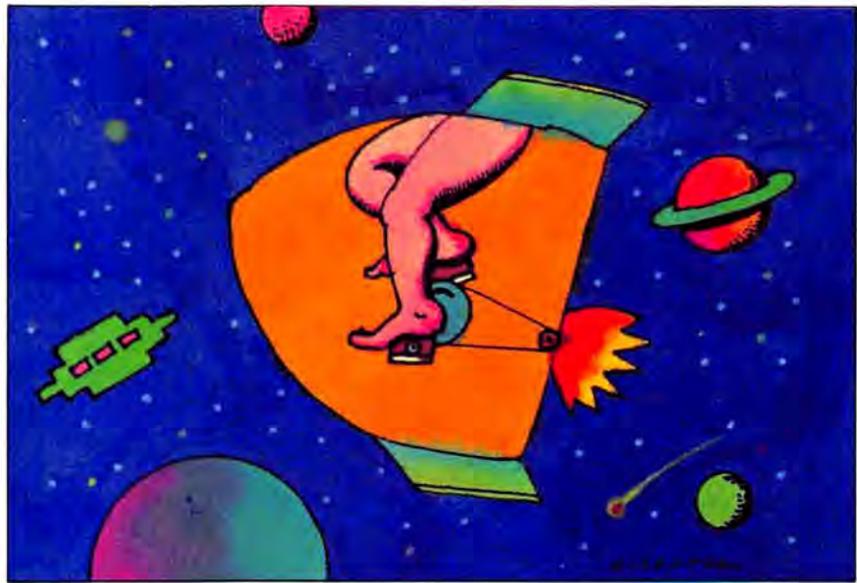
Recently IBM purchased additional stock in both Intel and Rolm as part of its agreement with those two firms, and now IBM Japan has purchased 35 percent ownership of Japan Business Computer Company. A spokesperson for IBM would not disclose any financial details of the deal, noting that the purchase was made so that IBM Japan could benefit from its new affiliate's technical knowledge. The Japan Business Computer Company currently markets some IBM computers and other office equipment.

Low-end Laser

A new laser printer has been announced by IBM for use with a number of the firm's computers. This machine, the Model III, is touted as the low-end product in the laser printer line; it sells for \$37,000 and prints but does not photocopy. The other two printers in the series, Models I and II, operate as both printer and copier and sell for an additional \$5000 to \$8000. We hasten to point out that although the Model III may be able to communicate with the PC, that printer doesn't qualify for IBM's newly created Entry Systems Division. In fact, it's part of the 6670 information distributor product group.

Pedal Power

Even if you can't afford to give someone a one-person video arcade (see "Grapevine") for Christmas, *Playboy* magazine has another game-playing gift suggestion for you—the Aerobics Joystick, produced by Suncome, Inc.



The product's name suggests perhaps full-body involvement in video games or even three-dimensional gremlins that fly out of a TV screen to chase you around the room.

But no, the Aerobics Joystick is a bit more tame: it is a device that attaches to a stationary bicycle and an Atari or Sears video game player. The faster you pedal the bike, the faster the action in the video game. So instead of just getting tendinitis in your wrists and elbows, now you can also wreck your knees and pull all sorts of muscles trying to keep those little space people from getting to earth.

Mystery Solutions



We've had two proposed solutions to the mysterious malfunctioning of our friend's hard disk, as reported in the

September issue. This fellow's problem was that programs stored on his hard disk worked only after the disk had warmed up for half an hour or more.

Our trusty correspondent John Draut, engineering supervisor for hard disk supplier Davong Systems of

hard disk supplier Davong Systems of Sunnyvale, California, offers the following solution:

"The fact that the problem occurs after a half-hour warm-up period suggests that either the controller or hard disk is temperature sensitive. Additionally, a controller takes 5 to 10 minutes to stabilize at operating temperature, while a disk takes at least a half hour due to its greater mass, so the hard disk itself is suspect.

"Also note that the fellow had his disk for 6 months, which means that he bought it sometime last winter. During that period no disk manufacturers were delivering 5¼-inch 20-megabyte drives in anything but prototype (low) quantities. So it looks like our fellow has a very early production drive with the inherent early production bugs.

"The heat bug is the inability of the drive to track the data as the disk surface itself heats and cools. On small capacity drives (5 and 10 megabytes) the problem is minor, but in high-capacity drives the tracks are smaller and closer together, thereby making the drive more sensitive to temperature....

"My guess is that when the fellow last formatted his disk he did so after it had been running a while, perhaps after running diagnostics and an install program. All was well as long as the disk was warm. But if he tried to read or write with a cold disk, the heads wouldn't have been on track, and his data would have been subject to error. The drive itself had either developed a fault over the 6-month period or had marginal head positioning control to begin with. I suspect that the fellow, if he got a new disk now, would find it to be a better and more reliable product than the one he had originally purchased."

Our friend did get a new disk, but John Draut has some suggestions for anyone whose disk is acting up similarly.

"First, back up data after the warm-up period, turn off the disk and the PC, and then reformat the disk when it is cold. Then add a fan to the PC to prevent the disk from heating up as much, or better yet, remove the cover from the PC and operate it with the cover off. [This is not a universal opinion; see *Help Screen* in this issue.] Keeping the drive at a constant temperature will ensure that you can use the disk at any time for as long as you want. Note that if you reformat the disk cold and do nothing to reduce the operating temperature of the drive, you may develop another problem—you may be able to use the disk for the first half hour of operation only."

Jeff Friedl of Rootstown, Ohio, offers an entirely different solution to the mystery.

"I believe that a substance or a corrosion formed on the edge connector of the board between the board and

the motherboard. This could explain how the system worked for several months without a problem, but there was a point at which the build-up caused some of the signals between board and computer to be lost. (Maybe a data bit was dropped.) After the card and connectors had time to warm up, the substance may allow perfect conductivity or may even melt back far enough to allow contact between pins and motherboard. Since the actual disk was fine, a new one wouldn't help. As for the new board—the connectors on the motherboard were still dirty. My solution would be to clean the edge connector with an eraser and somehow do the same to the motherboard connector.

"One big question remains: why did the substance build up? That could be the next Mystery of the Month."

Solo Flight



The man who wrote the original version of MS-DOS and PC-DOS, Tim Paterson, has established his own business. Paterson was formerly with Seattle Computer Corp., the firm that developed the operating system under Microsoft's direction. His new company, Falcon Systems, will produce—surprise!—peripherals for the IBM PC and compatible computers. At the time he announced the formation of Falcon Systems, however, Paterson declined to reveal what the company's specific products will be.



Massaging Entrepreneurs

As high-tech companies are merged or simply grow into large corporations, the delicate creative and entrepreneurial spirit may be damaged or even destroyed. The common pattern for many key innovators in the computer industry has been creation of a shoestring business, moderate or rousing success, and finally sale or phenomenal growth of the company. At that point the fun is over for many of the entrepreneurs who depart to start over from scratch.

More and more large companies are recognizing that they risk losing these innovators after acquiring or nurturing an entrepreneurial enterprise, and some have taken steps to keep these talented people. Instead of merely offering bonuses or executive perks, a few computer firms have created separate, autonomous companies within their corporate frameworks to keep the entrepreneurs

XyWrite II

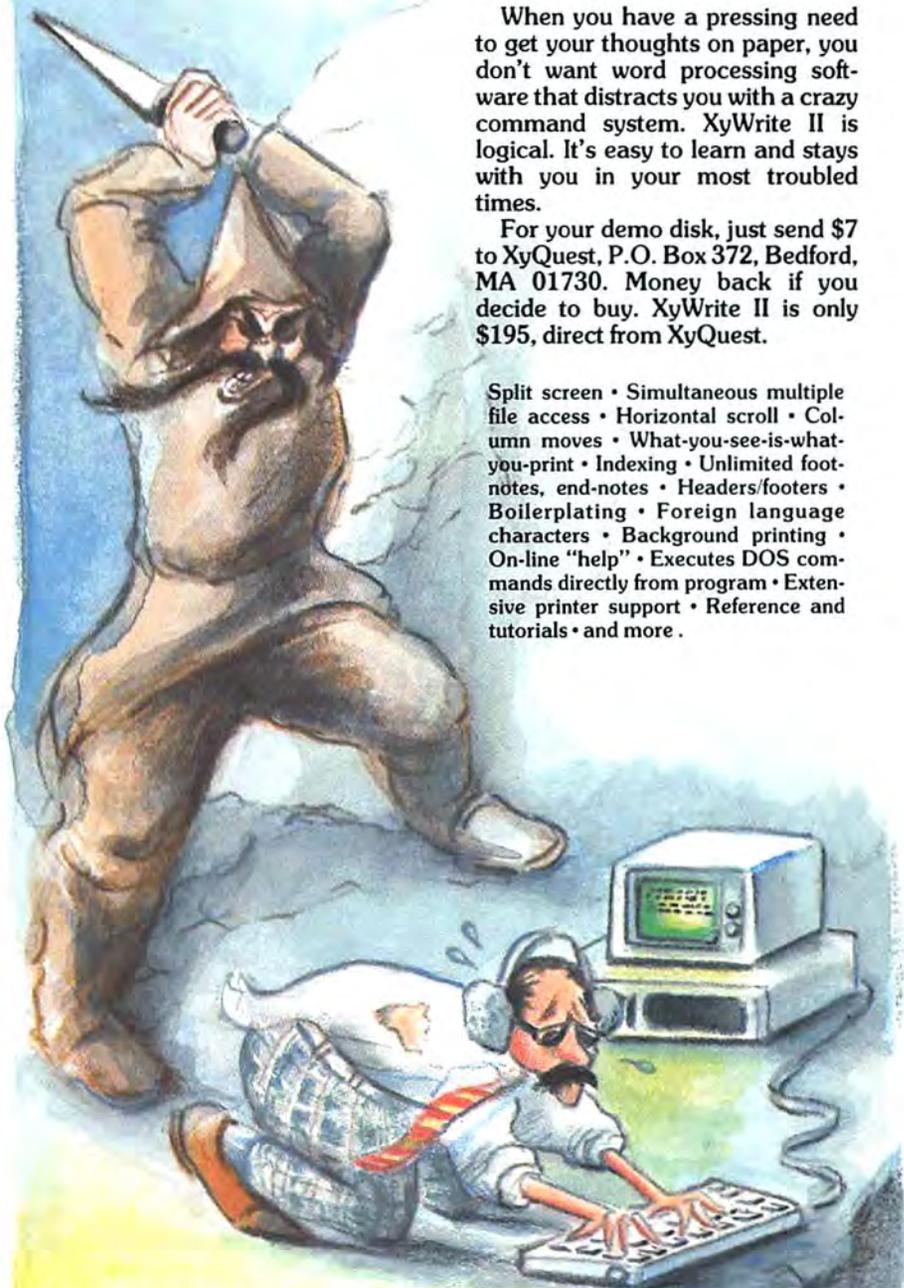
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happy and still employed by them. Apple's development group for Lisa is one example of that phenomenon; another is IBM's creation of 14 "independent business units" for such projects as robotics development.

Another company-inside-a-company was established by Matt Sanders at Convergent Technology. Sanders was essentially turned loose from his previous job, thrown out of his office, and told to create a new work station and to find new employees—not those on Convergent's payroll—to do it. He attracted professionals from other computer makers, luring them with stock offers and the opportunity to create a new product in an entrepreneurial environment.

The experiment worked well: the company's product is Convergent's impressive new Workslate, a portable work station that combines telephone and computer, has ROM software that includes a spreadsheet program, and features a built-in cassette recorder for both voice and data. The notebook-sized Workslate will cost \$895. ●

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- Coded in C language
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Standard Features-CLEO 3780

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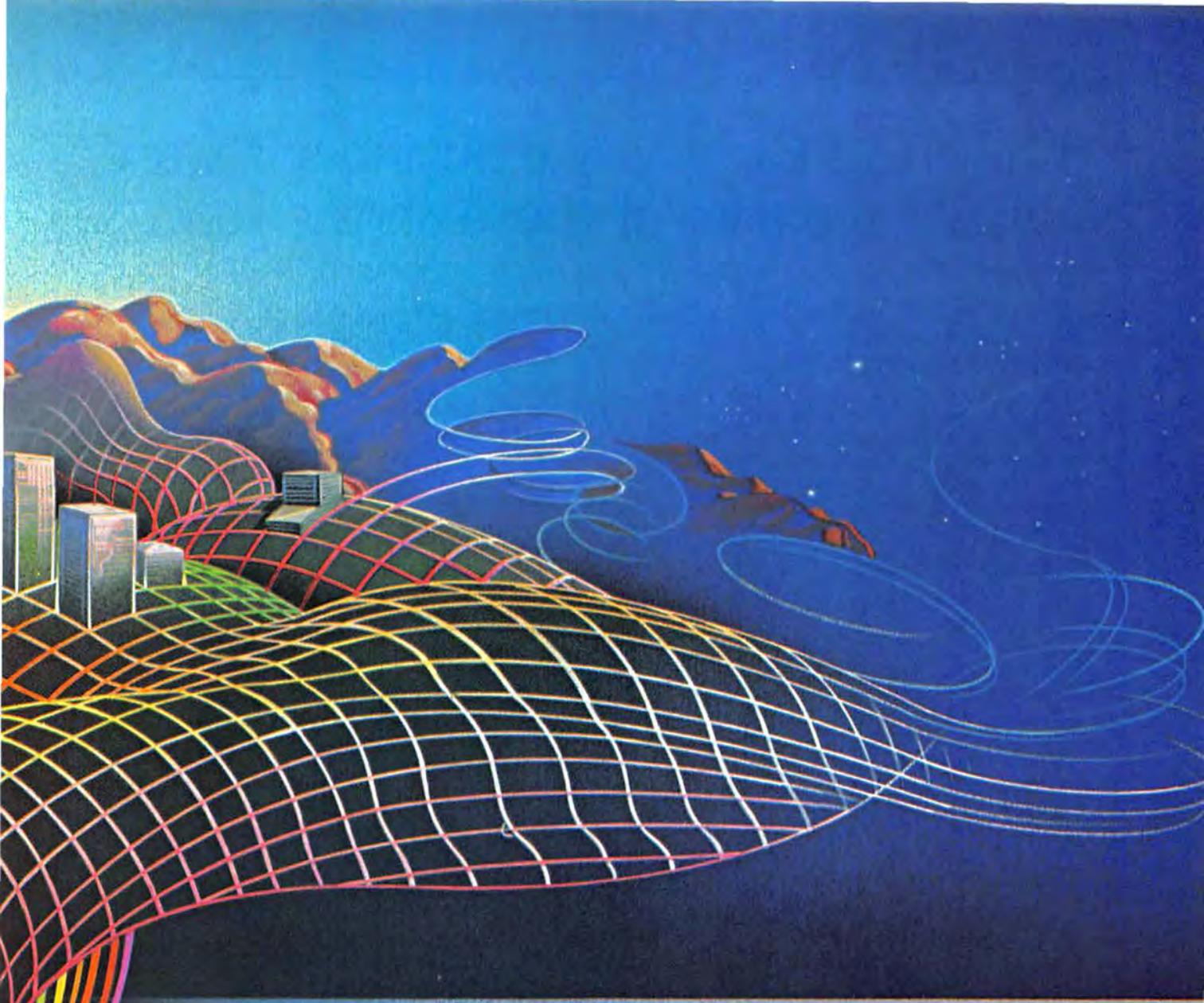
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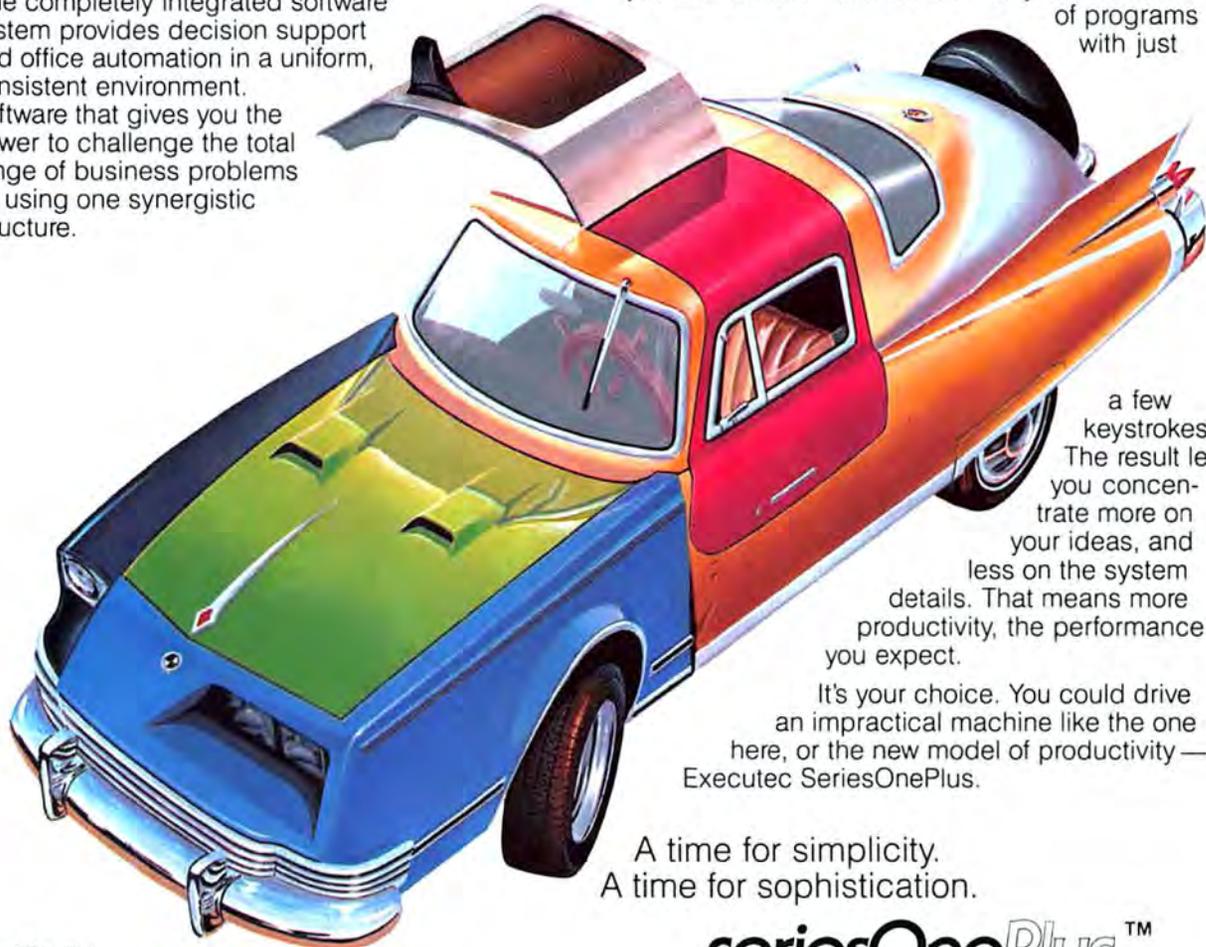
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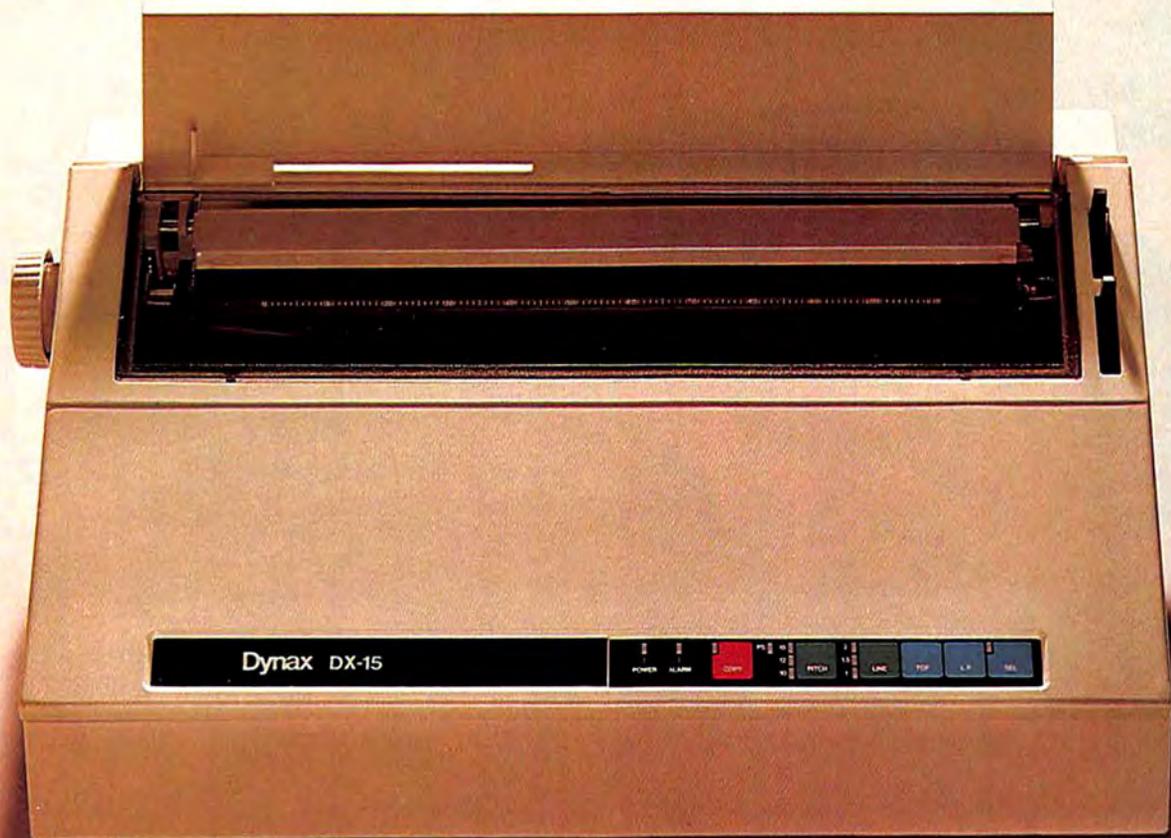
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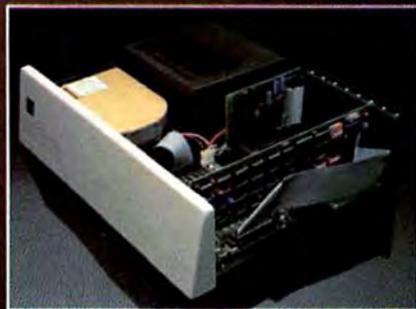
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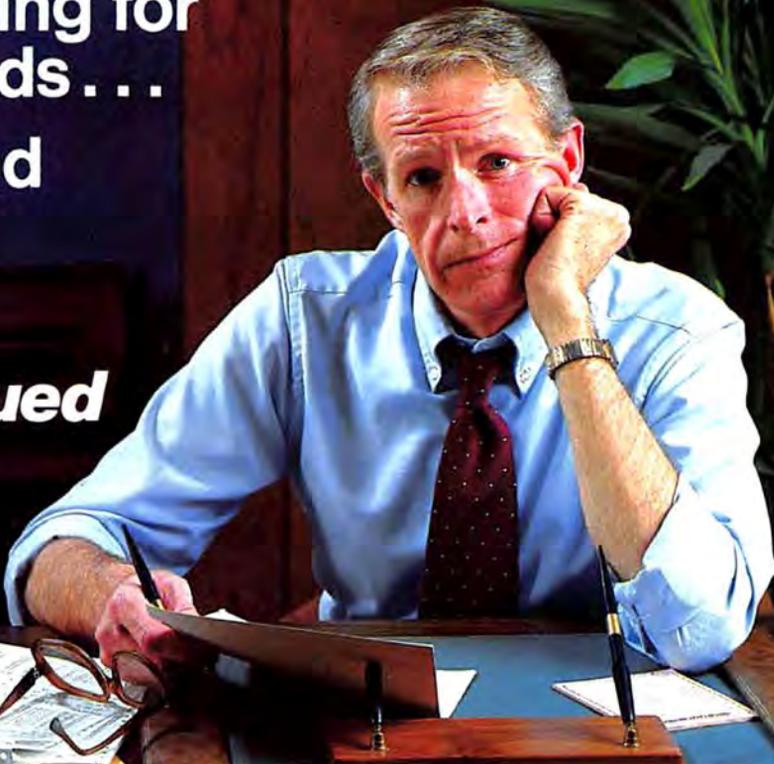


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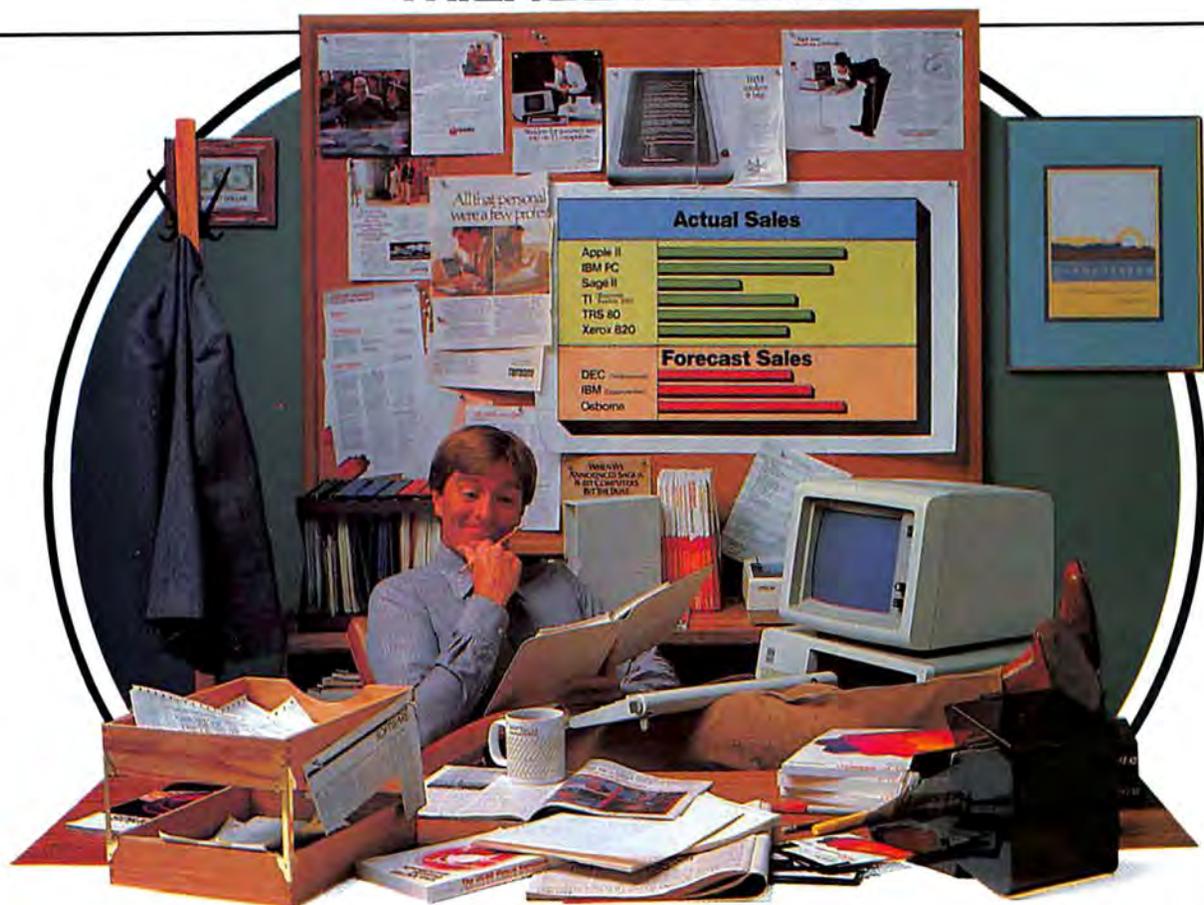
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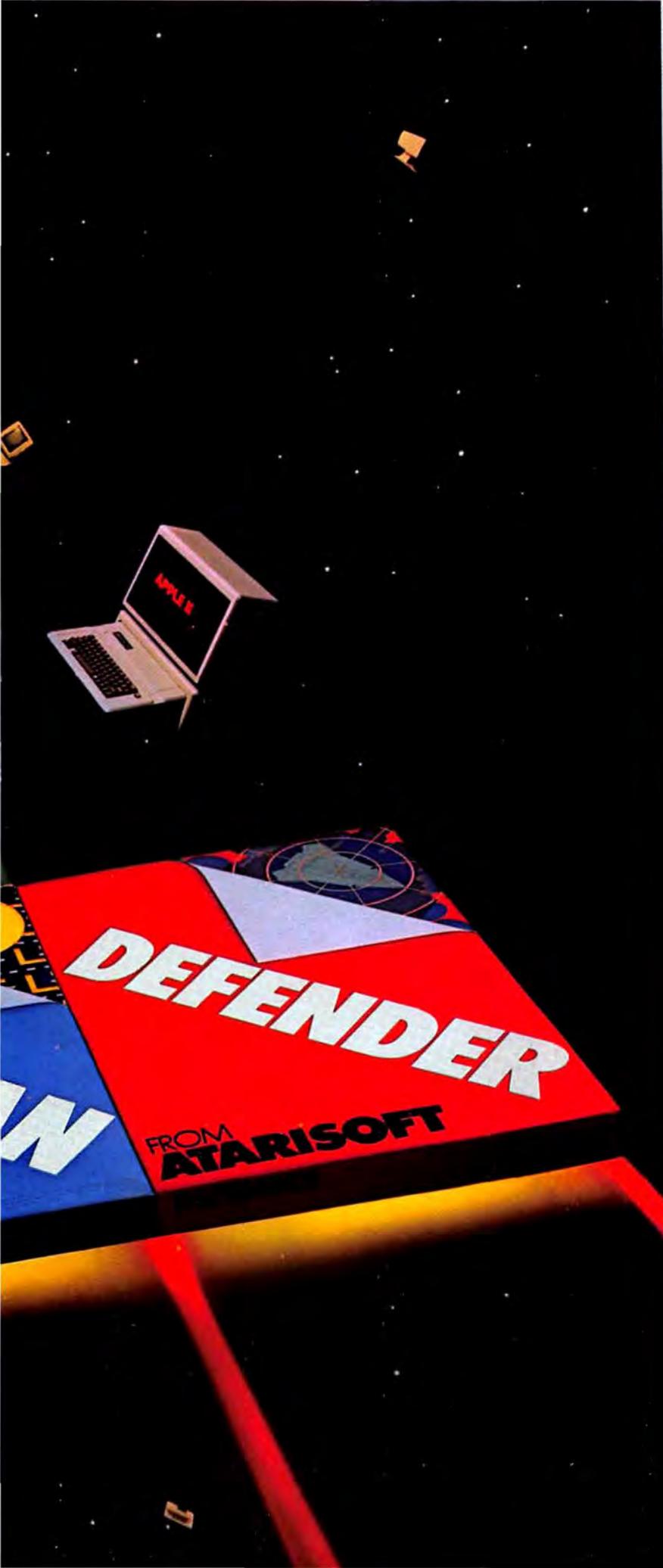
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Silent Running

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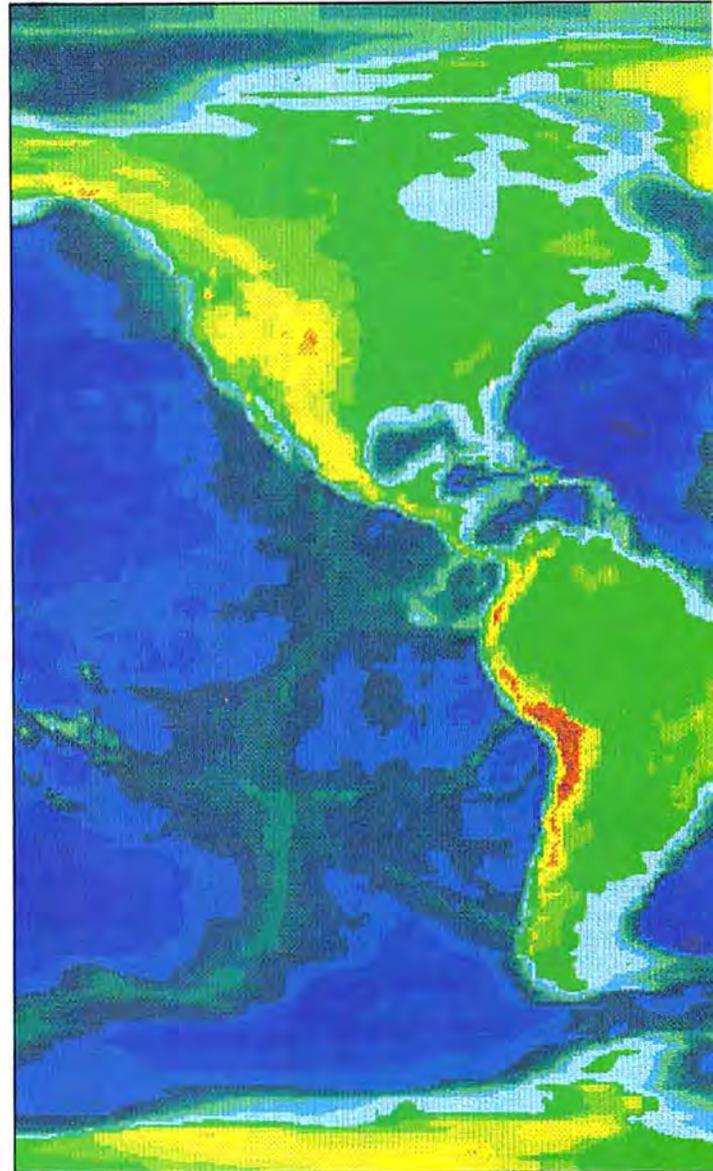
In the beginning there were dot matrix printers. They were fast, but the type was difficult to read. Then came letter quality character printers. They provided high-quality type but with a sacrifice in speed. Now a new type of printer has arrived that sprays ink instead of pounding the paper. Ink jet printers combine high speed and letter quality characters at an affordable price. The only thing an ink jet printer won't give you is noise.

Picture this. You're on deadline to finish a manuscript as the printer pounds away. The phone rings. You push the pause button on the printer, and as the conversation progresses, you start counting the minutes of lost printing time. When the call is completed, you resume printing, and the rat-a-tat hammering blots everything else from your mind. It's too noisy to read, and even if you had a print buffer, it would still be too noisy to write. You could leave the room, but the possibility of mechanical problems prevents you from leaving the printer unattended. There's nothing to do but wait and suffer.

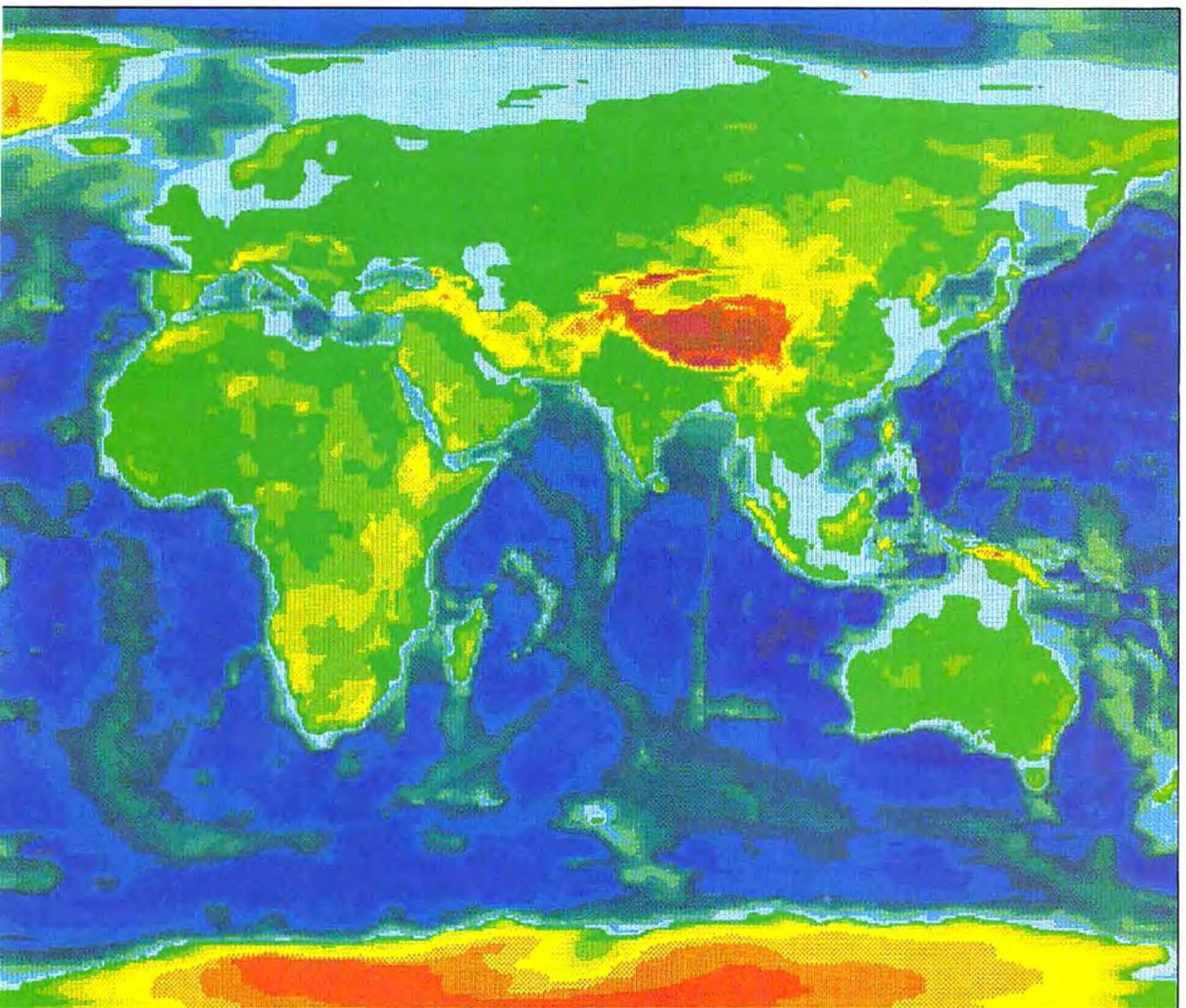
There are alternatives: buying a \$500 silence cover for a \$400 printer, wearing earplugs and taking the phone off the hook, putting the printer in a closet lined with soundproofing material while hoping that the tractor feed never fails, or—investing in an ink jet printer.

Ink jet printing technology has been in existence for several decades, but the last few years have shown major improvements in simplicity of design and mechanical reliability. Technological refinements and lowered prices have made ink jet printers a competitive alternative to other computer printers.

Ink jet is nonimpact printing—no mechanical part of the printhead makes contact with the paper or platen. The difference between impact printing and nonimpact ink jet printing is similar to that between pounding a hammer against a wall and squirting water from a hose onto a wall.



Color graphics with A.C.T. II



Review

Impact printers include pin-type dot matrix, daisy wheel, and thimble printers. Pin-type printers (also called needle or wire printers) have pins in single or double vertical rows at the tip of the printhead. Tiny hammers selectively hit the pins against a ribbon that is pressed against the paper on impact. The result is a matrix of dots that form characters. Daisy wheel and thimble printers are letter quality printers that have fully formed characters affixed to the spokes of plastic or metal print wheels. The print wheel or thimble is rotated on the printhead so that the selected character is positioned in front of a hammer. The hammer hits characters one at a time against a ribbon that impresses the image onto paper.

Character printers produce top-quality copy, but at slower speeds and greater cost. Impact dot matrix printers provide type of lesser quality, but they are faster and are capable of producing simple graphics images such as bars and lines. Most character printers can print only alphanumeric characters.

Nonimpact printers for the microcomputer market include thermal, electrosensitive, and ink jet. The first two require specially coated paper. Thermal printers create type by selectively heating pins of a dot matrix printhead. The heat darkens the coated paper in dot shapes that form the character matrix. The printhead

Ink jet printers are fast, achieving speeds from 150 to 270 characters per second.

never touches the paper. Electrosensitive printing has a similar printhead configuration, but the head emits electrical charges at selected dot points close to the surface of the paper. The charge removes the paper's coating in dot shapes, and the character matrix is formed.

Ink Jet vs. Impact

Instead of using pins at the printhead to form the dot matrix, ink jet printers use ink-filled channels that spray liquid ink drops. There are two major categories of ink jet printers: drop-on-demand and continuous stream. Continuous-stream printers use a single ink channel that emits a stream of ink, which is broken into separate drops by electrical stimulation and printhead movement. Not all ink from the stream is used. Some ink drops are

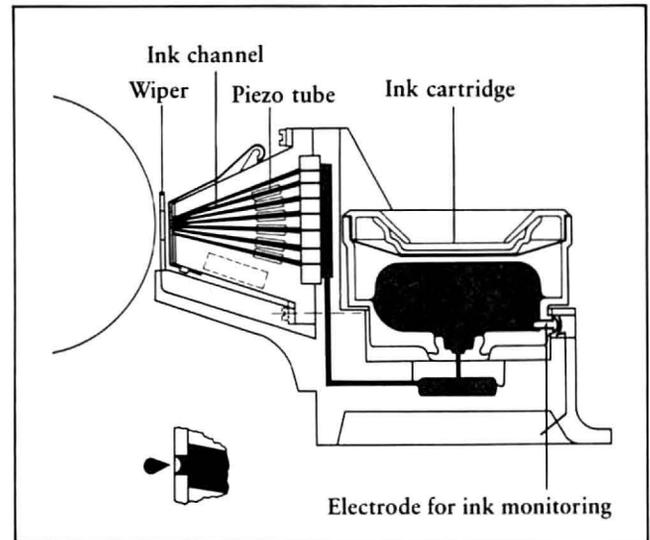


Figure 1: Siemens Model 2712 ink jet mechanism

discarded and recycled. The complexity of the recycling system makes continuous-stream printing very expensive (see "Ink Jet Printing Defined").

In drop-on-demand ink jet printing an ink cartridge feeds ink into several channels. When pressure is applied selectively in each channel, drops of ink are ejected and deposited on paper (see Figure 1). Unlike continuous-stream printers, no ink is spilled or wasted; hence, no need for a costly recycling system. High-quality bond paper can be used with ink jet printers, but special polyester-based paper with good absorbency is recommended for best results.

Ink jet printers have one obvious disadvantage compared to impact printers—they cannot produce multiple carbon copies. Manufacturers also warn users not to run the printers in dusty environments since particles in the air can become lodged in the ink outlet, thereby clogging the nozzle orifice. If the printer remains unused for long intervals, the ink at the channel orifice may dry up. But the printers come equipped with self-cleaning methods that allow the ink to be flushed out of the orifice by manual pressure on the ink supply cartridge. One further caution: if you want to use the printer at altitudes higher than 15,000 feet (Mt. Everest, for example), you might have a problem with atmospheric pressure. Tibetan word processors beware.

Ink jet printers have many advantages, the most notable of which is the noise factor—specifically the noise they do not make. My PC XT's fixed disk makes more noise than the Siemens printer I tested. Productivity is increased when there is less noise pollution, whether the working environment is an office full of people or the electronic cottage.

Another advantage of ink jet printing is low maintenance. The manufacturers claim that their printers are virtually maintenance-free. No oil or lubricant is needed for the printer since it has few moving parts in the body

and none in the printhead. The Siemens PT88 printer, for instance, has only two motors: one that moves the carriage from left to right and one that performs the paper linefeed function.

Since the printhead of the ink jet printer never touches a surface, it is not degraded through use. The life of the printhead is estimated at about 10 billion characters. Compare that to the estimated 200-million-character life of sophisticated impact dot matrix printheads. The uniformity of character image produced by ink jet printers compares favorably with that of impact printers. A worn ribbon produces increasingly lighter images, but an ink jet image always remains the same.

Ink jet printers are fast, achieving speeds from 150 to 270 characters per second (cps). In comparison, an IBM dot matrix printer is rated at 80 cps, a DataSouth dot matrix printer is rated at 180 cps, and letter quality character printers average between 12 and 80 cps.

Siemens PT88 and Model 2712

Siemens Communications Systems in Anaheim, California, is a pioneer in bringing ink jet printing to the micro-computer market. Siemens currently offers a low-priced ink jet printer called the PT88. The parallel model of the PT88 has a 165-character line buffer while the serial model has a 2K buffer. Additional memory can be added at \$33.50 for each 4K.

The PT88 uses a printhead equipped with one vertical row of nine ink channels to produce a 9 by 9 dot matrix. The printer runs at speeds of up to 150 cps, and operating noise has been rated at less than 50 dBA. Character printers are typically rated at about 65 dBA, but the difference seems much more dramatic in practice than the numbers suggest.

The PT88 printer comes with eight character sets—USASCII, International, English (British), Swedish/Finnish, Danish/Norwegian, Dutch, German, and French/Belgian. According to industry spokespeople, ink jet and color ink jet printers are in greater demand in Europe than in the United States.

Graphics are produced in bit-image (8-bit vertical) mode (see Figure 2). A function expansion module (available at additional cost) allows you to use special graphics methods such as block graphics. The module also provides loadable character generators of up to 96 additional characters and allows you to create your own character sets.

Characters can be spaced at 10, 12, and 17 characters per inch (cpi) in regular print and 5, 6, and 8.5 cpi in expanded print. Character spacing cannot be selected by the control switch panel but must be programmed from the terminal. Line spacing can also be programmed from 1/2 inch (for boldface) up to 9/2 inch. Proportional spacing is supported. The PT88 prints bidirectionally and uses logic seeking (for instance, dropping to a tab instead of returning to the left margin first) to increase speed.

Linefeed and form-feed controls are located on the printer console. The platen knob is on the right side of the printer, and the paper release lever is on the left side of the platen. This positioning is opposite that of most printers and makes paper insertion awkward. The PT88 will accept paper up to 9 1/2 inches wide and has a built-in tractor feed that is simple to load.

Control switches are readily accessible inside the printer. These switches allow the user to manually select character set, number of lines for form feed (66 lines = 11-inch-long paper; 72 lines = 12-inch-long paper), line length (80 or 136 characters per horizontal line), and other parameters. All selections are programmable from the computer.

Although bond paper can be used, prices for higher quality, polyester-based paper are competitive with commercial-quality bonds. Paper can be purchased in fanfold or roll formats. A paper roll holder with a cutter that attaches to the printer is available for \$30. Roll paper comes in a continuous roll and can be torn off on the paper cutter at any length desired. The ink supply cartridge (\$15) will last for 5 to 6 million characters based on an average of 10 dots per character. The PT88 is compact and weighs only 16 pounds.



Figure 2: Bit graphics printing with Siemens PT88

Siemens also makes a Model 2712 ink jet printer that is similar to the PT88. The Model 2712 has two rows of six nozzles on the printhead and uses a 12 by 9 dot matrix. The additional nozzles allow increased printing speeds of up to 270 cps. The built-in tractor will accommodate paper as wide as 15 3/4 inches. Graphics can be produced through bit image, raster scan, or block modes. An 8K buffer is standard.

By the end of 1983 Siemens plans to market a wide-carriage version of the PT88 (the PT89) that will be slightly higher in price. Future releases include a letter quality ink jet printer in the \$3000 to \$4000 range.

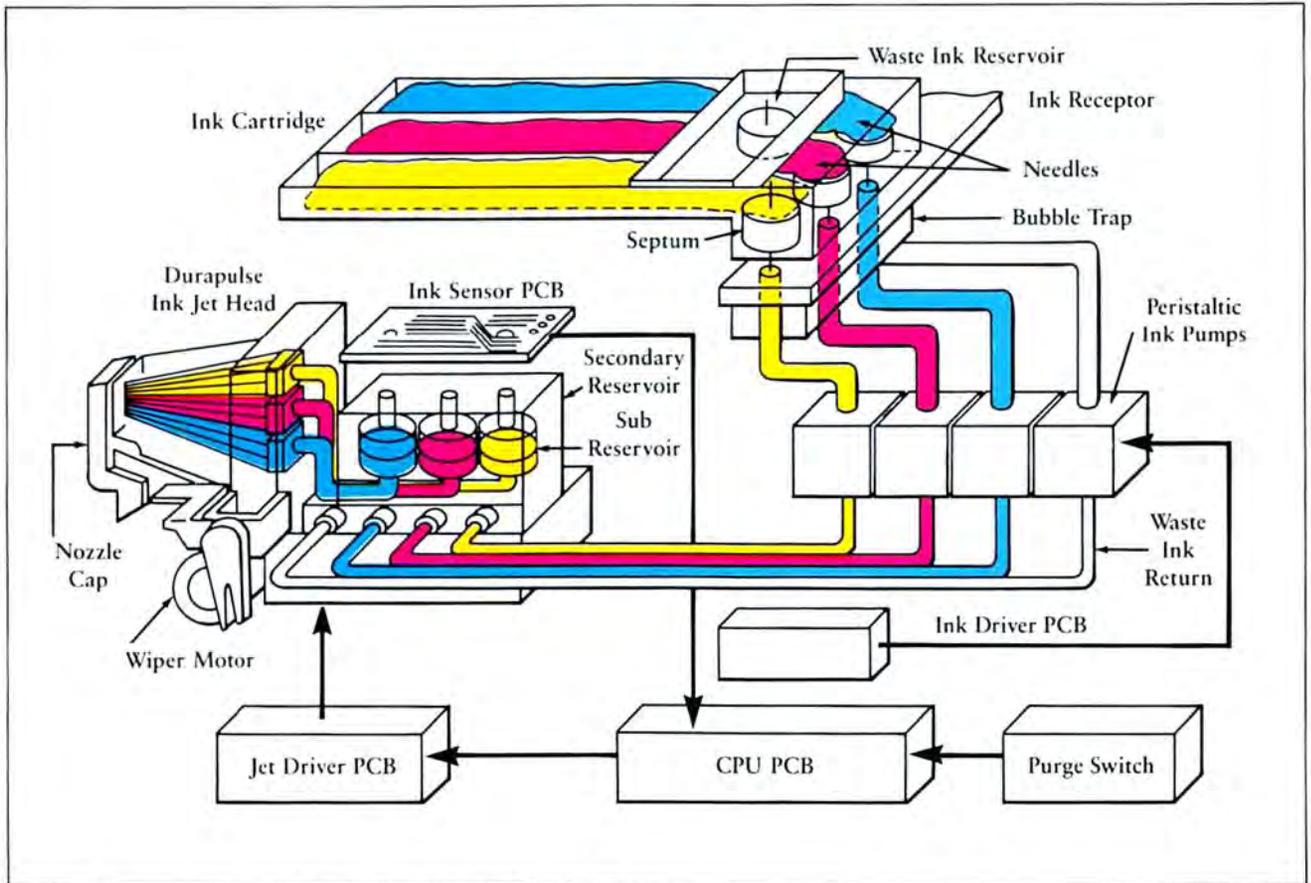


Figure 3: Construction of A.C.T. II color ink jet mechanism

Color Ink Jet Printing

We live in a world of color images. Our TVs, movies, even newspapers produce vibrant color imagery. Clearly, there is a trend in microcomputer hardware and software toward color imaging. While most color printing capabilities are still prohibitively expensive for the single user, they are becoming more affordable for environments in which hardware resources are shared.

My PC XT's fixed disk makes more noise than the Siemens printer I tested.

Color graphics can be used to call attention to detail. Since particular colors on the spectrum dominate, our attention is naturally drawn to the more vibrant, bright colors such as red and, consequently, to the data represented by the dominant color. For educational purposes, color can help the reader locate separate items

quickly, such as answers to questions, or differentiate between screen responses and user input. More information can be conveyed in a smaller amount of space with color graphics because more variations in detail can be achieved with multiple colors than with shades of black and white.

Color printing for the microcomputer can be achieved with both impact and nonimpact print techniques. In impact color printing a dot matrix printer can be used with a multicolor ribbon (usually three to four colors). The printer applies one color at a time on a line or page and then repeats the process until all colors have been applied. This is a time-consuming process. In addition, solid areas are often incompletely filled because the dots do not overlap. Ribbons become worn, so colors become less vibrant with wear. However, impact color printing is fairly inexpensive on a per copy basis.

Color ink jet printers use multicolor ink cartridges instead of single-color ink cartridges. The different color inks are fed from the cartridge to the channels in the printhead where colors and color combinations are sprayed onto paper or transparencies (see Figure 3).



Figure 4: Color graphics with A.C.T. II

Ink Jet Printing Defined

Two main technologies are used in ink jet printing. Drop-on-demand ink jet printing is the type used by Siemens and several other manufacturers because it is simple, efficient, and inexpensive. Continuous-stream ink jet printing is more complex and expensive, and consequently is not as widely used as drop-on-demand ink jet printing.

Drop-on-demand involves use of an airtight ink cartridge that feeds ink to channels aligned in vertical rows on the printhead. Each channel has an orifice from which drops of ink are selectively extruded and deposited on paper. A slight negative pressure is maintained inside each channel to keep the ink from inadvertently escaping through the orifice. A concave meniscus (inverted cone) forms at the orifice when extrusion is not in progress and keeps the nozzle orifice clean.

In the Siemens ink jet print mechanism, piezoelectric crystal tubes in each ink channel are stimulated by an electrical pulse. When stimulated the crystals expand, causing an increase in pressure inside the channel. High-frequency stimulation has an oscillating effect on the crystals. Increasing pressure in the channel pushes ink away from the crystal and toward the nozzle where a bulb of ink

forms. When pressure is decreased from the crystal's contraction during pauses in the application of the electrical pulse, the bulb breaks off, forming a drop that is deposited on the paper. Groups of drops on paper form character and graphic patterns.

Continuous-stream printing is faster than drop-on-demand printing and produces somewhat higher quality print and graphics. This method uses only a single channel on the printhead. The channel's nozzle emits a constant stream of ink that breaks into separate drops from horizontal printhead movement and the natural instability of the jet. Uniformity of drops is ensured through stimulation of the jet by an electrode. Drops are selectively charged and passed between two facing, charged deflector plates. Uncharged drops fall into a gutter while charged drops are propelled by the deflector plates onto paper. The unused ink that drops to the gutter is filtered and recycled. The recycling mechanism involves filtering systems and a circulation pump, making the technology complex and costly. IBM manufactures a continuous-stream ink jet printer that costs close to \$30,000.

Review

Color ink jet printers are decreasing in price so that they are now within the range of multiuser operations that share hardware costs.

Color ink jet printing has several advantages over impact color printing. Filling solid areas is more uniform because the ink droplets can overlap. In fact, different color ink drops can be sprayed directly on top of each other. Since the ink is translucent, this overlaying produces a great variety of colors out of the three to four primary colors provided. For example, when cyan and yellow are combined, green is produced.

Through a process called dithering different color intensities can be achieved. *Dithering* means that drops of ink are applied at an increased density within a dot matrix to create darker shades of a color. One dot applied to a two-square matrix will produce a lighter color image than four dots applied to the same area.

Two manufacturers produce color ink jet printers aimed at the microcomputer market. Both use Siemens printing mechanisms. PrintaColor uses the print mechanism from the Model 2712

in its TC1040 Color Ink Jet Printer. Advanced Color Technology (A.C.T.) uses the Siemens PT80i printing mechanism in its A.C.T. II Color Ink Jet Printer, the first in A.C.T.'s Chromajet series of printers. The TC1040 uses a nozzle configuration of two rows of six nozzles while the A.C.T. II uses three rows of four nozzles. Both printers use a basic 9 by 12 dot matrix and produce images at speeds of up to 270 cps. A 512 by 512 pixel image can be printed in 35 seconds on an A.C.T. II and in 60 seconds on a TC1040.

Both printers use three primary subtractive colors—cyan (green blue), yellow, and magenta (purple red)—to produce 125 basic shades and hundreds of color combinations (see Figures 4 and 5). The TC1040 has a resolution of 120 horizontal by 85 vertical dots per inch, and the A.C.T. II has a resolution of 140 horizontal by 85 vertical dots per inch. Both printers can be run with any graphics software available for the IBM PC, but they also come with device drivers to format and enhance output.

These color ink jet printers are much lower in price than their predecessors, which were usually linked to smart, dedicated graphics

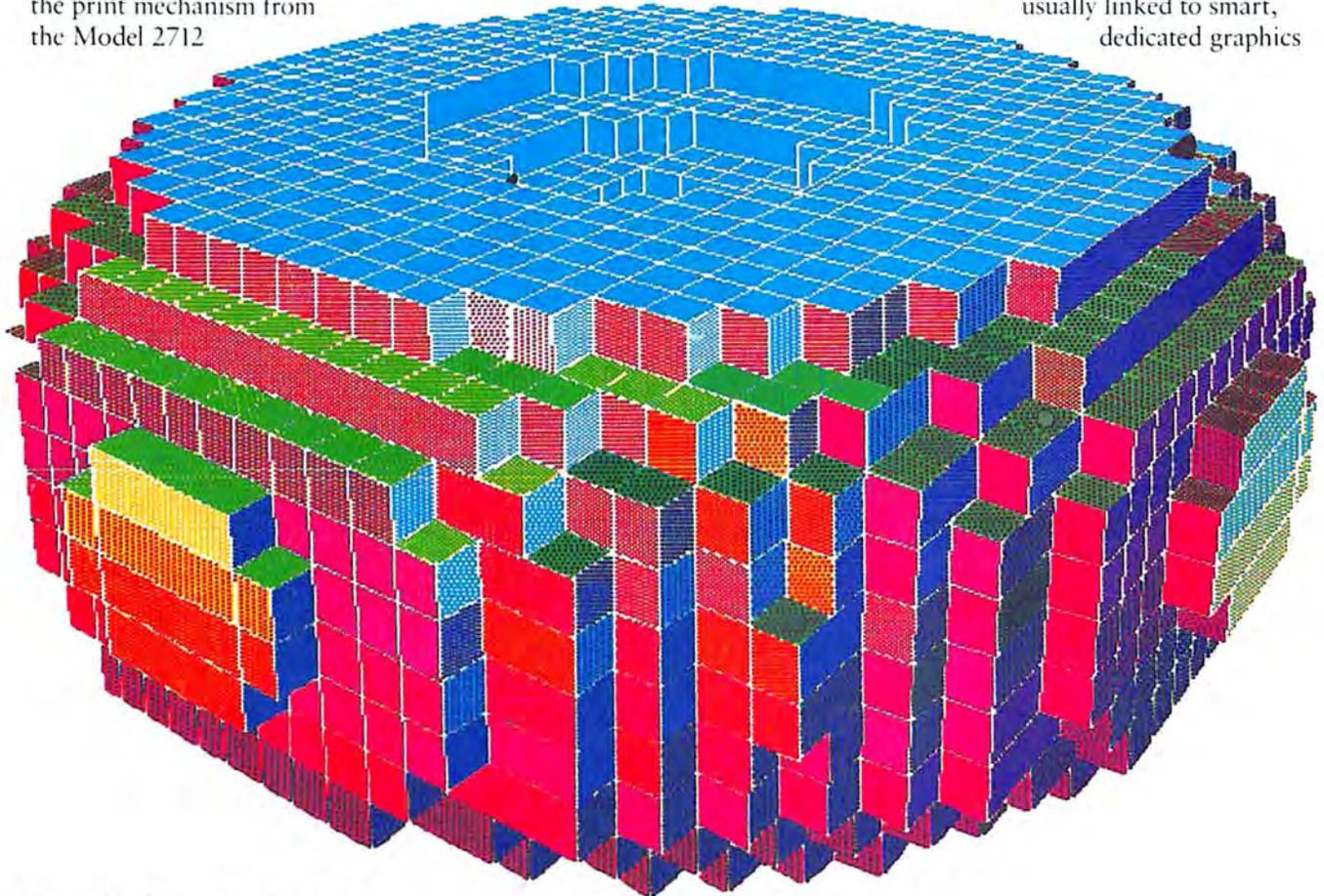


Figure 5: Color graphics with PrintaColor TC1040

terminals operating in the mainframe and minicomputer environments. Prices for these other color ink jet printers fall in the \$9000 to \$12,000 range, and they are not usually offered with a microcomputer interface.

Choosing any piece of computer hardware is a difficult task because *state of the art* is often a fleeting, if powerfully attractive, attribute in the rapidly changing world of microcomputers. We want better, cheaper, faster, smaller, and quieter. All those characteristics are now available in ink jet printers. If the ability to make multiple copies is a minor consideration for you while the ability to work near your equipment and think at the same time is major, maybe you should see what ink jet printing is like today. ☉

Janette Martin owns and operates an information processing company in San Francisco.

PT88-T2 Ink Jet Printer

Siemens Corporation
240 E. Palais Rd.
Anaheim, CA 92805
714/991-9700

List Price: parallel \$895, serial \$923
Requirements: 64K, one disk drive

Model 2712-M203 Ink Jet Printer

Siemens Corporation
240 E. Palais Rd.
Anaheim, CA 92805
714/991-9700

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Requirements: 64K, one disk drive

TC1040 Color Ink Jet Printer

PrintaColor
5965 Peachtree Corners E.
Norcross, GA 30071
404/448-2675

List Price: \$5495
Requirements: 64K, one disk drive,
color monitor, color graphics
board

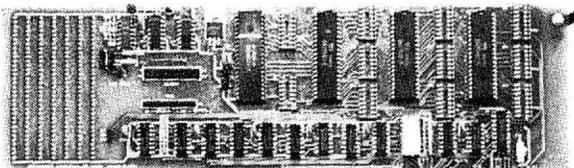
A.C.T. II Color Ink Jet Printer

Advanced Color Technology (A.C.T.)
21 Alpha Rd.
Chelmsford, MA 01824
617/256-1222

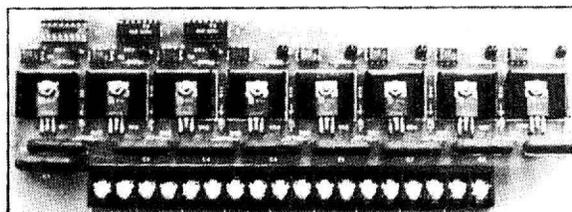
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Requirements: 64K, one disk drive,
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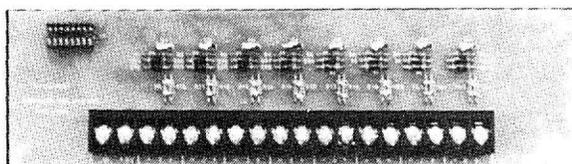
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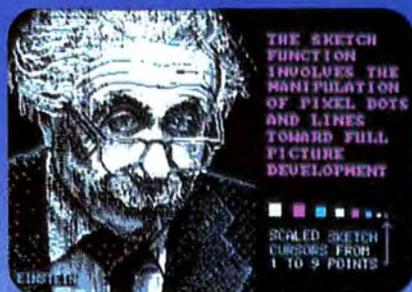
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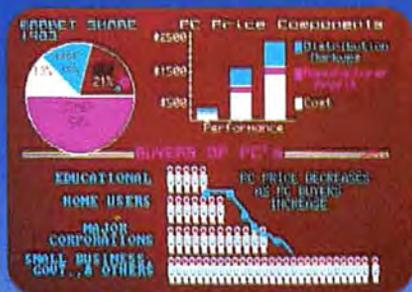
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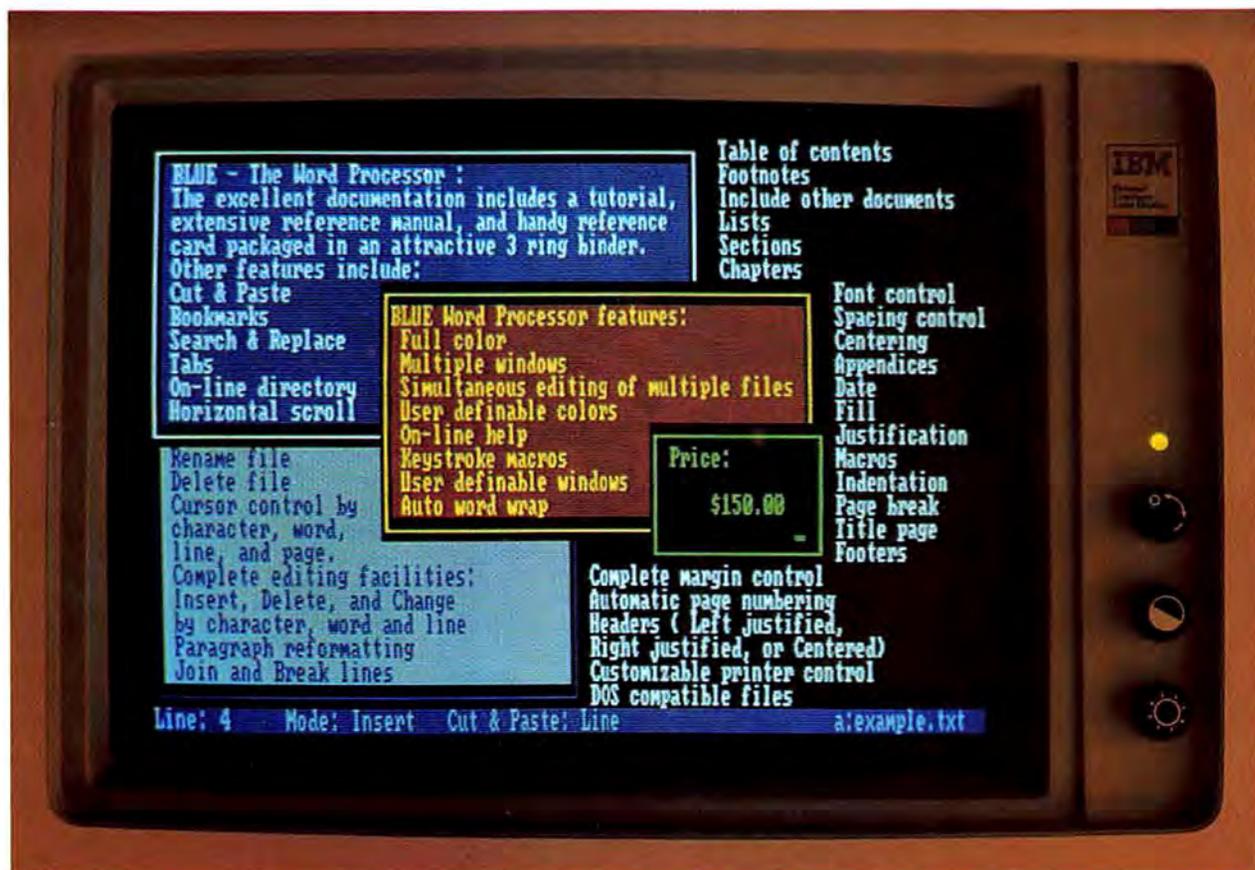
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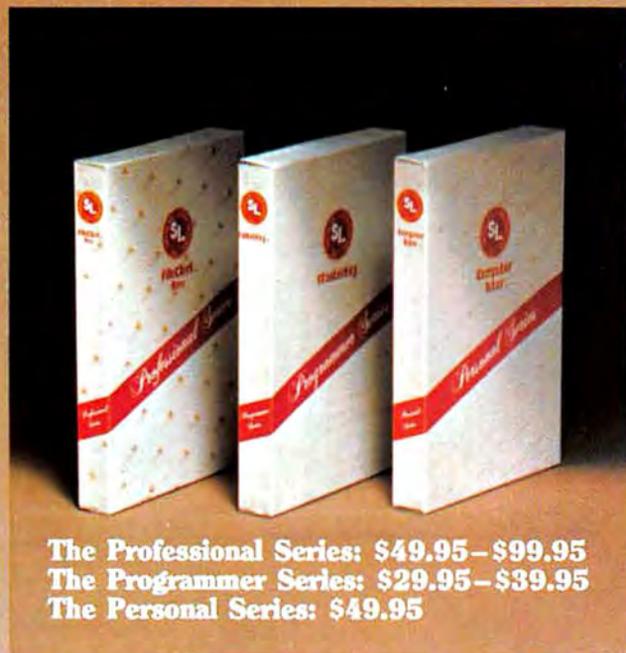
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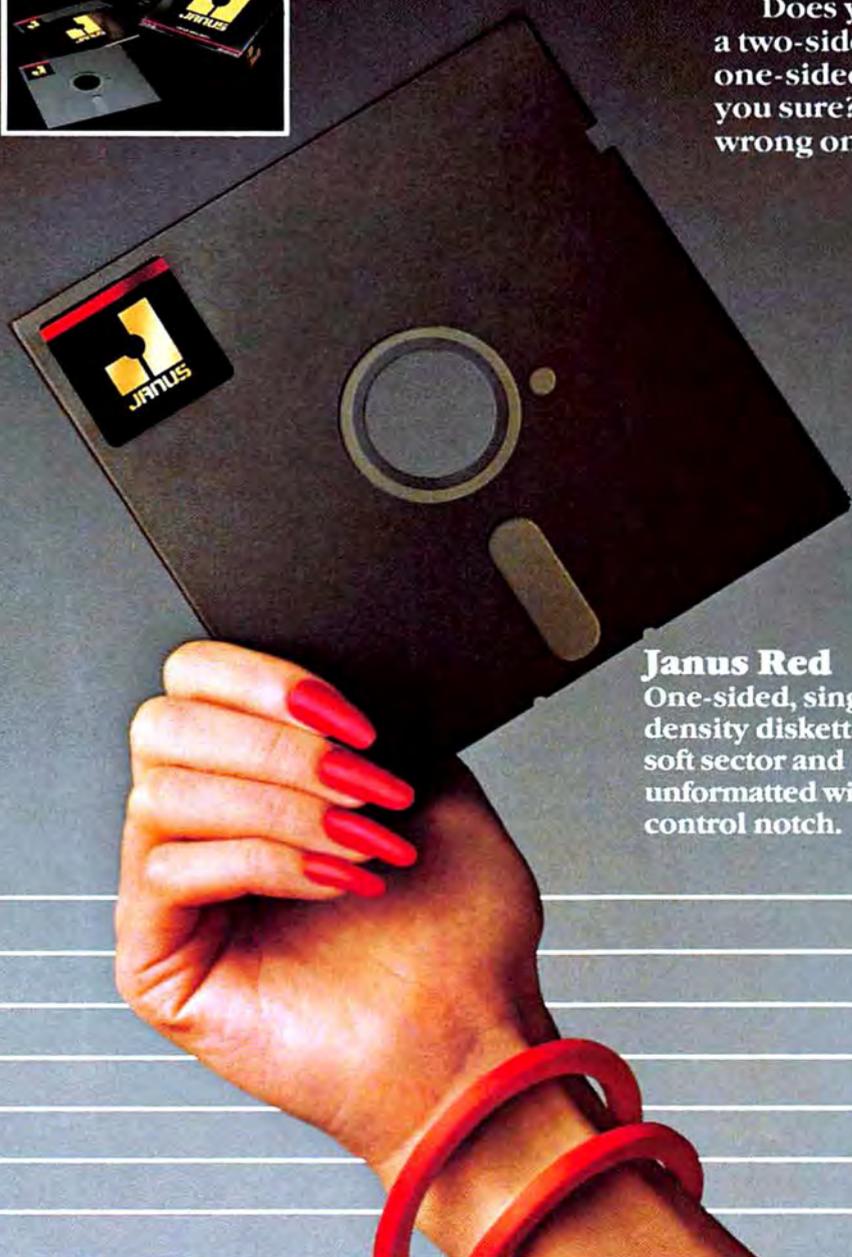
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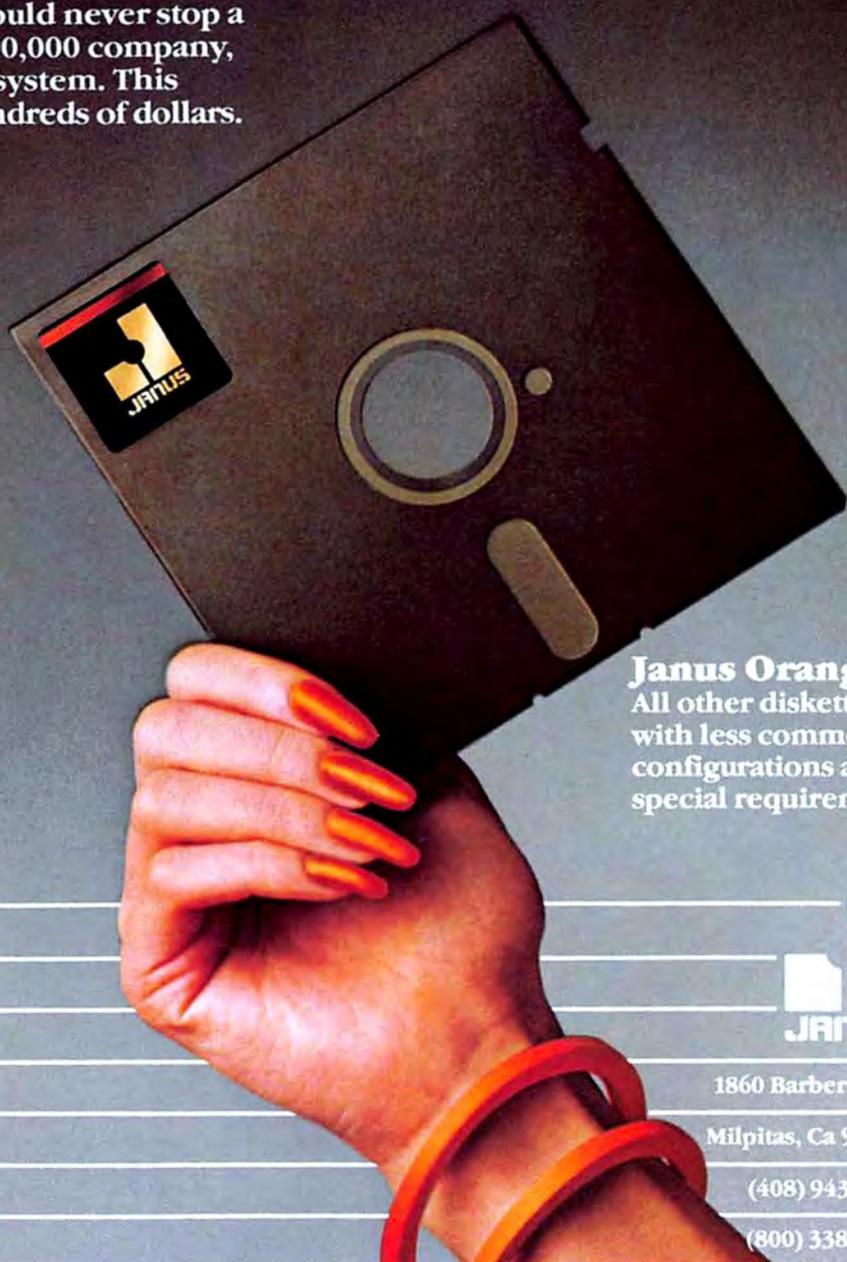
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- **Altos** 580-10, 586-10, 584-14, Series 5-15D
- **Billings** BC 12 FD
- **C. Itoh** Mini- (2s)
- **Columbia Data** 1600-1, 1600-4, VP Portable
- **Commodore** Super Pet, BX256 (Double Density)
- **Compal** 8200
- **Compaq** Portable Computer
- **Computhink** Mini Max I
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- **Eagle** Personal Computer
- **ECS Microsys.** ECS 4500
- **Fujitsu** Affinity 16
- **GNAT** System 10
- **Hewlett Packard** 8290-2
- **IBM** Personal Computer 320, 360 KB
- **IMS** Series 5000 (2S)
- **Info 2000** Performer
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- **Quay Corp.** 520
- **Qume** Datatrack 5

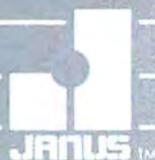
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- Findex
- Hazeltine MNM-5 400T
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- Lobo Horizon 1D, 2D Advantage
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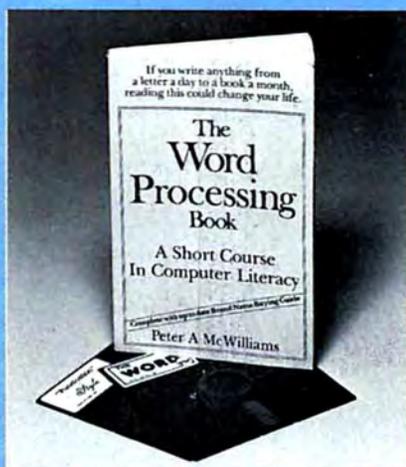
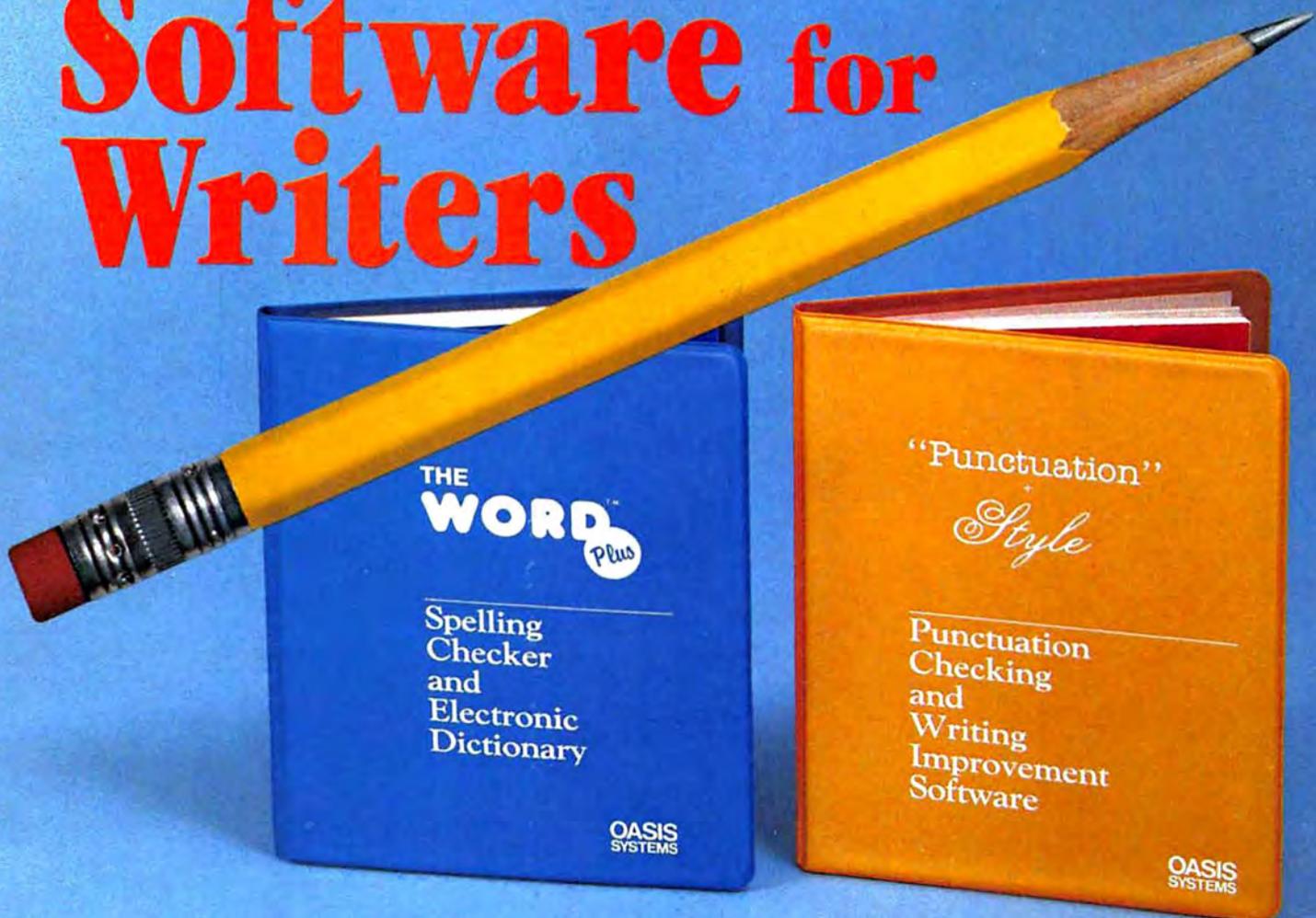
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Revenue:													
Components Div	100	115	135	150	215	260	325	430	540	645	750	955	4620
Micro Systems Div	10	20	40	80	120	165	240	325	430	535	630	750	3345
Industrial Sys. Div	25	25	50	75	100	130	160	190	225	250	300	350	1800
Total Revenue	135	160	225	305	435	555	725	945	1195	1430	1680	2055	9845
Cost of Sales:													
Components Div	80	90	100	110	135	165	210	245	350	405	525	605	3130
Micro Systems Div	15	15	20	40	55	75	100	140	185	230	300	335	1510
Industrial Sys. Div	25	35	35	50	75	100	125	150	175	200	225	275	1470
Total COS	120	140	155	200	265	340	435	535	710	915	1050	1295	6160
Operating Expenses:													
Components Div	100	125	150	170	190	200	200	200	205	200	205	190	2175
Micro Systems Div	75	85	95	100	105	105	110	110	115	115	120	120	1235
Industrial Sys. Div	50	65	75	90	105	100	100	105	110	105	100	100	1105
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A PC Spelling Bee

Find the computerized spelling checker that's right for you.

Jonathan Littman

A computerized spelling checker is no replacement for a friend, an editor, or another human proofreader. And no checker is capable of automatically correcting misspelled words without human assistance. What a spelling checker can do is locate misspellings, and in some programs help you spell the word correctly without the aid of a printed dictionary.

Spelling checkers work by matching the words in a file created by your word processor against their own dictionaries of correctly spelled words. When the spelling program finds a word in your file that isn't in its dictionary, it flags or marks the word as a mismatch and a possible misspelling. You can then enter your word processor and use the FIND command to locate the marked, mismatched words. If the words are misspelled, you key in the correct spellings.

Spelling checkers are limited. Until you add proper nouns and specific vocabulary to a program's dictionary, a spelling checker will be ignorant of your vocabulary. Once you have created this additional vocabulary, you will still have to confront

the inherent weaknesses of the spelling checker. While some have upwards of 100,000 words in their dictionaries, spelling checkers often do not include the plural or other forms of verbs or nouns. Some spelling checkers consider *run* correctly spelled, while *runs* is flagged as a mismatch.

A checker is not a proofreader. While programs mark mismatched words, they cannot catch a correctly spelled word used improperly. If you typed *your* but meant *you*, as far as the program is concerned "your are spelling just fine." It's best to run a document through a spelling checker first and then have it proofread for content, clarity, and punctuation. Used in this fashion, a spelling checker speeds the process of revision. Since proofreaders won't be burdened with typos and poor spelling, they are free to concentrate on what you've written.

The four major spelling checkers reviewed have surprising differences. All require 64K of RAM and most work with files created by *WordStar*, *EasyWriter 1.1*, *Volkswriter*, and the DOS editor, EDLIN. But beyond this, program logic, screen formatting, use (and quality) of prompts, and flagging and correcting misspelled words vary considerably from program to program.

Super Spellguard

Super Spellguard is a well-designed program supported by superb documentation. Like other spelling checkers, *Super Spellguard* compares the words in your documents with the words in its dictionaries. Any words that do not match are considered possible misspellings. *Super Spellguard's* advantage is that it proofreads your words faster than the other three spelling checkers reviewed.

Without confusing the novice *Super Spellguard* gives the advanced user the opportunity to create a "turnkey" system that anyone can use without training or documentation. *Super Spellguard* also allows for the creation of specialized dictionaries (legal, medical, etc.); these dictionaries can then be copyrighted and published.

A Sample Session

Typing SP will start *Super Spellguard* and bring up the main menu. *Super Spellguard* gives you two methods for selecting a menu option: pressing a mnemonic letter or a number. To use *Super Spellguard's* basic features, you need only understand these commands: 1 or P (Proof), 5 or ? (Help), and 6 or X (Exit).



● Review

Once the main menu comes up, press P or 1 to Proof spelling in a text file. What you see in Figure 1 is what will appear on the screen. *Super Spellguard* is saying that the dictionary it will use for proofreading is SP.DIC. This is the program's standard dictionary of 20,200 words. Later you can replace or supplement it with your own custom dictionary. You can do this by changing the initial instructions and altering the default tables. If you forget the name of a custom dictionary or a document you wish to proofread, you can get a directory of the disk on which they reside by indicating the appropriate disk drive.

After you select the appropriate dictionary, proofreading begins by typing the drive designation followed by the file name of the text you want proofread (e.g., A:LETTER.PC). A table (see Figure 2) of useful information about the words being processed appears at the top of the screen. Unlike most spelling checkers, *Super Spellguard* tells you what percentage of the proofing is done as well as the number and percentage of words unique in the document.

This second feature is more than a nicety. Certain documents, especially in education and the computer industry, are more understandable when the vocabulary is restricted.

When this initial proofreading process is complete, enter Word Review by pressing any key. In Word Review, each time a mismatched word appears you must decide how you want *Super Spellguard* to handle it. Generally, you will press M for "Mark incorrect word with symbol '[' in text file." When a mismatched word appears that is not misspelled, you must choose between A (Add Correct Word to Dictionary) and I (Ignore). When you encounter proper nouns (such as your name), technical terms, or other words specific to your writing, you will press A. The next time the dictionary is used, these words will be considered correctly

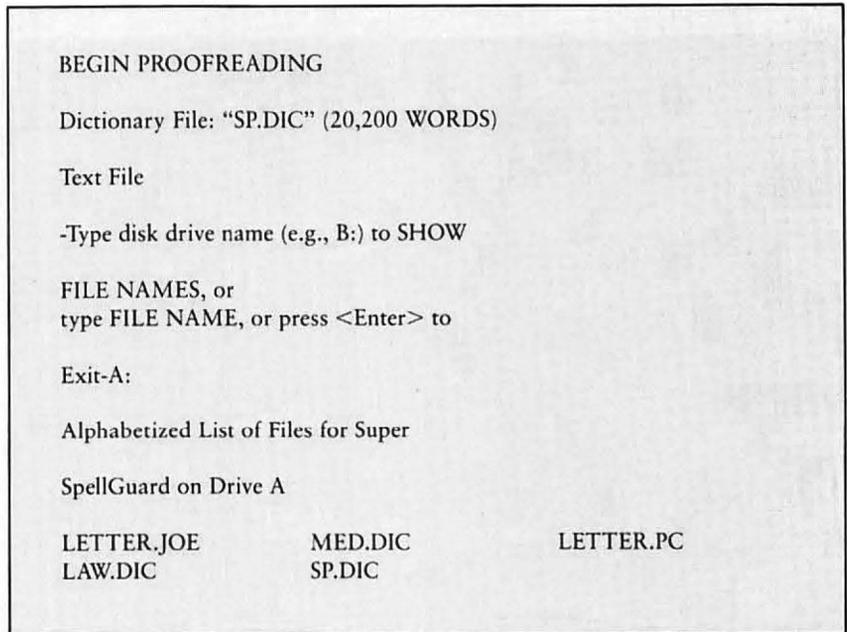


Figure 1: Super Spellguard's proofing menu

# Words read	# Words unique	% Words unique	# Words mismatch	% Words mismatch	% Proofing done
1,250	436	34.8%	21	4.8%	100.0%

Figure 2: Super Spellguard's sample screen

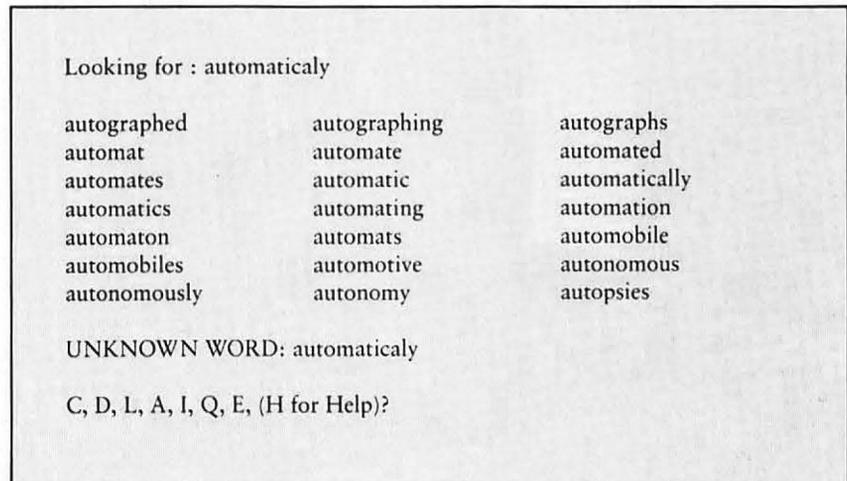


Figure 3: Random House ProofReader on-screen dictionary

spelled and the program will not list them as mismatched words.

Super Spellguard works on the theory that a smaller dictionary is better and faster. This is the secret of its speed. If you carefully monitor the words added to a dictionary, you will

preserve the speed and proofreading capabilities of the program.

Thus, when a document contains proper nouns or technical terms, you should select the I option. In this case the word will neither be flagged as a

possible misspelling nor added to the current dictionary. Until you develop a feel for adding or ignoring words, it is best to choose I. Later, if you have made a mistake, the program will provide a second chance for correction. Pressing 4 or R will return the previous word and give you a chance to reclassify the word.

After checking all the mismatched words in the document, exit *Super SpellGuard* and enter the word processor. Using the FIND command, you can jump to each word marked as misspelled with the special character '['. Necessary corrections can then be made.

Advanced Features

In this basic mode *Super Spellguard* can perform fast and effective proofreading. But *Super Spellguard* is capable of much more. Once you have mastered the basic use of *Super Spellguard*, you can begin to customize the program.

Super Spellguard is superior in creating custom dictionaries. Besides being able to list or delete words from dictionaries, you can create, copy, combine, and reorganize dictionaries. You can also subtract dictionaries from one another. This last feature allows you to subtract the words in one dictionary from those in another. *Super Spellguard* accommodates those wishing to sell the dictionaries that they have created. There is even room to "patch in" a copyright notice in bytes 12 to 105 of the program.

Super Spellguard allows you to alter the default tables. These not only determine which dictionary is used, but also which character is used to mark misspelled words. You have the additional option of preserving your original text in a backup file. You can adjust the default settings to your writing style and level of expertise. If the '[' symbol normally used to mark mismatched words appears often in your text, you can replace it with a

seldom-used symbol such as the ~ (tilde). Once you are well acquainted with the program, you may wish to advance from beginner to expert level, where you can skip and abbreviate some of the nonessential prompts.

Using a double-sided DOS 1.10 disk, *Super Spellguard* checked this article (about 35,000 characters) in only 40 seconds. The 2100-character sample letter included on the *Super Spellguard* disk took only 29 seconds to proof. But speed can be deceptive. Once *Super Spellguard* has proofread your document, you must then examine each word in the Review mode and reenter the word correctly. That means that the dictionary stays on your lap. When you have finished, there is no guarantee that the words you corrected will be properly spelled. If you pressed the wrong key, you may have replaced one misspelled word with another. When proofreading long or important documents, you actually need to run *Super Spellguard* twice.

ProofReader

The *Random House ProofReader* developed by Aspen Software does more than most spelling checkers. But those extra features do not compensate for a cumbersome and poorly documented program. The feature that may outweigh these weaknesses is the program's ability to copy your misspelled words into a file separate from your text. Then you can correct words in a two-line context. When you don't know the proper spelling of a word, you can look up similarly spelled words in an on-screen dictionary.

While the *ProofReader* is easy to start, the meager screen prompts make what the program is doing difficult to understand. After typing PRF B:FILENAME (assuming your file is on the disk in drive B), the program will record the number of words it has read until the entire document is read (about 30 seconds for a 3000-word



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Review

document). Then the message 'Sorting' will appear. When the program is finished sorting, the following message will appear:

```
Unique words: 50
Checking Dictionary
ABCDEFGHIJKLMNQRSTW
XYZ
```

The program will begin to check every word in your file against its master dictionary (depending on what version you have) of 32,000, 50,000, or 80,000 words. This process takes about two minutes and is not dependent on length of document. When the program is finished checking the master dictionary, it looks for an auxiliary dictionary called AUXDIC.TXT that has been created by the user. If it doesn't find AUXDIC.TXT, it asks you to enter the names of any auxiliary dictionary you want checked.

When all checking is complete, the *ProofReader* displays the following menu:

```
Select any Option:
C-Correct file SPELLER with Proof-Edit.
D-Display unknown words on screen.
E-Exit from ProofReader.
G-Grammatic: check file with GM.
P-Print unknown words on printer.
R-Review and edit unknown words.
S-Save unknown words in file SPELLER.BW.
```

Proofing Procedures

The procedure you follow will depend on your writing style and the number of errors you must correct. The easiest approach is to start with R (Review and edit unknown words). This option lists each word flagged as a mismatch and asks you if it is correct. Common errors are seldom-used names or technical terms that need not be added to the master dictionary. The fastest way to proof them is to press Y (Correct). This op-

tion tells the program that the word is spelled correctly but should not be added to the dictionary. If you're not sure if a word is spelled correctly or if you wish to add a correctly spelled word to the dictionary, press N.

Reviewing your words before correcting the file simplifies the rest of the proofreading process. Press C, and the program will automatically take you into the Proof-Edit program. The initial correction menu gives you three ways to correct a file. You can mark the unknown words in a file with '#' in much the same way as in *Super Spellguard*. You can also use the *WordStar* mode, which marks the line if the correction changed the width. Both of these methods require that at some point you reenter *WordStar*, which limits the *ProofReader's* ability to check quickly and conveniently. Lastly, you can correct in context and eliminate the need to reenter your word processor.

Interactive mode C allows you to correct your errors in context in a file separate from your word processor. Proof-Edit looks for the first possible misspelling in your file. The mismatched word will be clearly marked in a two-line context. The same word will also appear below the context, and you will be asked to "Correct a Word" (C), "Accept a Word" (A), or "Learn a Word" (L). "Learn a Word" adds the word to the auxiliary dictionary, PREFDIC.TXT. You can add as many words as you want to the auxiliary dictionary, but when it contains more than 300 words, it will begin to slow down the *ProofReader's* operations.

If the document is short or you prefer to skip the Review process, you may occasionally wish to "Accept a Word" (A). This functions like "Correct" (Y) in Word Review. The word will no longer be considered mismatched, nor will it be added to the current dictionary.

You will no doubt be pleased with "Dictionary Help" (D) if basic spelling is a problem. Pressing <Enter> lists the 21 words closest in spelling to your attempt (see Figure 3). If your

spelling is way off, you can try entering another spelling that may be closer to the word you are seeking. If you know the first two or three letters, you can usually figure out the correct spelling from the sample listing.

Strengths and Weaknesses

Unlike most spelling checkers, the *Random House ProofReader* is based on the *Random House Dictionary*—not on a dictionary compiled by a software firm. Random House was careful to include plurals of nouns and conjugate verb forms. This prevents most of the unnecessary mismatches that often occur on other checkers when they encounter plural nouns. The program also monitors your corrections. After you have figured out how to spell each word, press C to enter the correct spelling. If you make a typo, the program will warn you and ask for a new spelling. If the word is spelled correctly but is not in the dictionary, you can select A (Accept that spelling and continue). This feature makes the Random House checker nearly foolproof, eliminating the second proofreadings that other programs often require.

The *Random House ProofReader's* strengths are offset by some major problems. Once you enter the program, there is no turning back. Finding help in the middle of the program usually yields the next prompt. If you attempt to correct a mistake made in the reviewing or the correcting process, the keyboard will sometimes freeze up. The only solution is to exit, reboot, and start all over again. The corrections made are, of course, lost.

Despite additional limitations of unintelligible screen prompts and inferior documentation, the *Random House ProofReader* is a formidable spelling checker. Correcting words in a two-line context, with the aid of an on-screen dictionary, is as close to automatic as any spelling checker gets.

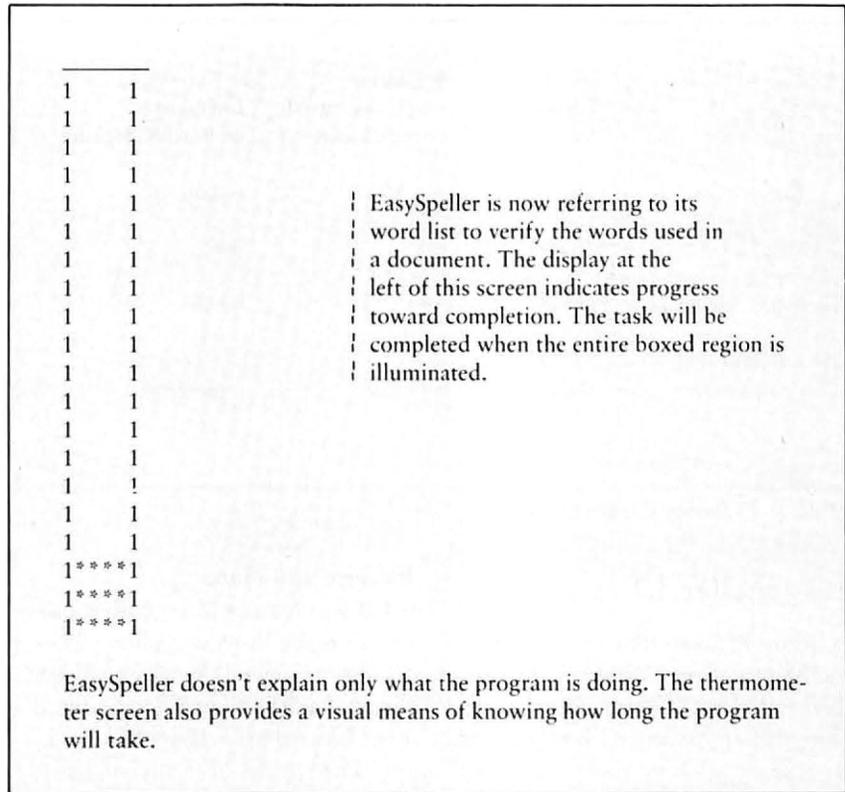


Figure 4: EasySpeller's thermometer screen

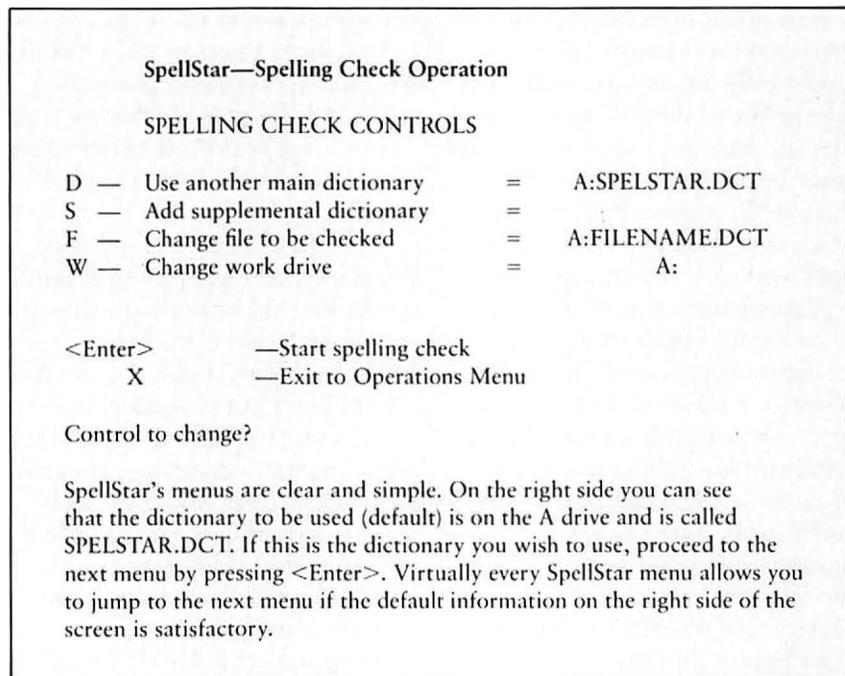


Figure 5: SpellStar spelling check screen

	Dictionary Size	Estimated Checking Speed (words/second)	Interactive or Batch Checking	In Context Checking	Memory Required	Drives Required
<i>EasySpeller 1.1</i>	88,710	40-80	interactive	yes	64K	2
<i>SpellStar 3.30</i>	20,000	80 +	batch	no	64K	2
<i>Super Spellguard</i>	20,000	300	batch	no	64K	2
<i>Random House ProofReader</i>	32,000 50,000 80,000	80 +	interactive	yes	64K	2

Table 1: Features Comparison

EasySpeller 1.1

Combining innovative programming and helpful screen prompts, *EasySpeller* is effective and easy to use. The program works with many word processors (such as *Volkswriter* and *EasyWriter* but not *WordStar*), any ASCII file, and EDLIN, the DOS editor.

EasySpeller makes correcting your spelling errors a game. The *EasySpeller* program and dictionary files take up the whole disk, so your work files will have to be in the other drive. Start the program by typing SPELL. *EasySpeller* automatically displays a neatly boxed directory of the files on your work disk and then asks you to type in the file you want checked. Then the fun begins. A big thermometer appears on the left of the screen (see Figure 4). The temperature rises as *EasySpeller* checks your document for spelling errors. This gives you a visual idea of how long a coffee break you can take. If the document is over a few pages in length, the message "LARGE DOCUMENT - intermediate pass of the Lexicon" will appear, informing you that the temperature is going to rise more than once.

Tortoise and Hare

What this feature hides is that *EasySpeller* is the slowest spelling checker of those reviewed. *Super Spellguard* checked a 5000-word document almost faster than *EasySpeller* did a 500-word letter. You can often end up watching thermometers rise for several minutes. If *EasySpeller* is a tortoise in reading and checking your documents, it may be the hare in correcting them. Using an 88,710-word dictionary, *EasySpeller* generally marks only mismatches that are truly misspelled. The process of correcting them becomes enjoyable as well as efficient.

Once the thermometer has filled, you can check your spelling in context or have the errors marked with a special character in an almost batchlike process. Later, you can use a word processor to make necessary corrections. The latter is useful if you are at an intermediate stage in editing a document. Since you may still be making text changes, you can edit the file and correct your spelling at the same time, thereby integrating the two processes.

When you are ready for a final copy, you will probably prefer to correct the mismatches *EasySpeller* has found in context. Pressing Y in response to the "Correct in Context" prompt brings up the *EasySpeller* Work Screen, consisting of a menu

and rectangular window through which a ribbon of text moves. Each mismatched word appears in inverse video as part of the ribbon of text. There are two methods of correcting a word. The easiest way is retyping the word correctly and pressing the key until the old misspelling is completely gobbled up. If you are still not sure whether the word is spelled correctly, you can press <Enter>, which jumps the cursor back to the first character in the word. If you press <F1> (Verify from the cursor), the spelling of your replacement word will be checked. You can also correct words by changing only the incorrect letters.

Special Features

The menu is well organized; it takes advantage of the special function keys to perform all the various options. Two of the more interesting features are tied to the <F2> key, which "undoes" your current attempt (in case you really foul things up), and the <F8> key, which will replace any misspelling you have made throughout the document. If you come upon a word that you have misspelled before, *EasySpeller* remembers the word and displays the former corrected spelling under the word. You can accept this suggested

correction by pressing <F5>. You can also add a word to the custom lexicon or exit at any time. If you decide to abort (using the <F7> key) you can log all the changes you have made so far. Whenever you exit or complete a session, you will be given a listing of all of the special utility programs on *EasySpeller*.

EasySpeller allows you to create custom lexicons that include not only words, but even phrases such as *read-only*. You can also create a log file that allows you to see all the corrections made during a spell check. This file includes the name of the document, the line number of the questioned word, the original spelling of the word, and the corrected spelling. When a document has been corrected, the new corrected file takes on the file name .TXT, while the original file is saved with .BAK. Unlike other spelling checkers, the *EasySpeller* disk is copy protected. This means that backup disks (at \$15 a copy) must be purchased. If by some chance the program disk proves defective or becomes damaged within 90 days of purchase, a free replacement is available.

The size of *EasySpeller's* dictionary (88,710 words, reputedly one of the largest on the market) makes the program slow in reading and finding mismatched words. However, the time you spend correcting properly spelled but unrecognized words will be greatly reduced.

SpellStar 3.30

The latest *SpellStar* version is much like the new *WordStar*, both of which are produced by MicroPro. A few new features make the program easier to use, and the documentation is vastly improved, but overall little has changed. *SpellStar* remains an unexceptional spelling checker.

SpellStar's advantage is tied to its limitations. It only works with *WordStar*, but it does so with a minimum of headaches. You start *SpellStar* by typing S from the *WordStar* menu.

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Review

You may need to insert a separate disk that contains the spelling dictionary. If the document you are checking has over 1000 unique words, *SpellStar* will create a separate file for all those words. If you have small-capacity disks (under 240K) or typically check long documents, it is wise to keep your spelling dictionaries on a separate disk. Although a three-disk system is clumsy, the manual and on-screen prompts make it easy to know when to put in and take out the disks.

Look but Don't Touch

SpellStar is virtually automatic in its basic mode of operation. If you wish to take a normal path through *SpellStar*, you need only press <Enter> (see Figure 5). When the spelling check has been completed, you can see what errors you have made by pressing L for "List the Misspelled Words." You can look, but you can-

not touch. *SpellStar* does not give you the option of deciding which words to flag. All mismatches are flagged in a batch process started by pressing <Enter>. If you have made a mistake and want to try again, press R for "Abandon the Check and Restart."

SpellStar is moderately fast. Checking a 35,000-character file took 53 seconds, and flagging the 151 errors found in that file took 47 seconds. When I reentered the file in *WordStar*, however, it took 20 minutes to check all the words the program flagged as misspelled.

Out of the 151 words, only 5 were actually misspelled. Spending 20 minutes to correct five mistakes does not make a good case for computer efficiency. Although any spelling checker with a small dictionary might have this problem, I found the following more than a little ironic:
ADD TO DICTIONARY: MISSPELLING (Y/N)

Of course, once you add words like *misspelling* to your dictionary, they won't be misspelled.

Despite its faults *SpellStar's* easy-to-follow screen prompts and manual make it simple to master. The manual contains diagrams that show the possible paths through *SpellStar*. Advanced features such as the creation and maintenance of dictionaries are easy to enjoy. If you use *WordStar* and desire no more than a dependable spelling checker, *SpellStar* won't provide any surprises.

The Checker for You

Choosing among these four spelling checkers is simpler than you might imagine (see Table 1). If you spell poorly or don't like opening dictionaries, you will want the convenience of the *Random House ProofReader's* on-screen dictionary. If you are in a hurry, spell reasonably well, or don't mind using a dictionary, *Super Spellguard* is a logical choice. If you enjoy appearances, *EasySpeller 1.1's* attractive screen design and user-friendly

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programming can make a game out of checking your spelling. Finally, if you use *WordStar* and don't want to be troubled with deciding, *SpellStar* is a conservative but dependable choice.

If you buy a spelling checker, remember to use it. During the course of writing this article, I had spelling checkers coming out of my ears. Yet I sent out 30 form letters without running them through any of the spelling checkers. One letter that had been incorrectly addressed was returned to me the following week. I congratulated myself on how professional it looked. I had even remembered to sign it. My spelling was impeccable until the last line.

Snicerly,
Jonathan Littman

Jonathan Littman is a freelance writer who is working on a book about IBM PC communications. He also conducts training seminars on WordStar and develops educational software.

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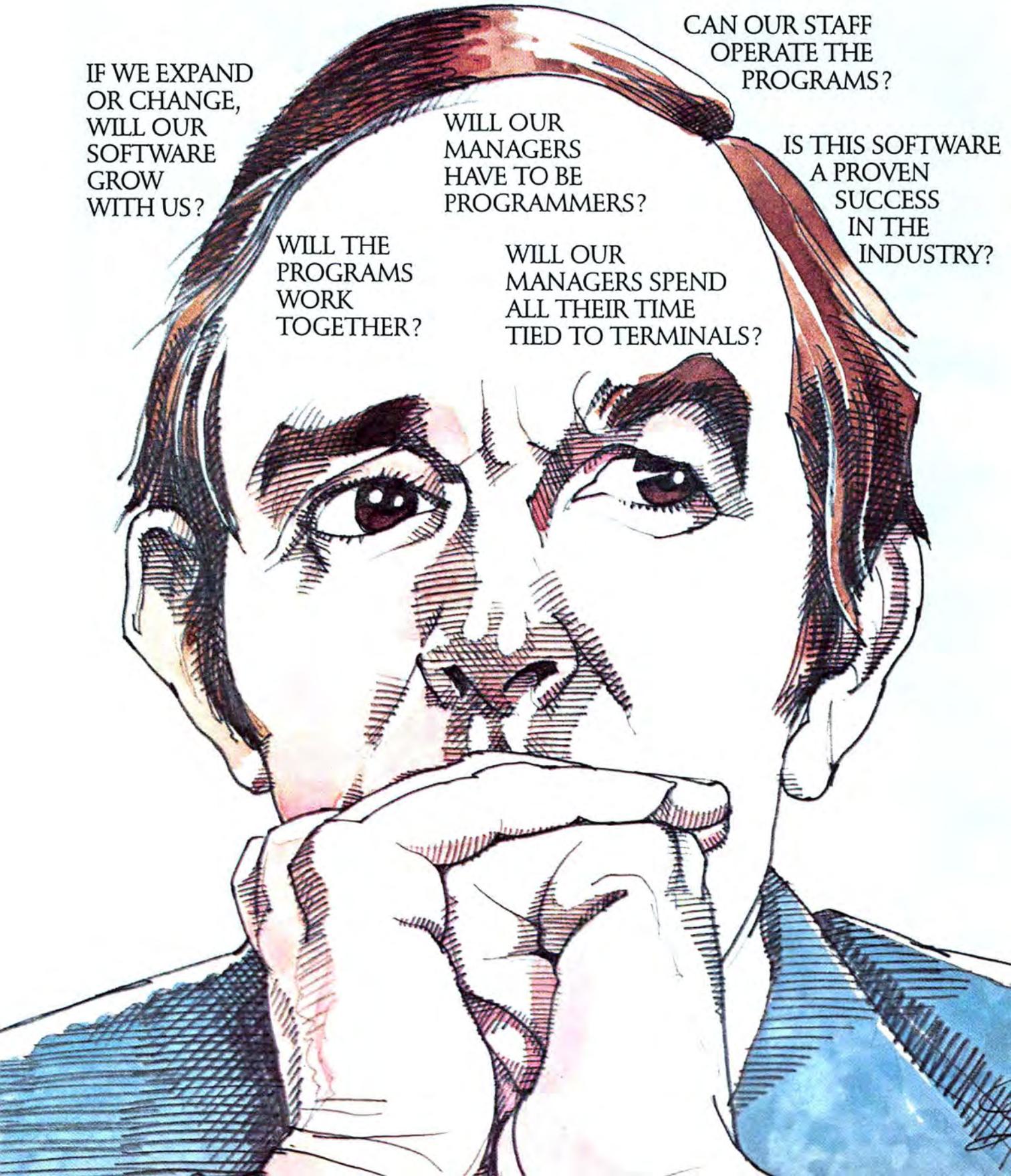
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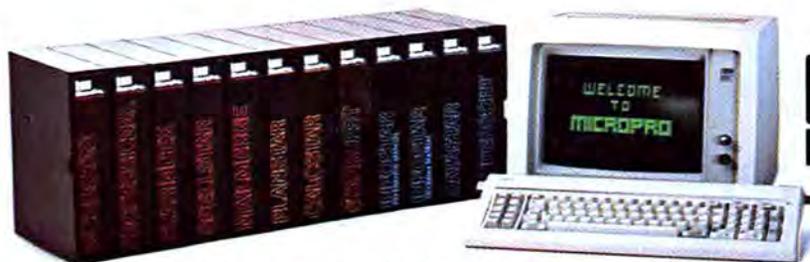
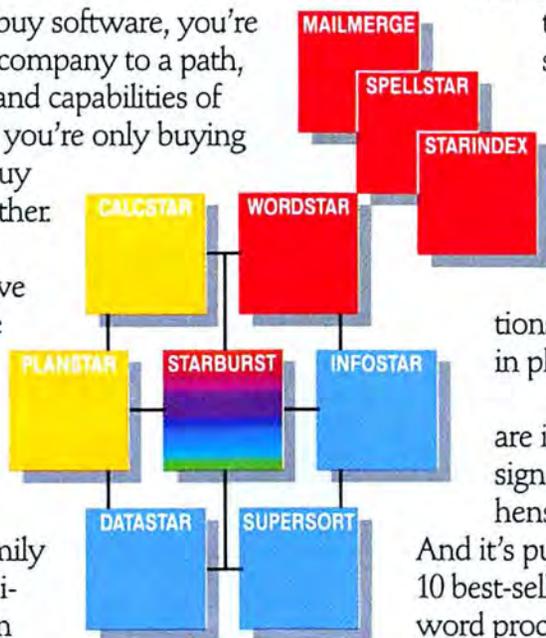
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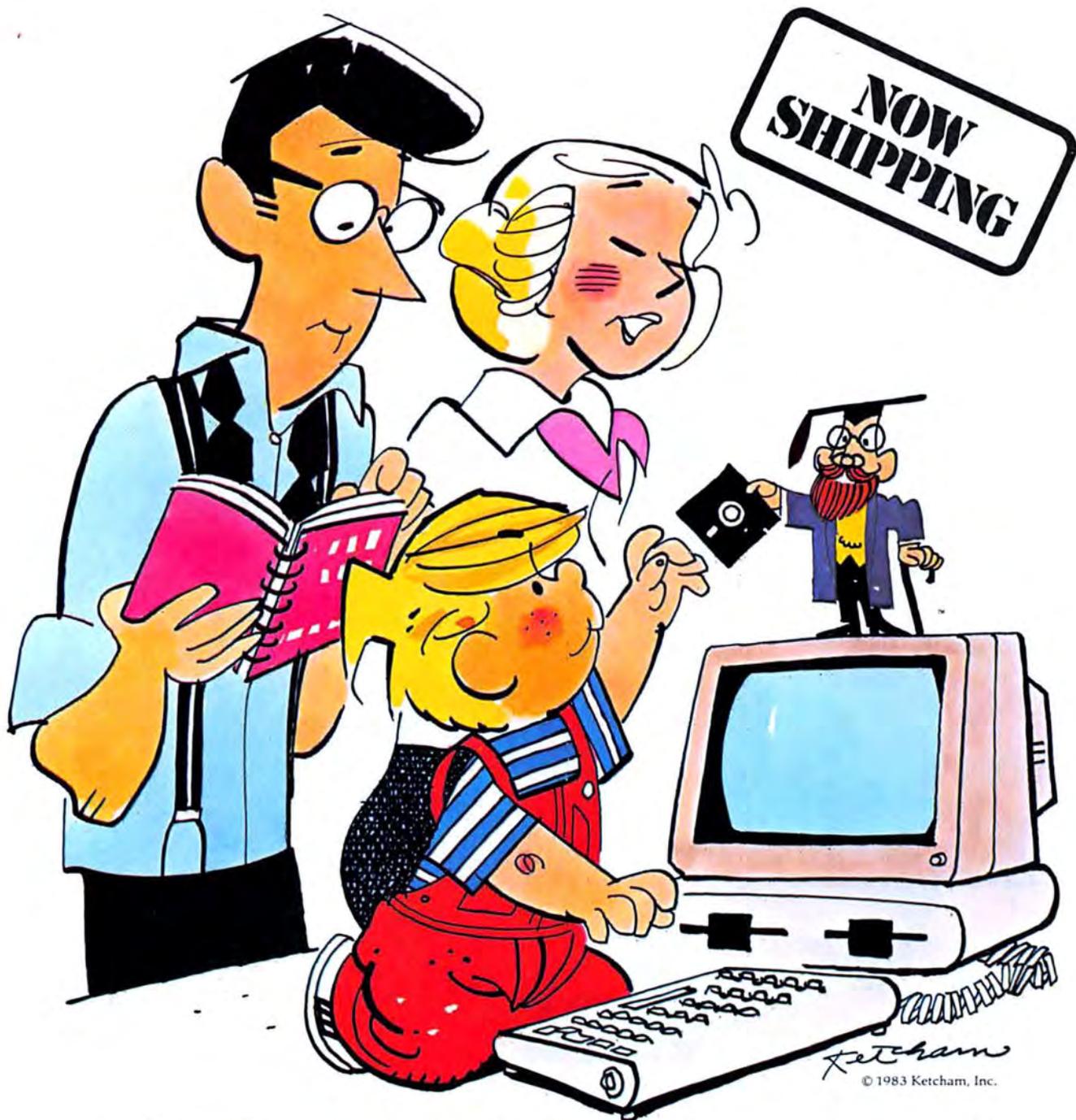
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HELENA ON CREATIVITY.

Name: Helena Paoli
Age: 9
Home: Belvedere, California
School: Bel Aire
Hobbies: Drawing, playing with
dolls, reading, swimming
Ambition: To be a fashion designer
Favorite
software: Creature Creator™
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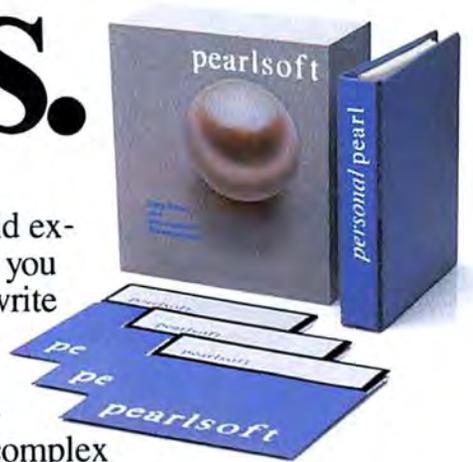
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In Search of the Hypothetical Zeus

Nelson Johnson

Imagine a hypothetically perfect display board—a board that can display text and graphics on a monochrome or color monitor with complete software transparency. This hypothetical board doesn't yet exist, but Hercules' Graphics Card, Orchid's Monochrome Graphics Adapter, and Tecmar's Graphics Master stack up against the ideal board with varying degrees of success.

You bought your IBM PC to do word processing, but now you want to perform more sophisticated tasks. You want to be able to write a report and include a chart to illustrate graphically what a table of numbers represents. And you want to do this without cutting and pasting graphics produced by another program on the report originals.

The IBM Monochrome Display Adapter doesn't have graphics capabilities. If, however, you have some capital to spend (after the initial shock caused by the cost of your computer wears off), you should look into a monochrome/graphics expansion board. This type of board allows you to use the IBM PC monochrome monitor to display graphics—not in color, of course—with higher addressable resolution than the monochrome monitor alone provides.

Before we take a look at some of the existing boards, let's examine an imaginary product, the Hypothetical Zeus (HZ) board, which would contain a set of ideal features for the PC user. Then let's compare the HZ board to what the market has to offer.

The HZ board was carefully designed over a period of a year and a half, commencing with the announcement of the IBM PC. Its developers realized that they would lose money by not striking while the iron was hot, but they felt that a rational design solution was impossible in the heat of the moment.

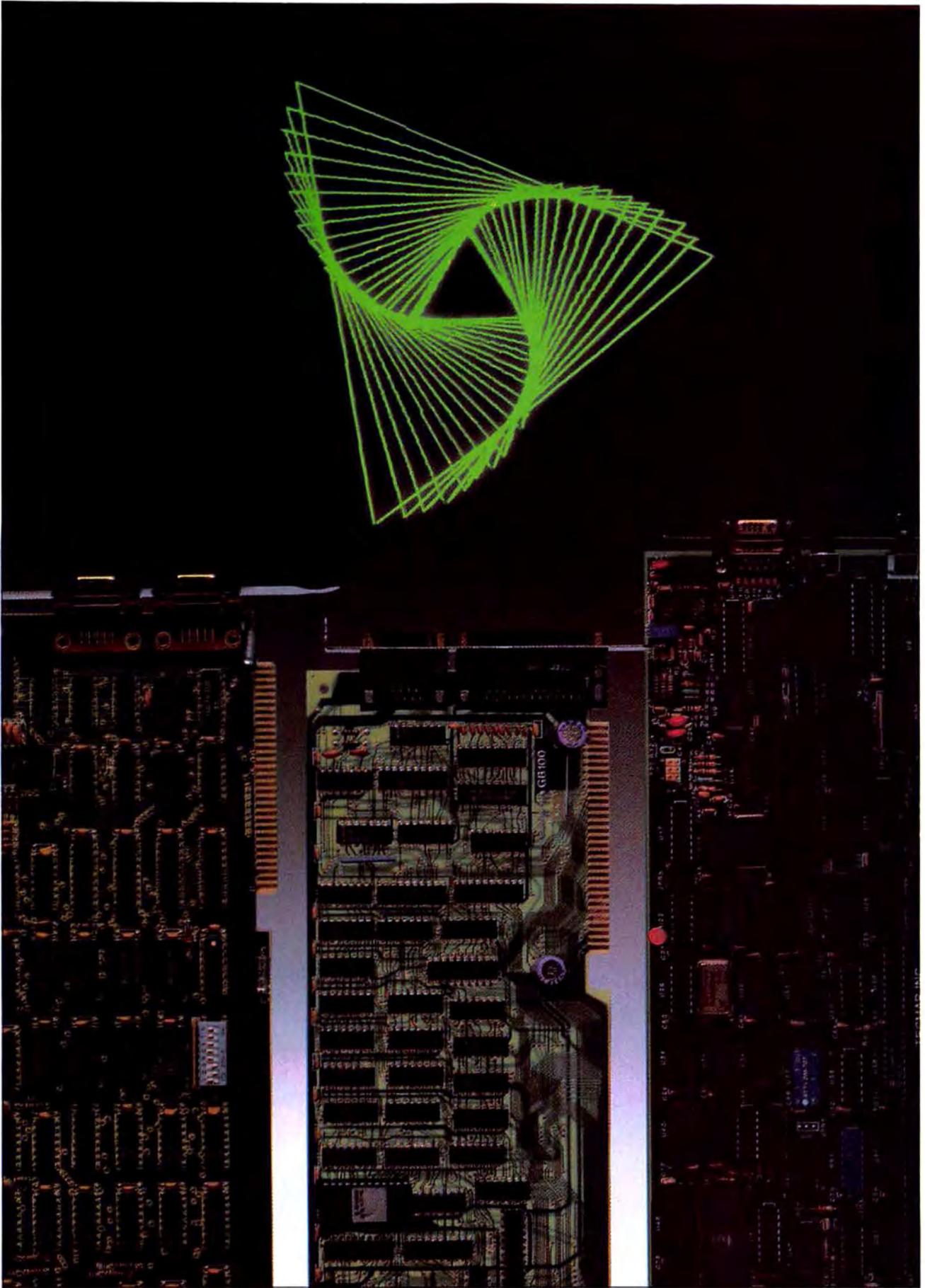
Hardware production differs from software production in a significant way. Software can be modified even while it is being sold and used, but hardware needs to be prototyped and completely debugged in advance of production. When the order is placed for a run of 1000 pieces, the design for the most part is engraved in silicon and solder. There is no going back.

The HZ board specifications finally evolved after an extensive study of user wish lists. The prospective user wanted the following features:

- The board should be able to run all PC software, even software designed for use with the IBM Color/Graphics Display Adapter.
- The board should be transparent to BASICA so that you can use it without changing the way you write programs.

The Hercules Graphics Card substitutes for the IBM board and takes up one expansion slot.

- You should be able to leave the board installed in the machine no matter what other boards are installed.
 - The board shouldn't take up more than one expansion slot.
 - The installation and support instructions should be clear to the inexperienced user.
- The result of this research was a combined text and graphics board that occupied one slot on the expansion strip, allowed any combination of graphics and text to appear on the



Review

monochrome display, and could display text and graphics directed to the Color/Graphics Adapter. In addition, the board didn't interfere with the operation of any expansion board that might be plugged into the expansion strip concurrently.

Unfortunately, the HZ is still on the hypothetical drawing board.

At present, Hercules Computer Technology and Orchid Technology offer popular alternatives that add graphics capability to the monochrome display. These expansion boards, similar in outward appearance to any other board, plug into the row of edge connectors near the left-rear corner of the PC motherboard.

A third board, Tecmar's Graphics Master, combines color graphics and monochrome functions on the same board. Although the board won't drive both monitor types concurrently, it is a step toward the HZ board.

Hercules' Graphics Card

The Hercules Graphics Card not only looks like the IBM Monochrome Display Adapter, it actually substitutes for the IBM board and takes up one expansion slot. If the purchaser already has a Monochrome Adapter, it will need to be relegated to the elephants' graveyard or sold.

The installation procedure for the Hercules board is identical to that for the Monochrome Adapter. The documentation is brief and easy to follow, although the novice will need to pick up some knowledge of memory mapping terminology to understand it fully.

So far the Hercules board stacks up well against our HZ, but this is where the comparison breaks down. The Hercules board won't work if you plug it into a PC in which a Color/Graphics Adapter is installed.

Hercules recognizes this problem and will furnish you with instructions to cut a trace or two on its board and on the Color/Graphics Adapter to make the two boards compatible. (A *trace* is a metallic electrical conductor attached to the surface of the printed circuit board.) Cutting the trace involves using a knife or another sharp implement to sever the conductor at the appropriate location on the board so that it no longer conducts electrical current. Future versions of the Hercules board will probably allow switch selection of display memory so that the portion of memory now shared with IBM color graphics display memory (the cause of the problem) will not overlap.

To run the Hercules board and make use of graphics you need to use a modified version of BASIC known as HBASIC. HBASIC is implemented by running HBASIC.EXE, which loads BASICA.COM, changes it as necessary, and then transfers control to BASICA. It is possible to use HBASIC and get a full set of BASIC functions. The screen refresh rate seems to be slower in the interpreter while you are editing, a problem that makes scrolling take longer.

When you compile programs for the Hercules board, you need to use an instruction set that is not shared with HBASIC. Compiling is done using the BASIC Compiler and normal BASICA along with a library of graphics subroutines, INT10 and GRAPHIX, which are available separately from Hercules as part of the *Graph X* software package. The *Graph X* manual notes that you can use BLOAD to load BAS2GRPH.BIN as part of your BASICA program and run the same code in both interpreted and compiled form.

One of the more attractive advantages of BASICA, especially for graphics programming (which involves considerable trial and error at times), is its ability to test a program without having to compile it. According to the *Graph X* manual, this feature is available if the graphics

functions are not loaded at locations that overlap space occupied by the compiled program. INT10.EXE needs to be resident as a DOS overlay for GRAPHIX calls to work.

When you are switching from graphics to text modes, the board does some strange things. GRAPHIX commands, specifically GMODE (which turns on graphics from a compiled program) and TMODE (which turns on text), cause the screen to go blank for a moment before it displays text or graphics. At

To run the Hercules board and make use of graphics you need to use a modified version of BASIC known as HBASIC.

first text is a little out of focus and slightly smaller than normal size. Also the display bobs up and down for a moment before stabilizing. When the computer is processing between changes in the display, an annoying snow effect occurs that consists of black dots flickering across the image on the screen. In comparison to the Monochrome Adapter performing the same tasks and using the same software, the Hercules board produces a less stable display.

The bobbing effect could be fixed by using a time delay to allow time for the screen to stabilize before displaying text. Some people are not bothered by the snow effect; if this is the case, you can't beat the price for the board, and it does offer an advantage over the strictly textual capabilities of the Monochrome Adapter.

The super-spreadsheet program 1-2-3 by Lotus Development has been

transported to the Hercules board, which makes the features of that program available at higher resolution than is possible using the Color/Graphics Adapter. Because *1-2-3* uses two pages of display memory, you cannot run it if you have a color graphics board installed.

Using the Hercules board you can't run software that directs its output to the Color/Graphics Adapter. Microsoft's *Flight Simulator*, for example, cannot run with the Hercules board because it requires use of the Color/Graphics Adapter. Also the Hercules board does not intercept color graphics instructions and convert them to graphics on the monochrome display.

Orchid's Monochrome Adapter

Orchid's Monochrome Graphics Adapter supplements the IBM Monochrome Adapter, and takes up one additional slot. At least you won't have to discard the Monochrome Adapter. Whereas the Hercules adapter has problems with snow and bobbing, the Orchid board has all the stable characteristics of the Monochrome Adapter, which is a strong point in favor of the Orchid. The board generates a comfortable display for text editing in addition to graphics on the monochrome display.

Installation of the Orchid board is a more elaborate and delicate procedure than that of the Hercules board. After the Orchid board is plugged in, a wire must be installed that links the Orchid board and the Monochrome Adapter. The wire is attached to the end of a chip using a pressure clip. The installation manual states that this connection can be soldered on for better contact. Of course, if you are constantly plugging in boards and pulling them out, you will find this connection particularly troublesome, but not much more so than if you needed to unplug a light pen.



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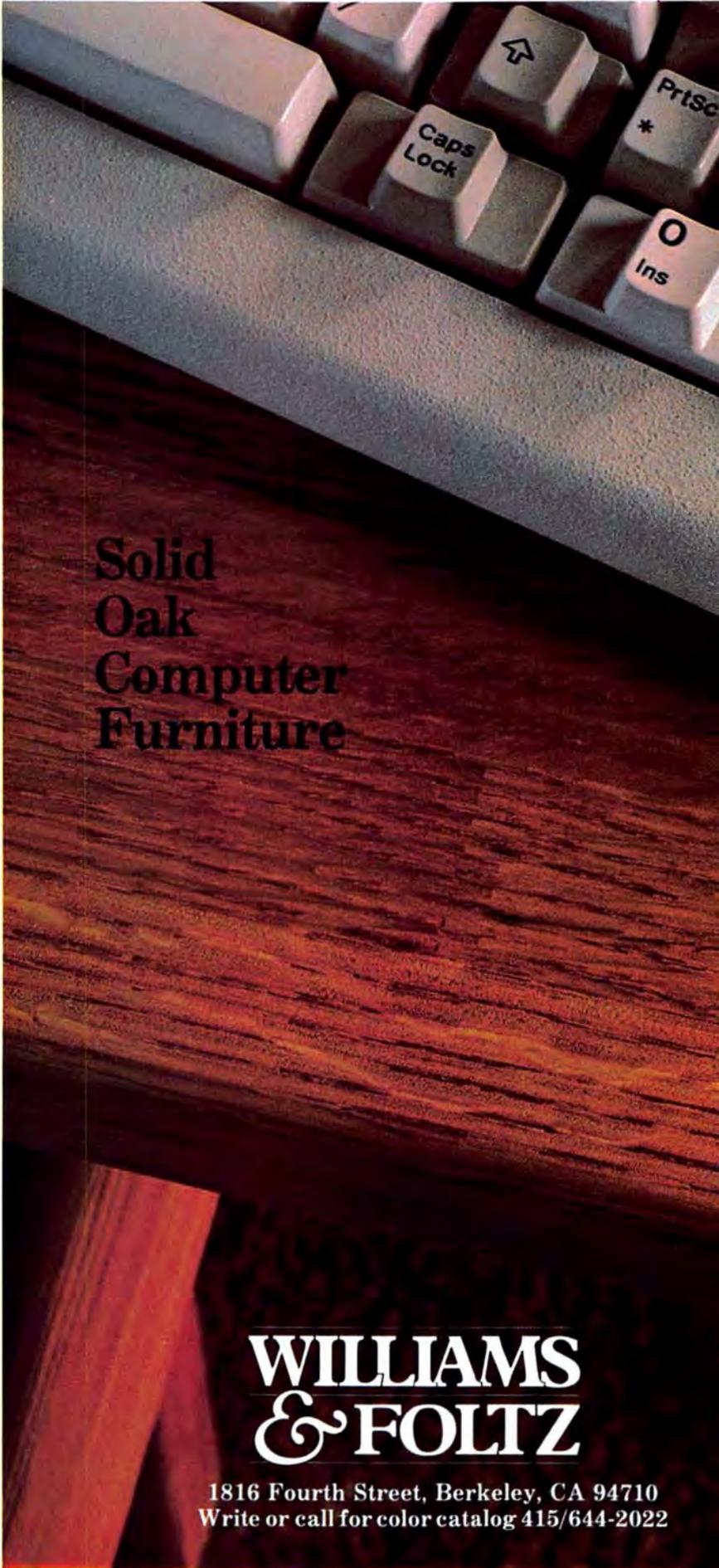
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In addition to the single wire that must pass from board to board, you will need to install a short cable (which is provided with the Orchid board) between the parallel port on the Monochrome Adapter and an appropriate connector on the Orchid board. This procedure is fairly straightforward and not as objectionable as installing the single fragile wire. One distinct advantage of using the Orchid board is that it doesn't interfere with the operation of the Color/Graphics Adapter. Unfortunately, a precious expansion slot needs to be sacrificed in the bargain.

The same limitations that apply to the Hercules board with regard to running graphics software designed for the Color/Graphics Adapter apply to the Orchid board. What both boards seem to offer is an expanded display buffer. Neither board goes far enough with firmware to create a useful, universal display device.

Supporting software for the Orchid board has the advantage of being compatible with the *Halo* graphics applications development tool, which brings a powerful graphics instruction set to the PC. *Halo*, developed by Media Cybernetics, has been around for some time and represents a standard in graphics programming languages. Using *Halo* can be an exciting experience, especially when you draw your first circle using Interpreted BASIC and the HALO.BIN set of subroutines. Suddenly the monochrome display does things you didn't think it could do. *Halo* gives you a powerful library of area fills, hatching patterns, line types, and text modes. You can type text at all angles, upside down, and backward. Characters can be displayed at different sizes. An integrated graphics word processor is definitely feasible and could be easily implemented using this set of subroutines.

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One of the best aspects of the Orchid board is the complete compatibility of *Halo* with BASICA and the BASIC Compiler. *Halo* provides a collection of graphics subroutines that enables programmers to implement sophisticated computer-generated graphics displays.

Another feature of *Halo* on the Orchid board (as compared with *Graph X* on the Hercules board) is the compatibility that exists between the instruction set, which can be executed in Interpreted BASIC, and the

The super-spreadsheet program 1-2-3 by Lotus Development has been transported to the Hercules board.

instructions used in Compiled BASIC. This means that *Halo* subroutines can be easily tested in the interpreter before they are compiled. *Halo* is more powerful and rich in functions than *Graph X* or the HBASIC overlay used by the Hercules board. In fact, the graphics functions of *Halo* are much more powerful than those of BASICA.

The instructions provided with the Orchid board are more detailed but not as well organized as the Hercules documentation. More work needs to be done on the documentation of both boards to make the described functions easy for the novice to understand. The manuals appear to have been written by technicians who have had little experience communicating at the layperson level. This orientation is typical of documentation for hardware options in the industry. The boards were designed especially for use by technically oriented people who are willing to delve into memory maps and other

esoterica. To the credit of Orchid, however, its documentation of the *Halo* software is quite readable and useful. The revised documentation for *Graph X* from Hercules is much improved from earlier versions.

Tecmar's Graphics Master

A more recent arrival to the volatile world of graphics boards is the Graphics Master from Tecmar. This expansion board comes closest to satisfying the specifications for the Hypothetical Zeus, at least to the extent that its many advertised capabilities could be tested.

The board design is based on making as much memory as possible available for use by the 6845 CRT controller. The 6845 is the same microchip used in both IBM's Monochrome Adapter and Color/Graphics Adapter. It is also used in the Orchid and Hercules boards. The 6845 has been criticized by graphics connoisseurs because it was originally intended to be used for the display of text and needs some complex programming to function adequately for graphics purposes.

Tecmar has produced an extremely powerful board in the Graphics Master. To give you an idea of what it can do, imagine one board that can be used either as a color graphics board or as a monochrome display board. Imagine being able to run almost any software on the market for the PC by simply flipping a switch and plugging in the appropriate monitor. The Graphics Master is a flexible board that can be expected to have a variety of software products developed for it.

The Graphics Master can be programmed to have many combinations of display resolutions, including 720 by 400 pixels and 4 colors, and 640 by 400 pixels and 16 colors. The board can easily be programmed to display 20 combinations of resolution

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and color on either the monochrome (black and white only) or color graphics display. Although testing all 20 would require some prodigious programming, the default modes work quite well, and the demonstrations available with the board show what can be done.

Alphanumeric (text) can be produced in eight combinations, including 80 columns by 50 rows of characters on either the monochrome or color graphics displays. Using the Tecmar board for a monochrome display produced a clean display identical to that produced by the Monochrome Adapter. In color mode the range of colors was breathtaking. The graphics demonstration revealed Tecmar's unusual graphics programming technique to be quite effective, although area fills took quite a bit longer than with BASICA. Graphics Master can produce graphics that approach but do not equal the capabilities of *Halo*. Its graphics options are far superior to those of BASICA or *Graph X*.

If you don't want to program the board, you can select combinations of jumpers that will allow you to use an external switch to change from one monitor type to another. Jumpers are tiny plastic objects containing metallic connectors that fit over pins on the board. As such, they qualify as inexpensive switches that permit you to select paths for signals on the board. You must be absolutely certain that the switch setting corresponds to the proper monitor; if you set the switch to its color graphics setting and plug in a monochrome display, you will hear a high-pitched squeal, and the monochrome display will be damaged. This fact is explained in splendid technical prose in the complex, but complete, installation manual.

One problem exists with a small toggle switch on the board that changes the setting from monochrome to color display. When you are removing or inserting the board, this switch can be accidentally activated by catching on the edge of the opening in back of the PC. Unless you check the switch before turning the machine on, you could end up in hot water.

If you want to program the board in detail, the user guide is thorough and informative. It extends the information available in the *IBM Personal Computer Technical Reference* manual and fills in some gaps that have made the 6845's programming

PC-Mate allows applications programs to open the graphics display device as an output device no matter what graphics mode is desired.

modes a mystery for many. The Graphics Master software support manual is not complete enough, however. It contains no clear explanation on running the demonstrations and is inaccurate about at least one jumper position.

Making the full capabilities of the 6845 available to users and programmers is not the only virtue of the Graphics Master. The Graphics Master's support software, *PC-Mate*, has the capability of emulating a terminal. *PC-Mate* allows applications programs to open the graphics display device as an output device no matter what graphics mode is desired. This means that the screen resolution can be set up independently, and standard escape sequences can

be sent from any type of software as long as the terminal emulator overlay resides in DOS. The overlay can be installed easily, and since it becomes a part of DOS itself, it doesn't require the use of an install program each time the board is powered up before graphics commands can be used.

Because the Tecmar board has so many possible configurations, testing them all for the purpose of any review is unfeasible. Tests were done using existing software running in both the standard monochrome mode and the standard color graphics mode. An additional test was done using Tecmar's terminal emulator overlay GM.SYS to send out various escape sequences. The board functioned with no noticeable difference between it and either IBM's Monochrome Adapter or Color/Graphics Adapter when programmed to emulate these devices.

PC-Mate is similar to *Halo* in that it is callable from BASIC or from a compiled program, except that it in-

volves the use of a DOS-resident device driver and thus will work either for interpreted or compiled programs without the use of compile-time libraries. One fundamental shortcoming of other techniques such as the use of OUTs to ports, run-time libraries, or compile-time libraries is the difficulty of selecting graphics modes. Part of the power of the terminal emulator technique is its ability to extend the BASICA COLOR statement and SCREEN functions. Using escape codes, the programmer can send out sequences that select display resolutions and color options. Escape sequences are combinations of characters beginning with the ASCII ESC character. This character is number 27 in the ASCII sequence and can be sent, for example, from BASIC using a statement such as
`PRINT#1,CHR$(27);"A";`
 Using *PC-Mate* this sequence moves the text cursor "up" in any display mode as long as a device is opened with the statement
`OPEN "GM" FOR OUTPUT AS #1`

It is difficult to find much that could be improved regarding Tecmar's design; still, we have yet to see anyone manufacture a board that enables users to display existing software designed to work with the Color/Graphics Adapter on the monochrome display. Neither Orchid nor Hercules has solved this problem. Tecmar's board, perhaps because it is so programmable, might allow for a programming solution to this problem, but the solution, if it exists, is not presented in Tecmar's documentation.

Tecmar's Graphics Master will initially receive much more interest from OEMs than end users. If the board becomes popular (its price may be the only barrier), software developers will be able to exercise more control over display resolution, color, and display type without concern for the target market. Hindsight is 20/20 of course, but if 64K RAM chips had been available in 1981, this board might have been produced by IBM. The result would have been a

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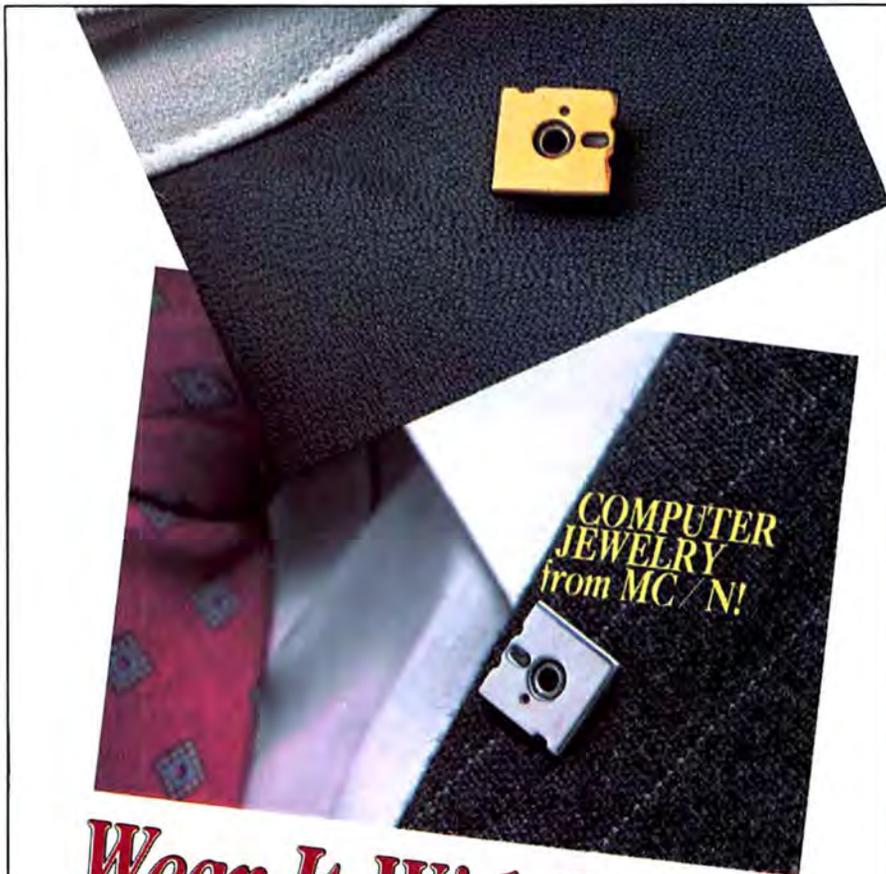
Reviews

more powerful and universal PC equipped with an even richer selection of compatible software. Instead, our only choice is to buy one board or another because it runs this or that software.

Every Myth Has a Message

The usefulness of a given computer expansion option is governed by complex forces, many of which are economic in nature. For example, a powerful feature of the Hercules board is that it occupies only one expansion slot on the motherboard. This means that if a user wants to buy several IBM PCs or compatibles and install a board that provides both graphics and monochrome capabilities, the overall cost of the installation can be reduced, at some sacrifice to the quality of the monochrome display. In the case of the Orchid board, the need to buy both the Monochrome Adapter and the Orchid board may dissuade buyers from making such a purchase. The Tecmar board does an excellent job of supplying universally desirable characteristics in this respect, although the price is somewhat higher. Of the three board designs, Tecmar's stands the best chance of becoming the universal display board for the PC, assuming that software becomes available to exercise all its options. If the availability of powerful graphics functions is desired, on the other hand, the Orchid board affords powerful monochrome graphics command capabilities.

The use of a light pen is impossible using the monochrome display, so both the Orchid and Hercules boards are unable to interface with this sometimes valuable option. The Tecmar board interfaces with the standard color graphics monitor type, so it allows the use of a light pen, although the resolution of the pen is 8 by 2 pixels. A pen interface that allowed 1 by 1 pixel resolution would be an improvement.



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In case you missed the point of the introduction, you can't buy a Hypothetical Zeus board—it doesn't exist. The HZ was "designed" for this article to illustrate a very important point: the need for transparency in the design of hardware for the personal computer. "Transparency" in this context means the ability of the hardware device to accept standard color graphics software instructions. Both the Hercules and Orchid boards lack this fundamental transparency and are plagued by the need for software and hardware fixes. The Tecmar solution is more universally applicable, but it would benefit from programming or firmware that would allow software intended for use with a color graphics board to be used with the monochrome display.

Keeping the cost down and providing a perfect mixture of text and graphics is not easily done. The PC's design manifests the limitations

placed upon function by the cost of hardware. As the cost of RAM goes down and screen resolution is improved, we can anticipate the day when text and graphics will be more naturally combined. Perhaps we will see the Hypothetical Zeus someday. ☉

Nelson Johnson, AIA, is an architect/engineer who has an extensive computer science background. He wrote a three-dimensional and two-dimensional professional design system called MicroCAD and is currently writing a book on microcomputer-aided design to be published by Prentice-Hall.

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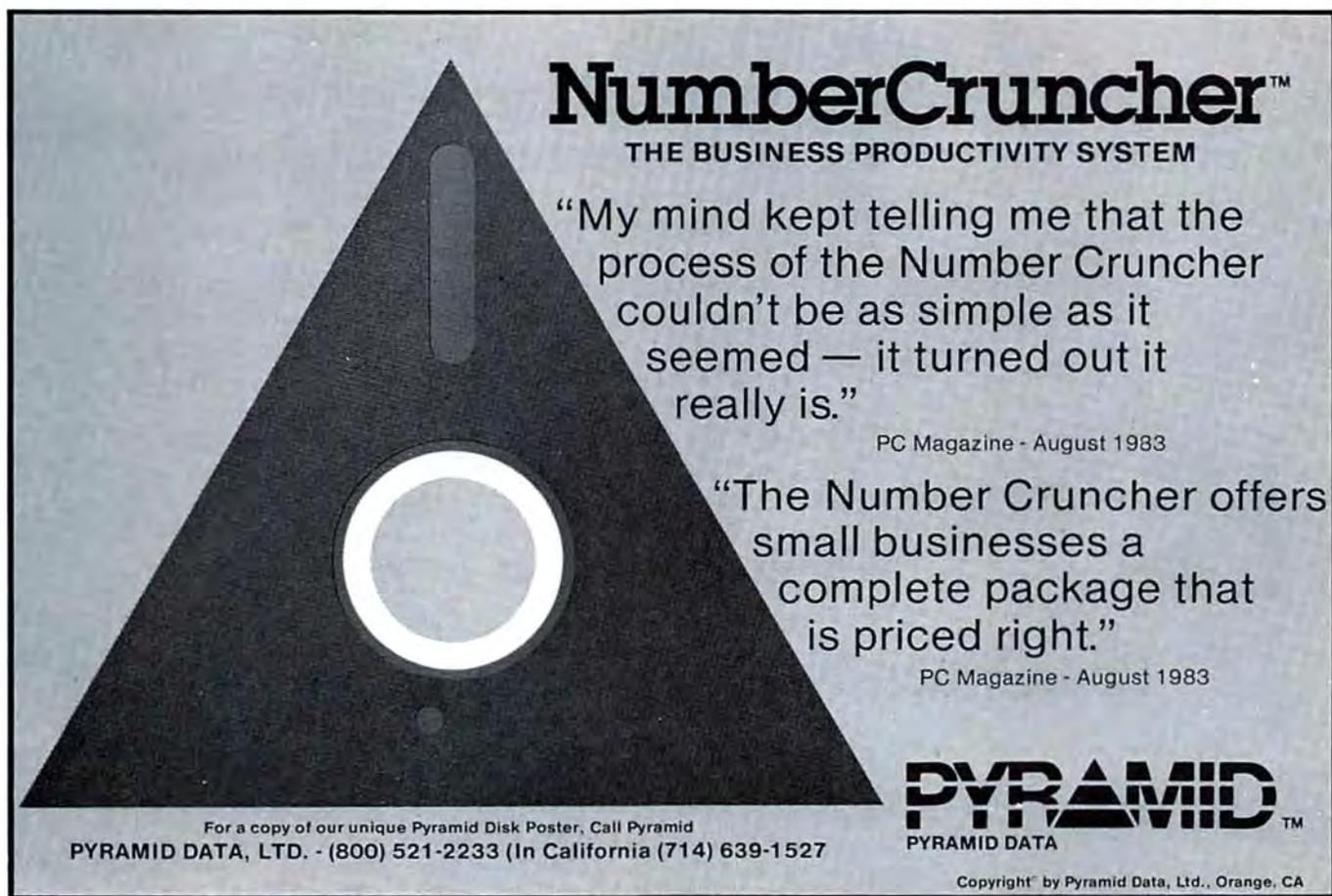
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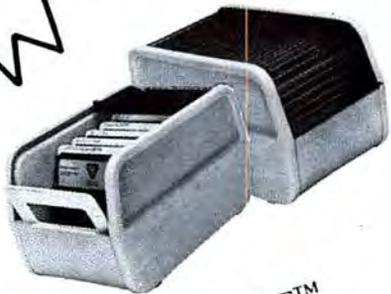


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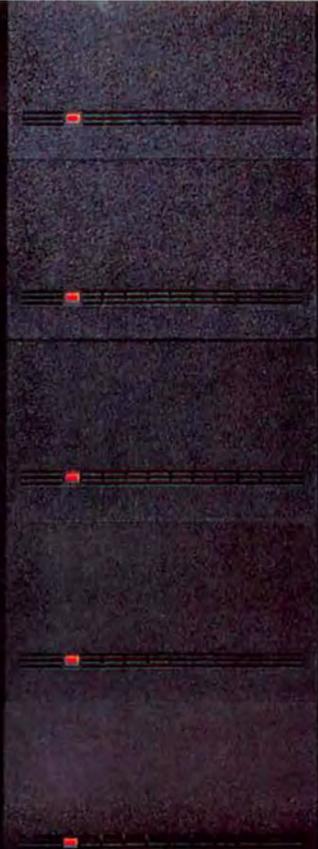
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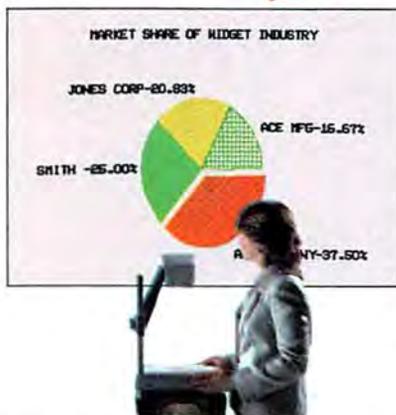
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dBASE II V2.4

Ashton-Tate's update of dBASE II is quicker and less bug-ridden, but it's still a long way from tapping the PC's potential.

David Jenkins

In the world of personal computer data management programs *dBASE II* is the undisputed king. But although kings are powerful, they tend to be less than innovative. Such is the case with version 2.4 of Ashton-Tate's ever popular *dBASE II*.

dBASE II was originally created for 8-bit CP/M computers. While version 2.4 acknowledges some PC features, little in it uses the PC's 16-bit power.

Some of 2.4's new features are quite useful. Extensive on-screen help prompts are included for the first time—a valuable aid for both beginning and advanced *dBASE II* users. The function keys on the PC are also fully utilized and are outfitted with standard *dBASE II* commands. Otherwise, the package enhances existing features or corrects program bugs of the earlier versions (see “It Stands Corrected”). 2.4 is more powerful and flexible but is essentially unchanged.

2.4 consists of three disks and a user manual. The program files, a help file, and an install program are on one disk. A second disk contains a demonstration program, and a third disk has sample files and programs. (Note: if you own *dBASE II* 2.3, you can buy the updated version from Ashton-Tate for \$75.)

File Changes

For the most part, enhancements to 2.4 are compatible with earlier *dBASE II* versions. However, changes in program files will affect single-sided disk users. In place of *DBASE.COM* and its 11 overlay files of the earlier versions are three files: *DBASE.COM*, *DBASEOVR.COM*,

2.4 is more powerful and flexible but is essentially unchanged.

and *DBASEMSG.TXT*. The size of the files has grown from 64K to 70K with the exception of the new *HELP* text.

One minor problem is the use of *MEM* files, which save memory variables. Because of enhancements to the *SAVE* command, 2.3 cannot read 2.4 *MEM* files and vice versa. If this is an inconvenience, the variables from a 2.3 file must be reentered manually.

Function Keys

The good news for IBM PC users is that the function keys can now be accessed directly in 2.4. When you enter the program, the function keys are preset to:

<F1> HELP
<F2> DISPLAY
<F3> LIST
<F4> LIST FILES;
<F5> LIST STRU
<F6> LIST STAT
<F7> LIST MEMO
<F8> CREATE
<F9> APPEND
<F10> EDIT

The function keys can also be redefined for commands or parts of commands. For example, *SET <F10> TO "BROWSE;"* will execute the browse instruction every time <F10> is pressed.

Colors Coordinated

In 2.3, inverse video is limited to black letters against a green background. 2.4 allows you to specify foreground and background colors (with the *SET COLOR TO* command) and also replace inverse video

Review

with underlining or flashing characters as a normal display. If you key in a lot of data, you may find that underlining is easier on your eyes.

Help

For anyone but the most experienced *dBASE II* programmer, the help screens included in 2.4 are a god-send. If you can't remember the exact way to phrase a command or don't have time to thumb through the manual, HELP is a fast and accurate command that gets the information you need. If you type HELP (or <F1>), a one-line description of each *dBASE II* command will be displayed.

Typing HELP followed by a specific command from the *dBASE II* prompt elicits a lengthy description of the command and its syntax.

The help screens are:

UTILITIES
FULL SCREEN
NEW
ERRORS
GLOSSARY
EXAMPLES
FUNCTION
INSTALL
DBASE
LIMITS
RUNTIME

DBASEMSG.TXT, which holds the HELP messages, is an ASCII file compatible with most word processors. Professional programmers who want to customize their own applications can alter the HELP text, rewriting descriptions and adding new HELPs.

Commands

The BROWSE command displays a file as columns and rows, each column holding a field, and each row across a record. In the past, fields were displayed in an order dictated by the structure of the originating file. BROWSE now functions more like LIST or DISPLAY, and specific fields can be shown as desired. Thus,

you could BROWSE FIELDS NAME, AGE or BROWSE FIELDS AGE, NAME.

2.4 now gives users the option of including or excluding deleted records. Removing an unwanted record is a two-stage operation. The record must first be DELETED (actually just marked for deletion), and then the file may be PACKed to erase the record. If you want to issue a report from the file, you must REINDEX. Under 2.4, a record can be marked for deletion and treated as having been deleted without actually removing it from a file. As a result, appropriate reports can be generated from a file without having to go through time-consuming PACK and REINDEX steps.

LIST STATUS is a new display command that shows data base file names, current date, default drive, SET parameters, and the latest function key definitions. It also displays the actual expression used to create the index file in question.

Two new *dBASE II* features make full-screen editing more convenient.

Open Files

The 2.4 documentation states that the program will prevent a user from opening an already opened file. This worked well in command files. In one test inside a command file named DUMMY the program would not let me execute another DO DUMMY. However, I was not prevented from opening a data base file in three different ways:

```
SELECT PRIMARY  
USE OPENTEST
```

```
SELECT SECONDARY  
USE OPENTEST
```

```
COPY STRUCTURE TO OPENTEST
```

I wouldn't recommend using any of the above, though the last command is a convenient trick for deleting all records in a file.

Wild Cards

The use of wild cards has been extended to include the SAVE, RELEASE, and DISPLAY FILES commands. For example, 2.4 lets you RELEASE ALL LIKE X* or SAVE ALL LIKE X*. You can RELEASE ALL EXCEPT X*. A definite advantage is that DISPLAY FILES LIKE now works with SET ALTERNATE and enables users to generate a list of any type of file easily.

Indexing

2.4's documentation asserts that selective indexing is possible. In other words, you could create a file with data on checks you have written and those you have received but index the file only by checks received. While such an index would be very useful, testing the INDEX command confirmed that 2.4 doesn't perform this function. I eventually called the Ashton-Tate hot line, at which point a technical supervisor honestly admitted that the INDEX command didn't work as documented. The documentation is currently being rewritten to reflect this fact.

Error Processing

When 2.4 receives a command it cannot process, it not only responds with an error message but also indicates the sequence of command files used and in which command file the problem occurred. This indication is invaluable for debugging, especially in the later stages of a large project, when the number of command file levels can be considerable.

Full-screen Editing

Two new *dBASE II* features make full-screen editing more convenient. First, large sections of text (form letters and headers or footers) between new TEXT and ENDTEXT commands are displayed and can be moved in their original format to a

It Stands Corrected

David Lindgren

In June 1983 the Capital PC user group, drawing on information supplied by its 1500 members, decided to collect and document the bugs and errors in version 2.3 of Ashton-Tate's *dBASE II*. The group supplied the company with its findings and was told that two task forces were reviewing the reported troubles and comparing them against their as-yet-unreleased version of *dBASE II 2.4*.

Using Capital PC's original problem list (see *User Group Dispatch*, PCW, Vol. 1, No. 8), I tested 2.4 to discover which problems have been corrected and which have not. Each problem is repeated (in italics) as it appeared in the list, followed by the results of my test.

PACK loses records. Corrected. The problem occurred when the file being PACKed was indexed. 2.4 ignores the index during PACK operation and then reindexes the PACKed file from the beginning.

PACKed file length doesn't pass to DOS. Not corrected. 2.4's PACK neither releases disk space nor updates the file size stored in the DOS directory. The space is reused as records are added to the file.

Macro substitution within DO CASE doesn't always work. Corrected.

SORT won't work for some files over 257 records long. Corrected.

COPY and APPEND can lose dBASE II data and mess up a disk. Partially corrected. The problem occurred when the SDF option

was omitted from a command to APPEND from a non-*dBASE II* file. If the user responded to the "Correct and Retry?" prompt by correcting the command and then continued, data would be written at random places on the disk.

In version 2.4, correcting the command results in an error message, "File is Currently Open," and the command will not execute. Unfortunately, any further attempt to access the SDF file results in the same message. You cannot complete a command without exiting to DOS and reinvoking *dBASE II*. This cannot be considered an acceptable fix to a simple problem.

MODIFY command has several errors. Not corrected. Although some improvements have been made, that command is still primitive. Several problems persist: blank lines are often appended to a file being edited; lines greater than 79 characters wrap around on display and blend with the following line; and any MODIFY STRUCTURE command following a MODIFY command produces screens full of gibberish and fails completely.

APPEND added blank records instead of correct data from the second data base. Not corrected. When I attempted to APPEND 346 records (each containing 13 fields of 57 characters each) to a file containing 175 records, only 344 records were added to the data base. The last two records were ignored.

Interruption of APPEND can put garbage records in the data base and lose size synch with DOS. Not corrected.

Parts of files get mixed up with dBASE II files. Not corrected. Executing a DELETE FILE command will delete the file in use, but the file remains open within *dBASE II*. Subsequent operations on the file will write data at random on the disk; in one instance the DOS directory was overwritten and destroyed. The same could occur on an IBM XT hard disk.

SET INDEX works with the primary file only. Corrected.

USE will not close a temporary index file so it can be deleted. Partially corrected. USE now closes the file, but DELETE FILE no longer checks to see if the file is open as it did in version 2.3. Thus, data can be randomly written over another file on a disk.

CLEAR and RESET scramble data in multiple disk operations. Not corrected. CLEAR and RESET (even with the appropriate drive specified) will not close or clear files. A disk swap may result in data being lost.

LINKAGE command doesn't work. Partially corrected. GOTO and SKIP do not update the position of both files. I also found that once I reached the end of a file, the ALL and NEXT n scopes stopped working altogether. However, the LINKAGE command does work when one file is indexed but the other is not.

INDEX must have all key fields of the same type. Not corrected. However, the STR function will combine numeric and character

(continues)

Review

word processing file without the use of '@ SAY' commands. Second, relative screen addressing is possible. Entire screen blocks such as data entry formats can be manipulated and moved around the screen by changing the top line of a block. A typical command would be:

```
@ 10,20 SAY "this is my first line"
```

```
@ $ + 2,$ SAY "this is two lines below and at  
the same column"
```

The second line is positioned at row 12, column 20.

Screen Layout

In 2.3, screen layout with EDIT, APPEND, INSERT, and CREATE was preset. With 2.4, SET FORMAT TO is used with EDIT, APPEND, INSERT, and CREATE to lay out a screen as desired. SET FORMAT TO combines the speed of APPEND with the flexibility of the READ command. You are allowed to write a command file of '@ SAY GET' commands including PICTURE and USING. When APPEND is issued, new screen layout specifications from a format file are displayed.

MODIFY Command

A new safety check has been added that cuts keyboard errors when users leave a MODIFY command. The two options for leaving a command file are <Ctrl>-Q (quit without accepting changes) or <Ctrl>-W (quit and save changes). These very different commands are unfortunately close to one another on the keyboard. But 2.4 asks for a confirmation when <Ctrl>-Q is issued. Y will quit, while N will return you to the text file being edited.

Text deletion commands have also been changed. <Ctrl>-Y originally erased an entire line. In 2.4, <Ctrl>-Y deletes a line to the right of the cursor no matter where the cursor is (as <Ctrl>-QY does in *WordStar*). The cursor then jumps to the left side of the screen.

It Stands Corrected

fields in the same index. STR did not work with INDEX in earlier versions.

JOIN creates two fields with the same name in the output data base. Not corrected.

The location of the last record is not consistent (GO TO [<last rec no>] then SKIP -1, etc.). Corrected.

String field comparison is not consistent, depending on the order of the comparison. Not corrected. The documentation for the EXACT option reads, "Requires that character strings match completely except for trailing blanks," but trailing blanks in the right-hand string are counted as part of the string.

Undocumented legal commands. A detailed description of each command is included in part B of the 2.4 documentation, but the tutorial (part A) has not been revised to correct past errors and omissions (such as the CASE command), nor does it include any of 2.4's new features.

The WHILE expression is not allowed in some commands but is not flagged as an error. Corrected. The WHILE option is now accepted by the APPEND and CHANGE commands.

The system date is not pulled in if dBASE II is invoked with a program name. Corrected.

DELIMITED WITH in APPEND FROM will accept only a comma, contrary to the manual. Corrected. The documentation has been changed to reflect this restriction.

'@...SAY...' will not go to an alternate file. Not corrected.

<CursorLeft> control is inconsistent in BROWSE. Not cor-

rected. <CursorLeft> performs differently from <CursorRight>; both change their behavior at the beginning or the end of a line.

A semicolon in dBASE II data will cause a carriage return and a linefeed in REPORT and DISPLAY. Not corrected. There is some mention of semicolon treatment in the REPORT command documentation, which describes its effect on page headings, column headings, and character strings. No mention is made of semicolons in data fields. This problem also affects the LIST and DISPLAY commands; output may be distorted. This is not mentioned in the documentation.

In APPEND, if no data is entered in field 24, an incorrect skip to the next record results. Corrected.

ENDIFn without required space before the n isn't trapped and doesn't work. Corrected.

CHR(7) will not beep the speaker. Corrected.

<Ctrl>-W (save program) causes file linkagesize errors. Corrected.

The last line is left in the printer buffer. This is not a dBASE II problem but a printer-dependent problem.

Too many ejects. Problem not found.

SET FORMAT causes ejects. Problem not found.

16-bit ZIP program promised? This interactive dBASE II screen generator will not be offered by Ashton-Tate as originally expected. A functionally equivalent package called VIP will be available soon.

Saving programs with <Ctrl>-W. Problem not found.

Documentation

Ashton-Tate's user manual has not improved significantly, and it discusses new features rather erratically. Information is often vague or incorrect, as in the case of the INDEX command. Categories are sometimes arbitrary. For example, the BROWSE FIELD command is not discussed in the "Changes Summary" but in the "Help New" section of DBASEMSG.TXT in the main body of the manual. The "Changes Summary" reads more like a series of notes than a formal manual, and I often had to experiment with the program to discover what the documentation meant to say.

dBASE II 2.4 is certainly a more attractive package than its predecessor and is a worthwhile investment for almost any owner of version 2.3. But this release is no earth-shaking event. Ashton-Tate continues to straddle the two continents of CP/M and PC-DOS. IBM users will have to wait for some future version to take advantage of the 8088's extensive memory and the hierarchical file structure of DOS 2.00. Ashton-Tate has taken some strides with this package, but it has a long way to go before it takes the PC seriously. ●

David Jenkins is a computer consultant based in Berkeley, California, who specializes in dBASE II applications. He currently directs several programming projects for PC World and is writing a series of dBASE II utility packages for future publication.

*dBASE II 2.4
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Culver City, CA 90230
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reduce footprint

"Higgins, where's your report?"

TO: Charlie
FROM: Carol
DATE: 11/14
SUBJECT: "the 17th"

I'm still waiting for your part of the sales report. We both know the presentation is on the 17th. And we both know what will happen if it's late.

Carol

11-14

Charlie: Our secretary just quit. We've either got to hire a temp or you're going to type the sales report yourself. I don't have to remind you about the 17th.

Carol

11-15
To: CHARLES HIGGINS
From: E.J. FENWICK

HIGGINS: WHO'S GOING TO GET A WORD PROCESSOR?
THAT'S RIGHT, YOU! MY ASSISTANT BILL GOT A RECOMMENDATION FROM A WORD PROCESSOR DEALER AND THERE'S A STACK OF PAPER. CALL HIM.

The Word From
Bill Stevens

DATE: 11/16

CHARLIE: I FOUND A WORD PROCESSING PACKAGE THAT RUNS ON OUR PC. THE BEST PART IS WE CAN BOTH LEARN IT OVER LUNCH. GETS A SANDWICH AND MEET ME IN MY OFFICE TODAY AT 11:30.

Bill

P.S. DON'T WORRY YOU'LL MAKE THE DEADLINE.

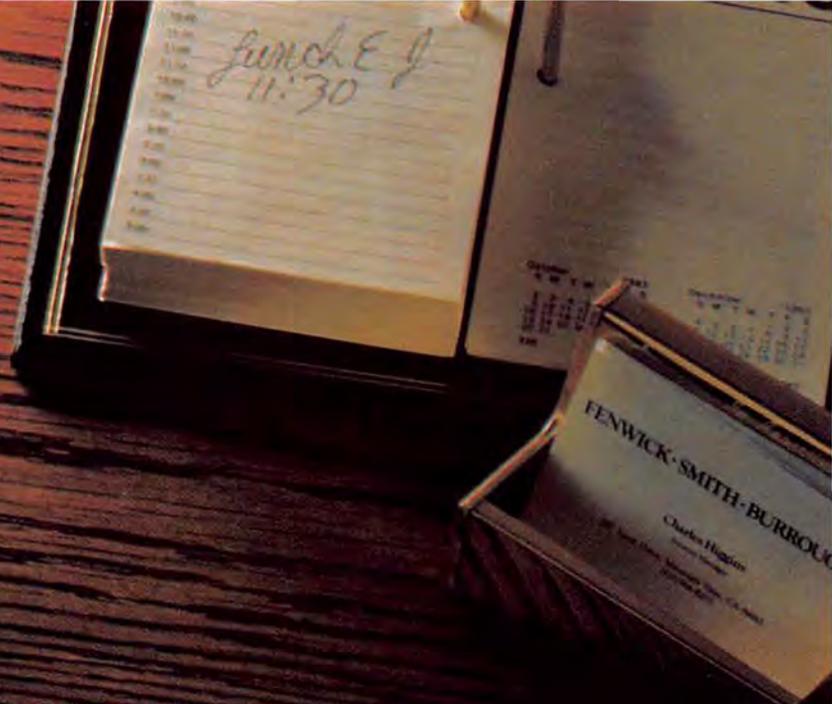
ts for: *B. Stevens*

AWAII

Date: Nov. 16
To: E.J.
From: Charles Higgins

Thanks for the tip. With Bill's help, I found the perfect word processor. It's called SELECT. It's got all the features we'll need. If you'd like, I'll show you how to use it after the report. Don't worry about the presentation, I've attached a copy and everything's under control.

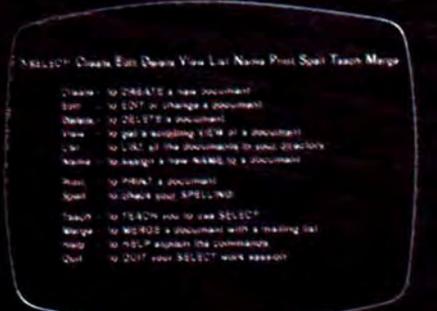
BILL
THANKS FOR SELECT.
WE GOT THE CONTRACT!
YOUR VAGABOND'S DU' US.
ALPHA
CHARLIE



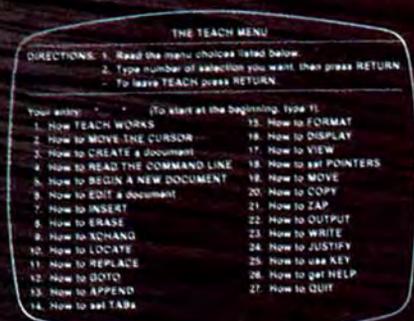
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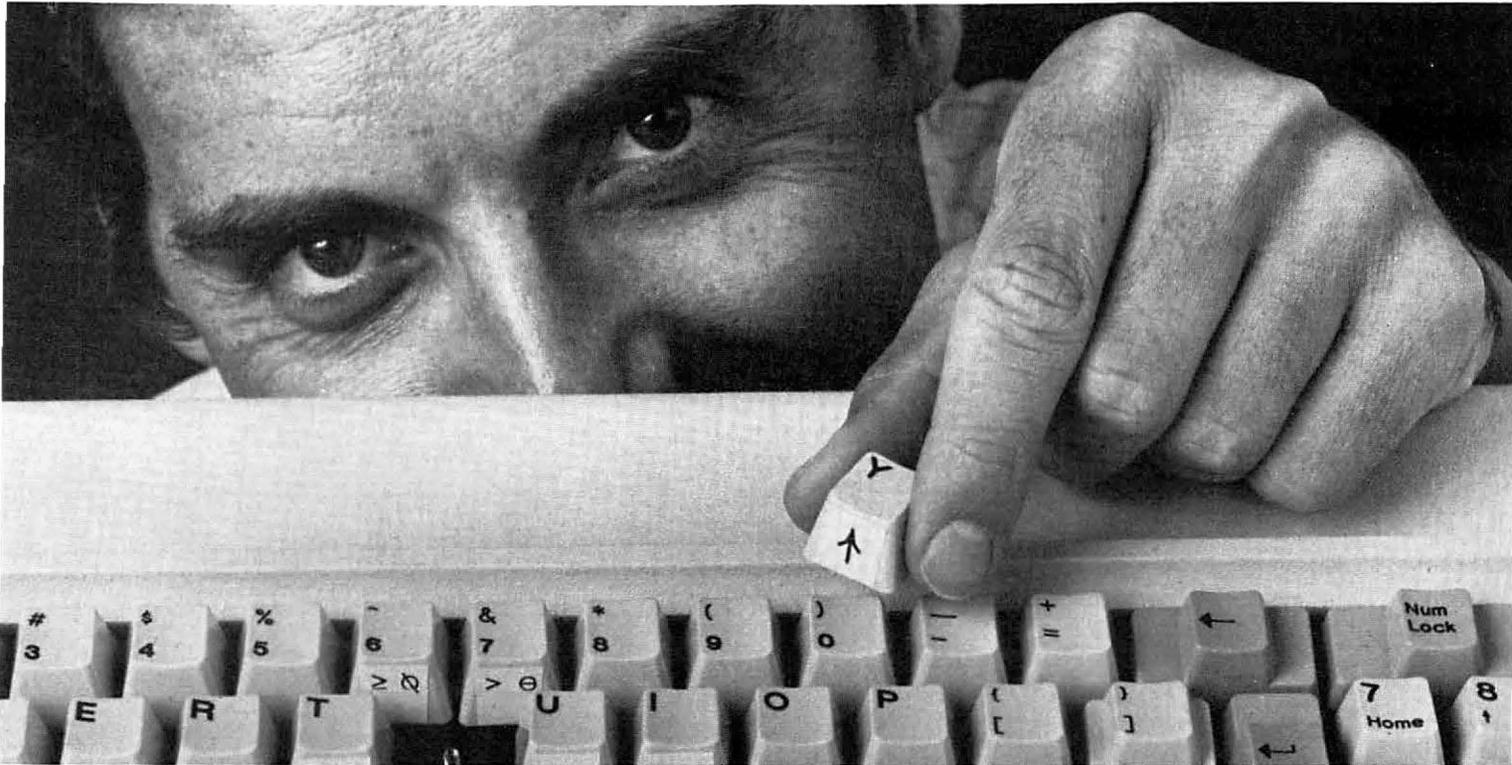
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Circle 282 on reader service card

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Gentlemen

Although this company feels it is important to save the turtles

Gentlemen

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Perfecting the BASIC Editor

SofTool Systems' BASIC Development System can put you in control of your programs.

Andrew Fluegelman

Earlier this year I undertook a major overhaul of a large and complex BASIC program. The original program had been expanded over time and eventually became too unwieldy to develop further. At this point I had to confront the limitations of BASIC.

Line number references within the program made it difficult to move sections of code to subroutines or more logical positions within the program. With all variables having global scope, specifying any variable might have disastrous effects somewhere in the program. The program had also become so large that it would have to be condensed before it could run on a 64K system. Making the needed changes would require many hours of editing, rewriting, and debugging.

The product I'm about to describe doesn't make up for any deficiencies of the BASIC language, but it does make programming in BASIC much more efficient. In fact, my project could not have been completed without it.

BDS

The *BASIC Development System (BDS)* from SofTool Systems is an enhancement to the editing features of IBM BASIC. Unlike other products that have similar names (such as

IBM's *BASIC Programming Development System*), BDS does not have the ability to rewrite programs; it gives you better control over the programs you write.

BDS operates as an overlay to the native BASIC editor. If you are running DOS 1.10, you patch BASIC.COM or BASICA.COM with

BDS provides an interactive cross-referencer that can be called while you are editing.

a file named BDSPATCH.COM. This patch modifies BASIC to look for one of two support files (BASIC.BDS or BASICA.BDS) when BASIC is first loaded. If you are using DOS 2.00, no patching is necessary. Running the program BDS.COM with specified parameters loads BASIC or BASICA with the support files in place. In either situation you have flexibility in specifying disk drives and memory use.

The instructions for implementing BDS are clear and the process is simple. Once the system is configured, you can load BASIC with a single command. The only difference be-

tween BDS-configured BASIC and standard BASIC is the additional editing capabilities.

Saving Keystrokes

BDS allows you to execute common functions with a single upper- or lowercase keystroke. For example, you can list line 1000 of a program by giving the command L 1000 from the OK prompt. The feature I use most allows you to list the next program line each time you press the <PgDn> key. Looking through a program until you find the line you're looking for is more convenient than using LIST and the <Ctrl>-<NumLock> key combination. BDS provides 15 useful single-key-stroke commands.

BDS also has a valuable debugging tool in the form of an enhancement to the TRON (trace on) command. This feature gives you the option of running a program one line at a time. The current line number is displayed in the upper-right corner of the screen, and the program pauses until a key is pressed. Any programmed screen output is displayed as usual. If you want to test variables at that point, you can stop the trace with <Ctrl>-<Break>. You can also cause the single-step trace to commence with a specified line number.

☉ Review

Cross-references and Dumps

Many cross-referencing programs are on the market, but *BDS* is far and away the most powerful "X-ref" utility I've encountered. Most others require that you run the entire program through the utility and produce a cross-reference printout. That operation can take 5 to 10 minutes or more. *BDS* provides an interactive cross-referencer that can be called while you are editing.

For example, suppose you want to know if the variable *A\$* is referenced in a program, and if so, where. Just give the command *x A\$* from the OK prompt, and you'll see a listing on the screen of the lines that contain *A\$* with a flag to indicate lines in which *A\$* is assigned a new value.

The utility of this feature is enhanced because you can use it repeatedly as you modify a section of code. I've made it standard practice to check any new variable I'm about to use to make sure that it isn't already lurking somewhere else in the program. If the cross-reference check turns up nothing, I know the variable is safe to use.

The cross-reference feature permits you to search for variables, line numbers, BASIC key-word references, quoted strings, and lines that contain remarks. You can search for several items or all of a class of items within the program. In each case you can send the cross-reference information to the screen or to a printer.

A related feature permits you to dump the current values of one or more variables to the screen or printer. Used in conjunction with step tracing, the dump feature gives you full control when you are debugging.

Super Renum

If *BDS* doesn't already sound like the answer to your programming prayers, consider the Super Renum feature. This feature lets you renumber any

section of code, specifying the new starting line number, the line number increment, and the beginning and ending line numbers on which to operate. You can renumber a section in the middle of a program using a different increment without disturbing other line numbers.

The most useful application of this feature is moving code from one position in a program to another. For instance, to move lines 1050 through 1085 to line 3200, you would give the command *R 3200,10,1050,1085*. All line references within the moved block and references to other portions of the program will be adjusted automatically. *BDS* will not let you renumber in such a way that you'll accidentally overwrite other program lines. Without the Super Renum feature, restructuring a large program is almost impossible.

Compression

Another tool in the *BDS* package is a code compression utility. Once again, the features exceed anything else I've seen on the market.

If you give the Compress command without any optional parameters, *BDS* will squeeze your code as much as is syntactically possible, merging lines; removing unnecessary blanks, LETs, and GOTOs; and eliminating comments. You can expect a 50 percent compression of an average program and a 25 percent compression of one that is already densely packed. This utility is a valuable aid if you are strapped for memory or need to conserve on disk storage.

As with the other *BDS* features, the compress feature provides utmost flexibility. You can selectively specify which of the above-mentioned compression operations you want to invoke. I often use only the blank and comment removal features to trim a program while keeping it readable and then use the cross-reference utility on the original version to produce

a separate merge file that contains nothing but comments.

As a complement to the compression utility, *BDS* offers an Uncompress command that inserts spaces between operators, splits statements into separate lines, and indents FOR...NEXT and WHILE...WEND loops. It can be used to undo the effects of a Compress command (except reinserting comments). Uncompress can also be used as a formatter to make programs more readable while you are editing. When you finish editing a program, you can use the Compress command to produce an operational version. Various uncompression features can be specified selectively.

A Perfect Tool

The 40 pages of documentation that come with the package explain each feature clearly and thoroughly. A short tutorial is also included that explains each feature using a sample file provided on the utility disk.

BDS has been thoughtfully created with the user's needs in mind. The flexibility and selectivity built into each feature represents a model of good program design. And I can report that after six months and thousands of lines of code using this package, I have not experienced a single bug or problem caused by *BDS*.

Normally one expects some reservations or criticisms in a product review. I have none to report. This utility is the most valuable item in my programming toolbox. I unqualifiedly recommend it to anyone who strives to speak IBM BASIC fluently. ☉

BASIC Development System
SofTool Systems
8972 E. Hampden Ave. #179
Denver, CO 80231
303/793-0145
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Requirements: 64K, one disk drive

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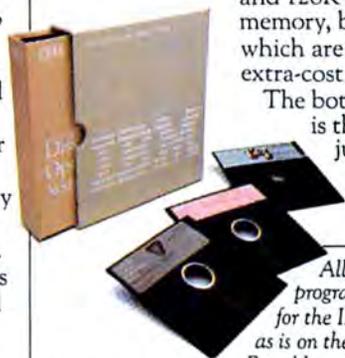
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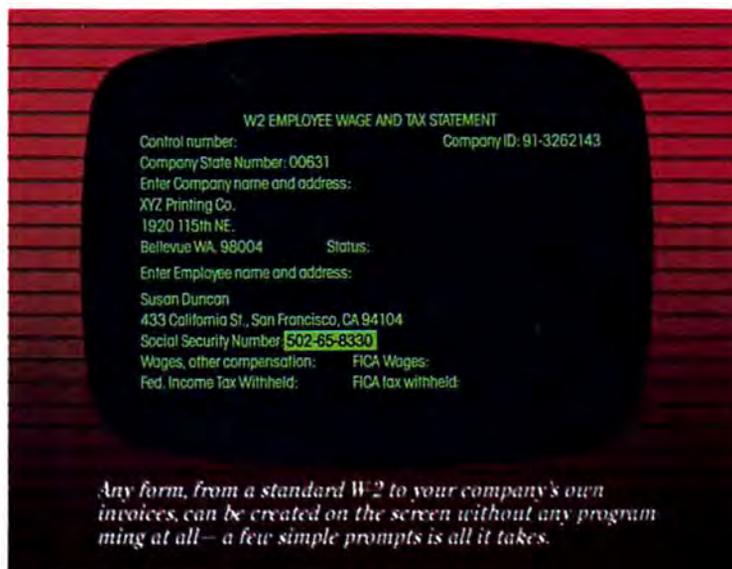
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as simple or complex as you like at the touch of a key. With R:base, prompted, ad-hoc queries and customized report formatting become the reality that first generation products could only promise!

R:base is also very forgiving. It's very hard to make a mistake. That's because commands are simple English expressions—like SELECT, PROJECT, WITH, WHERE, FROM, etc. Dates and dollar amounts are written normally: 11/16/83;

	MAXIMUM RECORDS DATABASE	FILES AVAILABLE CONCURRENTLY	MAXIMUM NUMBER FIELDS DATABASE	TIME TO SORT 1000 RECORDS* (MIN: SEC)	UPDATE MULTIPLE FILES CONCURRENTLY	PRICE (LIST)
R:BASE 4000	100 billion	40	400	0:59	Yes	\$495
dBASE II	65,535	2	32	5:47	No	\$695
CONDOR	32,768	2	127	2:03	No	\$650

*Sort 1000 records on 1 key value. (IBM PC with 256K and DS DD diskettes)

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PURCHASING dBASE II,TM THIS FIRST.

E(edit), R(relation list), A(attribute list), G(a), Q(uit)

SELECT is used for ad hoc queries from a relation.

What is the name of the relation? EMPLOYEE

Enter the word ALL to display all attributes or a list of attributes if you want selective attributes.

Enter ALL or a list: EMP_NAME EMP_SS SALARY DEPT

Enter the attributes to be used for sorting (this is optional)

Attribute list: DEPT

What conditions must be met? (this is the optional WHERE clause)

WHERE

```
SELECT emp_name emp_ss salary dept FROM employee SORTED BY dept
```

EMP_NAME	EMP_SS	SALARY	DEPT
GEOFF SMITH	501-87-9021	\$2900	ACCOUNTING
AL RIDER	543-67-8962	\$3100	ACCOUNTING
NICOLE JONES	507-43-9837	\$3400	ADVERTISING
BILL MURPHY	508-34-2175	\$4000	MARKETING
SALLY ROSS	507-74-5652	\$2400	MARKETING
SUSAN DUNCAN	502-65-8330	\$2700	PERSONNEL

New users can also choose to have command prompting. All you do is answer a sequence of plain-English questions by filling in recessed-out fields. R:base does the rest.

And here's your list. Notice that the command formed by "filling in the blanks" on the previous screen is written out to teach new users about R:base.

\$500.00. And, because data entry verification rules are defined up front, you just can't put any "garbage in"—even if you try!

What's more, R:base allows you to sort and select data on up to ten different criteria, perform totals, and then display the results—all with a single, powerful command (see screens).

QUESTIONS? ASK FOR HELP.

The R:base HELP feature provides detailed information that describes every command and process required for complete mastery of the database. (As does our plain-English documentation.) For example, if you're not sure what SELECT does, simply key in HELP SELECT and R:base will tell you what the command does, how it works, even the proper syntax. This way you don't have to keep referring back to the user manual—it's all right there in front of you.

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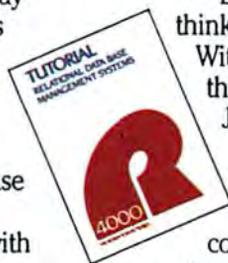
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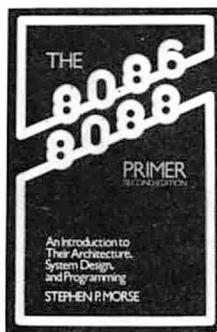
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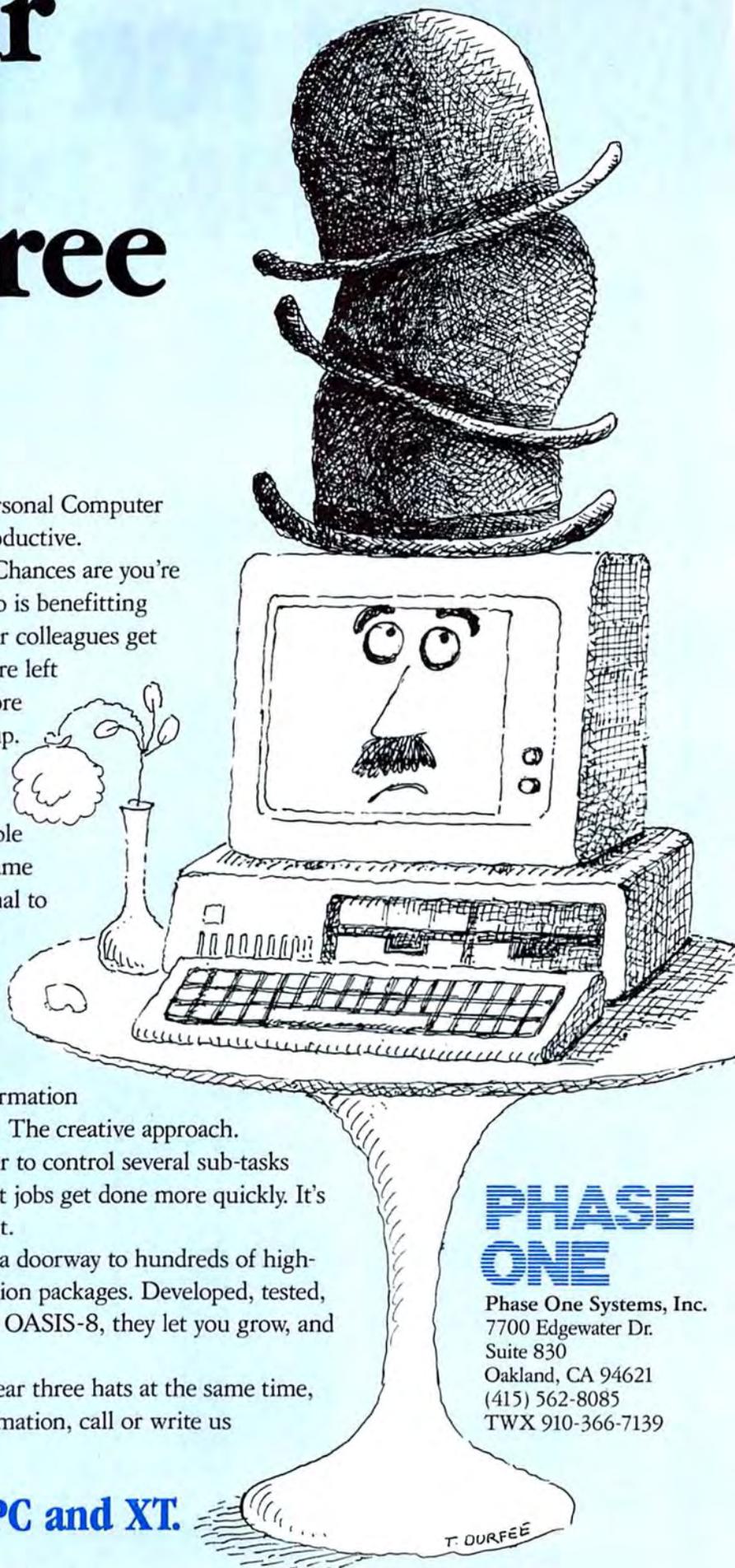
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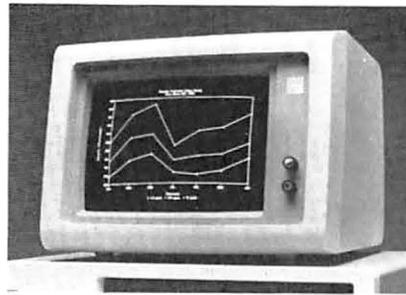
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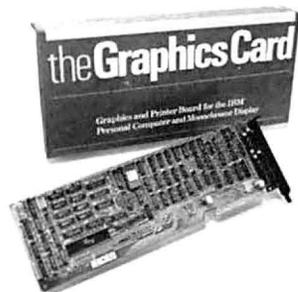
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Btrieve It or Not

A utility program brings fast and easy file handling to high-level languages.

James H. Cowden

Few computer problems can be solved without using disk files for storage. Since the introduction of the IBM Personal Computer, there has been a need for superior file-handling software that is easy to use with high-level languages. SoftCraft's *Btrieve* file management system has met that need. *Btrieve* is a high-quality tool that is worthy of serious consideration by anyone writing applications programs.

The important high-level languages available for the IBM PC using PC-DOS—IBM BASIC, IBM Pascal, Microsoft C, among others—provide only the most primitive file-handling operations. While other areas of these languages have grown, such as BASIC's graphics and Pascal's system extensions, virtually no improvement has been made in these languages' ability to deal with files in an easy, logical manner. This lack of growth explains much about the phenomenal sales of products, such as Ashton-Tate's *dBASE II*, whose major strength lies in their ability to deal with disk files.

IBM COBOL provides an improved file-handling capability (based on B-trees), but it is limited by three factors: you may have only one key in a disk file, you may not have duplicate keys, and COBOL itself is not

suited to all applications requiring disk files. Unlike some current programmer productivity tools that often add layers of code, increase program size, and lower system performance, *Btrieve's* response times are fast and reduce the amount of programming needed for file management. It adds 22 high-level file management commands to all of these languages. Figure 1 offers a complete list of *Btrieve* operations.

Btrieve's response times are fast and reduce the amount of programming needed for file management.

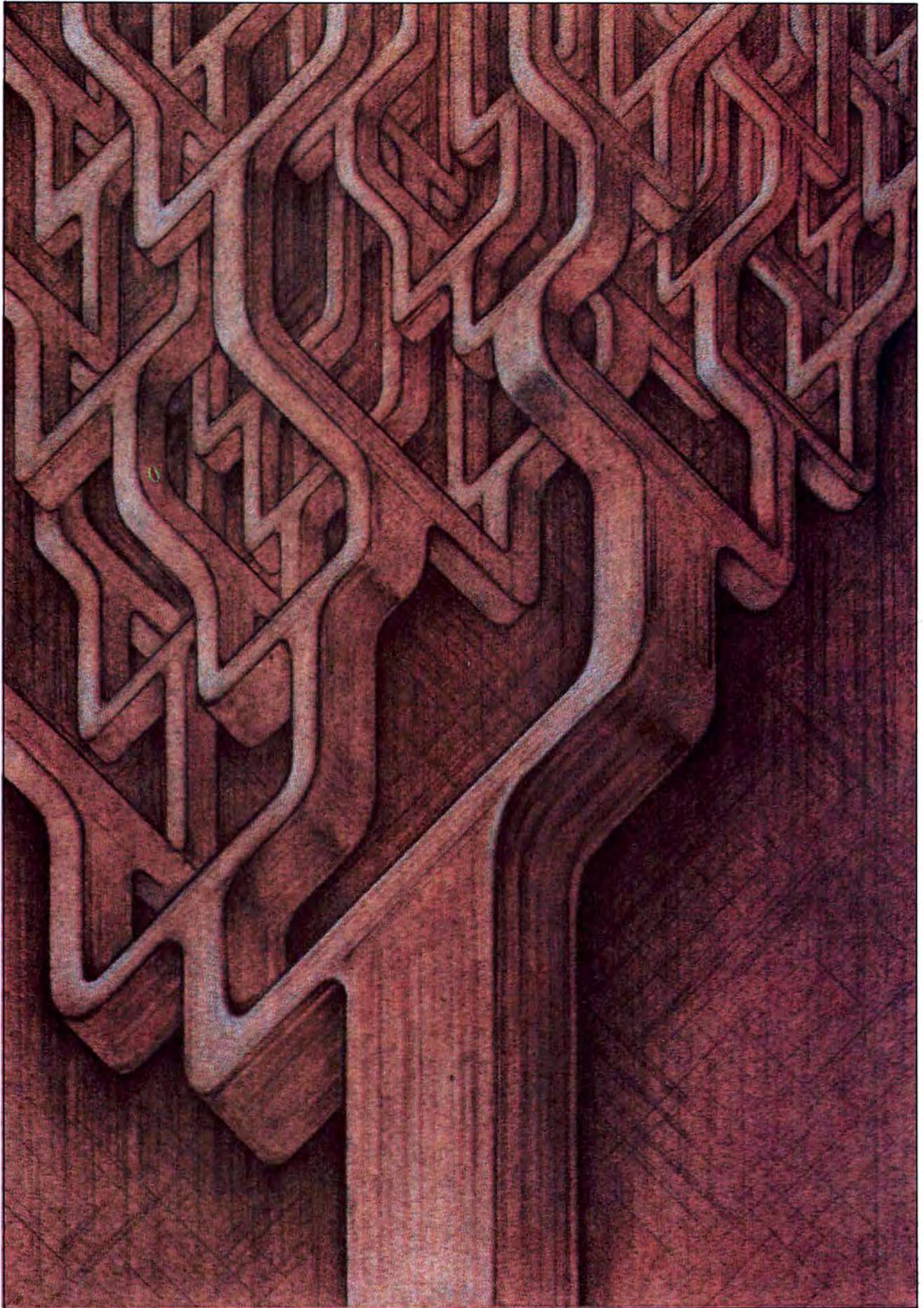
Climbing the B-tree

Most software professionals agree that the optimum solution for handling files is to structure them on disk with a technique known as a B-tree, a sophisticated file index that never needs reorganizing. This is the structural foundation of SoftCraft's *Btrieve*. A B-tree permits the applications programmer to view file records in a logical manner. Records are stored and extracted depending on whether a record field is greater than,

equal to, or less than a specific key value. *Btrieve* gives you access to any record by the value of a key field; allows you to locate all records in ascending or descending order (starting at the beginning or at the end and proceeding sequentially); and allows you to add, update, and delete any record based on its key. It is most significant that *Btrieve* permits a uniform interface to each major IBM PC language that uses DOS. This permits consistent, standard files that can be accessed by applications written in different languages.

The remarkable speed of *Btrieve* operations is due, in part, to the fact that it was specifically designed for the PC's operating system and is written entirely in 8088 assembly language. *Btrieve* was not an adaptation from an older 8-bit version.

Btrieve brings large-computer file-handling capability to the PC without the need for large amounts of memory or a hard disk. The program resides in only 13K of memory and is loaded separately, so your applications program is not burdened with extra code for the full file manager. Separate loading of the file manager is the same technique used successfully by IBM on its Series/1 minicom-



Review

puter, which may be used in real-time environments. *Btrieve* can take advantage of additional memory to buffer file records in memory, a technique known as caching. A cache buffer significantly reduces the number of disk accesses required, yielding even faster operation. *Btrieve* uses a least-recently-used algorithm to keep the most frequently used records in memory. It provides a unique method of maintaining data files across two disks or, for huge files, across two hard disks. Multiple hard disk capability could be important for downloading mainframe files. Hard disks are fully supported; timing comparisons are reported in Figure 2.

Btrieve may be the only file management system for high-level languages on the PC that has successfully solved the problem of automatic recovery from file damage caused by catastrophic machine or operating system failure. If you are writing to an open file and a power failure occurs or the operating system must be restarted, it is likely that the file's internal structure is no longer consistent. IBM COBOL deals with this problem by providing a separate utility program that will recover as much data as possible from the damaged file. *Btrieve*, however, uses "preimaging" to ensure that all incomplete records are removed from the file. This technique is performed automatically and completely without user intervention.

Documentation

The user manual is a professional, finished product. I wondered why a product that claimed to be easy to use came with a 100-page manual. The reason is simple: for each language SoftCraft has included a separate appendix that gives a complete example of how to use each *Btrieve* file operation. This means that you are not required to translate BASIC examples to Pascal or COBOL. For those of us who have endured poorly written and inadequate manuals, this

File Commands	
CREATE	creates a new <i>Btrieve</i> file from an application.
OPEN	makes a file accessible to an application.
CLOSE	terminates access to a file by an application.
STATUS	returns a <i>Btrieve</i> file's statistics to an application.
EXTEND	extends a <i>Btrieve</i> file to span more than one disk.
Record Maintenance Commands	
INSERT	puts a record into the file.
UPDATE	changes the contents of a record.
DELETE	removes a record from a file.
File Integrity Commands	
BEGIN TRANSACTION	defines the start of a logically related group of <i>Btrieve</i> operations for one or more files.
END TRANSACTION	defines the end of a logically related group of <i>Btrieve</i> operations for one or more files.
ABORT TRANSACTION	removes any <i>Btrieve</i> operations performed since the BEGIN TRANSACTION was issued.

Figure 1: *Btrieve* File Manager Commands

one is a pleasure to read. And the manual doesn't ignore the beginning programmer; clear illustrations and examples are included, as well as a complete glossary of all terms. It includes the best tutorial on data files I've seen. A name and address program in BASIC is included on the *Btrieve* disk as part of the tutorial material.

The tutorial doesn't get in the experienced programmer's way. He or she can turn to the appendix that

contains the examples of the appropriate language and examine them to get started quickly. The examples are realistic; they are not the "code fragment" variety that is often useless. The *Btrieve* documentation is one of the few manuals that gives real-world application examples of inventory and sales records. The table of contents is also complete: every page and appendix is listed. The status codes returned by *Btrieve* are fully explained.

SoftCraft is a small company, and for the user of *Btrieve* that has its own special reward: telephone sup-

Record Retrieval Commands

EQUAL

retrieves a record with a specific key value.

NEXT

retrieves the next sequential record.

PREVIOUS

retrieves the previous record.

GREATER

retrieves a record with a key greater than a specific value.

GREATER THAN OR EQUAL TO

retrieves a record with a key greater than or equal to a specific value.

LESS THAN

retrieves a record with a key less than a specific value.

LESS THAN OR EQUAL TO

retrieves a record with a key less than or equal to a specific value.

LOWEST

retrieves the record with the lowest key value.

HIGHEST

retrieves the record with the highest key value.

Directory Commands

GET DIRECTORY

returns the current default directory name.

SET DIRECTORY

changes the current default directory name.

port from those who know their product. This industry has too many well meaning but uninformed personnel assigned to telephone assistance. My calls to SoftCraft were handled courteously and questions were answered promptly and accurately. Reports from other users confirm my experience. You may never require telephone assistance due to the completeness of the documentation, but it is valuable insurance.

The following languages, which run under PC-DOS 1.10 or 2.00, are supported by *Btrieve*: IBM BASIC In-

terpreter, IBM BASIC Compiler, IBM Pascal, IBM COBOL, Microsoft C, Lattice C from Lifeboat Associates, Ci-C86 C from Computer Innovations, and IBM Macro Assembler. Bear in mind that the price of *Btrieve* includes interfaces for all these languages. And with *Btrieve's* generalized interface to the IBM Macro Assembler, those who know assembler can interface with any other language that operates in the standard DOS environment, such as IBM FORTRAN.

If you use DOS 2.00, you will have the full directory capability. Directory changing is important for users of IBM Pascal, IBM COBOL, and C since directories are not currently supported from these languages.

Full of Features

Btrieve's most impressive features are: multikey access to records, support for duplicate and modifiable keys, unlimited number of records per file, file sizes to 4 gigabytes, variable-size buffer cache, variable page size, automatic file recovery on sys-

The larger the cache,
the faster the response
time.

tem crash, complete error control and recovery within an application, partitioned files across disks, a transaction processing option, all indexes handled transparently to the application, and a complete set of load and unload utilities.

When a file is created, you elect whether it can be defined to allow duplicate keys. If duplicate keys are not permitted, an attempt to add a record with a duplicate key will return a status error indicating that the key is already in the file. The user also specifies when the file is created whether to permit modification of a key. If a key may not be modified, *Btrieve* returns this condition to the application whenever an attempt to modify the key is made. On the other hand, if a key is modifiable, *Btrieve* adjusts the file automatically when a key is changed. Each file may separately define up to eight keys, and each key carries the duplicate and modifiable attributes. Keys may be in either character or numeric format, and those in character format may contain up to 64 characters. With *Btrieve's* multikey capability, file sorting can be eliminated. That is good news for those of us who consider file sorting regressive.

Review

The program supports a maximum record size of 4090 bytes. The maximum number of files that can be opened simultaneously is limited only by available memory, except in the case of Interpreted BASIC, since BASIC imposes a limit of 15 open files at any time.

The cache buffer may be varied by the user from a minimum of 13K to a maximum of 64K. The B-tree page size may be varied from a minimum of 512 to 4096 bytes. The larger the cache buffer, the faster the response time.

A BASIC Example

Since *Btrieve* is loaded as a separate program, it is loaded once and remains resident in memory until the PC is powered down or the operating system is reloaded. You can use a one-line AUTOEXEC.BAT file to load the program automatically each time the machine power is turned on or the operating system is reloaded. This single line may include the parameters for both the cache buffer and page size; otherwise, *Btrieve* uses its own minimum defaults. If you forget to load *Btrieve* before calling it from an applications program, a status code is returned to your program telling you that the file manager has not been started.

Listing 1 illustrates the code a Compiled BASIC application might use to open a *Btrieve* file and retrieve the record with the lowest key.

The OPERATION variable is the parameter that determines what type of *Btrieve* function is to be performed. The operation indicates whether *Btrieve* is to read, write, update, or delete a file record. The operation can be any of the 22 *Btrieve* operation codes (see Figure 1).

The STATUS variable is the return code, supplied by *Btrieve* to the application, that permits full application control over file conditions. The variable FCB.ADDR contains the address of the file control block allocated by BASIC when the file is opened. *Btrieve* uses that block to maintain file positioning and to

The *Btrieve* timing tests were performed on an IBM Personal Computer running DOS 1.0. The test programs were written in IBM Compiled BASIC and used BASIC's TIMES function to get the time data. For each test, 1000 records were added, read, updated, and deleted. The record length was 110 bytes; the first key was 16 characters long and the second key 4 characters long. The hard disk used was a 10-megabyte Davong. Each test was run three times. The averages in seconds for each of the file maintenance operations are as follows:

Btrieve started with a 16K cache buffer:

	Floppy		Hard Disk	
	1 Key	2 Keys	1 Key	2 Keys
Insert	1.365	2.260	.333	.527
Read	.201	.200	.053	.053
Update	.721	.719	.220	.207
Delete	1.494	2.465	.351	.552

Btrieve started with a 64K cache buffer:

	Floppy		Hard Disk	
	1 Key	2 Keys	1 Key	2 Keys
Insert	1.222	2.081	.288	.470
Read	.153	.158	.052	.052
Update	.735	.723	.222	.209
Delete	1.504	2.346	.367	.528

Figure 2: *Btrieve* Timing Comparisons

transfer data records. In the example given in Listing 1 BASIC returns the address of the file control block for file #1 through the use of BASIC's VARPTR statement.

The KEY.BUFFER\$ string variable will contain the file record key after *Btrieve* is called. As an example of *Btrieve*'s comprehensive error checking, if the key buffer is too short for the key's length a status code is returned to the application indicating that exact condition.

KEY.NUMBER indicates to *Btrieve* which of the keys you wish to use to access the file. Recall that there may be up to eight different keys in one file. In Listing 1, key number 0 could have been assigned to the name field, key number 1 to the state, and key number 3 to the zip code, with access to any of the keys simply by changing the key number.

To prepare this Compiled BASIC program, you link two very short SoftCraft-supplied interface modules at the time you invoke the DOS Link program. Both modules add less than 256 bytes to the final program. If you use a batch file for linking, it might be prepared as:

```
LINK basprog + basxface + xdata
```

The 'basxface' and 'xdata' modules provide the complete *Btrieve* interface for Compiled BASIC. Similar object modules are supplied by Soft-Craft for all the languages that *Btrieve* supports. Some languages do not require the 'xdata' object module. And, of course, Interpreted BASIC does not go through a link process.

With the *Btrieve* file system, Soft-Craft supplies the following helpful utilities, which are called from a main menu that offers interactive prompts at each step. COPY copies the contents of one *Btrieve* file to an-

```

10 DEFINT A-Z                ' Use integer variables
20 OPEN "B:ADDRESS.BTR" AS #1 ' Open file from BASIC
30 FIELD #1, 30 AS NAME$, 30 AS STREET$,
    30 AS CITY$, 2 AS STATE$, 9 AS ZIP$
40 OPERATION = 0             ' Set file operation
50 STATUS = 0                ' Initialize file status
60 FCB.ADDR = VARPTR( #1 )   ' Get file block address
70 KEY.BUFFER$ = SPACE$( 30 ) ' Initialize key buffer
80 KEY.NUMBER = 0            ' Key number to use
90 CALL BTRIEVE( OPERATION, STATUS, FCB.ADDR,
    KEY.BUFFER$, KEY.NUMBER )
100 IF STATUS <> 0 THEN
    PRINT "Error opening file. Status = "; STATUS : END
110 OPERATION = 12           ' Set get lowest operation
120 CALL BTRIEVE( OPERATION, STATUS, FCB.ADDR,
    KEY.BUFFER$, KEY.NUMBER )
130 IF STATUS <> 0 THEN
    PRINT "Error reading file. Status = "; STATUS : END
140 PRINT "First record in file is: "; NAME$, STREET$, CITY$,
    STATE$, ZIP$

```

Listing 1

other. CREATE creates a new *Btrieve* file. EXTEND extends an existing *Btrieve* file to a second disk. LOAD loads a *Btrieve* file with data stored in a standard-format sequential file. SAVE retrieves data records from a *Btrieve* file and stores them in a standard-format sequential file. STATUS reports a *Btrieve* file's characteristics, including total records and key attributes. The CREATE, EXTEND, and STATUS functions are the interactive forms of the same *Btrieve* commands that can be called from applications programs.

Transaction Control

Btrieve's preimaging logic ensures the integrity of a single file's internal structure and provides an applications developer with a higher level of multifile integrity through the use of transactions. By grouping a set of logically related *Btrieve* file operations between a begin and an end transaction call to *Btrieve*, an application can ensure that none of the operations will be permanently made in the file unless all of them are. In the event of a system failure during a file transaction, *Btrieve* automatically removes any of the operations performed during the incomplete transaction when the file or files are next opened. In addition, an application can choose to "back out" or "roll

back" the entire set of related transactions by issuing an abort transaction call to *Btrieve*.

One common example of how transactions can be used is in an accounting application. If you want to enter the payment of a phone bill, both a debit and a credit must be made to the files before the books correctly reflect the paid phone bill. Assume that the appropriate file has recorded the debit and the system fails before the credit is recorded. With *Btrieve* this incomplete transaction will be removed when these files are next opened.

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James Cowden is an attorney who has 12 years experience in data processing on minis and mainframes.

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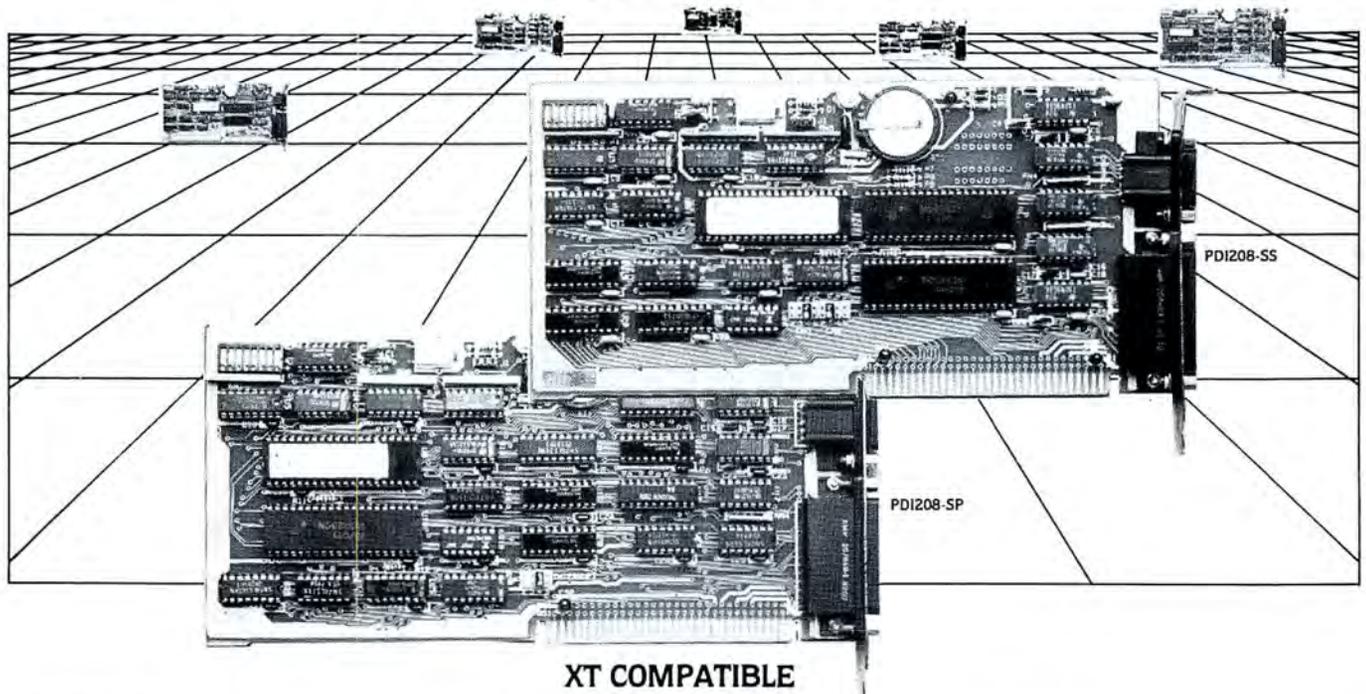
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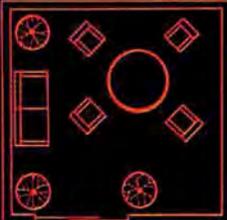
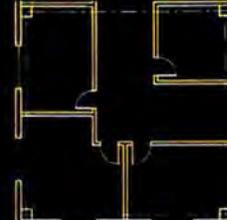
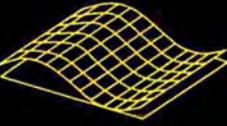
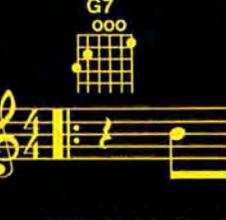
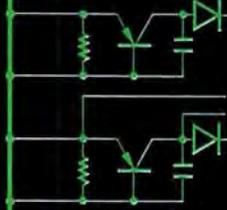
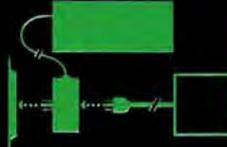
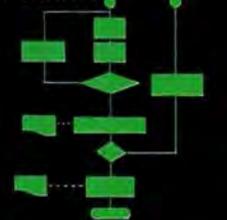
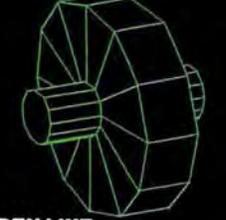
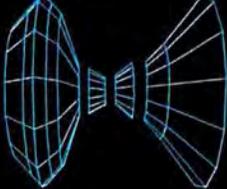
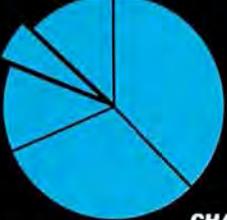
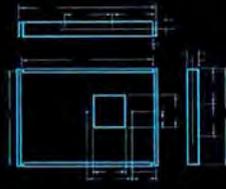
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Pixel to Printer

Peter Baenziger

Getting a picture from the screen onto paper without a graphics printer used to be expensive and time consuming. Now it's neither with GRUMP, a simple graphics screen dump program that uses BASIC and works with almost any standard dot matrix printer.

Almost everyone knows you can print a text screen with a single keystroke—<Shift>-<PrtSc>. It works well with most dot matrix printers and all versions of PC-DOS, but it is limited to text mode. Pressing <Shift>-<PrtSc> with a graphics screen full of your beautiful designs will print gibberish unless you have both DOS 2.00 and an Epson graphics dot matrix printer.

If you don't have DOS 2.00 and an Epson graphics printer and you want to print out graphics, you'll need a special graphics screen dump program. Commercially available programs are fast and flexible, but they can cost as much as \$50 each. And if you own an unusual dot matrix printer (one not commonly used with the PC), the program may not work.

Writing your own program can be a frustrating chore. Graphics screen dump programs written in BASIC are incredibly slow. They are full of DEF SEGs, PEEKs, POKEs, loops within loops, and memory addresses by the thousands—certainly not the kind of program you whip out in a couple of hours. But don't dismiss BASIC altogether, in particular BASICA. An effective, relatively small graphics dump routine, GRUMP, can be written with only one DEF SEG and PEEK, and it prints in less than three minutes.

What do you need to make GRUMP work? The answer: an IBM PC with an IBM Color/Graphics Adapter, a monitor, one disk drive, and Advanced BASIC (BASICA)—in other words, a standard PC configuration

for graphics work. (Disk BASIC does not have the necessary graphics commands.) You will also need a dot matrix printer with bit graphics mode, which allows free form printing. Keep the printer manual on hand; you may need it to adapt GRUMP to your printer.

You don't have to be a programmer, but you should be familiar with BASIC's commonly used commands, statements, and functions.

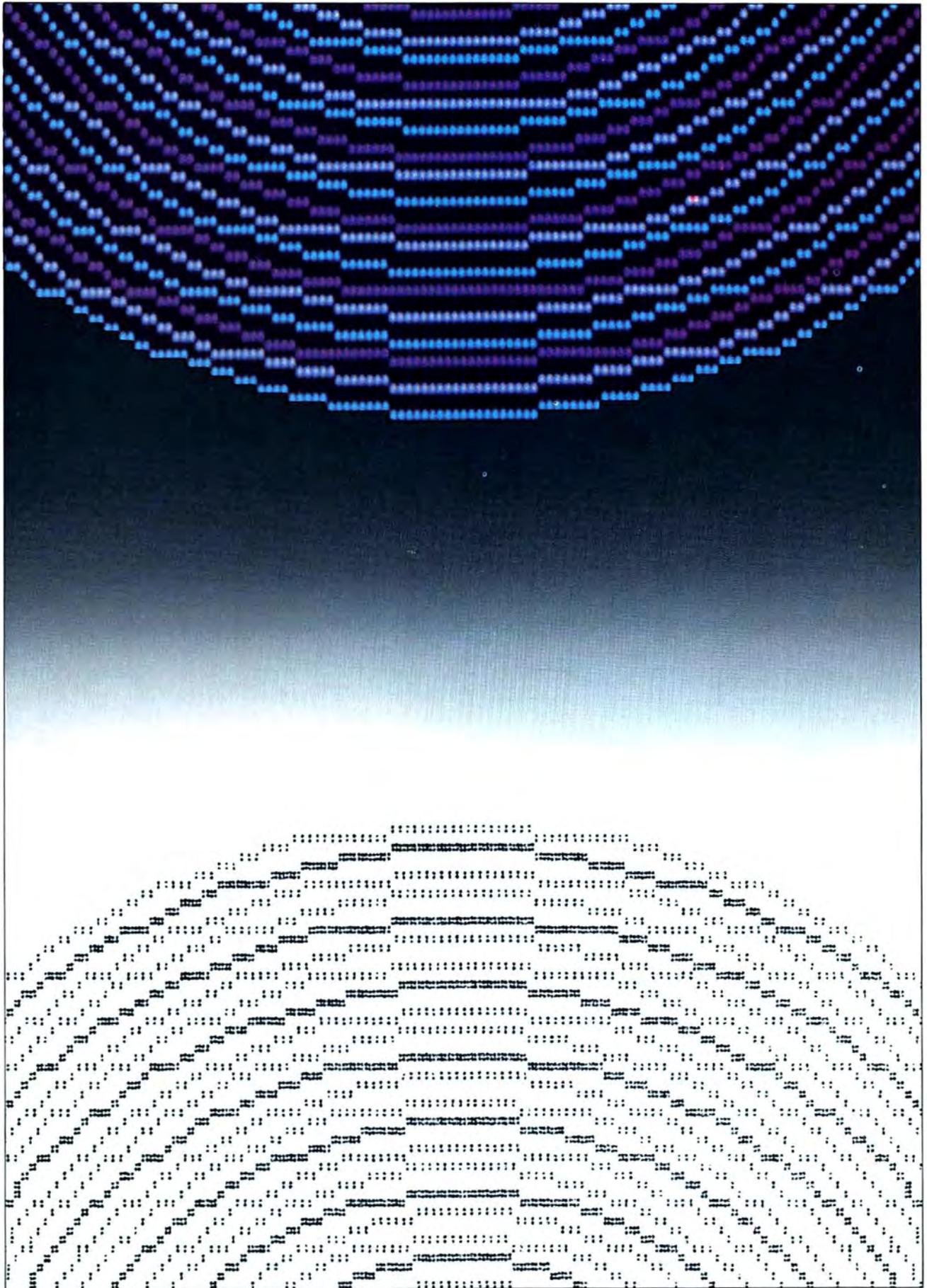
GRUMP converts a screen image into a form easily used by BASIC and then prints it.

Printer Primer

GRUMP performs two major tasks: it reads the screen and converts the graphic images into a form easily accessible to BASIC, and it converts data for the printer and prints it.

Most dot matrix printers with the exception of the original IBM PC printer have a bit graphics mode. What exactly does *bit graphics* mean? The printhead of a dot matrix printer has seven to nine needles that individually push out against an inked ribbon and print the miniature dots comprising a dot matrix character.

The printer normally prints a prestored pattern. When the PC tells the printer to print the letter A, it sends the printer a 1-byte number that identifies the letter A. The printer references the correct shape in its ROM and then prints it.



Hands On

In bit graphics mode the printer does not use pre-stored patterns, and the PC tells the printer which individual needles to extend. Each byte sent by the PC prints only one column of tiny dots. (One regular line has between 480 and 1440 dots, depending on the printer.) Since the needles are user controlled, you can print any shape. To print the letter A in bit graphics mode the PC must know the shape of the letter and send the printer anywhere from 8 to 15 bytes describing where to print the dots that make up the letter. Thus, speed and simplicity are traded for greater freedom.

A Matter of Bits

How does the PC tell the printer which needles to extend? It all depends on bits and bytes. All data in a computer is represented by the numbers 0 and 1, which correspond to the absence or presence of electricity in a circuit. Each 0 (off) or 1 (on) is a bit. A byte consists of 8 bits, which can represent a letter, a number, or in this

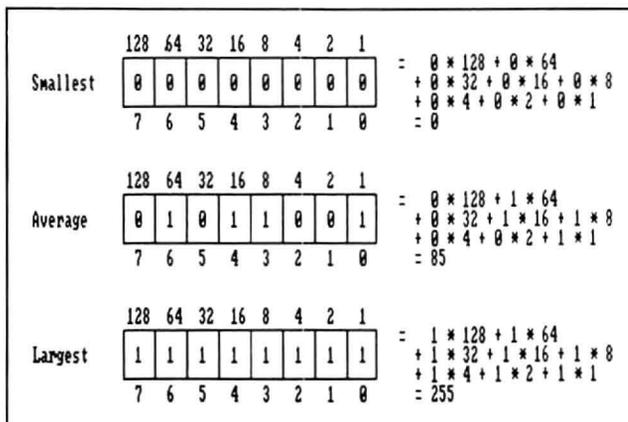


Figure 1: Smallest, average, and largest bytes

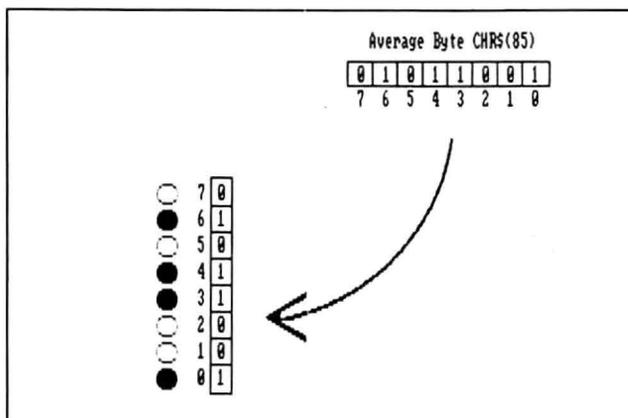


Figure 2: Average byte being printed by idealized dot matrix printer

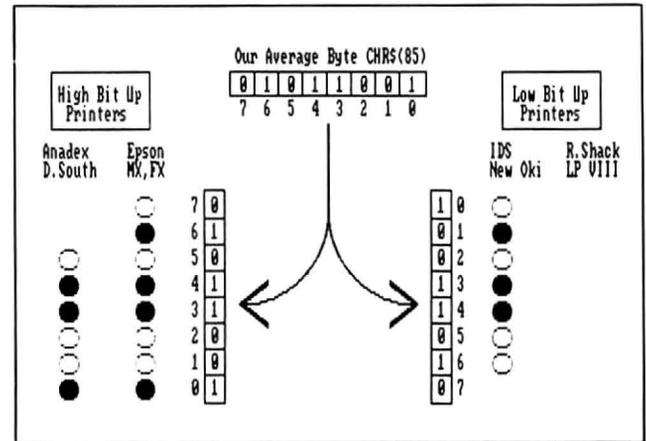


Figure 3: How some printers print our average byte (or don't)

case a small piece of a graphic image on a screen. Since 0 and 1 are the only numbers used, all information is represented in binary, or base 2.

The first bit in a byte, 0, can have a maximum value of 1; it is called the low bit. The second bit, 1, can have a maximum value of 2. Each position doubles as you move up the byte (see Figure 1). The last or highest bit is number 7; its decimal value is 128. Every printer uses a slightly different approach, but a typical, "idealized" dot matrix printer has eight needles stacked on top of each other; thus eight dots can be printed at a time.

When the PC sends a byte to our idealized printer, each bit of the byte is matched up with a needle (see Figure 2). If a bit is 1, one dot is printed; if a bit is 0, no dots are printed. The high bit (7) is matched with the top dot position; the low bit (0) is matched with the bottom dot position.

Thus, if LPRINT CHR\$(85) is keyed in, the PC sends the byte with the value 85 to the printer, and the printer prints the pattern shown at the left in Figure 2. Sending any byte between 0 and 255 will print a dot pattern that exactly matches the bit pattern of the number.

But in the real world of printers, what you send is not always what you get. Some printers print the byte upside down, with the low bit up (see Figure 3). The number of dots printed also varies. Some printers print only 6 or 7 of the 8 bits. This information is important since GRUMP stores and refers to this number in a constant called NUMDOTS.

The Radio Shack LPVIII printer won't print the byte at all—CHR\$(85) is not an acceptable graphic byte to this printer. It expects all graphic bytes to have the high bit set to 1. The high bit must be set to 1 before sending it the byte; it then prints the bottom 7 bits. Setting the high bit turns CHR\$(85) into CHR\$(213). However, if CHR\$(213) is sent to another printer, that printer will balk since the high bit is expected to be 0. Obviously, this matter of bits is important to printers

	IDS ¹ , New Okidata ²	Epson MX, FX ³ , IBM Graphic	DataSouth, Anadex ⁴	Radio Shack VIII
Byte orientation	Low up	High up	High up	Low up
Dots printed	7	8	6	7
Requirements for bits not printed				
Bit 7 (the eighth bit)			Should be 0	Should be 1
Bit 6 (the seventh bit)			Should be 1	
Graphics mode command (TOGRAPH\$)	CHR\$(3)	CHR\$(27) "K"	CHR\$(28)	CHR\$(18)
Does printer stay in graphics mode?	Yes	No	Yes	Yes
Command for graphic line length		CHR\$(144) CHR\$(1)		
Carriage return command (CRLF\$)	CHR\$(3) CHR\$(14)	CHR\$(13) CHR\$(10)	"6"	CHR\$(13) CHR\$(10)
Can you preset paper advance distance?	Optional	Yes	No	No
Preset command (SETCRLF\$)	CHR\$(27) "C 4\$"	CHR\$(27) "3" CHR\$(24)		
Can you preset the left margin?	Yes	No	No	No
How do you set/preset left margin? (LMARGIN\$) (8-inch paper width)	CHR\$(27) "J 120 960\$"	SPACES\$(6)	";100"	CHR\$(27) CHR\$(16) CHR\$(0) CHR\$(40)
Regular print mode command (TOREG\$)	CHR\$(3) CHR\$(2)	CHR\$(27) "2" CHR\$(27) "a "	CHR\$(29)	CHR\$(30)

¹ Applies to all Integral Data Systems models.
² Older (pre-1983) Okidata printers use different codes.
³ Epsoms with Graphtrax option installed.
⁴ Some Anadex models used different codes.

Table 1: Printer characteristics

and GRUMP. The routine stores data that tells which bits need setting in the variables SETBITS and CLEARBITS.

Don't forget to check the printer's instruction manual. Table 1 summarizes characteristics common to most printers and the questions to which you should seek answers in your manual. Keep in mind that variations and changes in printers do occur, so use this table as a guide.

Finding some of this information in your manual may be difficult. Rather than telling you how many bits it prints or that bit 7 should be 1 or 0, it may tell you, for example, that valid graphic characters are those that have ASCII values of 64 to 127 or H40 to H7F. These values describe a printer that prints 6 dots. Since the numbers are smaller than 128, bit 7 must be 0, and be-

cause the numbers are 64 or greater, bit 6 must be 1. Another example is ASCII values 128 through 255. In this instance, the printer prints 7 dots, and because the numbers are greater than 128, bit 7 must be 1. Values from 0 to 255 indicate a printer that uses all 8 bits.

Printer Commands

Four printer commands are needed to make GRUMP work: TOGRAPH\$, SETCRLF\$ and CRLF\$, LMARGIN\$, and TOREG\$. TOGRAPH\$ is a special command that switches printers to bit graphics mode. The command may be one character or a series of char-

Hands On

acters. Some printers stay in graphics mode until the mode is switched. Other printers need the TOGRAPH\$ command repeated at the end of every line because they switch out of graphics mode automatically after printing a specified number of bytes.

With printers that switch at the end of every line, the TOGRAPH\$ command often has to include the number of graphics bytes to be sent, usually 400 for GRUMP. But you can't send 400 because a byte's value cannot exceed 255. You must break the number into 2 bytes in a way that's easy for printers and computers to understand. You subtract 256 from 400 and send the difference (144) as the first byte. The second byte is 1, because you subtracted 256 only once. If you had to send 600 bytes, 256 would be subtracted twice. The first byte would be 88 and the second byte 2.

SETCRLF\$ and CRLF\$ commands can be used to override standard printer carriage returns. When a printer starts a new line, it advances the paper more than the height of the characters to allow some space between lines. In graphics printing, empty space is not desirable. The lines should butt seamlessly to make one continuous picture.

Some printers require special carriage return control characters. Others let you use the regular CRLF\$ command, CHR\$(13) CHR\$(10), but you must preset the paper advance with a special SETCRLF\$ command. A few printers will require either both or none.

Some printers require that certain graphics character codes be sent twice because the code by itself has a special meaning.

Some printers allow you to preset a left margin (LMARGIN\$), while others require that the left margin be specified after each line. How wide should the left margin be? That decision depends on the number of dots the printer lays down on a line, varying from 480 to 1440 dots for a regular 8-inch line. GRUMP can print a graphic image 400, 600, or even 800 dots wide. If, for example, a printer prints 480 dots across and GRUMP sends a picture 400 dots wide, the left margin would be 40 dots. Depending on the printer, you may be able to preset your margin to the 40-dot position, or you may have to send a positioning command at the beginning of each line. With printers that switch out of graphics mode

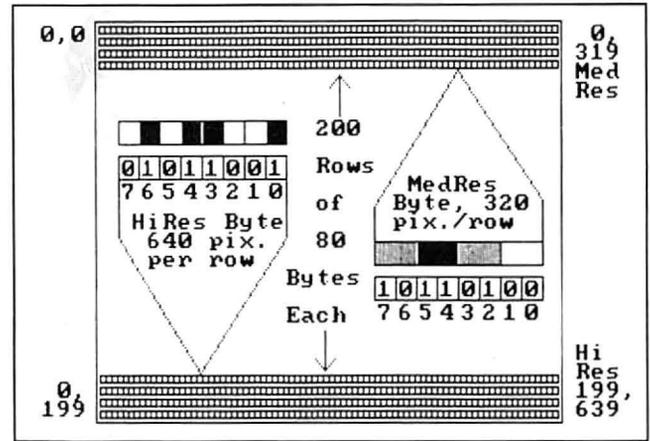


Figure 4: High- and medium-resolution screens

at the end of each line, it may be easier to insert 6 or 7 spaces in regular character mode so the printhead is close to the 40-dot position.

The TOREG\$ command resets a printer from bit graphics mode to regular mode. It may change only the printing mode, and the carriage return may need to be reset. You may also want to include a command to advance to the next page.

One last point: some printers require that certain graphics character codes (SPECNUM) be sent twice because the code by itself has a special meaning. Some printers use CHR\$(3) to switch to graphics printing. Thus, if you wanted to print the dot pattern corresponding to 3, you would send SPECNUM CHR\$(3) twice—once to switch the printer to bit graphics mode and the second time to generate the pattern.

Getting off the Screen

The PC screen displays 200 rows of dots (see Figure 4). The rows are numbered from 0 at the top (SCRTOP) to 199 at the bottom (SCRBOT); each row is made up of points of light called pixels. In medium resolution, a row has 320 pixels; in high resolution, 640. The pixels are numbered from 0 on the left (SCRLEFT) to either 639 or 319 on the right (SCRRIGHT). BASICA 2.0 allows you to use different numbering systems, but this system works for all versions.

A row is always represented by 80 bytes in memory. In high resolution (SCREEN 2) each bit in a byte stands for 1 pixel. Thus, 8 pixels are in a byte; 80 bytes for 640 pixels. A bit value of 1 corresponds to a visible pixel.

In medium resolution (SCREEN 1) 2 bits in each byte represent 1 pixel. Each byte stands for 4 pixels and 80 bytes for 320. Two bits can have four combinations: 00, 01, 10, or 11. The combination 00 stands for no dot,

and the other three stand for the three colors allowed in medium resolution. Since most printers can't print color, 11 is printed as black, 01 and 10 as grey stripes, and 00 as white.

Because the screen is shaped like a piece of paper held sideways, printing from the screen is simplified by dumping graphics onto paper in the same orientation—sideways. The top of the screen doesn't correspond to the top of the paper, but to the right or the left edge, depending on the printer. With a low-bit-up printer the right side of the screen becomes the top of the paper; with a high-bit-up printer the left side becomes the top.

If you are using BASICA's GET statement, a column of graphics bytes can be taken off the screen very quickly—200 columns in about 5 seconds. Screen memory addresses, or how the screen is arranged in memory, are handled by BASICA. You specify the coordinates of

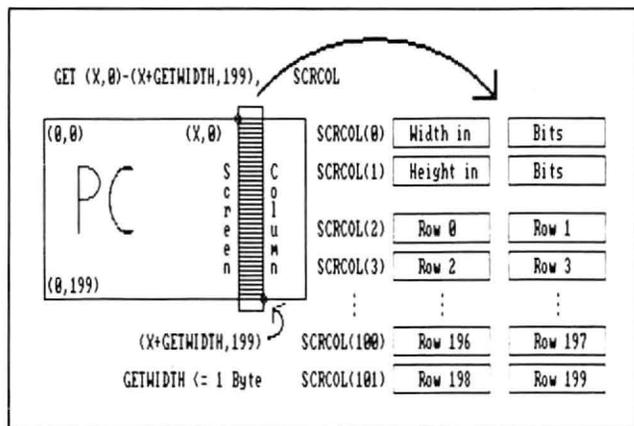


Figure 5: How screen bytes are stored in array SCRCOL

two diagonally opposite corners of a column (it doesn't matter which) and tell BASIC where to put the bytes. In high resolution, GET (0,0)-(7,199),SCRCOL takes the leftmost column of bytes off the screen and stores them in an array called SCRCOL. In medium resolution, in which 4 pixels are represented in 1 byte, GET (0,0)-(3,199),SCRCOL produces the same effect.

SCRCOL is a numerical array big enough to hold all the bytes taken off the screen. It doesn't matter what kind of numerical array you use (string arrays won't work) as long as there is sufficient space. The IBM BASIC manual gives the formula for determining how large the array should be.

Once you move bytes off the screen and store them in SCRCOL (see Figure 5), how do you send them to the printer? You can't LPRINT CHR\$(SCRCOL(N)). BASIC interprets the 2 bytes as one number rather than two separate numbers. And this number could exceed the maximum byte value of 255.

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Hands On

Luckily, BASIC has a function called MKIS() (make integer string) that lets you deal with each byte individually. MKIS() doesn't change the bytes—only the way BASIC looks at them.

But there are additional complications. LPRINT MKIS(SCRCOL(N)) does not produce desirable results. First, if one of the bytes is a 13 (normally a carriage return), LPRINT automatically adds another byte (a 10), which is normally a linefeed. On most printers the result looks like chicken tracks because the printer is in bit graphics mode and here 13 is a pattern of dots. With BASIC 1.10 you can avoid this problem by using PRINT #1 wherever LPRINT is required. Thus, the command would be
 OPEN "LPT1:" AS #1: WIDTH #1, 225: PRINT #1, MKIS(SCRCOL(N))
 The picture you finally get after all this will resemble what was on the screen—and that is another problem. The printed image will look as if there aren't enough dots in the vertical axis of the picture. Consider that a typical 12- by 9-inch monitor has a width-to-side ratio of 4 to 3. Corresponding to the 12 inches across are 640 pixels, versus 200 pixels for 9 inches, for a ratio of 4 to 1.25. The PC makes up for this unevenness by displaying pixels taller than they are wide.

A printer dot is usually "squarer" than a screen dot, and thus does not match a pixel on the screen, so two and sometimes even three dots are necessary. The number of dots used will depend on the printer. The solution is to pull the 2 bytes in each element of SCRCOL and double or triple them using the LEFT\$() and RIGHT\$() functions and REPS, which set how many times a byte is repeated.

Using the Listings

Before using any of the listings accompanying this article, review your printer manual. In particular, be aware of low- and high-bit placement, setting the printer for graphics mode, and setting left margins. All the listings run under BASIC 1.1 and 2.0 and work with the major printer types. GRUMP2ID is for Integral Data Systems' P-Series printers (formerly IDS Prism), specifically model 80 (see Listing 1). According to Okidata, its new printers generally follow the same commands as the P-Series printers.

GRUMP2RS is for the Radio Shack Line Printer VIII and newer DMP printers (see Listing 2). GRUMP2AD works on most Anadex and DataSouth printers (see Listing 3). (Don't forget that DataSouth printers must be set to 49 to print any graphics screen dumps.) GRUMP2EP works on the Epson MX and FX and the IBM Graphic printers (see Listing 4).

All versions of GRUMP start turning variables by default into integer variables. Integer variables are stored in memory as 2 bytes. This makes the program run

```

10 ' *****
20 ' *****      GRUMP for P-Series Printers      *****
30 ' *****      High and Medium Resolution Screens *****
40 ' *****      Machine Language Subroutine      *****
50 ' *****
60 ' This program prints IBM PC high and medium resolution
70 ' graphic screens (SCREEN 1, SCREEN 2) on a P-Series printer
80 ' using a machine language routine. It works with
90 ' BASICA 1.1 and BASICA 2.0.
100 'Peter Baenziger, 1215 Lane Blvd., Kalamazoo, MI 49001
110 '
120 '
130 '
140 DEFINT A-Z
150 GOSUB 4000 ' Determine what screen we're on
160 IF SCREENSTAT>6 OR SCREENSTAT <4 THEN ERRMSG$="Screen not in graphics
mode":GOTO 5000
170 '
180 GOSUB 4500 ' Load machine language subroutine
190 IF CROSSCHECK<>CHECK THEN ERRMSG$="One or more of the numbers in the
DATA is wrong":GOTO 5000
970 '
980 ' Screen related variables
990 ' -----
1000 SCRCOLSIZE=101
1010 DIM SCRCOL(SCRCOLSIZE) ' Holding array for data "gotten" from screen
1020 SCRLEFT=0:IF SCREENSTAT=6 THEN SCRRIGHT=639 ELSE SCRRIGHT=319 ' Screen
column numbers
1030 SCRTOP=0:SCRBOT=199 ' Screen row numbers
1040 '
1050 ' Printer dependent variables
1060 ' -----
1070 REPS=2 ' How many times a byte should be repeated in printing
1080 SETBITS=0 ' 0 means no bits need setting. To set a bit, set SETBITS
to the value of the bit you want to set
1090 CLEARBITS=255-128 ' 255 means no bits need clearing. To clear a bit,
subtract its value from 255.
1100 SPECNUM=3 ' Any special number for your printer that needs printing
twice, such as 3 for P-Series printers. SPECNUM=0 means no special number
1110 NUMDOTS=7 ' How many dots the printer prints in one pass
1120 STEPSIZE=-NUMDOTS ' How we step through the screen
1130 IF SCREENSTAT=6 THEN GETWIDTH=6 ELSE GETWIDTH=3 ' GETWIDTH+1 dots are
taken off the screen in one pass
1140 REMAINDER=SCRRIGHT MOD NUMDOTS ' Screen column number of last printer
line (HiRes) or last two lines (MedRes)
1150 SHIFT=1 ' Number of bit positions to shift to right. 0 means no shift.
1160 PRINTROW=0 ' This variable will hold the address of the printing
routine
1190 '
1200 TOGRAPH$=CHR$(3) ' Switch to graphics
1210 TOREG$=CHR$(3)+CHR$(2)+CHR$(12) ' Switch back & advance to next page
1220 SETCRLF$=CHR$(27)+"C 4 $" ' Set linefeed advance distance
1230 CRLF$=CHR$(3)+CHR$(14) ' Actual graphic carriage return/linefeed
1240 LMARGIN$=CHR$(27)+"J 150 960 $" ' Left paper margin to center image
1970 '
1980 ' Setting up the printer
1990 ' -----
2000 ON ERROR GOTO 5000:ERRMSG$="Printer is not responding"
2010 OPEN "LPT1:" AS #1 ' Printing in random mode
2020 WIDTH #1, 255 ' Keep BASIC from adding carriage returns every 80 bytes
2030 PRINT #1, SETCRLF$ LMARGIN$; ' Set advance and left margin
2040 PRINT #1, TOGRAPH$; ' Switch graphics mode on
2050 PRINT #1, CRLF$;
2060 '
2070 IF SCREENSTAT<>6 THEN 2500 ' MedRes printing
2080 '

```

(continues)

Listing 1: GRUMP2ID for Integral Data Systems P-Series printer

```

2090 ' High Resolution Printing
2100 ' -----
2110 FOR COL=SCRRIGHT TO REMAINDER+1 STEP STEPSIZE
2120 GET (COL,SCRTOP)-(COL-GETWIDTH,SCRBOT),SCRCOL
2130 GOSUB 3000 ' Printing routine
2140 NEXT
2150 '
2160 GET (REMAINDER,SCRTOP)-(SCRLEFT,SCRBOT),SCRCOL ' Last line, which is
    smaller
2170 SHIFT=8-(REMAINDER+1)
2180 GOSUB 3000 ' Printing routine
2190 GOTO 2640 ' To end
2470 '
2480 ' Medium Resolution Printing
2490 ' -----
2500 FOR COL=SCRRIGHT TO REMAINDER+1 STEP STEPSIZE
2510 GET (COL,SCRTOP)-(COL-GETWIDTH,SCRBOT),SCRCOL
2520 SHIFT=0:GOSUB 3000 'Printing
2530 GET (COL-GETWIDTH,SCRTOP)-(COL-2*GETWIDTH,SCRBOT),SCRCOL
2540 SHIFT=1:GOSUB 3000 'Printing
2550 NEXT
2560 '
2570 GET (REMAINDER,SCRTOP)-(REMAINDER-GETWIDTH,SCRBOT),SCRCOL '
    Second to last line
2580 SHIFT=0:GOSUB 3000 ' Printing
2590 GET (REMAINDER-GETWIDTH,SCRTOP)-(SCRLEFT,SCRBOT),SCRCOL ' Last line
2600 SHIFT=5:GOSUB 3000 ' Printing
2610 '
2620 ' Switch printer back to regular mode
2630 ' -----
2640 PRINT #1, TOREG$;
2650 END
2970 '
2980 ' Machine language printing subroutine
2990 ' -----
3000 PR(0)=REPS:PR(1)=SPECNUM:PR(2)=CLEARBITS:PR(3)=SETBITS:PR(4)=SHIFT '
    Transfer parameters so PRINTROW can get to them
3010 PR(5)=VARPTR(SCRCOL(2)) ' Transfer starting address of SCRCOL
3020 PR(6)=0 ' Clear error flag
3030 '
3040 '
3050 PRINTROW=VARPTR(PR(7)) ' Address of machine language routine

```

Listing 1 (continued)

slightly faster and sets up the proper format for SCRCOL, the array at which the graphics bytes from the screen are stored.

GOSUB 4000 indicates whether the screen has high or medium resolution; the value is stored in the variable SCREENSTAT. After returning from the subroutine, the program checks to see if the value is between 4 and 6. A SCREENSTAT value of 6 means a high-resolution screen (SCREEN 2); 4 or 5 means medium resolution (SCREEN 1). If the value is not 4, 5, or 6, the program jumps to a short error message routine at line 5000.

The program then loads the machine language printing subroutine. There are several ways to integrate a

machine language subroutine into a BASIC program. The best and easiest method is to reserve space for the routine within the BASIC work space (line 4500). DIM PR(48) creates an integer array having 49 elements of 2 bytes each. These 98 bytes are next to each other in memory, with PR(0) at the bottom and PR(48) at the top. BASIC sets each byte to zero and then leaves this memory space alone unless you assign a value to one of the elements. In lines 4520 to 4540, values are assigned to PR(7) through PR(48) with DATA statements.

Lines 1000 to 1250 declare all constants and most variables. Screen constants come first and are the same for all versions of GRUMP. SCRCOL(SCRCOLSIZE) is the holding array for the bytes you GET off the screen.

```

3060 CALL PRINTROW(PR(0))
3070 IF PR(6) THEN ERROR 24 ' Error 24 is Device Timeout, traps to 5000
3080 PRINT #1, CRLF$;
3090 RETURN
3970 '
3980 ' Find out what screen we're on
3990 ' -----
4000 DEF SEG = 0:SCREENSTAT=PEEK(1024+73):DEF SEG
4010 RETURN
4470 '
4480 ' Load machine language printing routine
4490 ' -----
4500 DIM PR(48) ' Array to hold machine language subroutine
4510 CHECK=0 ' Check-value, to catch typos in entering the &H'numbers
4520 FOR N=7 TO 48 ' PR(0) to PR(6) hold data, so start with 6
4530 READ PR(N):CHECK=CHECK XOR PR(N)
4540 NEXT
4550 READ CROSSCHECK ' CHECK and CROSSCHECK should be the same
4560 RETURN
4570 '
4580 ' Data for machine language routine
4590 ' -----
4600 ' Data on following line is for printer that prints LOW BIT UP. For
    printers that print HIGH BIT UP, change to &HBADF
4610 DATA &HB AFC
4620 ' Data on following line is for LPT1:. For LPT2: change it to &H0001,
    for LPT3: to &H0002
4630 DATA &H0000
4640 ' Data on following 5 lines is the same for all versions
4650 DATA &H8B55,&H8BEC,&H065E,&H778B,&H8A0A,&H084F,&HC8BF,&HAC00,&HE8D2
4660 DATA &H4722,&H0A04,&H0647,&H22E8,&H0A00,&H75E4,&HF617,&H0247,&H74FF
4670 DATA &H3A0C,&H0247,&H0775,&H10E8,&H0A00,&H75E4,&H4F05,&HDB75,&HC033
4680 DATA &H4789,&H5D0C,&H02CA,&H8A00,&H322F,&HCDE4,&HF617,&H29C4,&H0B75
4690 DATA &HCD FE,&HF375,&HE432,&H00C3
4700 ' Next line is a CROSSCHECK for LOW BIT UP printers and LPT1:. For
    HIGH BIT UP printers and LPT1: change to &H3452
4710 DATA &H3453
4970 '
4980 ' Error messages
4990 ' -----
5000 BEEP:PRINT ERRMSG$:END

```

SCRLEFT, SCRRIGHT, SCRTOP, and SCRBOT are the four extremes of the PC graphics screen.

Lines 1070 through 1240 declare the printer-dependent variables. REPS indicates how many times a byte from the screen is repeated for printing. REPS will be 2 for most printers. SETBITS holds the value of the bit(s) that you want to set to 1. CLEARBITS sets a bit to 0. You subtract the value of the bit you want to clear from 255. For example, CLEARBITS=255-128 clears the high bit, because bit 7 has a value of 128. AND CLEARBITS is the actual command.

NUMDOTS (line 1110) is the number of dots a printer prints, be it 6, 7, or 8. Closely related is STEPSIZE (line 1120), which sets the size of the "step" the computer takes across the screen as it takes graphics bytes. You should set a STEPSIZE to take the NUMDOTS value previously specified. (If your printer prints 6 dots, a step should be 6. This means that a column 6 pixels across and 200 lines high is taken.)

Remember that STEPSIZE for medium-resolution graphics is half that for high-resolution graphics because each pixel is 2 bits. With 7-dot printers, STEPSIZE is always the same since you can't take 3½ pixels. The sign of STEPSIZE is positive if the printer is a high-bit-up type and negative if it is a low-bit-up type.

```

10 ' *****
20 ' *****      GRUMP for the Radio Shack LP VIII      *****
30 ' *****      High and Medium Resolution Screens      *****
40 ' *****      Machine Language Subroutine            *****
50 ' *****
60 ' This program prints IBM PC high and medium resolution
70 ' graphic screens (SCREEN 1, SCREEN 2) on an RS LP VIII
80 ' printer using a machine language routine. It works with
90 ' BASICA 1.1 and BASICA 2.0.
100'

100-1060 same as in Listing 1

1070 REPS=2 ' How many times a byte should be repeated in printing
1080 SETBITS=128 ' 0 means no bits need setting. To set a bit, set SETBITS
      to the value of the bit you want to set
1090 CLEARBITS=255 '255 means no bits need clearing. To clear a bit,
      subtract its value from 255.
1100 SPECNUM=0 ' Any special numbers for your printer that need printing
      twice, such as 3 for P-Series printers. SPECNUM=0 means no special number
1110 NUMDOTS=7 ' How many dots the printer prints in one pass
1120 STEPSIZE=-NUMDOTS 'How we step through the screen
1130 IF SCREENSTAT=6 THEN GETWIDTH=6 ELSE GETWIDTH=3 ' GETWIDTH+1 dots are
      taken off the screen in one pass
1140 REMAINDER=SCRRIGHT MOD NUMDOTS ' Screen column number of last printer
      line (HiRes) or last two lines (MedRes)
1150 SHIFT=1 ' Number of bit positions to shift to right. 0 means no shift.
1160 PRINTROW=0 ' This variable will hold the address of the printing routine
1190 '
1200 TOGRAPH$=CHR$(18) ' Switch to graphics
1210 TOREG$=CHR$(30)+STRING$(8,10)+CHR$(13) ' Switch back to regular
1220 ' SETCRLF$, not needed for this printer
1230 CRLF$=CHR$(13)+CHR$(10) ' Actual graphic carriage return/linefeed
1240 LMARGIN$= CHR$(27)+ CHR$(16)+CHR$(0)+CHR$(40) ' Not preset
1970 '
1980 ' Setting up the printer
1990 ' -----
2000 ON ERROR GOTO 5000:ERRMSG$="Printer is not responding"
2010 OPEN "LPT2:" AS #1 ' Printing in random mode
2020 WIDTH #1, 255 ' Keep BASIC from adding carriage returns every 80 bytes
2030 PRINT #1, TOGRAPH$; ' Switch graphics mode on
2040 PRINT #1, CRLF$;
2050 '
2060 IF SCREENSTAT<>6 THEN 2500 ' MedRes printing
2070 '
2080 ' High Resolution Printing
2090 ' -----
2100 FOR COL=SCRRIGHT TO REMAINDER+1 STEP STEPSIZE
2110 GET (COL,SCRTOP)-(COL-GETWIDTH,SCRBOT),SCRCOL
2120 GOSUB 3000 ' Printing routine
2130 NEXT
2140 '
2150 GET (REMAINDER, SCRTOP)-(SCRLEFT,SCRBOT),SCRCOL ' Last line, which is
      smaller
2160 SHIFT=8-(REMAINDER+1)
2170 GOSUB 3000 ' Printing routine
2180 GOTO 2640 ' To end
2470 '
2480 ' Medium Resolution Printing
2490 ' -----
2500 FOR COL=SCRRIGHT TO REMAINDER+1 STEP STEPSIZE
2510 GET (COL,SCRTOP)-(COL-GETWIDTH,SCRBOT),SCRCOL
2520 SHIFT=0:GOSUB 3000 'Printing
2530 GET (COL-GETWIDTH,SCRTOP)-(COL-2*GETWIDTH,SCRBOT),SCRCOL

```

Listing 2: GRUMP2RS for Radio Shack Line Printer VIII

```

2540 SHIFT=1:GOSUB 3000 'Printing
2550 NEXT
2560 '
2570 GET (REMAINDER,SCRTOP)-(REMAINDER-GETWIDTH,SCRBOT),SCRCOL '
      Second to last line
2580 SHIFT=0:GOSUB 3000 ' Printing
2590 GET (REMAINDER-GETWIDTH,SCRTOP)-(SCRLEFT,SCRBOT),SCRCOL ' Last line
2600 SHIFT=5:GOSUB 3000 ' Printing
2610 '
2620 ' Switch printer back to regular mode
2630 ' -----
2640 PRINT #1, TOREG$;
2650 END
2970 '
2980 ' Machine language printing subroutine
2990 ' -----
3000 PR(0)=REPS:PR(1)=SPECNUM:PR(2)=CLEARBITS:PR(3)=SETBITS:PR(4)=SHIFT '
      Transfer parameters so PRINTROW can get to them
3010 PR(5)=VARPTR(SCRCOL(2)) ' Transfer starting address of SCRCOL
3020 PR(6)=0 ' Clear error flag
3030 '
3040 PRINT #1, LMARGIN$;
3050 PRINTROW=VARPTR(PR(7)) ' Address of machine language routine
3060 CALL PRINTROW(PR(0))
3070 IF PR(6) THEN ERROR 24 ' Error 24 is Device Timeout, traps to 5000
3080 PRINT #1, CRLF$;
3090 RETURN
3970 '
3980 ' Find out what screen we're on
3990 ' -----
4000 DEF SEG = 0:SCREENSTAT=PEEK(1024+73):DEF SEG
4010 RETURN
4470 '
4480 ' Load machine language printing routine
4490 ' -----
4500 DIM PR(48) ' Array to hold machine language subroutine
4510 CHECK=0 ' Check-value, to catch typos in entering the &H'numbers
4520 FOR N=7 TO 48 ' PR(0) to PR(6) hold data, so start with 6
4530 READ PR(N):CHECK=CHECK XOR PR(N)
4540 NEXT
4550 READ CROSSCHECK ' CHECK and CROSSCHECK should be the same
4560 RETURN
4570 '
4580 ' Data for machine language routine
4590 ' -----
4600 ' Data on following line is for printer that prints LOW BIT UP.
      For printers that print HIGH BIT UP, change to &HBAFD
4610 DATA &HBAFC
4620 ' Data on following line is for LPT2:.. For LPT1: change it to &H0000,
      for LPT3: to &H0002
4630 DATA &H0001
4640 ' Data on following 5 lines is the same for all versions
4650 DATA &H8B55,&H8BEC,&H065E,&H778B,&H8A0A,&H084F,&HC8BF,&HAC00,&HE8D2
4660 DATA &H4722,&H0A04,&H0647,&H22E8,&H0A00,&H75E4,&HF617,&H0247,&H74FF
4670 DATA &H3A0C,&H0247,&H0775,&H10E8,&H0A00,&H75E4,&H4F05,&HDB75,&HC033
4680 DATA &H4789,&H5DOC,&H02CA,&H8A00,&H322F,&HCDE4,&HF617,&H29C4,&H0B75
4690 DATA &HCDFE,&HF375,&HE432,&H00C3
4700 ' Next line is a CROSSCHECK for LOW BIT UP printers and LPT2:.. For
      HIGH BIT UP printers and LPT2: change to &H3453
4710 DATA &H3452
4970 '
4980 ' Error messages
4990 ' -----
5000 BEEP:PRINT ERRMSG$:END

```

```

10 ' *****
20 ' ***** GRUMP for Anadex & DataSouth Printers *****
30 ' ***** High and Medium Resolution Screens *****
40 ' ***** Machine Language Subroutine *****
50 ' *****
60 ' This program prints IBM PC high and medium resolution
70 ' graphic screens (SCREEN 1, SCREEN 2) on many Anadex &
80 ' DataSouth printers using a machine language routine.
90 ' Compatible with BASICA 1.1 and BASICA 2.0.
100'

100-1060 same as in Listing 1

1070 REPS=2 ' How many times a byte should be repeated in printing
1080 SETBITS=64 ' 0 means no bits need setting. To set a bit, set SETBITS
to the value of the bit you want to set. 64 means set bit 6.
1090 CLEARBITS=255-128 ' 255 means no bits need clearing. To clear a bit,
subtract its value from 255. 255-128 means clear the high bit.
1100 SPECNUM=0 ' Any special number for your printer that needs printing
twice, such as 3 for P-Series printers. SPECNUM=0 means no special number
1110 NUMDOTS=6 ' How many dots the printer prints in one pass
1120 IF SCREENSTAT=6 THEN STEPSIZE=NUMDOTS ELSE STEPSIZE=NUMDOTS\2 ' MedRes
dots are 2 bits, so we step only half the number of dots
1130 IF SCREENSTAT=6 THEN GETWIDTH=5 ELSE GETWIDTH=2 ' GETWIDTH +1 dots are
taken off the screen in one pass
1140 REMAINDER=SCRRIGHT MOD STEPSIZE ' Screen column number of first
narrower printer line
1150 IF SCREENSTAT=6 THEN SHIFT=8-(REMAINDER+1) ELSE SHIFT=
8-((REMAINDER+1)*2) 'Number of bits to shift for the first remainder
column
1160 PRINTROW=0 ' Variable will hold the address of the printing routine
1190 '
1200 TOGRAPH$=CHR$(28) ' Switch to graphics
1210 TOREG$=CHR$(29)+CHR$(12) ' Switch back & advance to next page
1220 ' SETCRLF$, not needed for this printer
1230 CRLF$="6" ' Actual graphic carriage return/linefeed
1240 LMARGIN$=";100" ' Left paper margin to center image, not preset
1970 '
1980 ' Setting up the printer
1990 ' -----
2000 ON ERROR GOTO 5000:ERRMSG$="Printer is not responding"
2010 OPEN "LPT1:" AS #1 ' Printing in random mode
2020 WIDTH #1, 255 ' Keep BASIC from adding carriage returns every 80 bytes
2030 PRINT #1, TOGRAPH$; ' Switch graphics mode on
2040 PRINT #1, CRLF$;
2050 '
2060 ' High and Medium Resolution Printing
2070 ' -----
2080 GET (SCRLEFT,SCRTOP)-(REMAINDER,SCRBOT),SCRCOL ' First line, which is
smaller
2090 GOSUB 3000 ' Printing routine
2100 '
2110 SHIFT=2
2120 FOR COL=REMAINDER+1 TO SCRRIGHT STEP STEPSIZE
2130 GET (COL,SCRTOP)-(COL+GETWIDTH,SCRBOT),SCRCOL
2140 GOSUB 3000 ' Printing routine
2150 NEXT

```

Listing 3: GRUMP2AD for Anadex and DataSouth printers

```

2160 '
2170 ' Switch printer back to regular mode
2180 ' -----
2190 PRINT #1, TOREG$;
2200 END
2970 '
2980 ' Machine language printing subroutine
2990 ' -----
3000 PR(0)=REPS:PR(1)=SPECNUM:PR(2)=CLEARBITS:PR(3)=SETBITS:PR(4)=SHIFT '
    Transfer parameters so PRINTROW can get to them
3010 PR(5)=VARPTR(SCRCOL(SCRCOLSIZE))+1 ' Transfer starting address of SCRCOL
3020 PR(6)=0 ' Clear error flag
3030 '
3040 PRINT #1, LMARGIN$;
3050 PRINTROW=VARPTR(PR(7)) ' Address of machine language routine
3060 CALL PRINTROW(PR(0))
3070 IF PR(6) THEN ERROR 24 ' Error 24 is Device Timeout, traps to 5000
3080 PRINT #1, CRLF$;
3090 RETURN
3970 '
3980 ' Find out what screen we're on
3990 ' -----
4000 DEF SEG = 0:SCREENSTAT=PEEK(1024+73):DEF SEG
4010 RETURN
4470 '
4480 ' Load machine language printing routine
4490 ' -----
4500 DIM PR(48) ' Array to hold machine language subroutine
4510 CHECK=0 ' Check-value, to catch typos in entering the &H'numbers
4520 FOR N=7 TO 48 ' PR(0) to PR(6) hold data, so start with 6
4530 READ PR(N):CHECK=CHECK XOR PR(N)
4540 NEXT
4550 READ CROSSCHECK ' CHECK and CROSSCHECK should be the same
4560 RETURN
4570 '
4580 ' Data for machine language routine
4590 ' -----
4600 ' Data on following line is for printer that prints HIGH BIT UP. For
    printers that print LOW BIT UP, change to &HBAFC
4610 DATA &HBAFD
4620 ' Data on following line is for LPT1:. For LPT2: change it to &H0001,
    for LPT3: to &H0002
4630 DATA &H0000
4640 ' Data on following 5 lines is the same for all versions
4650 DATA &H8B55,&H8BEC,&H065E,&H778B,&H8A0A,&H084F,&HC8BF,&HAC00,&HE8D2
4660 DATA &H4722,&H0A04,&H0647,&H22E8,&H0A00,&H75E4,&HF617,&H0247,&H74FF
4670 DATA &H3A0C,&H0247,&H0775,&H10E8,&H0A00,&H75E4,&H4F05,&HDB75,&HC033
4680 DATA &H4789,&H5DOC,&H02CA,&H8A00,&H322F,&HCDE4,&HF617,&H29C4,&H0B75
4690 DATA &HCDFE,&HF375,&HE432,&H00C3
4700 ' Next line is a CROSSCHECK for HIGH BIT UP printers and LPT1:. For
    LOW BIT UP printers and LPT1: change to &H3453
4710 DATA &H3452
4970 '
4980 ' Error messages
4990 ' -----
5000 BEEP:PRINT ERRMSG$:END

```

```

10 ' *****
20 ' ***** GRUMP for Epson MX, FX & IBM Graphic Printers *****
30 ' ***** High and Medium Resolution Screens *****
40 ' ***** Machine Language Subroutine *****
50 ' *****
60 ' This program prints IBM PC high and medium resolution
70 ' graphic screens (SCREEN 1, SCREEN 2) on Epsons with bit
80 ' graphics mode & the IBM Graphic printer using a machine
90 ' language routine. Works with BASICA 1.1 and BASICA 2.0.
100'

100-1060 same as in Listing 1

1070 REPS=2 ' How many times a byte should be repeated in printing
1080 SETBITS=0 ' 0 means no bits need setting. To set a bit, set SETBITS
to the value of the bit you want to set
1090 CLEARBITS=255 ' 255 means no bits need clearing. To clear a bit,
subtract its value from 255.
1100 SPECNUM=0 ' Any special number for your printer that needs printing
twice, such as 3 for P-Series printers. SPECNUM=0 means no special number
1110 NUMDOTS=8 ' How many dots the printer prints in one pass
1120 IF SCREENSTAT=6 THEN STEPSIZE=NUMDOTS ELSE STEPSIZE=NUMDOTS\2 ' In
MedRes each dot is 2 bits, so we step half the number of dots
1130 IF SCREENSTAT=6 THEN GETWIDTH=7 ELSE GETWIDTH=3 ' GETWIDTH +1 dots are
taken off the screen in one pass
1140 ' REMAINDER, not needed for 8 bit printers
1150 SHIFT=0 ' Number of bit positions to shift to right. 0 means no shift
1160 PRINTROW=0 ' This variable will hold the address of the printing
routine
1190 '
1200 TOGRAPH$=CHR$(27)+"K"+CHR$(144)+CHR$(1) ' Switch to graphics and tell
how many graphic bytes we are going to send
1210 TOREG$=CHR$(27)+"2"+CHR$(27)+"@" ' Reset printer to normal state
1220 SETCRLF$=CHR$(27)+"3"+CHR$(24) ' Set graphic linefeed advance distance
1230 CRLF$=CHR$(13)+CHR$(10) ' Actual graphic carriage return/linefeed
1240 LMARGIN$=SPACE$(6) ' Left paper margin to center image, not preset
1970 '
1980 ' Setting up the printer
1990 ' -----
2000 ON ERROR GOTO 5000:ERRMSG$="Printer is not responding"
2010 OPEN "LPT1:" AS #1 ' Printing in random mode
2020 WIDTH #1, 255 ' Keep BASIC from adding carriage returns every 80 bytes
2030 PRINT #1, SETCRLF$; ' Set linefeed advance distance
2040 PRINT #1, CRLF$; ' Clear buffer
2050 '
2060 ' High and Medium Resolution Printing
2070 ' -----
2080 FOR COL=SCRLEFT TO SCRRIGHT STEP STEPSIZE
2090 GET (COL,SCRTOP)-(COL+GETWIDTH,SCRBOT),SCRCOL
2100 GOSUB 3000 ' Printing routine
2110 NEXT
2120 '
2130 ' Switch printer back to regular mode
2140 ' -----

```

Listing 4: GRUMP2EP for Epson and IBM Graphic printers

```

2150 PRINT #1, TOREG$;
2160 END
2970 '
2980 ' Machine language printing subroutine
2990 ' -----
3000 PR(0)=REPS:PR(1)=SPECNUM:PR(2)=CLEARBITS:PR(3)=SETBITS:PR(4)=SHIFT '
    Transfer parameters so PRINTROW can get to them
3010 PR(5)=VARPTR(SCRCOL(SCRCOLSIZE))+1 ' Transfer starting address of
    SCRCOL
3020 PR(6)=0 ' Clear error flag
3030 '
3040 PRINT #1, LMARGIN$ TOGRAPH$;
3050 PRINTROW=VARPTR(PR(7)) ' Address of machine language routine
3060 CALL PRINTROW(PR(0))
3070 IF PR(6) THEN ERROR 24 ' Error 24 is Device Timeout, traps to 5000
3080 PRINT #1, CRLF$;
3090 RETURN
3970 '
3980 ' Find out what screen we're on
3990 ' -----
4000 DEF SEG = 0:SCREENSTAT=PEEK(1024+73):DEF SEG
4010 RETURN
4470 '
4480 ' Load machine language printing routine
4490 ' -----
4500 DIM PR(48) ' Array to hold machine language subroutine
4510 CHECK=0 ' Check-value, to catch typos in entering the &H'numbers
4520 FOR N=7 TO 48 ' PR(0) to PR(6) hold data, so start with 6
4530 READ PR(N):CHECK=CHECK XOR PR(N)
4540 NEXT
4550 READ CROSSCHECK ' CHECK and CROSSCHECK should be the same
4560 RETURN
4570 '
4580 ' Data for machine language routine
4590 ' -----
4600 ' Data on following line is for printer that prints HIGH BIT UP. For
    printers that print LOW BIT UP, change to &HBAFC
4610 DATA &HBAFD
4620 ' Data on following line is for LPT1:. For LPT2: change it to &H0001,
    for LPT3: to &H0002
4630 DATA &H0000
4640 ' Data on following 5 lines is the same for all versions
4650 DATA &H8B55,&H8BEC,&H065E,&H778B,&H8A0A,&H084F,&HC8BF,&HAC00,&HE8D2
4660 DATA &H4722,&H0A04,&H0647,&H22E8,&H0A00,&H75E4,&HF617,&H0247,&H74FF
4670 DATA &H3A0C,&H0247,&H0775,&H10E8,&H0A00,&H75E4,&H4F05,&HDB75,&HC033
4680 DATA &H4789,&H5DOC,&H02CA,&H8A00,&H322F,&HCDE4,&HF617,&H29C4,&HOB75
4690 DATA &HCDFE,&HF375,&HE432,&H00C3
4700 ' Next line is a CROSSCHECK for HIGH BIT UP printers and LPT1:. For
    LOW BIT UP printers and LPT1: change to &H3453
4710 DATA &H3452
4970 '
4980 ' Error messages
4990 ' -----
5000 BEEP:PRINT ERRMSG$:END

```

☉ Hands On

GETWIDTH (line 1130) is the width of the column taken off the screen measured in pixels. Because GET takes both “edges” of a screen column, the value of GETWIDTH must be 1 pixel less. For an 8-dot printer GETWIDTH is 7 in high resolution and 3 in medium resolution; for 6-bit printers GETWIDTH is 5 in high resolution and 2 in medium resolution.

REMAINDER (line 1140) is the number of pixels left over after you’ve stepped through the screen—for 6- and 7-dot printers (8-dot printers don’t have a remainder). In high resolution, for example, 639 pixels divided by 7 (for a 7-dot printer) leaves a REMAINDER of 2; 639 divided by 6 (for a 6-dot printer) leaves 3. The MOD function computes the REMAINDER.

If you are using BASICA’s GET statement, a column of graphics bytes can be taken off the screen very quickly—200 columns in about 5 seconds.

As mentioned before, when BASIC GETs a graphics byte from the screen, it stores it in SCRCOL. However, when it GETs fewer than 8 bits at a time (such as 7 bits for a 7-bit printer), it left justifies bits into the eight bit positions of a byte starting from the highest bit.

But printers prefer the bits to be right justified. So you must undo what BASIC has done and SHIFT the bits back to the right. For a 7-bit column you have to SHIFT 1 position. For a REMAINDER of 3 the SHIFT is 3.

The beginning of the main routine (line 2000) starts with an error trap in case the printer malfunctions or you forget to turn it on. RESUME does not follow because there is no point in printing a graphics image with an error message printed over it. It’s best not to insert this line in your own GRUMP version until it is fully debugged, because any error (not just printer errors) will send the program to the error message routine.

The printer is set to “infinite” width with the WIDTH #1, 255 statement (line 2020), which keeps BASIC from inserting unwanted carriage returns and paper advances at the end of every line.

Next the printer is set for graphics printing. CRLF\$ (line 2050) at the end of the initialization clears the

printer’s buffers by printing it out. The exact procedure varies from printer to printer, but the pattern is essentially the same.

Finally, the system is ready to start getting bytes off the screen and begin printing. The actual print sub-routines start at line 3000.

Because machine language is so fast, PRINTROW always performs operations such as shifting, setting, and clearing bits and checking for special numbers even if the printer doesn’t need it. Thus, PRINTROW works for all printers. The five familiar BASIC variables—REPS, SPECNUM, CLEARBITS, SETBITS, and SHIFT—determine what the routine does. By changing two DATA statements (lines 4610 and 4630), you can customize the routine for low- or high-bit-up printers.

If your printer doesn’t need a particular function, you can set SPECNUM, SETBITS, and SHIFT to 0, or CLEARBITS to 255 to keep them from having any effect. The actual printing bypasses BASIC and DOS; PRINTROW uses a printing routine that’s built into the BIOS ROM chip of the PC.

First, the variables needed by PRINTROW are assigned to PR(0) through PR(4). Then the beginning address of SCRCOL is transferred through PR(5). For low-bit-up printers the beginning address is that of SCRCOL(2). For high-bit-up printers, the beginning is at the other end, one more than the address of SCRCOL(SCRCOLSIZE).

PR(6) is used as an error flag, and it is cleared before calling PRINTROW. If something goes wrong in the printing, PRINTROW sets PR(6) to a value other than 0 and generates a Device Timeout Error. The ON ERROR GOTO 5000 statement from line 2000 goes into effect, and an error message is sent.

On printers that require it, control strings are sent just before printing a graphics line. PRINTROW is called, a line is printed, and control returns to the main routine.

And that’s how GRUMP works. Even if the printer you have isn’t listed here, you should be able to modify a GRUMP program without major problems. If I’m wrong, please don’t call me at 2 a.m.; I’m quite grumpy when awakened. ☹

Peter Baenziger is a freelance writer and filmmaker who also works as manager of photographic and audiovisual services for the Upjohn Pharmaceutical Company.

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Enter project name: BUDGET PLANNING

Enter report name: SALES-ADMINISTRATIVE EXPENSES

Description of budget period: 1983

COMMAND: Example Help Load Next Quit Review Save

Enter responses:
Press tab to move to command line. Expert System response

SELLING AND ADMINISTRATIVE - INTERVAL SELECTION

Monthly

Quarterly

Annually

Other

COMMAND: Example Help Load Next Quit Review Save

Type an "x" beside one choice
Press tab to move to command line. Expert System response

SALES REVENUE

Enter sales revenue for each quarter

1st Qtr 1983 \$ 2500000

2nd Qtr 1983 \$ 2600000

3rd Qtr 1983 \$ 2500000

4th Qtr 1983 \$ 2600000

COMMAND: Example Help Load Next Quit Review Save

Enter responses:
Press tab to move to command line. Expert System response

VARIABLE SELLING EXPENSES - EXPENSES INCLUDED

List desired subprograms by typing an "x" beside the number on the line.
If suggested responses should not be wanted, delete them or
replace them with your own preferred categories.

Variable Selling Expenses: 1 - Commissions

Variable Selling Expenses: 2 - Office

Variable Selling Expenses: 3 -

Variable Selling Expenses: 4 -

Variable Selling Expenses: 5 -

Variable Selling Expenses: 6 -

Variable Selling Expenses: 7 -

Variable Selling Expenses: 8 -

Variable Selling Expenses: 9 -

Variable Selling Expenses: 10 -

COMMAND: Example Help Load Next Quit Review Save

Select option or type command letter
Press tab to move to command line. Expert System response

Gentlemen, start your computers.

Select budget intervals.

Enter sales revenue.

Enter selling expenses.

Time: 0

Time: 0.5

Time: 1.0

Time: 1.5

	1983	1st Qtr 1983	2nd Qtr 1983
7 SALES REVENUE	2,560,000	2,500,000	
8 VARIABLE SELLING EXPENSES			
9 Commissions	150	25,000	26,559
10 Other	120	30,720	31,870
11			
12 TOTAL VARIABLE SELLING	56,320	55,720	58,429
13 FIXED SELLING EXPENSES			
14 Salaries	112,140	112,140	
15 Advertising	100,000	100,000	
16			
17 TOTAL FIXED SELLING	212,140	212,140	
18			
19			
20 VARIABLE ADMINISTRATIVE EXPENSES	950	23,040	23,903
21 Accounting			

COMMAND: Alpha Blank Copy Delete Edit Format Grids Help Insert
Lock Move Names Options Print Quit Sort Transfer
Value Window Window

Select option or type command letter
Press tab to move to command line. Expert System response

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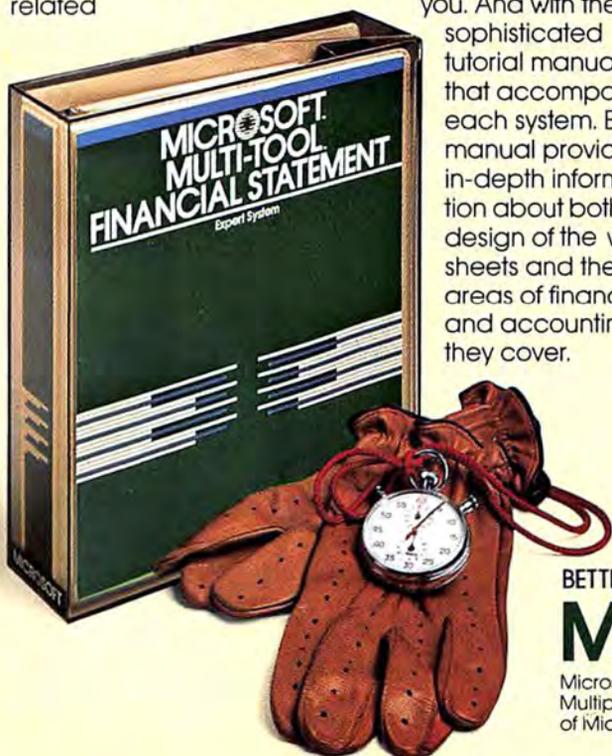
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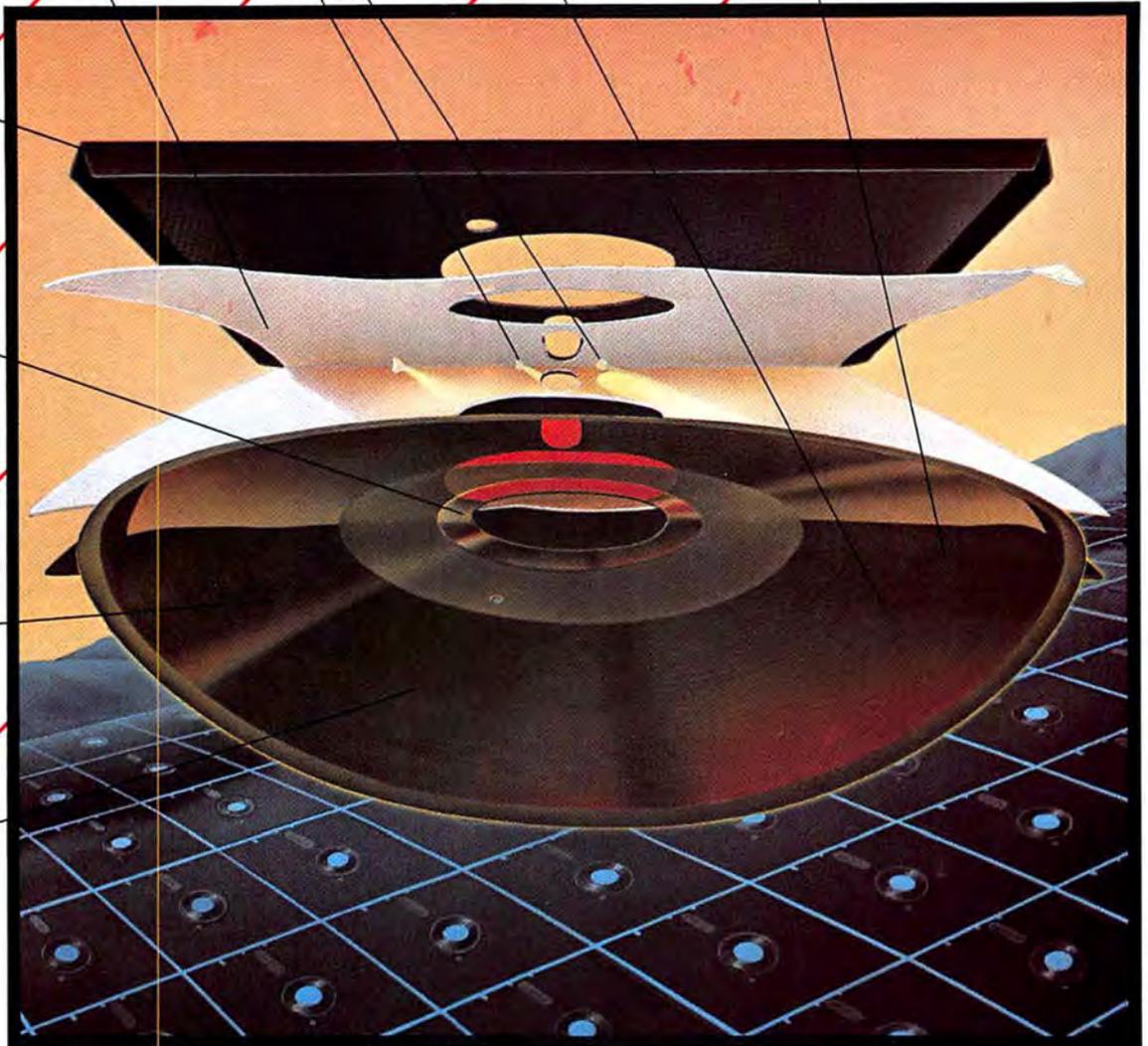
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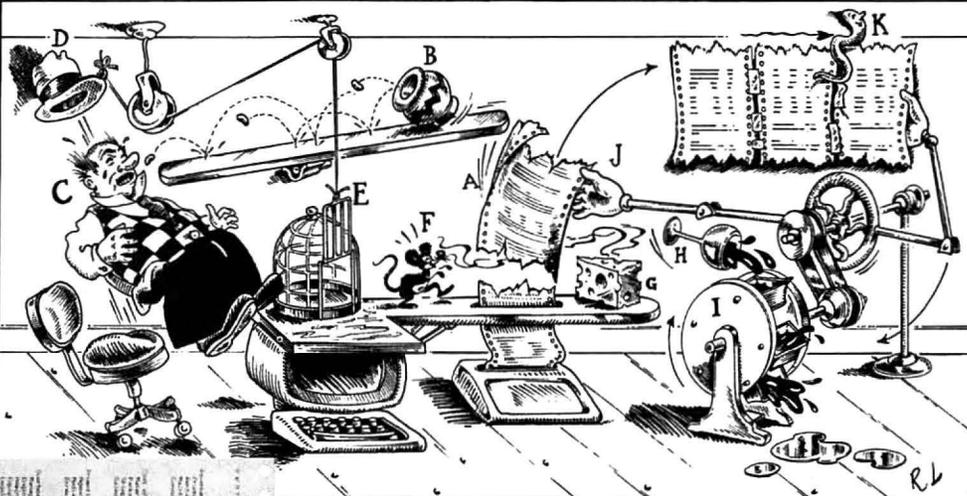
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MOUSE, INSPIRED BY SCENT OF PERFECTLY AGED CAMEMBERT CHEESE, GNAWS THROUGH SPREADSHEET, ONLY TO DISCOVER HE HAS BEEN FOOLED BY AROMA OF OVER-RIPE GORGONZOLA (G).

IN A FIT OF PIQUE HE SPILLS VINTAGE WINE (H) INTO WATER-WHEEL (I) WHICH TURNS PULLEY THAT CAUSED GLOVE (J) TO GRASP SPREADSHEET AND MOVE IT TO TAPING AREA.

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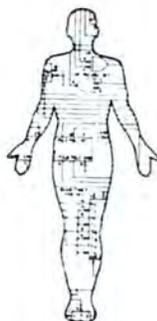
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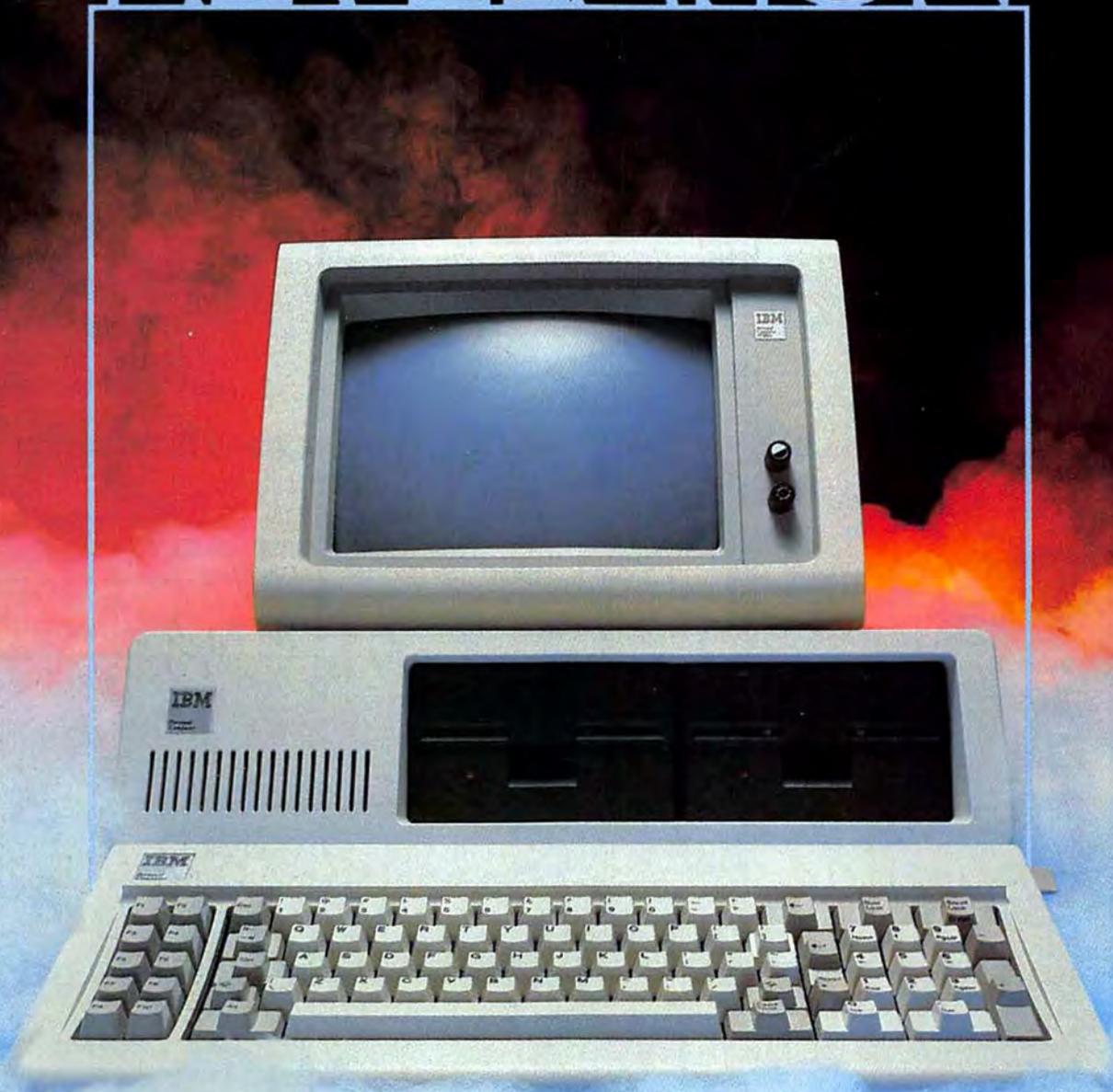
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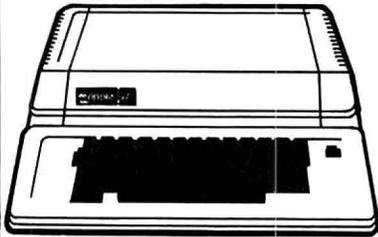
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APPLE IIe STARTER SYSTEM BY APPLE (System A) 64K and 80 column Disk II with controller Apple Monitor III Monitor Stand	\$1,650
APPLE IIe STARTER SYSTEM BY CONROY-LA POINTE [SYSTEM B] 128K and 80 column 1 Micro-Sci Drive with controller Frier. Utility and DOS 3.3 Diskette Sanyo 9" Green Monitor RF Modulator (for color TV) Game Paddles Game with color graphics and sound 20 Blank Diskettes	\$1,695

WARRANTY: Limited warranty is 100% Parts & Labor for 90 days by us.

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DESCRIPTION	LIST PRICE	OUR PRICE
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μ-SCI A2, 5-1-4, 143K Disk Drive	\$ 479	\$ 219
MICRO-SCI Controller Card for A2 Drive	\$ 100	\$ 79
★ A40, 160K, 40 Track Drive	\$ 449	\$ 299
★ A70, 286K, 70 Track Drive	\$ 559	\$ 299
A40 A70 Controller Card	\$ 100	\$ 79



Elite 1, 163K, 40 Tracks	\$ 379	\$ 249
Elite 2, 326K, 80 Tracks	\$ 649	\$ 399
Elite 3, 652K, 160 Tracks	\$ 849	\$ 499
Elite Controller w/ Manual & Diskette	\$ 145	\$ 84



● 143K Disk Drive, 1 2 High Controller Card	\$ 379	\$ 259
● Electronics by ComX	\$ 89	\$ 69



Solo, 5" 143K Disk Drive Std Height Controller Card	\$ 300	\$ 249
Disk Pak V1200, 6MB Backup Sys.	\$ 89	\$ 75
★ V1000 Dual 8" Std Format w/ Controller, Complete for Apple	\$1549	\$1049
	\$2195	\$995

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DESCRIPTION	LIST PRICE	OUR PRICE
★ ALS Synergizer - Supercalc - Condor for (II -)	\$ 749	\$ 299
★ Aston 320K RAM Disk System (- or e)	\$1000	\$695
★ CCS , Sena Interface 7710A (Can Set/Baud)	\$ 150	\$ 99
★ ComX 16K RAM Card, 1Yr. Warranty, for II -	\$ 179	\$ 39
Microsoft 16K RAM Card for II -	\$ 100	\$ 69
Saturn Systems 32K RAM Card for II -	\$ 249	\$169
64K RAM Card for II -	\$ 425	\$299
128K RAM Card for II -	\$ 599	\$399
Silicon Valley Word Handler	\$ 250	\$ 39
★ List Handler	\$ 90	\$ 35
Videx , Videoterm 80 column card for II -	\$ 345	\$229



DESCRIPTION	LIST PRICE	OUR PRICE
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10 each, 5-1-4, with ring, DS, DD, 48T (IBM, H.P, etc.)	\$ 75	\$ 35
DYSAN, 10 each, 5-1-4, SS, DD, 48T (Apple, etc.)	\$ 69	\$ 39
10 each, 5-1-4, DS, DD, 48T (IBM, H.P, etc.)	\$ 85	\$ 49
MAXELL, 10 each, 5-1-4, MD-1, SS, DD or DS, DD	\$ 55	\$ 29
10 each, 5-1-4, MD-2, DS, DD, 48T (IBM, H.P, etc.)	\$ 75	\$ 39
VERBATIM, 10 each, 5", Verex, SS, DD, (Apple, Alan)	\$ 40	\$ 21
10 each, 5", MD525-01, SS, DD, (Apple, Alan)	\$ 49	\$ 25
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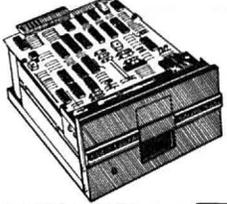
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Apple Interface, Manual & Cable Kit	\$ 300	\$ 239
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MAYNARD , Floppy Drive Control Board, for up to 4 drives, same with Parallel Port	\$ 195	\$ 165
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VISTA IBM-PC XT 6MB Backup for Hard Disk, V1200 \$1549 \$1049

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★ 12" Amber, #300A	\$ 210	\$ 149
★ 12" Amber, 310A for IBM-PC, XT	\$ 230	\$ 159
★ 13" Color I, Composite	\$ 379	\$ 289
★ 13" Color II, RGB, Hi Res (Ap. II, III & IBM-PC)	\$ 529	\$ 439
★ 13" Color III, RGB, Commercial (Ap. II, III)	\$ 479	\$ 399
DVM, Color II or III to Apple II Interface	\$ 199	\$ 175
NEC , 12" Green, Model JB1201/J	\$ 249	\$ 159
12" Color, Composite, Model JC1215M	\$ 400	\$ 299
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PRINCETON , RGB Hi Res, HX-12	\$ 795	\$ 539
★ QUADRAM , Quadchrome 12" RGB Color, 16 colors up to 690X480 Quadscreen 17", 968 x 512, 2 pages, w cable, card, disk	\$ 795	\$ 499
★ SANYO 9" Green, Model DMS 109	\$ 200	\$ 139
12" Green, Model DM8112CX	\$ 260	\$ 199
13" Color, Composite, Model DM6013	\$ 470	\$ 349
ZENITH 12" Green, Model ZVM121	\$ 150	\$ 89

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MX100FT, 80 CPS, with Graftrax + FX100, CPS	\$ 995	\$ 639
Apple II Graphics Dump Program	\$ 15	\$ 9
Graftrax Plus, specify for MX80 or MX100	\$ 95	\$ 79
LEADING EDGE , Gonila Banana	NEW!	\$ 209
OKIDATA , Microline 82A, 80 col., 120 cps, Para. friction & prin feed	\$ 549	\$ 448
Microline 83A, 132 col., 120 cps, Para. friction & tractor feed	\$ 699	\$ 699
Microline 92, 160 CPS, 80 Col., Para. Graphics	\$ 699	\$ 559
Microline 93, 160 CPS, 136 Col., Para. Graphics	\$1249	\$969
ORANGE MICRO , Graffiti - for Apple, specify printer	\$ 165	\$ 119
PRACTICAL PERIPHERALS , Microbuffer In-Line 64K, Parallel Microbuffer In-Line 64K Serial	\$ 349	\$ 259
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IBM-PC Smartcom II Software	\$ 119	\$ 89
Stack Chronograph (RS-232)	\$ 249	\$ 189
Stack Smartmodem 300 (RS-232)	\$ 289	\$ 225
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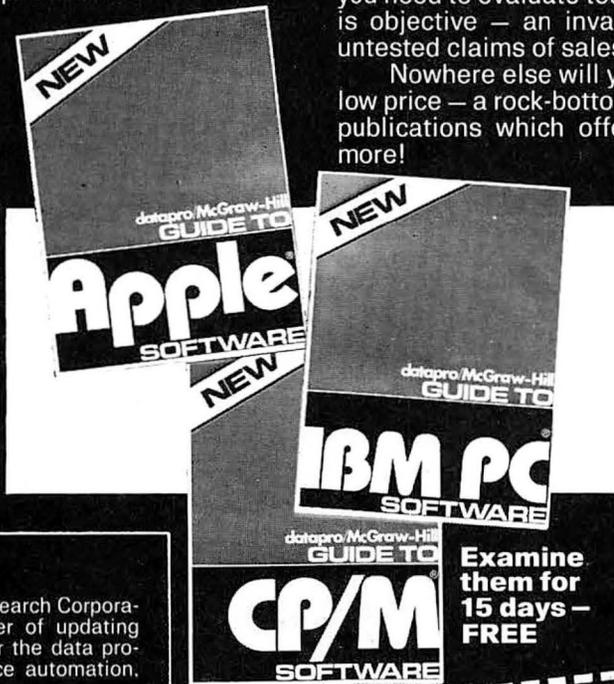
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Text Over Video

Mixing and matching computer and video images on the PC is a matter of the monitor and the interface you choose and how you use them.

Charles Branch

It seems that every time I pick up a computer magazine I see a multitude of advertisements promoting color video monitors for the IBM PC. They come in all sizes and prices and with varying features. There are modified TVs and composite color monitors; low-, medium-, and high-resolution RGBs; TTL RGBs and analog RGBs; positive and negative sync, separate horizontal/vertical sync, composite sync, and sync on green. You can even purchase kits that allow you to build your own monitor. How do you make an intelligent decision in the face of so many choices?

Color monitors can be used for applications such as game playing, brightening up a spreadsheet program, displaying business graphics, or photographing pictures from the screen. You can also use them to display video from a camera, videotape, or video disk—or from several sources at once.

As a professor of physiology at Auburn University School of Veterinary Medicine, my particular interest is creating realistic simulations of animal physiology through interactive video. In my work I need to display standard video from TV cameras and videotape recorders as well as high-resolution text and graphics on the PC. Displaying text and video simultaneously is desirable so that text can be overlaid onto video. This new

technology combines the best features of traditional analog video recording and digital, computer-generated material. Analog video can economically present huge quantities of high-quality, realistic video material. For example, a single \$20 video disk can store 54,000 pictures—quite a step above floppy disk technology. The computer can concentrate on what it does best—controlling the sequence of video presentations interactively based on a student's responses.

Interactive video requires a controller to couple the computer with a video device. These controllers are available for Apple computers and are now becoming available for the PC. Some of the controllers use the RS-232C serial port and are relatively machine independent. Such controllers are becoming available from CAVRI, BCD, and Allen Communications.

Even with the use of these controllers, some problems persist. Some systems require that the computer and the videotape recorder have different monitors; this setup can be very distracting. Others permit a single monitor that switches between the computer and the video recorder. A few systems permit computer text and graphics to be overlaid onto the video display, but most of these devices are difficult to use and produce relatively poor overlays.

RGB vs. Composite Video

Color monitors can be categorized into two main groups: RGB monitors and composite monitors. In an RGB (red-green-blue) video signal, sepa-

RGB monitors are especially useful for displaying computer-generated text and graphics.

rate wires are used to carry intensity information for red, green, and blue components of any color. The monitor combines the separate signals to produce various colors, just as a painter mixes three colors to get various hues. RGB monitors are especially useful for displaying computer-generated text and graphics.

RGB monitors may use either TTL (transistor-transistor logic) or analog input. TTL input refers to ordinary digital signals; the individual red, green, and blue colors are either on or off, and only preset levels of each color component are available. This

situation is comparable to telling an artist that equal portions of the three colors must be used. If both red and blue are on, you get purple. All the possible combinations of red, green, and blue produce only eight colors. The IBM PC can generate eight more colors by using an additional wire to tell the monitor to increase the intensity; this operation yields more shades of the original eight colors.

Analog input provides continuously varying values for each of the three color intensities. Theoretically, an infinite number of color combinations is possible. This process permits some computers to display more colors (typically 256), but the IBM Color/Graphics Adapter cannot take advantage of this feature since it uses TTL signals.

In a composite video signal the red, green, and blue components are superimposed onto one video signal that may be carried over a single wire or TV channel. The composite video monitor must then extract the color intensity information of each color. From that point the colors are processed separately, much as they are in an RGB monitor. An ordinary TV signal requires one additional step—superimposing the composite video signal onto a radio signal. A TV must extract the original composite signal from the radio signal.

Transmitting all the required information on a single channel is more difficult than carrying separate portions of the information on three channels. For practical reasons related to broadcasting requirements and economics, a standard composite color or TV signal cannot match the resolution possible with an RGB signal. That difference in resolution may not be apparent to the viewer. Normal TV screens appear to have better resolution because text is seldom displayed (characters are more difficult to resolve than pictures) and small gradations of intensity and color are supplied. The total picture information on a TV screen is great, but the resolution itself is very limited.

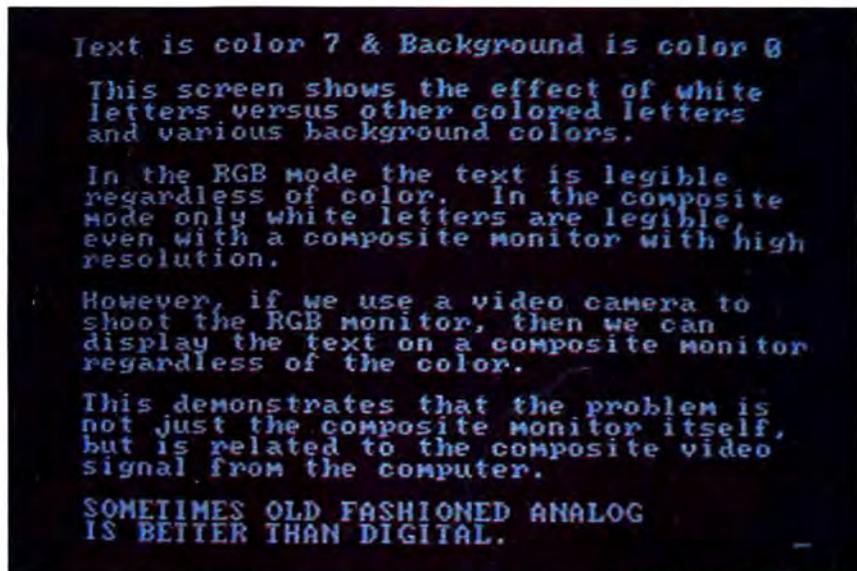


Figure 1: Text on an NEC composite color monitor in black and white

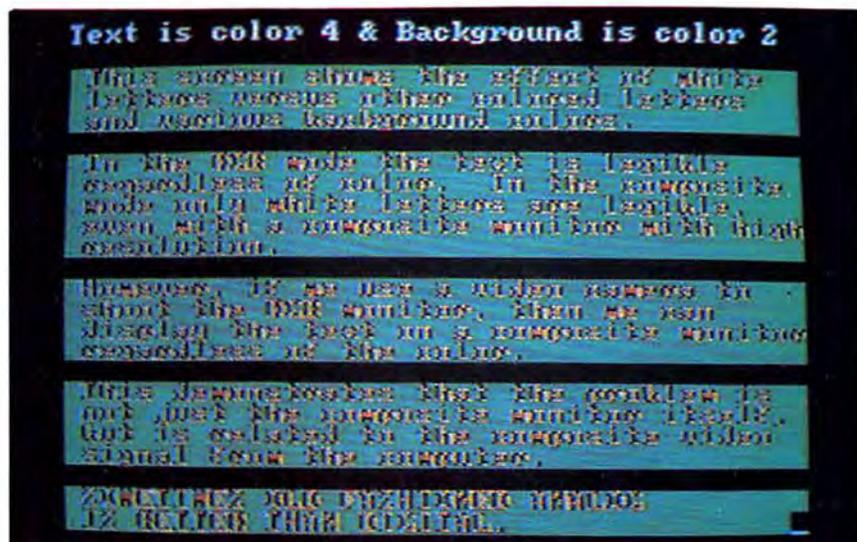


Figure 2: Text on an NEC composite color monitor in red on green

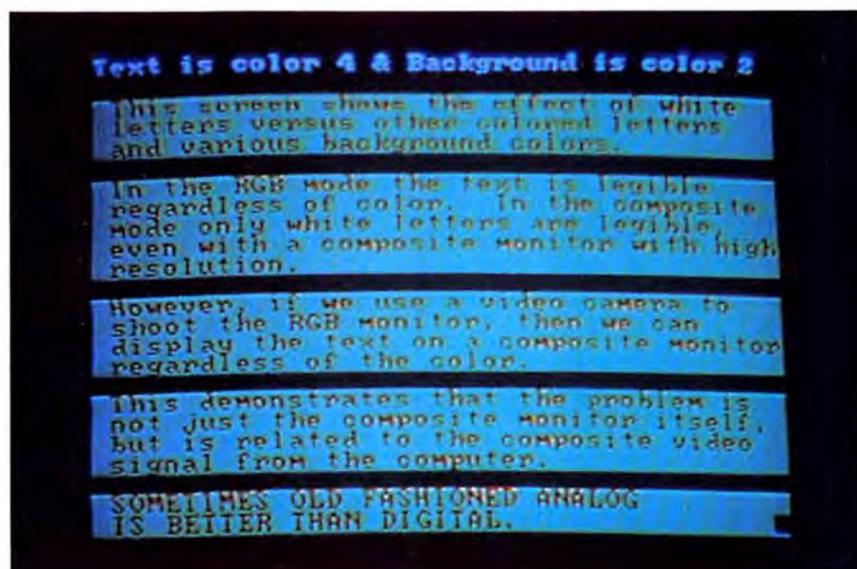


Figure 3: Text display on an RGB monitor

● Hands On

Timing and Drawing a Picture

Color information can be depicted in several ways on a CRT (cathode ray tube). The common method, and the only one considered here, is the raster scan method used in both RGB and composite video monitors. The raster scan method uses a finely focused electron beam that strikes a phosphorescent screen in a predetermined pattern. The beam scans back and forth as it moves down the screen. After scanning 525 horizontal lines, the beam has completely scanned the screen.

As the beam sweeps the screen it causes phosphors to glow with an intensity related to the intensity of the electron beam itself. A picture is created by carefully controlling the intensity of the beam in relation to its location on the screen. Due to the brief life span of a phosphor glow, the picture cannot be seen unless the screen scans are repeated many times each second so that the separate screen scans appear to merge into a single, continuous image.

If the frequency of screen scans is too slow, the image will appear to flicker as the phosphors fade between scans. The right screen-scanning frequency must be chosen to prevent flicker. The required frequency is related to the length of time the phosphors glow after being excited by the electron beam. A lower scanning frequency can be used with phosphors that persist longer, but that process reduces the ability to depict motion because the separate screen scans leave after-images. In practice, compromises are made among cost, resolution, absence of flicker, and minimal after-images during motion.

The recognized standard for composite video in the United States designates 15,750 horizontal lines scanned per second, which produces 30 screens per second, each consisting of 525 lines. Actually, a modified scan system is used in which every other line on the screen is scanned.

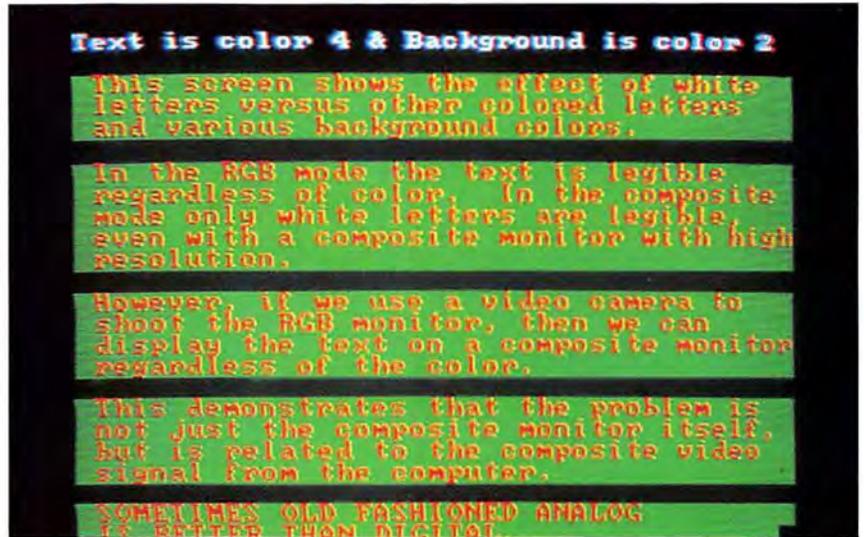


Figure 4: Text on an NEC composite color monitor created by sending a video camera image of the RGB monitor display to the NEC monitor



Figure 5: A composite video and RGB overlay. The RGB signal is from an IBM PC; the composite video is from a JVC KY 19000 CH camera.



Figure 6: A series of colored labels on an RGB monitor

This “half” of a screen is called a field, and alternate fields are scanned in an overlapping pattern. Each complete screen is called a frame, which is made up of two overlapping fields. This technique, called interlace, reduces the apparent flicker; as the first field begins to fade, the second field is scanned onto the screen.

These compromises explain why most CRTs use a green screen. Green phosphors are more persistent than white phosphors, so monitor manufacturers can get by with a lower scanning frequency and lower bandwidth without the attendant flicker. The trade-off is that green screen monitors cannot adequately depict animation.

Bandwidth

Two interdependent factors are especially important in the quality of resolution. First, the greater the number of horizontal scan lines per screen, the greater the vertical resolution. Secondly, the faster the electron beam can turn on and off, the greater the horizontal resolution. If the intensity does not change rapidly enough, the image is fuzzy. For a given number of horizontal lines and a given screen signal frequency, the beam must move at a specific speed across the screen as it scans one line. The changes in intensity must keep up with the scan frequency to produce a desired horizontal resolution.

The term *bandwidth*, one measure of a monitor’s quality of resolution, encompasses these two factors. Low-resolution monitors have a limited bandwidth and cannot adequately display more than about 40 characters per line. Higher resolution monitors have a greater bandwidth and can display 80 or more characters. Standard TVs have a very limited bandwidth and cannot even display 40 characters adequately.

It is important to distinguish between the number of horizontal scan lines and the number of lighted dots (pixels) a computer uses to depict an image. As noted earlier, the United States standard is 525 lines per frame

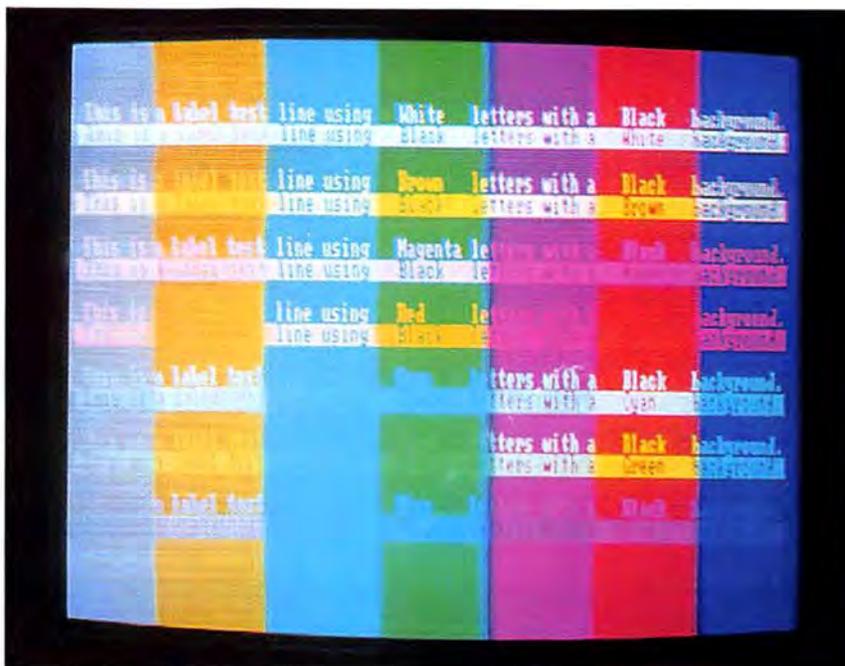


Figure 7: An overlay of the RGB colored labels and a color bar pattern generated by a composite video camera



Figure 8: A composite video picture of a pen and ink drawing

for 30 frames per second. Using the interlace mode, 262.5 lines are scanned in each field, with two fields comprising a frame.

The PC does not normally use interlace. The PC scans 262 lines per field at about 60 times per second.

But in this case, both fields are identical. The PC can be programmed to double the apparent vertical resolution by separating these two identical fields so that the pixels overlap, producing 524 scan lines at about 30 times per second. But this resolution is paid for in increased flicker.

☉ Hands On

In the normal high-resolution, 80-column mode the PC displays 200 vertical pixels down (25 letters 8 pixels high) and 640 horizontal pixels across (80 letters 8 pixels wide). But scanned lines number 262, not 200, and each scan line has 912, not 640, pixels. The extra 62 lines and the extra 272 pixels per horizontal scan are not displayed. Although these extra lines (and pixels) are never seen, they must be considered for timing and resolution purposes.

Most monitors, even a TV, are able to resolve 200 vertical pixels. Resolving the 640 horizontal pixels is more demanding and requires a higher resolution monitor. Adding color complicates the situation even more, particularly in composite video mode.

Trade-offs with Composite Color

The PC allows you to display 640 horizontal pixels in 80-column mode and 320 pixels in 40-column mode. In either mode the monitor turns the intensity on and off to turn the pixels on or off. The minimum speed required to turn pixels on and off can be roughly calculated and the required bandwidth estimated. This estimate is based on the total number of lines scanned, not just the lines displayed.

The PC uses about 15,700 lines, or 59.92 complete screen scans, per second. (Neither the horizontal nor the vertical frequency is quite standard). In 80-column mode there are 15,700 scans with 912 pixels (640 + 272) per scan. Simple multiplication indicates that 14,318,180 pixels are turned on and off each second. This frequency of switching pixels on and off is expressed as a 14 MHz bandwidth. It's no coincidence that 14,318,180 is the frequency of the IBM PC clock oscillator, from which all other frequencies are derived.

Displaying 40 columns requires 15,700 scans times 456 pixels (320 + 136) per scan, or 7,159,090 pixels turned on and off per second for a 7



Figure 9: A composite video picture of a pen and ink drawing with an overlay of colored labels

MHz bandwidth, half that required for an 80-column, high-resolution display. In essence, a high bandwidth is needed to display higher resolution.

TV screens usually have a limited bandwidth since broadcast TV signals run at a 4.5 MHz bandwidth. Thus, a TV cannot display 80 columns; if you have a very good TV, you might be able to display 40 columns. Some modified TVs are beginning to appear that can accept a composite video signal at an increased bandwidth, thus increasing horizontal resolution. However, the presence of a direct video input jack is no assurance that a TV will be a good monitor. An 80-column display is certainly possible with a composite monitor. For example, a Zenith ZVM-121 green-screen composite video monitor with a 15 MHz bandwidth displays 80-column text legibly.

The Color Barrier

Most composite color monitors do not have sufficient bandwidth for high resolution, 80-column display, but many are technically capable of medium-resolution, 40-column display.

But displaying 40-column color text is not easy. Part of the difficulty is with the method chosen years ago to add compatible color to black-and-white TVs. Another problem is the nature of the composite color signal used by the IBM PC and other computers; the display may lose pixels in some columns or be washed out. Text is difficult to read; surprisingly, a low-quality monitor may provide a better display since the alternate columns of dots bleed together and make the text more legible.

A composite monitor can display color text—but it never receives the proper signal from the PC. Figure 1 demonstrates the 40-column text display on a composite color monitor in white on black, and Figure 2 in red on green. White on black is legible, but red on green is not. Figures 3 and 4 display the same color text on an RGB monitor and again on a composite color monitor; the color text is legible on a composite color monitor although it has lower resolution. The trick? The RGB display was photographed with a video camera, and the camera signal was displayed on a composite color monitor.

Synchronization

So far only brief reference has been made to the important question of synchronization—relating the video intensity data to the screen. This process involves two problems. First, a signal must tell the monitor to begin the screen scan at precisely the right time (59.92 times per second). Secondly, another signal may be used to begin the scans of each of the 262 lines. These two signals are referred to as vertical and horizontal sync pulses. In the RGB signal from an IBM PC, the sync pulses are produced separately and are carried on different wires. In some RGB systems the sync pulses are carried on the green signal.

The vertical hold control on a standard TV is used to adjust the vertical sync pulse. If improperly adjusted, the picture will roll and jump in a vertical direction because the screen scan does not always begin at the top of the screen. The horizontal hold control adjusts the horizontal sync. If improperly adjusted, the picture will appear to tear or jump sideways.

Composite color monitors are best for depicting video from a TV camera, videotape recorder, or video disk player. This fact is not due to any inherent superiority of composite video, but broadcasting trade-offs

have led to the adoption of composite video as a standard. Composite color monitors are unsuitable for displaying high-resolution computer text or graphics in color. Using RGB monitors that separate the three color signals is a more economical method; they offer greater color resolution at a lower net cost than composite color monitors.

What if you need to display both computer text and video images? Do you buy a standard TV or an inexpensive composite video monitor? Do you buy a high-resolution RGB monitor? In that case, text and computer graphic resolution are superior but the monitor cannot be used for standard video.

Video Signal Overlay

The simplest way to combine computer-generated graphic material and standard video on a composite monitor is to alternate the scans: first send one screen from the computer, and then send one from the video source. The two images appear to merge, although flicker occurs because the frequency of each source is cut in half. Half of the vertical resolution is also lost from the video source since the interlacing mode cannot be used. Many computers, including the PC, permit this type of overlay.

Assuming that you can create the

overlay, the PC and the video signals must be synchronized from one of the sources. If the monitor is synchronized with the computer, the image from the video source is like a TV with the vertical hold out of adjustment. If the monitor is synchronized with the camera or videotape recorder, the computer text and graphics are distorted. Thus, the computer and the video camera or recorder must be synchronized with each other.

Keep in mind that the PC scans 15,700 lines, while standard video equipment scans 15,750 lines. When the PC and video equipment are tied together, this 50-line difference skews the picture as the beam scans down the screen if we use only the vertical sync. The solution is to synchronize the monitor with the horizontal and vertical pulses from both the PC and any video source. This synchronization is possible, but there are practical problems. You could synchronize the PC with the video sources or synchronize the video sources with the PC. Unfortunately, the PC does not easily synchronize with an external video signal. Moreover, since the PC does not use standard video conventions, an interface to permit this synchronization is complex and expensive.

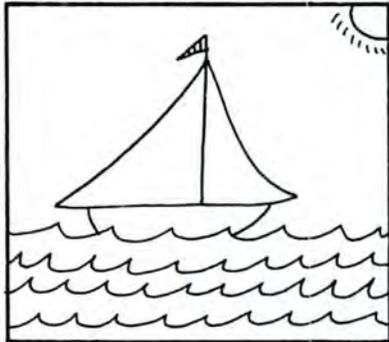
Brand	Model	List price	Size (inches)	TTL	Analog	Composite video
Amdek	Color II+	\$550	13"	Yes	Yes*	No
Amdek	Color IV	\$995	13"	Yes	Yes	No
Electrohome	1302-3	\$499	13"	No	Yes	**
IBM	5153	\$700	12"	Yes	No	No
NEC	JC1203	\$795	12"	Yes	No	No
Princeton	HX-12	\$695	12"	Yes	No	No
Quadram	Quadchrome	\$795	12"	Yes	No	No
Sony Profeel	KX-1211HG	\$895	12"	Yes	Yes*	Yes
Sony Profeel	KX-1901A	\$850	19"	Yes	Yes*	Yes
Sony Profeel	KX-2501A	\$1300	25"	Yes	Yes*	Yes
Sony	PVM-1270Q	\$915	12"	Yes	Yes*	Yes

Note: Some monitors will need adapters for the IBM PC.
* A special cable or adapter is needed to use the analog signal.
** NTSC composite video with optional NTSC module.

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Hands On

In the meantime, it is possible to synchronize video equipment from the PC. Cameras are available that extract sync information from an external source such as the composite video output of the PC. These cameras are used in TV studios to enable a director to switch from one camera to another without losing synchronization. Such cameras are relatively specialized and expensive, but the sync circuitry itself does not add much to the cost.

Synchronizing a videotape or disk recorder is more difficult, since it requires controlling mechanical motors, not just electronic signals. Some videotape recorders (such as Sony's SLO-323 and VO-5600) can be synchronized from the PC. The results are not very satisfactory because both the horizontal and vertical frequencies from the PC are not standard. Getting standard sync frequencies from the PC requires changing the system clock.

Sony Two for One

The solution to some of these problems would be a monitor that could serve as an RGB and a composite video monitor, ideally performing both functions at once so that computer text and graphics can be overlaid with video images.

Such monitors exist, the most prominent being the Sony Profeel 12-, 19-, and 25-inch monitors. For individual use the 12-inch monitor (KX-1211HG) is the appropriate choice. New 19- and 25-inch models of the Profeel offer similar features. (Another 12-inch Sony monitor, the PVM-1270Q, has features similar to the Profeel but higher resolution since it uses smaller phosphor screen dots.)

In RGB mode the 12-inch Sony can display 80 columns of text. The RGB input can accept either analog or TTL signals, and it has the capacity to display medium- or high-resolution graphics. The Sony Profeel has







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Joe Devlin, *Creative Computing*, September, 1983

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Monitors and Accessories

The following is a list of controllers, synchronization devices, software, and monitors available from manufacturers. Most of these devices are also available from video suppliers.

Controllers

UVC video tape/disk controller
Allen Communication
140 Lakeside Plaza #2
5225 Wiley Post Way
Salt Lake City, UT 84116
801/537-7800
List Price: \$1200

VideoLink-232 videotape controller
BCD Associates, Inc.
5809 S.W. 5th St. #101
Oklahoma City, OK 73128
405/948-1293
List Price: \$1295

Intermedia videotape controller
CAVRI Systems, Inc.
26 Trumbull St.
New Haven, CT 06511
203/562-4979
List Price: \$1800

Synchronization Devices and Software

SoftSwitch
Jack Strick and Associates
949 S. Southlake Dr.
Hollywood, FL 33019
305/925-7004
List Price: \$70

Remote Selection Software
Telex Inc.
P.O. Box 339
Warrington, PA 18976
215/343-3000
List Price: \$59

RGB-16 Interface Module
Tokyo Electronics
Japanese Cultural and Trade Center
San Francisco, CA 94115
415/398-1004
List Price: \$179

Monitors

Color II+, IV
Amdek
2201 Lively Blvd.
Elk Grove Village, IL 60007
312/364-1180
List Price: Color II+ \$550,
Color IV \$995

Profeel KX-1211HG
PVM-1270Q
Sony Video Communications
Sony Drive
Parkridge, NJ 07656
201/930-1000
List Price: Profeel \$895,
PVM-1270Q \$915

Quadchrome
Quadram Corporation
4357 Park Dr.
Norcross, GA 30093
404/923-6666
List Price: \$795

1302-3
Electrohome
809 Wellington St.
Kitchner, Ontario
N2G4J6 Canada
519/744-7111
List Price: \$499

5153
IBM
Systems Products Division
P.O. Box 1328
Boca Raton, FL 33432
800/447-4770, 800/332-4400
Illinois, 800/477-0809 Alaska,
Hawaii
List Price: \$700

JC 1202DH
NEC America, Inc.
Consumer Products Division
1401 Estes Ave.
Elk Grove, IL 60007
312/228-5900
List Price: \$795

HX-12
Princeton Graphic Systems
1101-1 State Rd.
Princeton, NJ 08540
800/221-1490
List Price: \$695

selectable vertical resolution of either 525 or 625 lines, and it probably could display twice the vertical resolution of the 200 pixels available on the PC.

The Sony Profeel's level of resolution can be achieved with many popular RGB monitors commonly used with the PC. However, most cannot display composite video signals.

Most importantly, the Sony Profeel can display both RGB and composite input at the same time—it can overlay high-resolution RGB signals onto composite video signals. Alternating the screens between RGB and composite is not necessary. These characteristics do not eliminate the need for

synchronization between the two video sources, but the monitor can be set to synchronize from either the PC or the video source.

Hands On

The Sony Profeel monitor does require a special cable to function as an RGB monitor from the PC. A special cable that allows 16 colors is avail-

● Hands On

able from Tokyo Electronics, Telexmax, and Jack Strick and Associates. Potentiometers, which mitigate between TTL and analog signals, can also be included on the above cables to adjust the color tint of the display. When set for TTL input, the RGB picture is crisp in the RGB-only mode, but it is too dim in the RGB/composite overlay mode.

Setting the monitor for analog input produces the opposite problem: the picture is too intense. To correct this effect you must manually turn down the brightness to reduce the RGB intensity, but this procedure correspondingly darkens the composite picture. The potentiometers permit a compromise that is suitable for both RGB-only and RGB/composite overlay.

You can also switch the monitor from RGB to composite mode in software using the *SoftSwitch* package developed by RATCOM of Miami and distributed by Jack Strick and Associates. If you want to add other software-controlled features, the sync cable can be modified by adding additional wires from the parallel printer port on the PC. The Sony monitor accepts TTL control signals directly from the PC that allow you to switch modes and switch the RGB input between analog and TTL as well as change the RGB level, synchronization modes, composite video level, and even audio channels.

Figure 5 illustrates a composite video and RGB overlay. The RGB signal is from a PC; the composite video is from a JVC KY 19000CH camera. The camera was synchronized from the composite video output of the PC. The signals are very stable, and the screen shows no flicker or loss of vertical resolution.

Using the Profeel for overlays requires some judgment in selecting the composite video signal. Different background colors affect the overall quality of the display. A dark background is best and the contrast sharp; a white background reduces

apparent contrast enough to make it difficult to read text. To illustrate, Figure 6 shows a series of RGB colored labels, and Figure 7 shows an overlay of the labels and a color bar pattern generated by the composite video camera. Figure 8 shows a composite video picture of a pen and ink drawing, and Figure 9 shows the drawing with an overlay of colored labels. The intensity of the background affects the quality of the total image.

The Future

As soon as interactive controllers are available, interactive video applications using the PC will no doubt become popular. The addition of RGB and composite video overlays will make it easy to change the overlaid text that would normally be recorded on videotape or disk. More importantly, the overlaid text information can be changed without having to reshoot the video material.

Rumors are circulating concerning upcoming interfaces that will synchronize the PC from an external source. The advertisements for Tecmar's high-resolution graphics board indicate that it has an external sync input, but it is not clear that this product will synchronize both the horizontal and vertical components of a picture. Other companies are expected to develop similar products. There is even talk of IBM marketing such a board.

So much for rumors. These monitors are powerful. They are controlled by standard computer signals, and they produce high-quality RGB and composite video pictures. Getting the most out of them requires some effort, but it is well worth the investment. ●

Editors note: readers are advised not to attempt modification of any monitor unless they are qualified to do so.

Charles Branch is a professor of cardiovascular and respiratory physiology at Auburn University where he is working with interactive video in veterinary and medical education.

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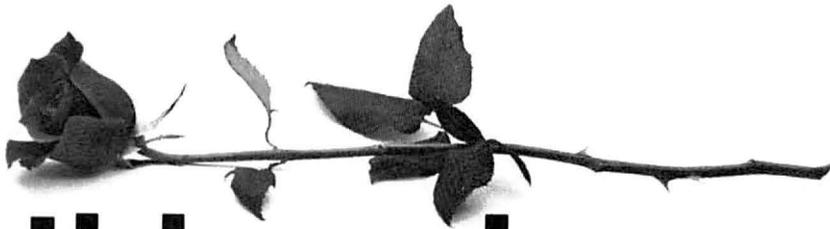
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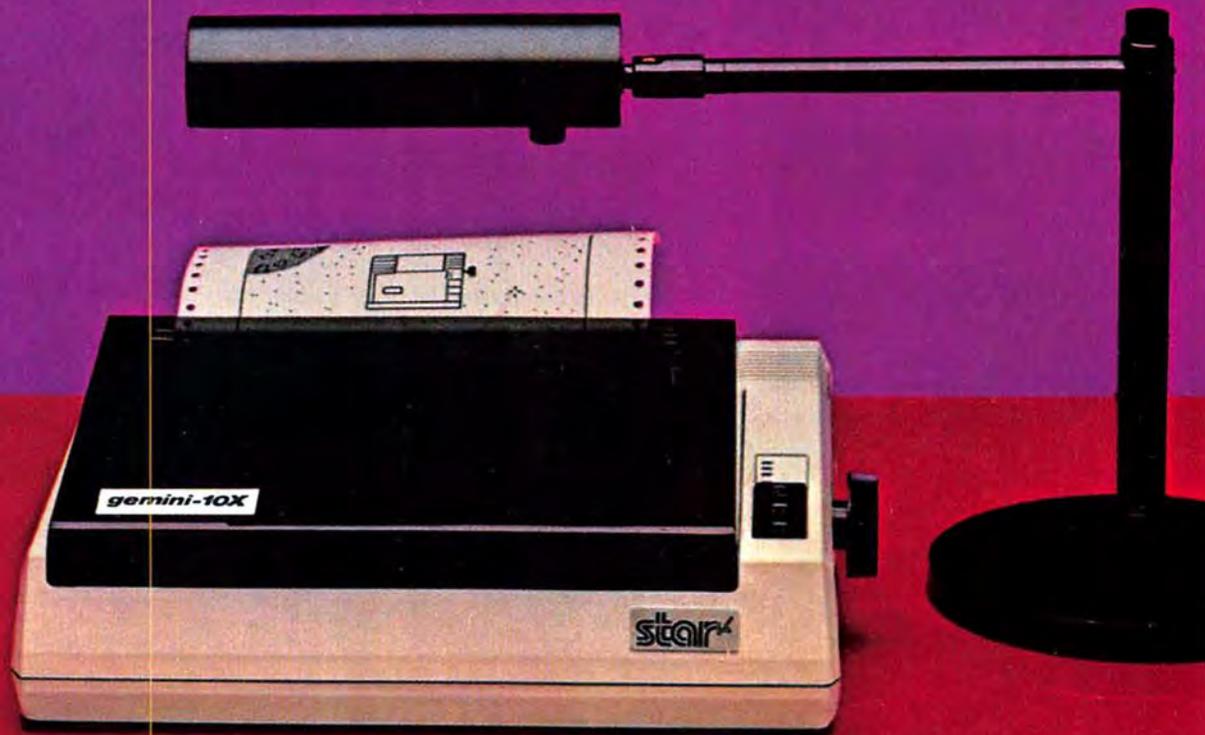
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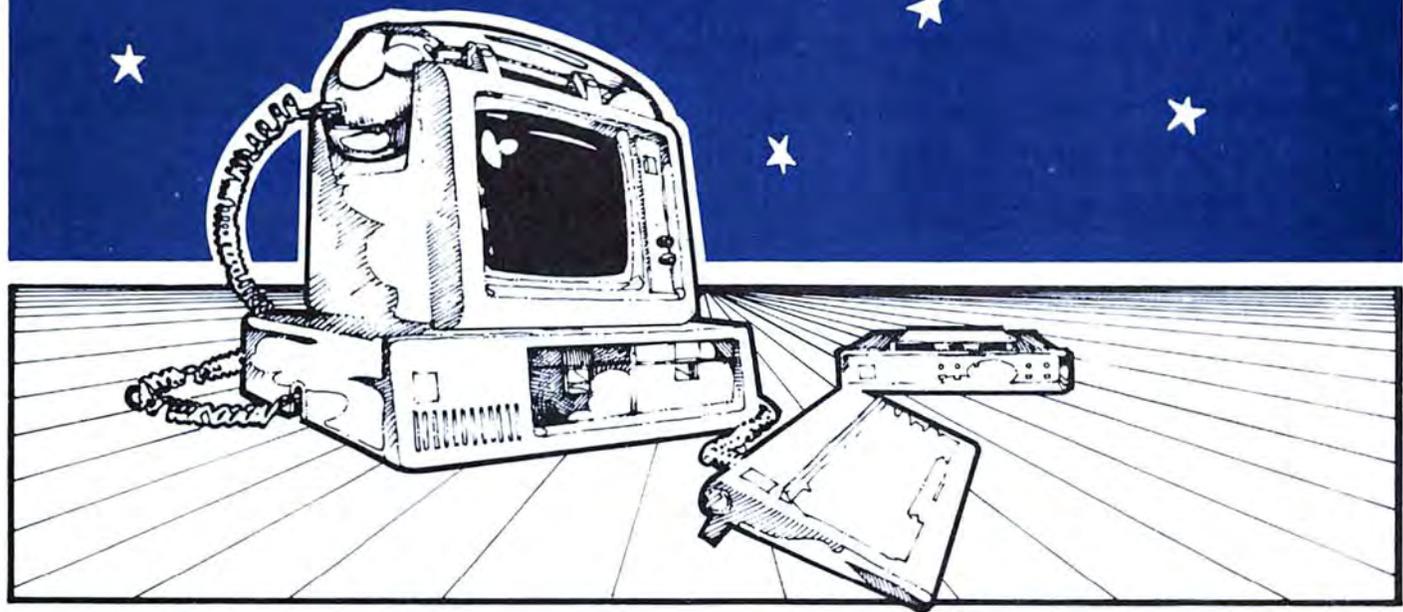
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Cell can extract data from independent tables	No	No	Yes
Cell can be entire program	No	No	Yes
Color, reverse video, blinking, half-intensity, bell.	No	No	Yes
Form-at-a-time processing	No	No	Yes
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A08K2

The Cassette Port Lives!

The PC's forgotten port can be used to do far more than turning a cassette recorder on and off.

Michael A. Covington

The least-used standard feature of the IBM PC is surely the cassette port. IBM originally included a cassette port in order to compete with the TRS-80 Model I and the Apple II. What no one foresaw was that far less expensive machines such as the Commodore VIC-20 and the Radio Shack Color Computer would shortly take over the low-budget end of the market, and few people willing to pay for the higher performance of the PC would then want to economize by leaving out disk drives. Cassette-based PCs have become as rare as Cadillacs without air conditioning. In fact, the cassette port has been eliminated from the IBM XT, and it may soon disappear from the PC itself.

You can do much more with the cassette port than saving and reloading data on cassettes. The relay that controls the cassette recorder motor is easily manipulable from BASIC and can be used to switch almost anything on and off.

To use the relay all you need is a 5-pin male DIN connector to plug into the cassette port. The relay contacts are connected to the two DIN connector pins that are farthest apart (pins 1 and 3—they aren't numbered sequentially) and are rated to handle 1 amp at a low DC voltage (nominally 6 volts, but you can use some-



what higher voltages if you stay well below 1 amp). Both contacts are fully isolated from the circuitry of the PC. You can also use the relay inside the PC to control another, heavier relay, Figure 1 shows how.

The relay contacts start out open ("off") when the PC is turned on. Their status can be changed using the MOTOR statement in BASIC. Specifically, the statement MOTOR N closes the contacts if N is nonzero, and it opens them if N is zero. N can be any expression that evaluates to a numeric value; in the simplest case, MOTOR 1 closes the contacts and MOTOR 0 opens them. Remember that logical expressions evaluate to numeric values (zero if false, nonzero if true), so that for example MOTOR A\$="ON" closes the contacts if A\$ equals "ON" and opens them otherwise.

Once set, the relay retains its position until another MOTOR statement is executed or the PC is reset or turned off; resetting the PC or turning it off causes the contacts to open. You can leave and reenter BASIC as many times as you wish and run virtually any kind of software without affecting the relay.

A statement consisting of the word MOTOR without an expression after it causes the relay to swap states. If the contacts are closed, they open; if they are open, they close. Toggling is handled by the BASIC Interpreter, which assumes that the contacts start out open. If you enter BASIC with the contacts closed, your first attempt to swap states will have no effect.

The cassette motor relay can control a wide variety of external functions. Using the relay alone or in combination with a larger relay, you can do such things as the following:

- Make your home look lived-in while you are away by turning lights on and off in as complex a pattern as you wish.

- Turn laboratory equipment on and off for specific periods of time or generate long pulses of accurately controlled length.

- Control lights or other equipment at the computer work station from the keyboard.

- Control a tape recorder or a slide projector for computer-run audiovisual presentations.

- Use the PC as part of the access control and user logging system for another piece of equipment.

- Key a ham radio transmitter to send computer-generated Morse code.

- Generate telephone dialing pulses.

- Turn a light on or sound an alarm at a remote location to indicate the status of the computer.

Timer

A program that enables the PC to be used as a timer can be as simple as the following:

```
10 IF TIMES="08:00:00" THEN MOTOR 1
20 IF TIMES="15:00:00" THEN MOTOR 0
30 GO TO 10
```

This sample program turns something on at 8 a.m. and off again at 3 p.m. It makes the computer repeatedly examine its internal clock. If the clock reads 08:00:00, it closes the relay contacts; if it reads 15:00:00, it opens them; at other times it does nothing. The computer checks the clock several times each second, and when it sees 08:00:00 or 15:00:00, it executes the accompanying MOTOR statement several times. Fortunately, this duplication of readings causes no problem—the computer is told to put the contacts into the position that they are already in, and so nothing happens.

Timing an interval, as opposed to waiting for a specific time of day, is a bit more complicated; Listing 1 shows how it's done. The main program, which begins at line 100, can be customized to give whatever timing pattern you want. Set the three variables—HR, MN, and SC—to indicate the length of the interval (in hours, minutes, and seconds), then

put the motor relay in whatever state you want and GOSUB 10000 to wait out the interval. The subroutine at line 10000 calculates the time of day at which the interval will be over and waits for it; that routine in turn calls another subroutine, at line 20000, which returns the time of day as a number of hours instead of a character string.

Cassette-based PCs have become as rare as Cadillacs without air conditioning.

Morse Code Generator

Listing 2 shows a program that generates Morse code and outputs it either by sounding tones in the PC's speaker, by closing and opening the relay contacts, or by doing both. In theory, the relay contacts can act as a telegraph key; in practice, they may be unable to handle the voltage or current. Check the specifications of your transmitter, and interpose a larger relay if necessary.

Burglar Alarm

Another intriguing possibility is to use the computer as its own burglar alarm. Close the relay contacts when the computer is to be left unattended and leave them closed; then run a program such as the following to open them when any key is pressed.

```
10 REM Open relay contacts when any key
   is pressed
20 MOTOR 1
30 IF INKEYS="" THEN 30
40 MOTOR 0
```

The contacts will also open if the computer is turned off or unplugged. Hence, an alarm that sounds when the contacts are open will protect the computer from theft or unauthorized use; it will, of course, also sound if

Hands On

someone simply unplugs the cable from the cassette port. Figure 2 shows a suitable circuit. An alarm that sounds when the contacts are closed is a far simpler affair: simply use the PC relay to switch power to a small buzzer.

Data Output

You can even use the relay as a crude type of output port to transmit digital data to other equipment. To do this have the equipment on the receiving end count how many times the contacts close and/or measure how long they stay closed. You could, for example, transmit a string of ones and zeros, and hence an unlimited amount of data, by treating a

brief closure as a zero and a longer closure as a one.

The main difficulty with such a method is that the relay contacts do not go cleanly and instantaneously from open to closed; they bounce against each other for a couple of milliseconds, moving together and then apart, and any attempt to count openings and closings directly will give inaccurate results. Figure 3

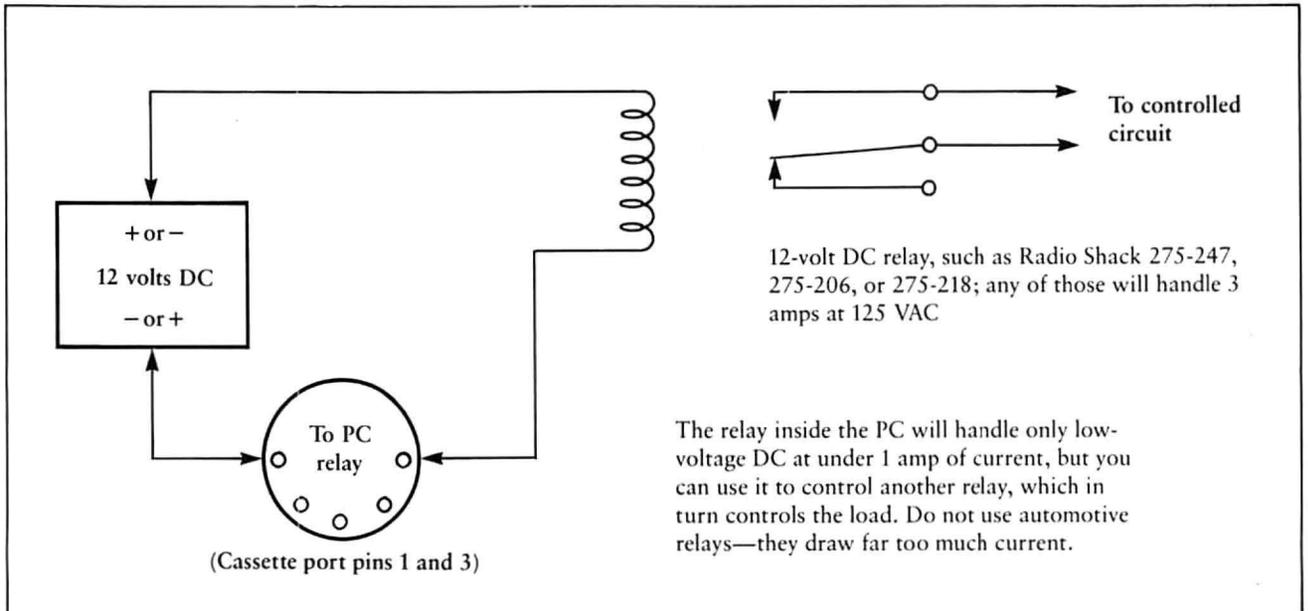


Figure 1: Controlling another relay

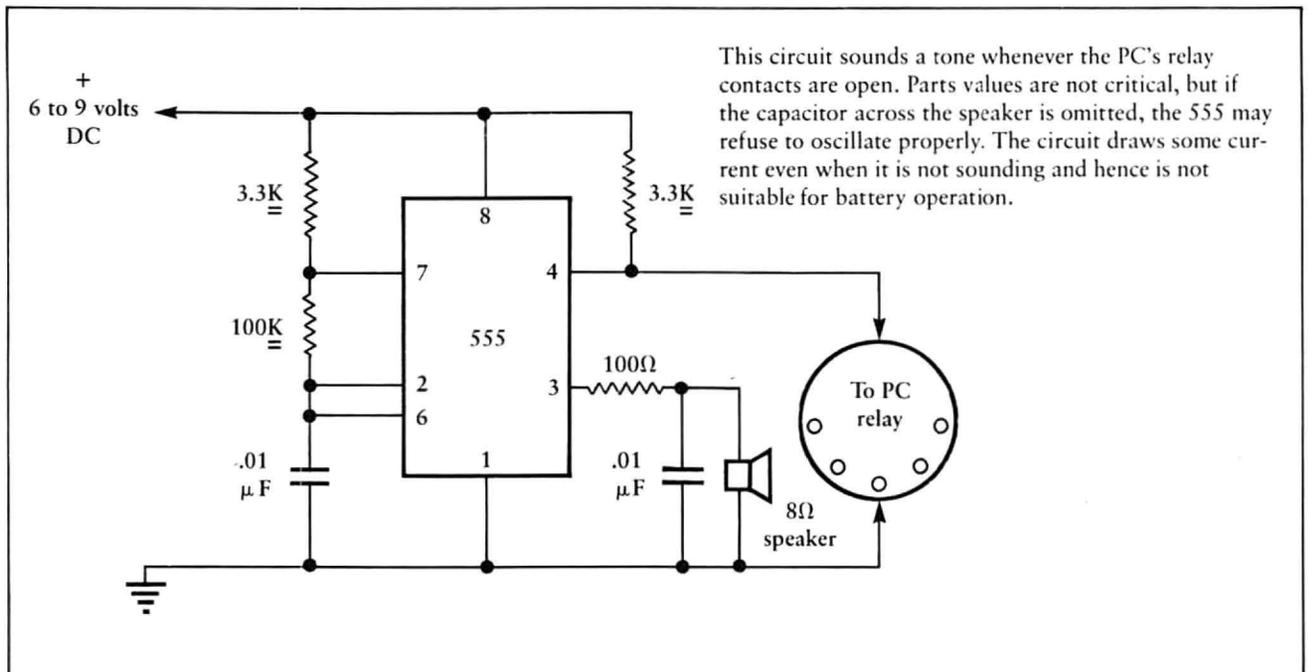


Figure 2: Burglar alarm

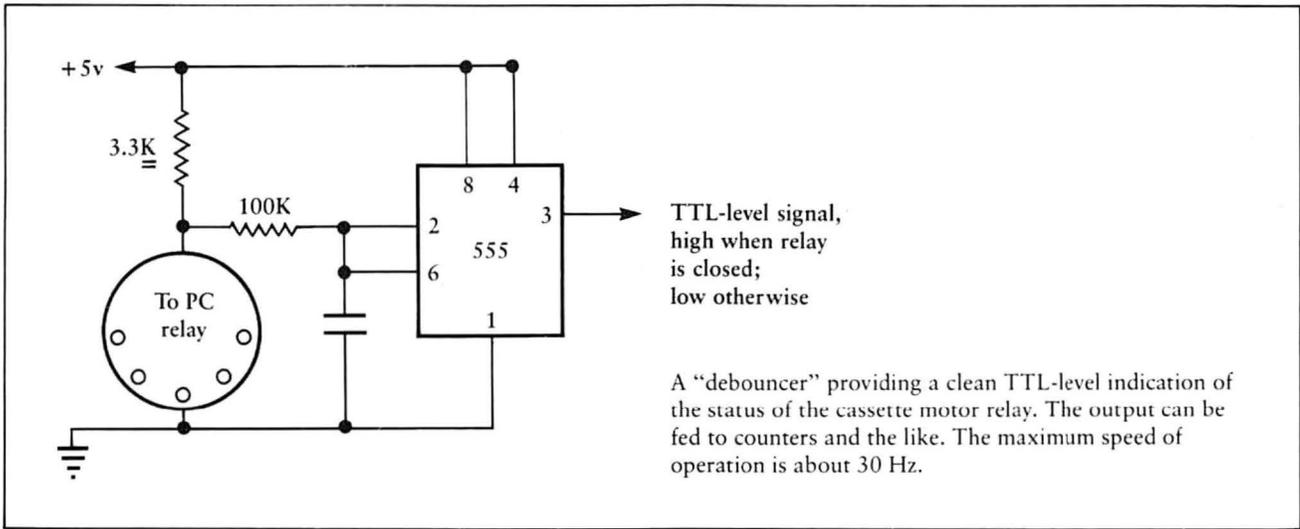


Figure 3: Debouncer for data output

shows a possible remedy; a circuit whose output is a clean TTL-level signal is free of bounce and indicates the state of the relay accurately. Because of the time taken to open and close the contacts, the relay is quite slow—about 10 or 20 state changes per second. This method is obviously not suitable for transferring files, but it could come in handy for controlling relatively simple equipment.

Sometimes the humblest parts (and ports) of a computer can be the most useful because of their simplicity. It would be a pity to spend hundreds of dollars on an interface board to encode your data if all you really need is a simple on-off. Besides the cassette motor relay, other underexploited features of the PC include the data lines in the cassette port, the joystick port (very handy for data acquisition), and the speaker (which can drive tone-decoding devices or produce single pulses). When you want to connect a custom-built, one-of-a-kind gadget to the PC, you may be able to save a good bit of money by using these neglected options instead of more conventional interfaces. ●

Michael A. Covington is a post-doctoral fellow at the University of Southern California, where he works with computer applications in the humanities.

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Hands On

```
10 ' Interval timer program      (Michael A. Covington 1983)
20 '
30 ' Turns devices controlled by the cassette port relay
40 ' on or off for specified periods
50 '
60 ' Lines 100-9999 are the control program; modify it as
70 ' needed. Essential subroutines begin at line 10000.
80 '
90 DEFDBL A-Z
95 '
96 ' This sample program turns the controlled device on for 1 min 30 sec,
97 ' then off for 2 min 45 sec, then on for 3 minutes, then off.
98 '
100 HR = 0
110 MN = 1
120 SC = 30          ' Set control variables to 0 hrs 1 min 30 sec
130 MOTOR 1         ' Turn controlled device on
140 GOSUB 10000     ' Wait out the interval
150 MOTOR 0         ' Turn device off
160 HR = 0
170 MN = 2
180 SC = 45        ' Set control variables to 0 hrs 2 min 45 sec
190 GOSUB 10000     ' Wait out the interval
200 HR = 0
210 MN = 3
220 SC = 0         ' Set control variables to 0 hrs 3 min 0 sec
230 MOTOR 1         ' Turn device on
240 GOSUB 10000     ' Wait out the interval
250 MOTOR 0         ' Turn device off
9990 END           ' Quit
9995 '
9999 ' .....
10000 ' SUBROUTINE -- Causes computer to wait (in a loop) for the
10010 ' duration specified by HR, MN, SC .
10020 '
10030 DUR = HR + MN/60 + SC/3600 ' convert duration to decimal hours
10040 GOSUB 20000
10050 FINISH = TOD + DUR ' compute time at which to finish
10060 WHILE TOD < FINISH
10070   GOSUB 20000 ' check time repeatedly
10080 WEND
10090 RETURN
19999 ' .....
20000 ' SUBROUTINE -- Get time of day (TOD) in decimal hours.
20010 ' Add 24 hours for each whole day elapsed.
20020 T$=TIME$
20030 THR=VAL(LEFT$(T$,2))
20040 TMN=VAL(MID$(T$,4,2))
20050 TSC=VAL(RIGHT$(T$,2))
20060 TOD = THR + TMN/60 + TSC/3600
20065 '
20070 WHILE TOD < OLDTOD ' (i.e., if date has changed since last call)
20080   TOD=TOD+24 ' (add 24 hrs. as many times as necessary)
20090 WEND
20100 OLDTOD = TOD ' (On first run, OLDTOD = 0 .)
20200 RETURN
```

Listing 1: Interval timer

```

10 '   IBM Personal Computer Morse Code Program
20 '
30 '   Michael A. Covington
40 '
50 '   This program produces Morse code by switching
60 '   the cassette motor relay on and off.  In addition,
70 '   the code can be indicated by sound from the speaker.
80 '
90 ''' Initializations
100 DEFINT A-Z
110 DIM CODE(128,7)
115 MSTART = 1 : MSTOP = 0 ' codes for motor control
120 PLAY "MB" ' sound, if used, will run in the background
200 ''' Start-up screen
205 CLS : KEY OFF
210 LOCATE 10,18 : PRINT "IBM Personal Computer Morse Code Program"
220 LOCATE 12,18 : PRINT "Michael A. Covington           1983"
230 FOR DELAY = 1 TO 1000 : NEXT
300 ''' Create an array with the code in it
310 READ I
320 IF I<0 THEN 1000
330 FOR J=1 TO 7
340 READ CODE(I,J)
350 NEXT
360 GOTO 310
400 ''' Each DATA statement contains ASCII code for the character
410 ''' followed by 7 numbers: 3 for dah, 1 for dit, 0 for null filler.
412 DATA 65, 1,3,0,0,0,0,0 :REM A
414 DATA 66, 3,1,1,1,0,0,0 :REM B
416 DATA 67, 3,1,3,1,0,0,0 :REM C
418 DATA 68, 3,1,1,0,0,0,0 :REM D
420 DATA 69, 1,0,0,0,0,0,0 :REM E
422 DATA 70, 1,1,3,1,0,0,0 :REM F
424 DATA 71, 3,3,1,0,0,0,0 :REM G
426 DATA 72, 1,1,1,1,0,0,0 :REM H
428 DATA 73, 1,1,0,0,0,0,0 :REM I
430 DATA 74, 1,3,3,3,0,0,0 :REM J
432 DATA 75, 3,1,3,0,0,0,0 :REM K
434 DATA 76, 1,3,1,1,0,0,0 :REM L
436 DATA 77, 3,3,0,0,0,0,0 :REM M
438 DATA 78, 3,1,0,0,0,0,0 :REM N
440 DATA 79, 3,3,3,0,0,0,0 :REM O
442 DATA 80, 1,3,3,1,0,0,0 :REM P
444 DATA 81, 3,3,1,3,0,0,0 :REM Q
446 DATA 82, 1,3,1,0,0,0,0 :REM R
448 DATA 83, 1,1,1,0,0,0,0 :REM S
450 DATA 84, 3,0,0,0,0,0,0 :REM T
452 DATA 85, 1,1,3,0,0,0,0 :REM U
454 DATA 86, 1,1,1,3,0,0,0 :REM V
456 DATA 87, 1,3,3,0,0,0,0 :REM W
458 DATA 88, 3,1,1,3,0,0,0 :REM X
460 DATA 89, 3,1,3,3,0,0,0 :REM Y
462 DATA 90, 3,3,1,1,0,0,0 :REM Z
464 DATA 49, 1,3,3,3,3,0,0 :REM 1
466 DATA 50, 1,1,3,3,3,0,0 :REM 2
468 DATA 51, 1,1,1,3,3,0,0 :REM 3
470 DATA 52, 1,1,1,1,3,0,0 :REM 4

```

(continues)

Listing 2: Morse code generator

```

472 DATA 53, 1,1,1,1,1,0,0 :REM 5
474 DATA 54, 3,1,1,1,1,0,0 :REM 6
476 DATA 55, 3,3,1,1,1,0,0 :REM 7
478 DATA 56, 3,3,3,1,1,0,0 :REM 8
480 DATA 57, 3,3,3,3,1,0,0 :REM 9
482 DATA 48, 3,3,3,3,3,0,0 :REM 0 (ASCII 48, not 58!)
484 DATA 47, 3,1,1,3,1,0,0 :REM /
486 DATA 46, 1,3,1,3,1,3,0 :REM .
488 DATA 44, 3,3,1,1,3,3,0 :REM ,
490 DATA 63, 1,1,3,3,1,1,0 :REM ?
492 DATA 45, 3,1,1,1,3,0,0 :REM -
494 DATA 58, 3,3,3,1,1,1,0 :REM :
496 DATA 59, 3,1,3,1,3,1,0 :REM ;
498 DATA 40, 3,1,3,3,1,3,0 :REM (
500 DATA 41, 3,1,3,3,1,3,0 :REM ) (same)
502 DATA 43, 1,3,1,1,1,0,0 :REM + representing AS ("Wait")
504 DATA 42, 1,3,1,3,1,0,0 :REM * representing AR ("End of message")
506 DATA 35, 1,1,1,3,1,3,0 :REM # representing SK ("End of contact")
600 DATA -1
700 ''' If restarting, clear away leftovers of previous run
710 MOTOR 0 : SOUND 32767,0 : RESTORE
1000 ''' Start-up parameters
1005 CLS : LOCATE 20,1
1010 PRINT "Do you want to hear the generated code through the PC speaker?"
1020 INPUT YN$: YN$ = LEFT$(YN$,1)
1030 IF YN$ = "y" OR YN$ = "Y" THEN FREQ=880 : GOTO 1060
1040 IF YN$ = "n" OR YN$ = "N" THEN FREQ=32767 : GOTO 1060
1050 PRINT "Answer YES or NO." : GOTO 1020
1060 PRINT : PRINT "Do you want to use the cassette motor relay for keying?"
1070 INPUT YN$: YN$ = LEFT$(YN$,1)
1075 IF YN$ = "y" OR YN$ = "Y" THEN 1100
1080 IF YN$ = "n" OR YN$ = "N" THEN MSTART = 0 : GOTO 1100
1085 PRINT "Answer YES or NO." : GOTO 1070
1100 PRINT : PRINT "Enter transmission speed (words per minute):"
1110 INPUT S! ' (floating-point)
1120 TIMEUNIT = 2000/S!
1150 CLS
1160 PRINT "The following characters are supported:"
1170 PRINT
1172 FOR I=1 TO 128
1174 IF CODE(I,1)>0 THEN PRINT CHR$(I);
1176 NEXT
1180 PRINT : PRINT : PRINT
1200 PRINT "The following characters have special meanings:"
1210 PRINT " "
1220 PRINT "+ for AS ('Wait')"
1230 PRINT " "
1240 PRINT "* for AR ('End of message')"
1250 PRINT " "
1260 PRINT "# for SK ('End of contact')"
1270 PRINT
1280 PRINT "Unsupported characters are ignored and are not echoed"
1290 PRINT "as the message is sent."
1295 C = CSRLIN : LOCATE 25,1 : COLOR 0,7
1300 PRINT ".END .RESTART + Wait * End msg # End contact";
1310 LOCATE C+1,1 : COLOR 7,0
1320 PRINT "Type .END to end the program, .RESTART to restart it."
1330 PRINT:PRINT "Type one line in response to each question mark:"

```

(continues)

Listing 2 (continued)

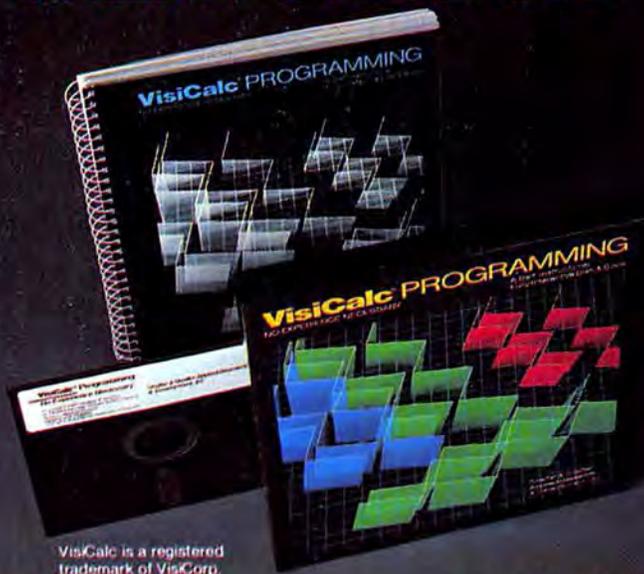
```

1340 PRINT
2000 ''' Read a line and send it
2010 PRINT "? "; : LINE INPUT M$: PRINT " ";
2015 IF M$=".END" OR M$=".end" THEN CLS: KEY ON: MOTOR 0: SOUND 32767,0: END
2020 IF M$=".RESTART" OR M$=".restart" THEN 700
2025 FOR BYTE = 1 TO LEN(M$)
2030     ASCII = ASC(MID$(M$,BYTE,1))
2035     IF ASCII > 96 THEN ASCII = ASCII - 32 ' convert to upper case
2040     IF ASCII = 32 THEN GOSUB 5000 ELSE GOSUB 10000
2050 NEXT BYTE
2060 PRINT : PRINT
2070 GOTO 2010
5000 ''' Subroutine : Pause between words '.....
5005 PRINT " ";
5010 FOR I = 1 TO 7*TIMEUNIT : NEXT : RETURN
10000 ''' Subroutine : Send a letter '.....
10005 IF CODE(ASCII,1)>0 THEN PRINT CHR$(ASCII);
10010 FOR I = 1 TO 7
10020     IF CODE(ASCII,I) = 0 THEN 10080
10030     MOTOR MSTART : SOUND FREQ,32767
10040     FOR J = 1 TO CODE(ASCII,I)*TIMEUNIT : NEXT
10050     SOUND FREQ,0 : MOTOR MSTOP
10060     FOR J = 1 TO TIMEUNIT : NEXT ' pause between dits/dahs
10070 NEXT I
10080 FOR J = 1 TO 3*TIMEUNIT : NEXT ' pause between letters
10090 RETURN

```

Listing 2 (continued)

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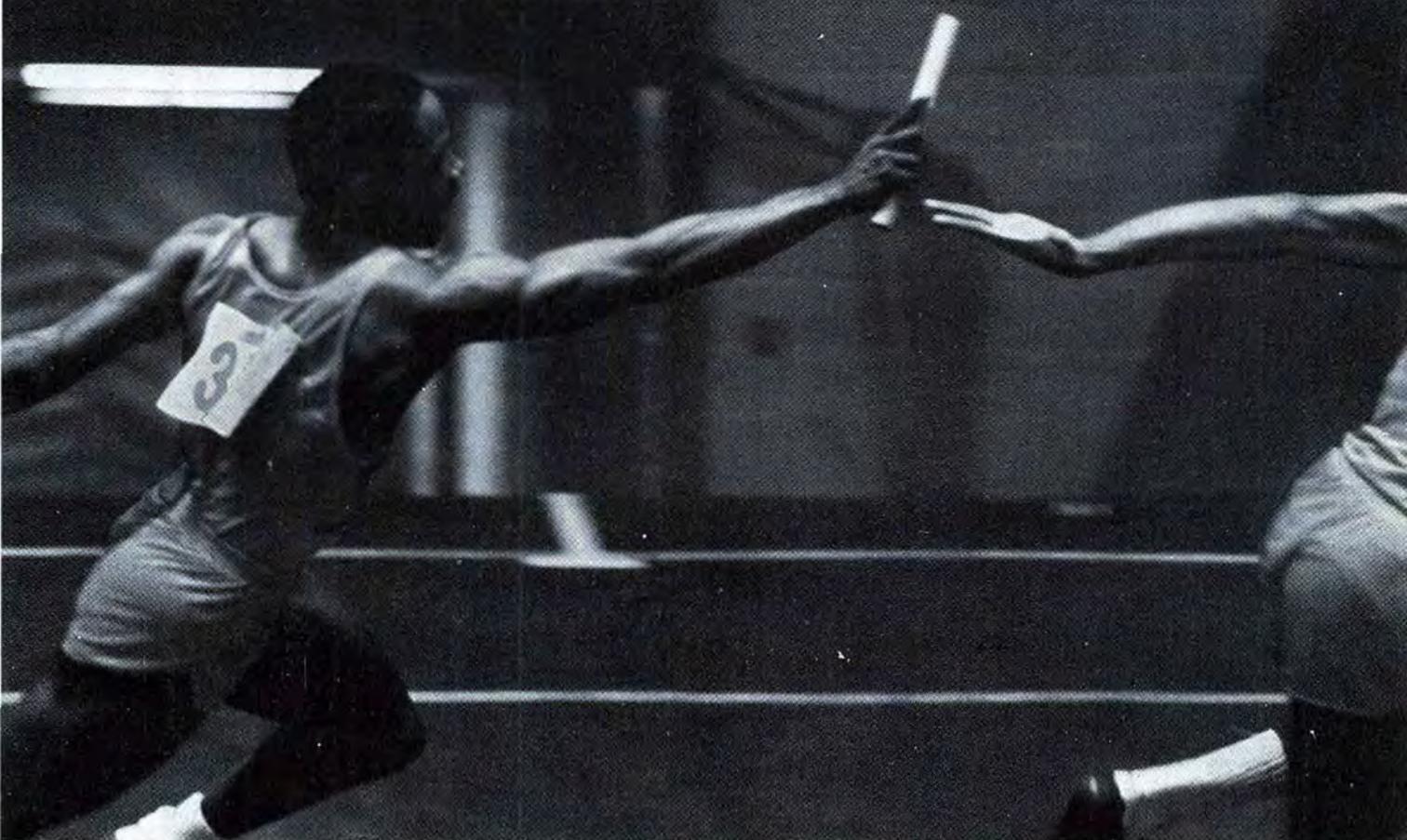
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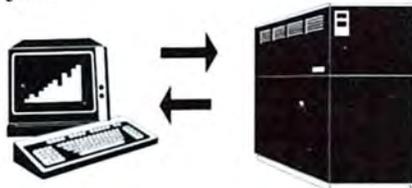
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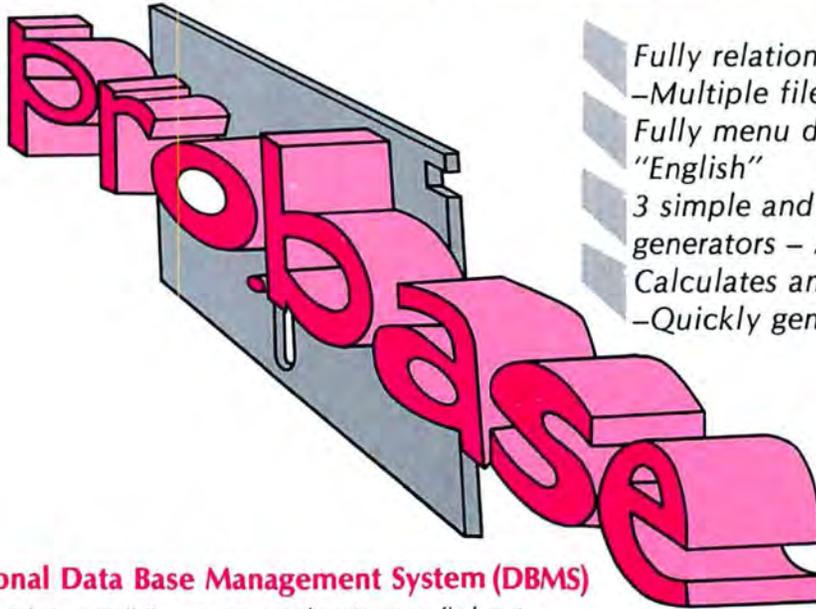
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John Stephenson

The p-System presents a consistent and straightforward interface for PC programmers, one that is independent of hardware. Supporting a pseudo-machine, or p-machine, and emulating it on a host system is the key to the p-System's hardware independence. Emulation is accomplished by translating the p-machine codes into codes understood by the host processor during program execution. In the case of the IBM PC, p-machine codes are translated into 8088 processor codes.

P-System compatibility is based on the fact that as manufacturers release new super chips, only part of the p-machine translator needs updating. All p-machine software previously developed within other chip environments will execute in the new environment. Some chips that presently have functioning p-code translators are the 6502, Z80, 68000, and 9900.

While the p-code can execute in different environments, the code's portability does not always extend to data files. Problems occur when files are moved from machine-based processors that represent data by placing the most significant byte last, such as the IBM's 8088, to processors that represent data by placing the most significant byte first, like Sage's 68000. Other limitations extend to p-Systems configured not to support real numbers, two-word real numbers, or four-word real numbers. The portability of the p-System, despite these boundaries, is remarkable.

The complete UCSD p-System consists of filer, editor, compilers, assemblers, linker, and debugger. All are accessed via single keystrokes in response to a command line. (see Table 1 for a list of p-system commands and their functions.)

Filer

The filer allows commands for dating, verifying, cataloging, saving, reading, moving, and deleting disk files. The commands also enable you to list available devices, such as a printer or a remote input/output line.

These devices, referred to as volumes, may be either block structured (capable of storing files and directories) or unstructured (capable of producing a stream of data). Volumes can be referred to by number or name, followed by a colon, as shown in Table 2.

Subsidiary volumes provide two levels of directory hierarchy to facilitate efficient use of large-capacity devices such as hard disk drives. Subsidiary volumes are virtual disk images that reside within regular p-System files. Virtual disk file names

Command	Use
Transfer	Move files, print files, copy disks
Make	Reserve space on disks and create .SVOLs
Change	Change file and disk names
Remove	File deletion
Krunch	Contiguous space consolidation
Zero	Clear entire disk directory
Get	Designate a work file
Save	Save a work file under permanent name
New	Clear work file
What	Show status of work file
Volumes	List devices on-line
List	List device directory
Extended list	List device directory with all attributes
Bad block	Check media for damaged blocks
Xamine	Repair damaged blocks
Prefix	Set default disk drive
Date	Change system date
Quit	Return to main system command line
Online	Mount/dismount subsidiary volumes

Table 1: Filer Command Options

● Hands On

end with the suffix .SVOL so the p-System can recognize their special structure. Table 3 lists the p-System file name suffixes. The Make command creates subsidiary volumes, while the filer's Online command mounts or unmounts them. Total on-line storage accessible to the p-System exceeds 1.7 billion bytes.

Editors

The p-System has both line and full-screen editors that are used to prepare documents and program source code for submission to the appropriate compiler.

YALOE (Yet Another Line-Oriented Editor) was designed for systems without flexible screen terminals, specifically for DEC's RT 11 system. YALOE was included with the p-System mainly for historical purposes.

In the screen-oriented editor, the Set Environment command allows parameters, such as auto-indent, left margin, and right margin, to be configured to your specifications. Known simply as the editor, this is a powerful tool. The screen is a window into a text file that typically displays the editor's prompt line followed by 23 lines of text. For the most part, what you see is what you get. The cursor shows the user's precise place within the file, and the screen shows the part of the file surrounding the cursor. All action takes place at the cursor position.

Some parts of the p-System assume a work file—a scratch-pad area for keeping unnamed material. This transient file is named SYSTEM.WRK.TEXT on the root disk volume, which is the default disk. When summoned, the editor searches for this file immediately. If found, the first page is displayed and the editor waits for further instructions. Otherwise, you are asked to specify a file for display. When quitting the editor, you may elect to Update the work file or Write to a specific file. People new

Volume Number	Volume Name	Description
#0:		Not used
#1:	console:	Screen/keyboard with echo
#2:	system:	Screen/keyboard without echo
#3:		Not used
#4:	<disk name>:	Root or boot disk
#5:	<disk name>:	Second disk drive
#6:	printer:	Line printer
#7:	remin:	Remote port as input port
#8:	remout:	Remote port as output port
#9:–#12:	<disk name>:	Other disk drives
#13:–#127:	<disk name>:	Subsidiary or virtual disks
#128:–#256:	<special name>:	User-specified

Table 2: Device References

Suffix	Description
.TEXT .BACK	Human readable text formatted for the p-System editors
.CODE	Executable p-code or machine code
.DATA (no suffix)	Data in user-specified format, typically random access
.FOTO	Graphic screen image
.BAD	An unmovable file covering a physically damaged area of the disk
.SVOL	Virtual disk image

Table 3: File Name Suffixes

to the p-System find the optional automatic maintenance of their work file convenient.

Some commands in the editor immediately perform a function when summoned, while others lead to a sublevel of commands. This is typical and consistent throughout the p-System. Many commands permit a repeat parameter. Typing 9 followed by CursorDown, for instance, drops the cursor nine lines and readjusts the window accordingly. The cursor pad, Space, Tab, Backspace, and ENTER keys all manipulate the cursor to any position on the screen. The '<' and

'>' keys set default direction to backward or forward.

The Find and Replace commands are especially useful and flexible and can search for target strings as literals (which may occur anywhere) or as tokens (isolated occurrences). This latter mode prevents inadvertent recognition of identical letter sequences within other words. The Replace command allows a verify parameter, which is useful when passing a repeat factor of '/', meaning "all instances," because as the editor processes the entire file, it also allows you to check for any mistakes. The Exchange command is related to the Replace command and allows character-by-character replacement of the text at

Command	Description
Adjust	Change indentation of lines left, right, or center
Copy	
Buffer	Copy contents of temporary buffer to screen
File	Insert contents of file at cursor position
Delete	Remove characters and/or lines
Find	Locate literal or token
Insert	Enter characters into file
Jump	
Beginning	Position cursor at beginning of file
End	Position cursor at end of file
Marker	Position cursor at preset marker in file
Kolumn	Use arrow keys to adjust parts of lines
Margin	Realign paragraph within preset margins
Page	Move one screen in preset direction
Quit	
Update	Modify SYSTEM.WRK.TEXT and leave editor
Exit	Leave editor without modifying any disk files
Return	Return to editor prompt line
Write	Modify specific file
Replace	Change target string with designated string
Set	
Environment	Change margins, indentation, autofill, etc.
Marker	Preset a logically named marker in the file
Verify	Center the cursor and redisplay the window
Exchange	Replace characters at cursor position with the character typed
Zap	Delete user-specified text and readjust page format

Table 4: Editor Commands

the cursor position. This is similar to erasing and correcting in a single operation. A summary of the various editor commands can be found in Table 4.

Compilers

Compilers are specialized translators that read a source language and produce object code. The object code is stored in a .CODE file for use at ex-

ecution time. In the p-System all compilers produce p-code, which is subsequently translated during execution by an interpreter that can produce the machine instructions of the host processor. On the IBM PC a stream of p-code instructions is read and a stream of 8088 instructions is produced, but not necessarily on a one-for-one basis.

Three compilers are available with the p-System, with each producing p-code object files but reading different

The p-System Environment

Initially designed as a program development system at the University of California at San Diego, the UCSD p-System was found to have a variety of uses, such as supporting the Pascal programming language on microcomputers. Collected software components—saved as files on disks—form the p-System. In 1979 SofTech Microsystems of San Diego presented the p-System as a commercially available product with the original design implementations remaining intact: a simple menu-driven operating system, a relatively small amount of main memory, an interactive terminal (a CRT), and low-capacity on-line storage media (floppy disks).

The p-System's high-level languages (Pascal, FORTRAN, and BASIC) are compiled to an intermediate language called p-code, which is machine code for an idealized "p-machine." To work properly this p-machine must be emulated by the host processor. This emulation may be performed by an interpreter that processes operations at runtime, by performing a translation prior to runtime by a code generator, or through hardware implementation that executes p-code directly. The interpreter is the method used by most current installations.

For the IBM Personal Computer the p-System is fully supported by IBM, which has leased the license for the product from SofTech Microsystems. There are over 400 software products running in the p-System environment. SofTech publishes a biannual catalog of p-System products for \$5. Contact SofTech Microsystems, 9494 Black Mountain Rd., San Diego, CA 92126, 619/451-1230.

```

PROGRAM SortPrint;           { <--- program name           }
CONST                       { <--- section for global constants }
TYPE                        { <--- section for data definition  }
VAR                         { <--- section for global variable  }
                           {     allocation                    }

                           { <--- support routine. Can have as  }
                           { many as required. Each may contain }
                           { its own support procedures as well }

BEGIN {SortPrint}          { <--- statement of main program }
END.                        { algorithm here.                }

```

Listing 1: General Program Skeleton

```

PROCEDURE InitializeProgram;
{ Set up global variables. }
BEGIN
END;

FUNCTION FileAvailableForProcessing : boolean;
{ Return true if file available otherwise false. Set FileName. }
BEGIN
END;

PROCEDURE SortFile;
{ Sort text lines in ram. }
BEGIN
END;

PROCEDURE PrintFile;
{ Send text lines to printer in sorted order. }
BEGIN
END;

```

Listing 3: Procedure and Function Additions

source languages. The most frequently used is the Pascal compiler, the compiler that understands UCSD Pascal. The other two read BASIC and FORTRAN.

P-code interpretation is more efficient than direct translation of BASIC, which means that p-code execution time is dramatically faster. Because the executable .CODE files are separate and distinct from the .TEXT source files, a run-time system occupies much less disk space. The

necessity of invoking the appropriate compiler during program development each time changes are made to your source file may take some getting used to. The simple RUN command used after making alterations to BASIC code is not available to p-System users. Careful typing is advised.

The p-System program development process involves entering your program in one of the three source languages. The .TEXT file created by the editor is then compiled. If the compilation fails, you're shown where the language syntax error occurred. To correct the mistake, the

editor is again summoned. If the compilation is successful, object .CODE is produced.

The object file is executed from the main p-System command line in much the same way as RUN in BASIC initiates a program. If the program doesn't run as expected, a runtime (logical) error is uncovered. You then have to go back to the editor or to your flowcharts to find the error. Once the program executes correctly, you're done.

The p-System compilers support compile-time options, specially

```

BEGIN {SortPrint}
InitializeProgram;
WHILE (FileAvailableForProcessing) DO
  BEGIN
  MARK(TreeSpace);
  SortFile;
  PrintFile;
  RELEASE(TreeSpace);
  END;
WRITELN ('Bye!');
END.

```

Listing 2: Main Program

```

TYPE
  TextPointer=    ^TextRecord;
  TextRecord=    record
                  left,
                  right  : TextPointer;
                  contents: string;
                  end;
VAR
  TreeSpace      : ^INTEGER;
  Root           : TextPointer;
  FileName       : STRING;
  TextFile       : TEXT;
  SortedOutput   : INTERACTIVE;

```

Listing 4: Global Data Structures

marked instructions, often called switches, that control how the compiler operates. The Pascal compiler has the 'I+/' switch. When set to '-' the compiler stops the program from inserting an error message to halt the program if an I/O operation isn't completed properly during execution. This allows the programmer to take responsibility for I/O error checking, such as notifying the user that a disk is write protected.

Assemblers and Linkers

The p-System comes with assemblers and cross assemblers that are used to prepare stand-alone machine language code and machine language routines for integration into p-code routines. If a program is written in a high-level language and compiled

into p-code for portability but contains a time-critical machine language routine specific to an individual machine's hardware, an environmental move of that program entails only the recoding of the isolated machine language routine using a new assembler. This characteristic is common to communications systems. P-system assemblers operate like p-System compilers; they translate assembly language .TEXT files prepared with the editor into machine language .CODE files.

The linker is needed to combine external assembly language routines with p-code files produced from high-level languages. The linker reads in the .CODE files produced by the assembler and the compiler and emits a .CODE file containing the combined routines with resolved references.



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```

PROCEDURE InitializeProgram;
{ Set up global variables. }
BEGIN
Root:=nil;
Page(output);
WRITELN ('Welcome to SortPrint [1.0] - Copr. John Stephenson 1983');
WRITELN;
REWRITE (SortedOutput, 'PRINTER:');
PAGE(SortedOutput);
END;

FUNCTION FileAvailableForProcessing : boolean;
{ Return true if file available otherwise false.  Set FileName. }
VAR
    OpenedOkay: boolean;

    PROCEDURE GetFileName;
    BEGIN
    END;

    PROCEDURE UserQuits;
    BEGIN
    END;

    FUNCTION IOstate : INTEGER;
    BEGIN
    END;

BEGIN
REPEAT
    GetFileName;
    IF LENGTH(FileName)<1 THEN UserQuits
    ELSE OpenedOkay:=(IOstate=0);
UNTIL(OpenedOkay);
FileAvailableForProcessing:=TRUE;
END;

PROCEDURE SortFile;
{ Sort text lines in ram. }
VAR
    s:          STRING;
    column:    INTEGER;

```

Listing 5: Final Levels

Debugger

The symbolic debugger has been stabilized and enhanced in p-System version IV.1. This is a diagnostic tool for analyzing gritty problems during program execution. Memory may be displayed and altered, p-code may be single stepped, and stack pointer chains may be displayed and traversed. The debugger is a low-level

tool to be used carefully; it is not for the faint of heart. The debugger can set, remove, and list breakpoints; view text files; list registers; print p-code mnemonics; and interact with the performance monitor—all during program execution.

Utilities

Utilities, such as Compare and Patch, are included in the p-System. A description of a few of these utilities follows.

Copydupdir and Markdupdir manage duplicate directories on disks; using them costs a few blocks of disk space but is excellent insurance against disaster. For those who neglect to take advantage of these two utilities at the appropriate time, the utility Recover attempts to reconstruct a disk directory by analyzing the disk's contents.

The utility NCG, for Native Code Generator, converts selected parts of

```

PROCEDURE InitSortFile;
BEGIN
END;

PROCEDURE Insert (var where:TextPointer;
                 var what:string);
BEGIN
END;

    PROCEDURE ScreenFeedback;
    BEGIN
    END;

BEGIN
InitSortFile;
READLN(TextFile,s);
WHILE NOT(EOF(TextFile)) DO
    BEGIN
    IF NOT(LENGTH(s)<1) { It's not a null line } THEN
        BEGIN
        Insert(Root,s);
        ScreenFeedback;
        END;
    READLN(TextFile,s);
    END;
WRITELN;
END;

PROCEDURE PrintFile;
{ Send text lines to printer in sorted order. }

    PROCEDURE PrintNext (p:TextPointer);
    BEGIN
    END;

BEGIN
WRITELN ('Printing ',FileName);
PrintNext(Root);
WRITELN;
END;

```

p-code files into native (machine) code. This utility sacrifices portability for speed. The program can be beneficial when many iterative calculations occur during single procedures, but it is often not worth the delay.

Patch is the byte-dump/disk-block editor. Disk blocks can be displayed in hex or ASCII form and altered as desired. Compare determines the subtle differences between similar source files.

PCDOS allows transfer of files from PC-DOS version 1.10 to p-System disks. Turnkey controls disk formatting and various IBM PC-specific hardware configuration details, such as serial line characteristics and graphic defaults.

A Glance at Pascal

UCSD Pascal is the primary language of the p-System. Pascal is a block-structured, procedure-oriented lan-

guage that encourages top-down design. This type of design contributes toward the successful management of large programming projects. Pascal is modular, has readable syntax, and is more formal than BASIC or FORTRAN. As a result, it is much more maintainable. Anyone who has tried to repair or modify someone else's programs, or even one's own old pro-

```

PROGRAM SortPrint;
TYPE
    TextPointer=    ^TextRecord;
    TextRecord=    record
                    left,
                    right    : TextPointer;
                    contents: string;
                    end;
VAR
    TreeSpace      : ^INTEGER;
    Root           : TextPointer;
    FileName       : String;
    TextFile       : Text;
    TextLine       : TextRecord;
    SortedOutput   : Interactive;

PROCEDURE InitializeProgram;
{ Set up global variables. }
BEGIN
    Root:=nil;
    Page(output);
    WRITELN ('Welcome to SortPrint [1.0] - Copr. John Stephenson 1983');
    WRITELN;
    REWRITE (SortedOutput, 'PRINTER:');
    PAGE(SortedOutput);
    END;

FUNCTION FileAvailableForProcessing : boolean;
{ Return true if file available otherwise false.  Set FileName. }
VAR
    OpenedOkay: boolean;

    PROCEDURE GetFileName;
    BEGIN
        WRITELN;
        WRITE ('Enter EXACT FULL FILE NAME To Sort or <cr> to quit: ');
        READLN (FileName);
        END;

    PROCEDURE UserQuits;
    BEGIN
        FileAvailableForProcessing:=FALSE;
        EXIT(FileAvailableForProcessing);
        END;

    FUNCTION IOstate : INTEGER;
    VAR
        IO:    INTEGER;
    BEGIN
        {$I-}
        CLOSE(TextFile);
        RESET(TextFile, FileName);

        {$I+}
        IO:=ioresult;
        IF(IO<>0) THEN
            WRITELN('Reset ', FileName, ' failed on I/O error ', IO);
        IOstate:=IO;
        END;

```

Listing 6: Complete Program

```

BEGIN
REPEAT
  GetFileName;
  IF LENGTH(FileName)<1 THEN UserQuits
  ELSE OpenedOkay:=(IOstate=0);
UNTIL(OpenedOkay);
FileAvailableForProcessing:=TRUE;
END;

PROCEDURE SortFile;
{ Sort text lines in ram. }
VAR
  s:      STRING;
  column: INTEGER;

  PROCEDURE InitSortFile;
  BEGIN
  WRITELN('Reading / sorting file --> ',FileName);
  column:=1;
  END;

  PROCEDURE Insert (var where:TextPointer;
                    var what:string);
  BEGIN
  IF where=nil THEN
    BEGIN
    NEW(where);
    where^.left:=nil;
    where^.right:=nil;
    where^.contents:=what;
    END
  ELSE
    IF (what<where^.contents) then Insert(where^.left,what)
    ELSE Insert(where^.right,what);
  END;

  PROCEDURE ScreenFeedback;
  CONST
    MaxColumn = 32;
  BEGIN
  WRITE ('. ');
  column:=column+1;
  IF column=MaxColumn THEN
    BEGIN column:=1; writeln END;
  END;

BEGIN
InitSortFile;

READLN(TextFile,s);
WHILE NOT(EOF(TextFile)) DO
  BEGIN
  IF NOT(LENGTH(s)<1) { It's not a null line } THEN
    BEGIN
    Insert(Root,s);
    ScreenFeedback;
    END;
  READLN(TextFile,s);
  END;

```

(continues)

```

WRITELN;
END;

PROCEDURE PrintFile;
{ Send text lines to printer in sorted order. }

    PROCEDURE PrintNext (p:TextPointer);
    { Traverse a binary tree in order with recursive calls. }
    BEGIN
    IF (p<>nil) THEN
        BEGIN
        PrintNext(p^.left);
        Writeln(SortedOutput,p^.contents);
        PrintNext(p^.right);
        END;
    END;

    BEGIN
    WRITELN ('Printing ',FileName);
    PrintNext(Root);
    WRITELN;
    END;

BEGIN {SortPrint}
InitializeProgram;
WHILE (FileAvailableForProcessing) DO
    BEGIN
    MARK(TreeSpace);
    SortFile;
    PrintFile;
    RELEASE(TreeSpace);
    END;
WRITELN ('Bye!');
END.

```

Listing 6: Complete Program (*continued*)

grams, will appreciate the need for maintainable systems.

A Pascal program consists of heading, constant and type definitions, variable allocations, and support procedures and functions, all followed by the main program. As each level of support procedure and function is added, further levels of detail for solving an application are defined. Thus, a complex program is broken down into smaller and more manageable problems until the solution seems trivial.

To illustrate this process, a program to alphabetize and print the

contents of small .TEXT files utilizing a binary tree structure is shown in Listings 1 through 5. Initially, the editor is summoned and the Insert mode is invoked. The general skeleton is typed in (Listing 1), followed by insertion of the main program (Listing 2). The procedure and function stubs needed by the main algorithm are entered (Listing 3), and the global data structures, which support the main algorithm, are filled in (Listing 4). Notice that no special Const information is required, so that reserved word is Deleted.

The file is saved to disk and submitted to the Pascal compiler. Hopefully, no syntax errors are detected. The .CODE file produced may be executed, but it will do nothing because

the support functions and procedures are still empty. The next level (Listing 4) should now be filled in. The final step is shown in Listing 5, and the complete program is shown in Listing 6.

Program SortPrint should run successfully, and your introduction to the p-System has, hopefully, whetted your appetite for more knowledge. ☉

John Stephenson owns a computer consulting business in the New York metropolitan area.

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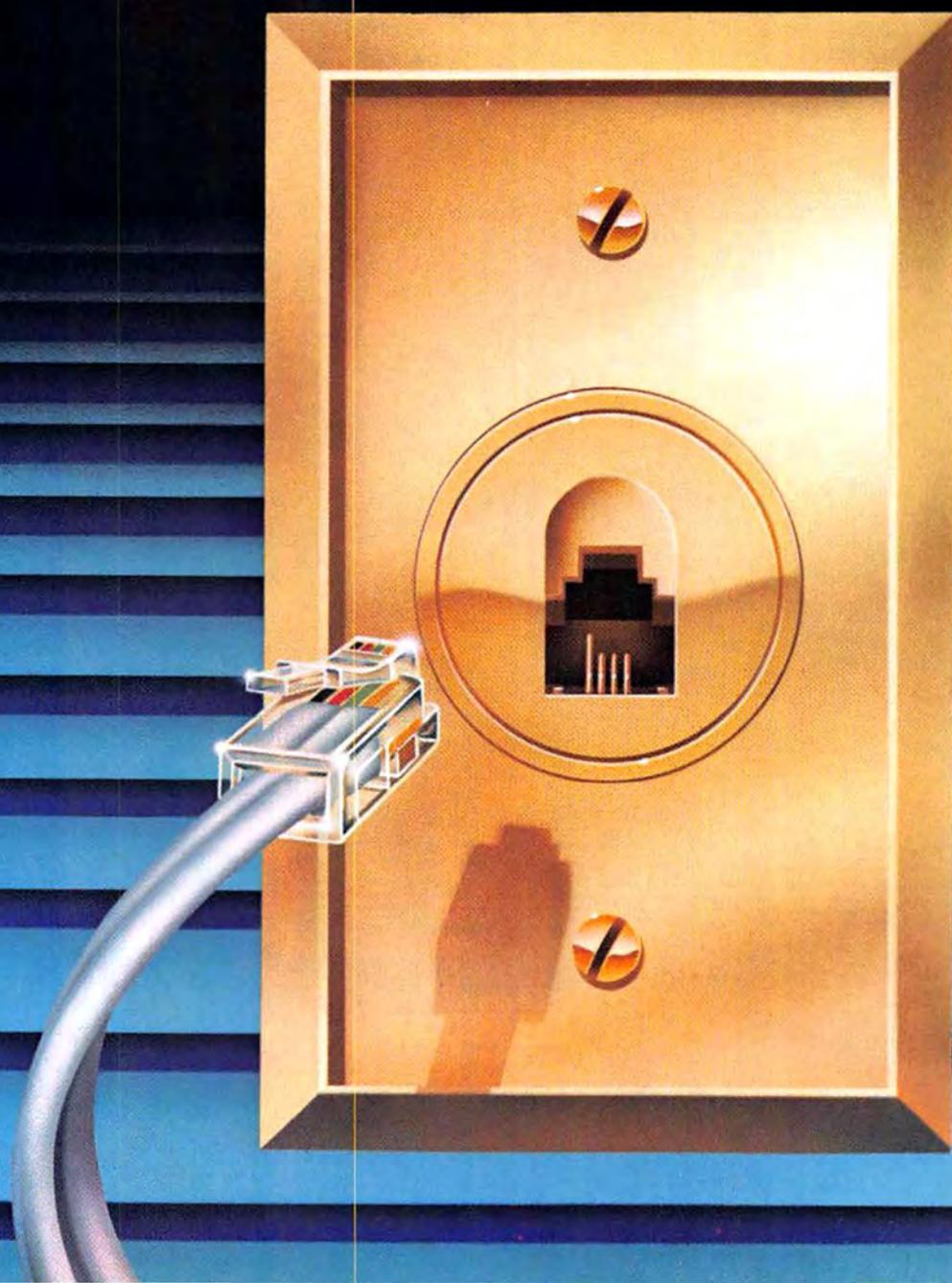
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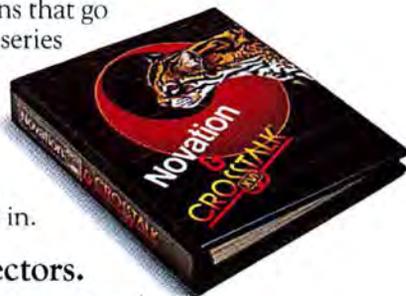
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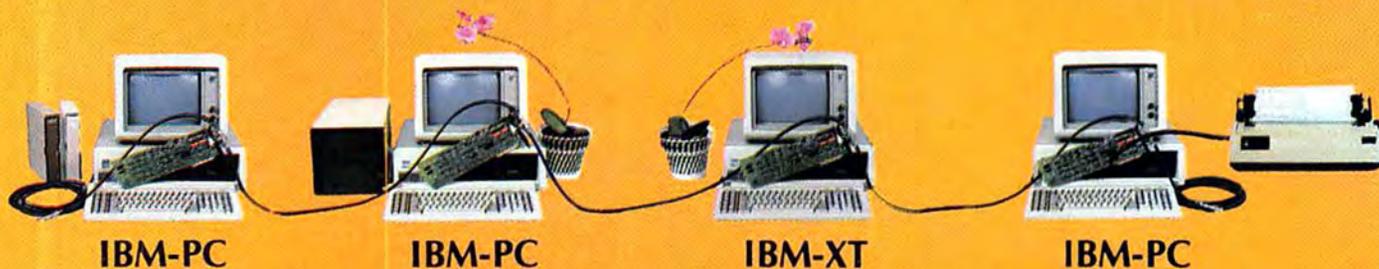


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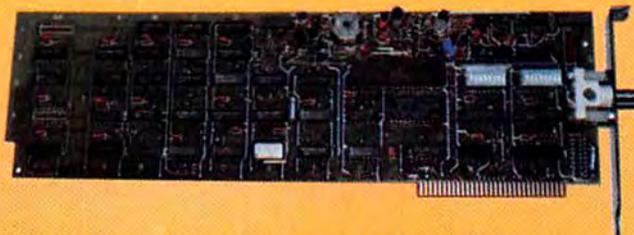
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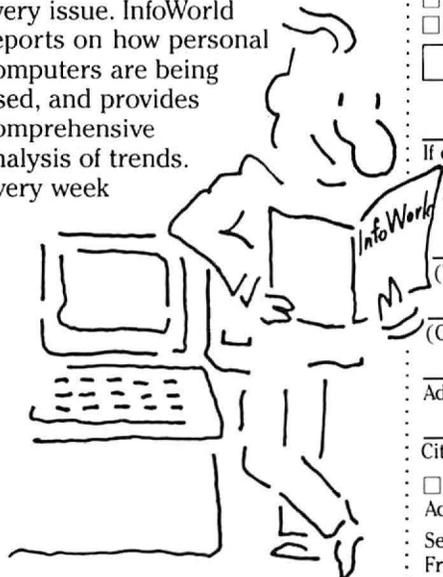
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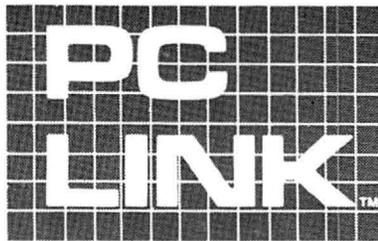
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Getting Started with an 8087

Intel's 8087 proves that two chips can be better than one.

Walter Cooke

If you were ever curious enough to pull the cover off your PC and nose around, you might have wondered why there is an empty socket next to the 8088 processor. This socket is the designated landing pad for what IBM manuals vaguely refer to as a "coprocessor." It didn't take long to figure out that the intended occupant was Intel's high-speed 8087 Numeric Data Processor. But why add another processor when the 8088 is capable of math operations?

The 8087 is a specialized processor that quickly handles the computational chores that the 8088 labors over, thus freeing the 8088 for control functions. But the 8087 cannot perform control functions for itself or work without the presence of the 8088. The two microprocessors operate symbiotically, doing more together than either can do alone.

Since IBM's announcement of its support for the 8087, a number of rash claims have been made about its performance. Although the 8087 is fast, consider what it can and cannot do for you before you rush out to buy one.

Pinning It Down

The package that I brought home from my local computer store is from Seattle Computer. It contains a three-page installation pamphlet, a 5 MHz Intel 8087 chip, a disk with 8087 macros for the Microsoft Macro-86 Assembler, and a copy of Intel's *8087 Software Support Library Reference Manual*.

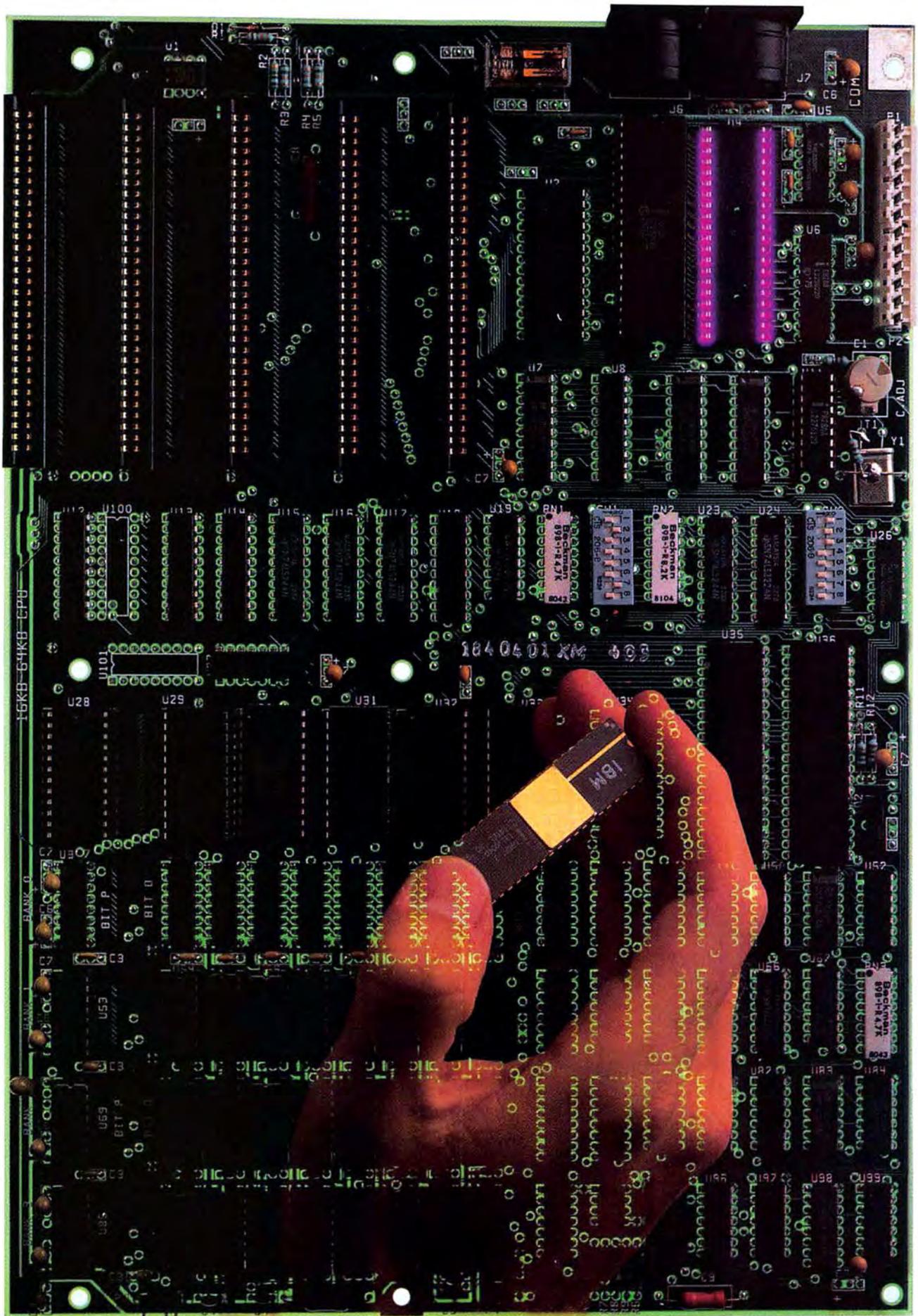
The 8087 far outstrips the 8088 in real number calculations of all kinds.

The 40-pin 8087 chip is not the easiest object to maneuver into the tight quarters on the IBM PC system board. Wiggling a chip into a barely visible socket underneath your shaking fingers while you wonder how many pins are snapping off is not an activity I would recommend. As you gently push it into its socket, the 8087 emits squeaks and groans—not the most reassuring sounds to hear emanating from your PC. Not only that, the instructions tell you to re-

move the chip to make sure you did not bend any pins. Such a maneuver gives you an opportunity to bend the pins you missed the first time.

If you are purchasing an 8087 from an authorized IBM dealer, it is probably a good idea to save yourself the trouble and let them install the chip. If you must install the chip yourself, follow the usual precautions for handling integrated circuit chips. Any source of static electricity can destroy the chip while you are handling it. Leave the chip in its antistatic case until you are ready to install it. Avoid wearing polyester clothing, but make sure to wear rubber-soled shoes. Also, don't handle any plastic, vinyl, or Styrofoam while working with the 8087. Make sure you are well grounded by wrapping some wire around your wrist and securing the end of the wire to a pipe or a doorknob.

The rest of the installation is straightforward. Removing circuit boards from the slots next to the 8087 socket may be helpful, providing you with some extra finger space during the installation procedure. The only modification to the PC itself is to turn DIP switch 2 on the motherboard from on to off. If the 8087



● Hands On

is later removed from the PC, the switch must be returned to its original on position.

Testing the 8087

Later, I turned on my PC and ran the 8087 demonstration program included on the disk. Saying that the 8087 is fast is a gross understatement. Square roots and quadratic equations are child's play for the 8087, and the answers, accurate to 17 digits, are displayed as fast as you can hit the <Enter> key.

The disk also includes a library called 8087.MAC, which holds all the assembly language instructions necessary for the 8087's operation with the 8088. But a single assembly language instruction is usually insufficient to direct the 8087 in a task, so they are grouped together in various macros. Each macro can be named with a single word, called a mnemonic, and used when needed throughout the assembly language program. The macros extend the assembler to include the 8087 operation codes such as FCOMPP, for floating-point compare and pop, and FPTAN, for floating-point partial tangent (see Table 1).

The macros work with the standard *Macro Assembler* sold by IBM and are entered into an assembly language program on the first line of code using an INCLUDE 8087.MAC command. With the aid of the macro library, the 8087 performs 77 different mathematical, store, and control functions out of a total repertoire of 146 machine instructions.

Coming to Terms

The advantage of using the 8087 in a PC involves three crucial factors: precision, range, and speed. Until the introduction of 16-bit microcomputers, performing complex mathematics on

a personal computer was difficult. Eight-bit computers were limited by the size of numbers they could handle, but current 16-bit computers like the PC routinely manipulate numbers up to 32 bits long. These are referred to as double-precision numbers because they take up 2 bytes of memory, compared with regular, single-precision numbers that fit into 16 bits, or 1 byte. In a 32-bit double-precision number, 17 digits of precision are possible, with values ranging from 10^{-38} to 10^{38} . These are "real" numbers since they have a decimal point and a fractional component.

Square roots and quadratic equations are child's play for the 8087.

They're also known as floating-point numbers because the decimal point floats around inside the memory location where the number is stored.

Inside the computer, real numbers are stored in two parts: the exponent stores the magnitude of the number and defines where the decimal point will be placed; the mantissa stores all the significant digits that make up the number. But if you looked at the contents of the memory location, you would not see any indication that a decimal point is stuck anywhere in the mantissa.

Keep in mind that the accuracy of any calculation is limited. Rounding occurs when real numbers cannot be absolutely defined with a limited number of digits. For example, 1 divided by 3 results in the number .333333333..., which is accurately represented with an infinite number of digits. Such a number cannot be used easily in calculations. The least significant digit of the number must

be rounded so that it can be stored in the limited memory of the computer.

Some calculations do not even round off the last significant digit but "chop off," or truncate, the result at the least significant digit. Great differences in magnitude further skew the accuracy of a result. For example, if you add 10^{-29} to 10^{33} , the answer may well be 10^{33} . With only 18 significant digits to store the result, the tiny addition is lost.

All these error-magnifying problems, while acceptable by themselves, are compounded when a calculation repeats a looping process to arrive at a final answer. By the end of a calculation the result contains a significant error and, as such, can be considered only an approximate answer.

To address some of these problems, "two's-complement" arithmetic is used in which negative operations (subtraction) and results are expressed as positives. The zeros and ones representing a negative number in memory are "complemented"; all the zeros are turned into ones and all the ones into zeros, with one added to each value. Thus, the 8087 does not have to subtract; only addition is required. As a result, computations are performed more quickly and accurately. A binary number has a bit that tells the computer that it is handling a negative number so that later, when the number is displayed, the computer puts a minus sign in front of it.

Precision

Precision is the most important consideration in calculation. It relates to the accuracy of operations performed on a number, the decimal places of accuracy, and how long calculations can continue before an unacceptable amount of error through rounding, truncating, large differences in mag-

Processor Control Instructions

FINIT/FNINIT	= Initialize NDP
FDISI/FNDISI	= Disable interrupts
FENI/FNENI	= Enable interrupts
FLDCW	= Load control word
FSTCW/FNSTCW	= Store control word
FSTSW/FNSTSW	= Store status word
FCLEX/FNCLEX	= Clear exceptions
FSTENV/FNSTENV	= Store environment
FLDENV	= Load environment
FSAVE/FNSAVE	= Save state
FRSTOR	= Restore state
FINCSTP	= Increment stack pointer
FDECSTP	= Decrement stack pointer
FFREE	= Free register ST(i)
FNOP	= No operation
FWAIT	= CPU wait for NDP

Comparison Instructions

FCOM	= Compare real to ST(0)
FCOMP	= Compare real and pop
FCOMPP	= Compare real and pop twice
FICOM	= Integer compare to ST(0)
FICOMP	= Integer compare and pop
FTST	= Test ST(0)
FXAM	= Examine ST(0)

Data Transfer Instructions

Real Transfers:

FLD	= Load real to ST(0)
FST	= Store real
FSTP	= Store real and pop
FXCH	= Exchange registers ST(i) and ST(0)

Integer Transfers:

FILD	= Integer load to ST(0)
FIST	= Integer store
FISTP	= Integer store and pop

Packed Decimal Transfers:

FBLD	= Packed decimal (BCD) load to ST(0)
FBSTP	= Packed decimal (BCD) store and pop

Arithmetic Instructions

Addition:

FADD	= Add real with ST(0)
FADDP	= Add real and pop
FIADD	= Integer add

Subtraction:

FSUB	= Subtract real with ST(0)
FSUBP	= Subtract real and pop
FISUB	= Integer subtract
FSUBR	= Subtract real reversed
FSUBRP	= Subtract real reversed and pop
FISUBR	= Integer subtract reversed

Multiplication:

FMUL	= Multiply real with ST(0)
FMULP	= Multiply real and pop
FIMUL	= Integer multiply

Division:

FDIV	= Divide real with ST(0)
FDIVP	= Divide real and pop
FIDIV	= Integer divide
FDIVR	= Divide real reversed
FDIVRP	= Divide real reversed and pop
FIDIVR	= Integer divide reversed

Transcendental:

FPTAN	= Partial tangent of ST(0) $0 \leq ST(0) < \pi/4^*$
FPATAN	= Partial arctangent of ST(0) + ST(1) $0 \leq ST(0) < ST(1) < +\infty^*$
F2XM1	= $2^{ST(0)} - 1$ $0 \leq ST(0) \leq 2^{-1^*}$
FYL2X	= $ST(1) \cdot \log_2[ST(0)]$ $0 < ST(0) < \infty^*$ $-\infty < ST(1) < +\infty^*$
FYL2XP1	= $ST(1) \cdot \log_2[ST(0) + 1]$ $0 < ST(0) < (2 - \sqrt{2})/2^*$ $-\infty < ST(1) < \infty^*$

Load Constant Instructions

FLDZ	= LOAD +0.0 into ST(0)
FLD1	= LOAD +1.0 into ST(0)
FLDPI	= LOAD π into ST(0)
FLDL2T	= LOAD $\log_2 10$ into ST(0)
FLDL2E	= LOAD $\log_2 e$ into ST(0)
FLDLG2	= LOAD $\log_{10} 2$ into ST(0)
FLDLN2	= LOAD $\log_e 2$ into ST(0)

Other Instructions

FSQRT	= Square root of ST(0) $-0 \leq ST(0) \leq +\infty^*$
FSCALE	= Scale ST(0) by ST(1) $-2^{15} \leq ST(1) < 2^{15}$ and ST(1) integer*
FPREM	= Partial remainder of ST(0) \div ST(1)
FRNDINT	= Round ST(0) to integer
FXTRACT	= Extract components of ST(0)
FABS	= Absolute value of ST(0)
FCHS	= Change sign of ST(0)

ST(0) = current stack top

ST(i) = first register

below stack top

*Functional conditions

Table 1: 8087 Macros

☉ Hands On

nitude, or conversion operations significantly affect the answer.

Precision is controlled by the size of the mantissa, which holds the most significant digits of a number, regardless of where the decimal point is located. Precision is not a problem with integers. Each integer in the PC is precisely represented by the two's-complement arithmetic. But even the smallest real number can have an infinite number of digits, so it must be approximated to fit into a finite amount of memory.

The 8087 with its 64-bit mantissa is accurate to 1 part in 2^{64} . Such accuracy is seldom needed for a final result, but it is important during the intermediate stages of a calculation with a large number of steps.

Range

Range determines how large or small a number can be represented. With integers, the range is controlled by

the number of bits used. Using 16 bits, the smallest and largest integers you can represent are -32768 and +32767 (using two's complement). For real numbers the range is controlled by the size of the exponent. In the 8087 the exponent is 15 bits long, allowing a very wide range of numbers, from 10^{-4932} to 10^{4932} , to be represented.

Speed without Pain

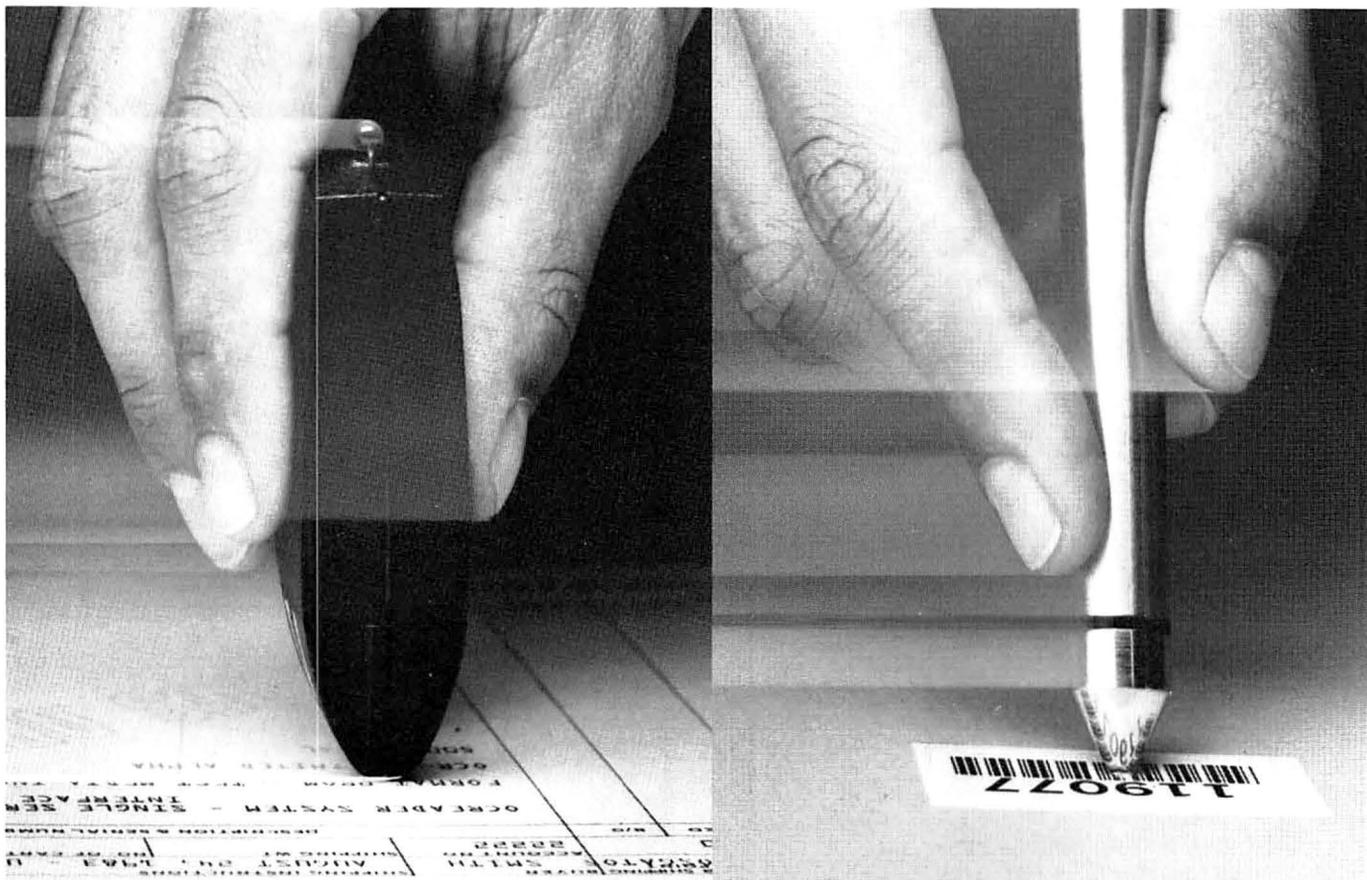
Beyond the esoteric considerations of precision and range is the issue of speed. Those who are bothered by the sluggishness of the BASIC Interpreter may not be willing to devote time to converting their BASIC programs into a faster-running language such as Pascal or C. The 8087 may provide a possible way to speed up BASIC programs.

As Table 2 demonstrates, the 8087 far outstrips the 8088 in real number calculations of all kinds. For any type of scientific or calculation-intensive work (involving programs such as

I-2-3 or *TK!Solver*) the 8087 can provide speed improvements of 10 to 100 times what an ordinary 8088 machine language program can accomplish.

Animation and color graphics routines that calculate circle, arc, and positional information will also benefit from the 8087. While graphics routines chug along when displaying complex shapes on the screen, rewritten 8087 graphics routines produce the final image on the screen almost instantly.

Another task that requires rapid and precise computing is data encryption, the science of transforming information into a secret or secure form unintelligible to anyone but the intended receiver. Data encryption is used with increasing frequency in industry and by the military. Large numbers called keys are typically used in the mathematical process of transforming data into unreadable "ciphertext." The 8087 makes using powerful encryption systems possible



in telecommunications and data management with the PC.

One recently advertised encryption package that does not utilize the 8087 suggests that when large files need decoding, the user start the program and leave the PC running for the weekend to complete the calculations. Programs that calculate the encryption keys are similarly demanding. In this area of "number-crunching," the 8087 is the clear choice.

Inner Workings

As a coprocessor the 8087 shares both the I/O bus and the instruction "stream" with the 8088, and it monitors all the instructions sent to the 8088 for processing. The 8087 instructions are like bottles floating in a stream. The 8087 plucks them out, while the 8088 channels the rest of the flow. When the 8087 detects a special escape code in the instruction stream (which is transparent to the 8088), it prepares itself for work. The

Instruction	Precision	Execution rate with 8087	Execution rate without 8087
Multiply	Single	19	1,600
Multiply	Double	27	2,100
Add		17	1,600
Divide	Single	39	3,200
Compare		9	1,300
Load	Single	9	1,700
Store	Single	18	1,200
Square Root		36	19,600
Tangent		90	13,000
Exponentiation		100	17,000

Table 2: Execution rates (in microseconds) for an IBM PC with and without an 8087 installed

first five bits of the escape code are always 11011; the last three bits contain part of the operation code (opcode) for the 8087 (see Figure 1).

Meanwhile, the 8088 processes the next byte in line, which contains three more bits of the opcode and addressing information. The 8087 now

knows exactly what operation to perform and lets the 8088 get the first byte on which to operate. The 8088 then releases the bus to the 8087, which retrieves extra bytes of data if necessary, performs its computation, and sends the answer down the bus.

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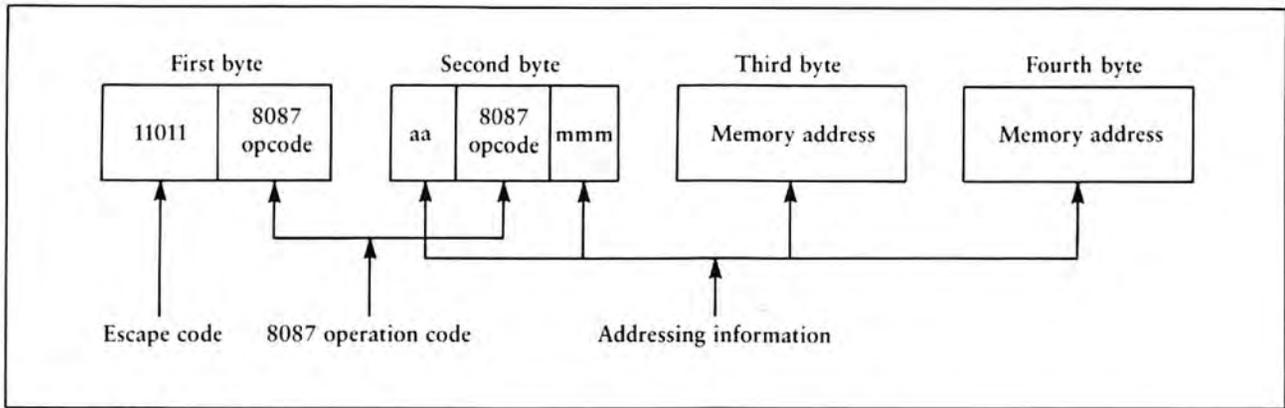


Figure 1: A 4-byte 8087 instruction

PC-DOS do not use identical formats for storing data. The Intel 8087 *Software Support Library Reference Manual* provides the few steps needed for making these small changes.

The 80-bit temporary real format requires 1 bit for the sign, 15 bits for the exponent, and 64 bits for the mantissa. A bias is added to the exponent, allowing an equal number of large and small numbers to be repre-

sented. A bias is a way of indicating whether the exponent of the number is positive or negative without using a sign bit. A temporary real number can be as small as 2^{-16382} (3.36×10^{-4932}) or as large as approximately 2^{16384} (1.19×10^{4932})

You can appreciate the magnitude of some of these numbers if you consider that about 2.0×10^{77} elementary particles would be needed to fill

the entire universe. This number is tiny compared with the range of the 8087. Yet mathematicians can easily exceed the 8087's computing power. For example, the 8087 can compute factorials only as high as 1754.

The 8087 is not limited to "ordinary" numbers. It can work with conditions that do not correspond to normal floating-point operations. These conditions include denormals and unnormals (numbers usually too

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large or too small to process), infinities (such as a number divided by zero), indefinites (such as zero divided by itself) and NaNs (not a number), which are involved in calculation error debugging.

8087 Limits

While the 8087 is preferable in most numeric processing, certain limits should be considered. The temporary real conversion process essential to the 8087's speed with large numbers is a hindrance with small ones. An 8087, 16-bit register-to-register addition using small integers is nearly 30 times slower than with the 8088. The 8087 is useful in this situation only when computations involve different types of numbers that require conversion to one format.

Write or Wait

It is important to realize that plugging an 8087 chip into your PC will not make your existing programs

magically run faster. While the chip is fast and relatively cheap (Intel recently cut the price from \$300 to \$223), few applications packages currently use the 8087.

If you want to write your own programs that support the 8087, you must get the appropriate software to extend the programming language being used. This software is now becoming available for such programming languages as BASIC, Pascal, C, and Macro Assembler.

A number of companies offer both Intel's 8087 and the extension software for prices ranging from \$250 to \$375. If you buy the 8087 support for BASIC, for example, you receive a library of assembly language code, which is used in conjunction with the IBM BASIC Compiler (not the BASIC Interpreter.) When you compile your BASIC programs, the library of 8087 functions replaces the slower 8088 algorithms of common BASIC functions.

When you are evaluating the 8087, remember that most software pack-

ages, such as *VisiCalc* or even the BASIC Interpreter, do not yet support the 8087. Be wary of salespeople who say that they think the particular program can use the 8087 but aren't really sure and have no documentation to prove it. When in doubt about using an 8087 for a particular application, talk to a reliable computer retailer who knows your work and system requirements.

Benchmarking

The best way to determine if a piece of software uses the 8087 is to test it. Run a benchmark program comparing two PC setups: one with and one without an 8087 installed. Use the software first on a machine that does not have an 8087, and run a program that takes several minutes or more to complete its calculations. Run the same program and data on a system that does have an 8087 installed. If the calculations are not completed in a much shorter time (10 to 100 times shorter), the software is not using the 8087's functions.

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Circle 163 on reader service card

Choosing a calculation-intensive program for the test is, of course, important. A program that reads and writes data from one place to another is not going to run any faster with an 8087. As a wise programmer once said, "All computers, no matter how

If the 8088 is waiting for disk input and output to occur, the 8087 will not help it wait any faster.

fast, wait at the same speed." If the 8088 is waiting for disk input and output to occur, the 8087 will not help it wait any faster.

As a final puzzle to ponder, there is the possibility of ending up with software that runs on a system with an 8087 installed but fails on a system

without an 8087. It would be convenient if software using one algorithm for the 8087 would provide another in a system that does not have an 8087 installed. But the prospects for this feature are unlikely. If you buy a program that uses the 8087, it is probably worth your while to see if it runs on a PC without an 8087. You may find out eventually if your 8087 or your PC fails.

If your PC is going in for repairs, you can pull the 8087 out of its socket and plug it into another PC to keep your special application running. If your 8087 chip goes "pins up," you will have to get another one before running any applications that require 8087 support. But unless you regularly run your PC without ventilation in 90-degree weather, it's unlikely that an 8087 will fail.

In the event that 8087-supported software fails to work in a properly configured PC, check the 8088 processor. Intel recently discovered that older 8088 chips stamped "© 1978" cannot function with the 8087.

Those stamped "© 1978, 1981" will function with the 8087 without difficulty.

The popularity of the 8087 will be restricted until more high-level programming tools and applications programs are developed that put the 8087 to good use. For those who are anxious to get started with the 8087, a working knowledge of assembly language programming and engineering is advisable, along with a large reserve of patience.

Walter Cooke is a computer security specialist with the British Columbia Telephone Company in Vancouver.

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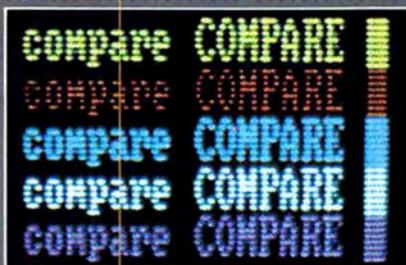
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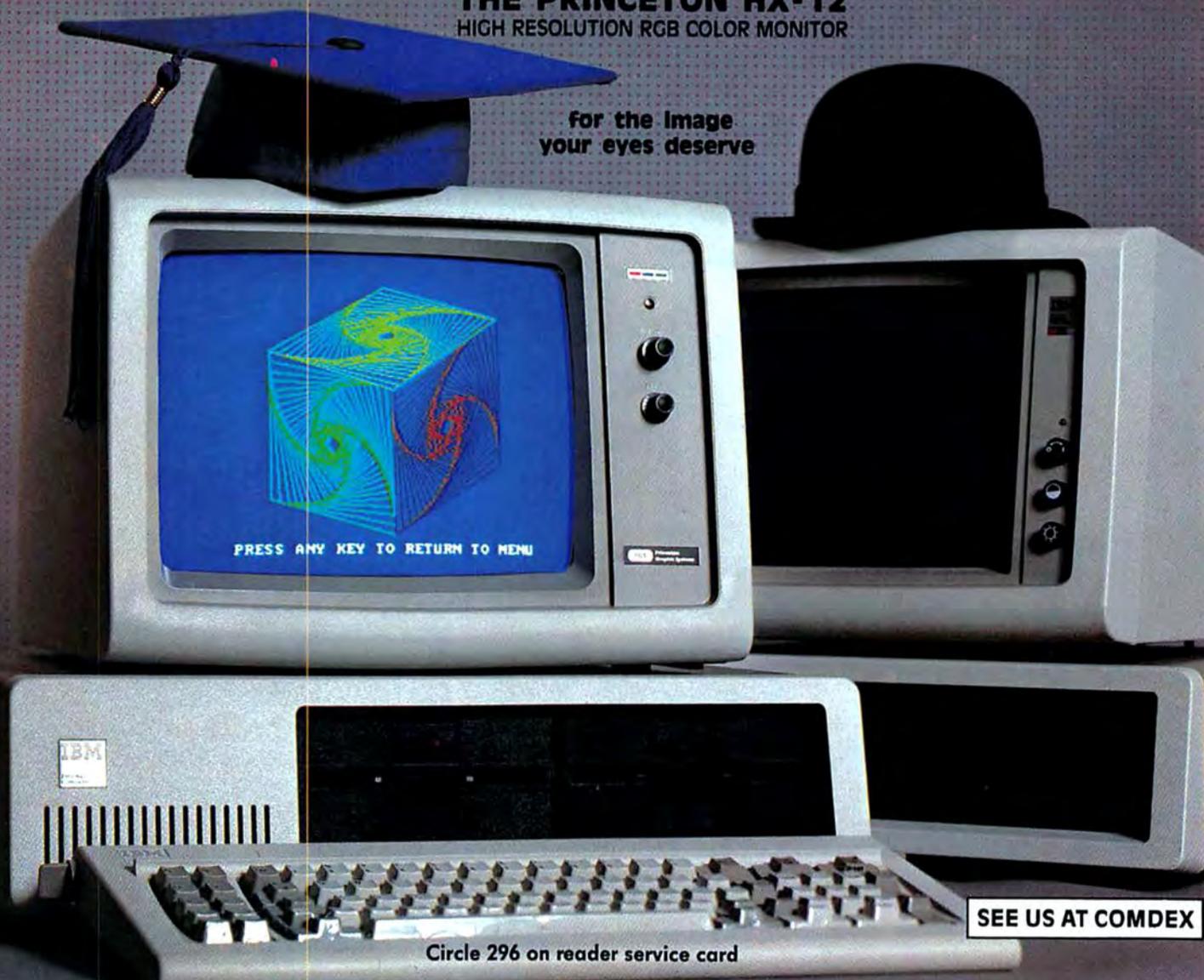
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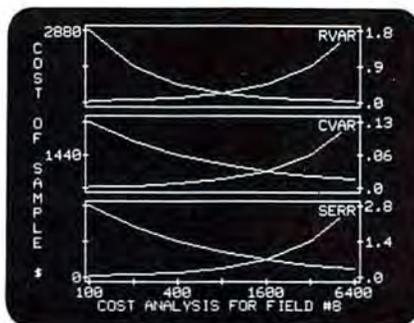
Statistics Modules Menu

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IF YOU'RE CONFUSED ABOUT BUYING A PERSONAL COMPUTER, HERE'S SOME HELP

Computers come in two parts.

One part is the "hardware," the machinery itself. The other is the "software," which tells a computer what to do, the way a driver tells a car what to do.

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.

The simpler the better.

Some people will tell you that software has to be complicated to be powerful. Nothing could be further from the truth.

Good personal software should be, as the computer people say, "friendly." Meaning that it helps you do what you want to do without getting in the way.

Good software keeps the complications in the computer, where

they belong. And keeps the capability at your fingertips. It's that simple.

Simply see for yourself.

You can read any number of interesting books and magazines about personal computers. You can ask your friends who have them.

Or look at all the sales literature you can get your hands on.

But as helpful as that can be, there's no substitute for a live demonstration.

When you do go shopping, we recommend you take a look at the PFS® Family of Software.

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PFS:WRITE is ideal for people who want to make their writing time more productive. It displays what you write on your computer screen so you can make revisions as you compose.

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WRITE also works with most popular software programs, including the PFS Family of Software.

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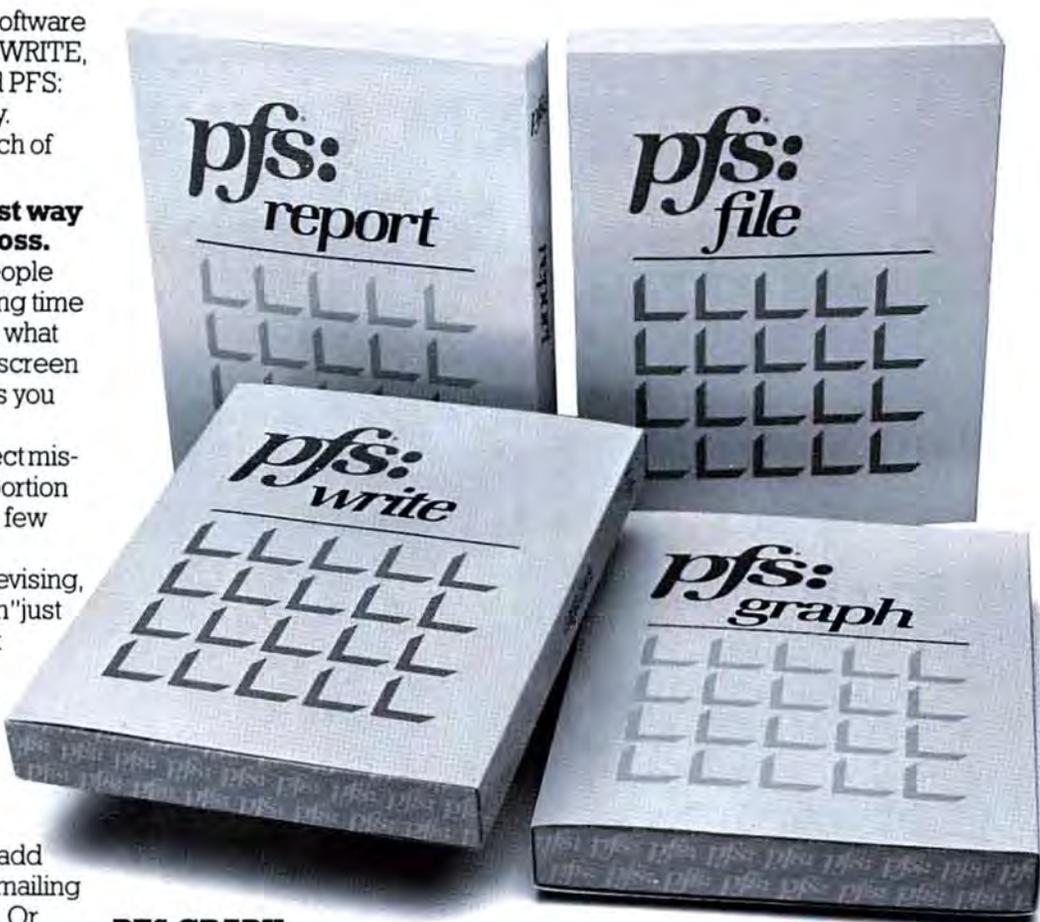
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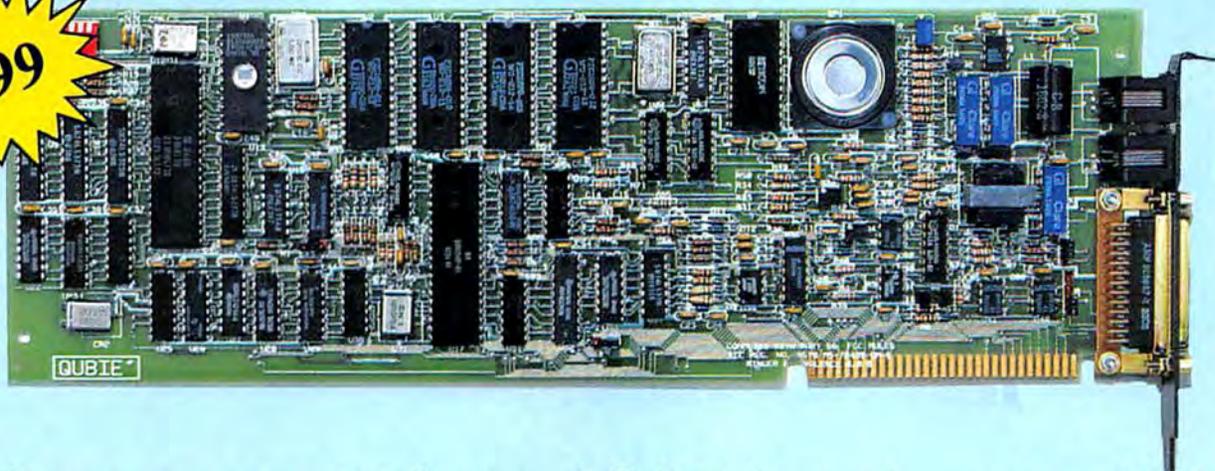
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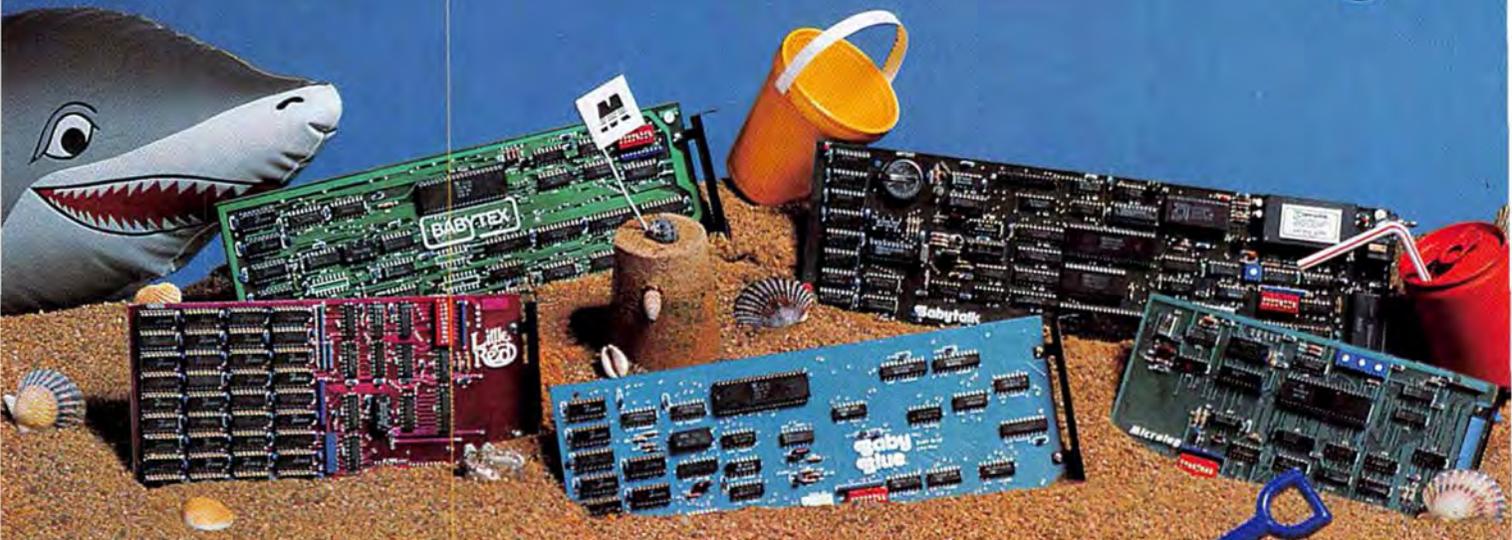
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The Help Screen

PC World offers answers and advice at every level.

Karl Koessel

This month a user gives us feedback on the multifunction card that makes his PC overheat, causing disk read errors; a computer consultant shares additional advice about parity check errors that were not caused by defective memory chips; and another reader wonders about the safety of turning on the PC and all its peripherals with one master switch. Finally, a reader has an NEC 3550 printer that inexplicably loses control, causing changing margins, backward printing, and so on.

Hot and Bothered

Q. You did Mr. Schumacher [PCW, Vol. 1, No. 5] and your readers a disfavor by ignoring his comments about overheating. I have exactly the same problem, and by the highly unscientific technique of holding my hand over parts of the system, I believe the source of the heat is my AST MegaPlus board. Specifically, the heat seems to come from the rear portion of the board. As a result of the heat I must operate my PC with the system cover completely removed, or after one or two hours I get lots of "Disk Read Error" or "Disk Boot Failure" messages when I restart the system. The worst part of it is that because a non-IBM accessory is causing the problem, I can't make use of my IBM maintenance contract to do anything about it. What do you suggest to cure the problem? I'm concerned that I may be doing permanent damage to the other components in the computer.

*Mike Ruby
Seattle, Washington*

A. Your concern is well founded because overheating can cause damage to internal components. The precautions suggested to Mr. Schumacher were intended to inform users that airflow into and out of the system unit must not be restricted; the PC must be allowed to cool itself.

Unfortunately, the densely packed circuitry of multifunction boards and "piggybacked" expansion boards (as

Your heat problem is probably caused by a sensitive component.

well as internally mounted hard disk drives) do produce a burdensome amount of heat. All those extra ribbon cables don't help either, but operating the PC with the system cover removed is not a good idea. It may keep the heat of other boards away from the disk-controller board, but it causes cooling by convection rather than by forced airflow and thus makes all the chips run hotter. The following suggestions may help your PC keep its cool.

Move the AST MegaPlus board to the far left expansion slot. The PC has air intake holes along most of the left underside of the system unit, so the board in this slot receives the greatest amount of fresh air. You might also mimic the design of the XT and increase the amount of airflow into the left side by using mask-

ing tape to cover the intake holes below the disk drives only, underneath the front edge of the PC.

If you have other boards that also produce a lot of heat, place them in nonadjacent slots. The PC does a better job of removing heat from several small sources than from one concentrated area.

Arrange all internal cabling so airflow inside the system unit is as free as possible. Unrestricted airflow above the boards (along the entire underside of the system unit cover) is especially important. Ribbon cables should not be placed above the expansion boards or atop the disk drives.

All boards, including the MegaPlus, produce heat. Your heat problem is probably caused by a sensitive component within your system that would fail from the heat of any expansion board.

Should the suggestions above fail to remedy your problem, take your system, sans AST board, to your IBM service center and explain to them that you suspect a heat problem with the disk controller board or drives (especially bad on warm days). They should be able to determine if heat is affecting the system's performance.

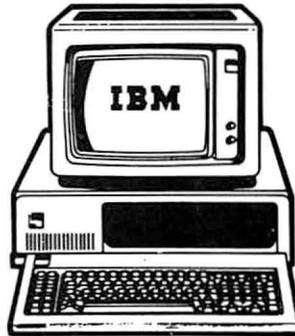
My PC is equipped with an AST ComboPlus multifunction board and a Plantronics ColorPlus board (which is two full-length expansion boards, piggybacked to plug into one slot). Needless to say, the system unit cover gets very hot. To help keep the sys-

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The Help Screen

tem cool I keep the back of the PC at least 5 inches away from the wall. Also the top left third of the system unit cover is much hotter than the right, so I keep my monitor atop the far right side of the system unit, allowing the hotter portion of the system cover as much exposure as possible.

RAM Chips Vindicated

Q. Additional information to your response to the question on parity check [PCW, Vol. 1, No. 4] could prove helpful to your readers.

A parity check error indicates memory malfunction. This may mean a bad chip, but often it is due to a "socketing problem" (poor connection with one of the chip leads). During the past 18 months I have encountered the parity check error 10 to 20 times in my own PCs and those of my clients. In every case the problem was socketing; I have never had a bad chip! The problem has occurred on the system board and on added RAM boards—but I have not observed any correlation between the problem and either board or chip manufacturer. I have noticed, however, that the situation tends to occur when the system unit has been moved, though it has also occurred without any apparent cause.

The parity check error code (which indicates the problem chip) is usually on the screen very briefly; it may be necessary to restart the system and watch carefully as the error code "flashes by."

Often just pushing firmly but gently on the "bad" chip will remedy the situation. If the problem continues, the next step is removing the

chip and putting it back in the socket. If the problem still continues, you probably do have a bad chip.

A pair of chip-removal tongs (about \$2), a pair of 4116-200 chips (16K by 1 bit—200ns), and a pair of 4164-200 chips (64K by 1 bit—200ns) will make a nice spare-parts kit for these situations. The total cost is about \$15 to \$20.

John W. Menne
Floral City, Florida

A parity check error is often due to a "socketing problem."

A. Thanks for the tip. I am pleased that *The Help Screen* has encouraged you to share your experience and expertise. Chip manufacturers should be pleased to hear that RAM chips are not always to blame for memory errors. I have also seen a memory board that produced parity check errors even though all the RAM chips were functional. One of the memory board's "support" chips was defective.

PC/Peripheral Powering Sequence

Q. John A. McCristall [PCW, Vol. 1, No. 6] asked about the proper procedure for turning the PC on and off. Although the PC power switch appears rugged and probably lasts a long time, I understand that replacing

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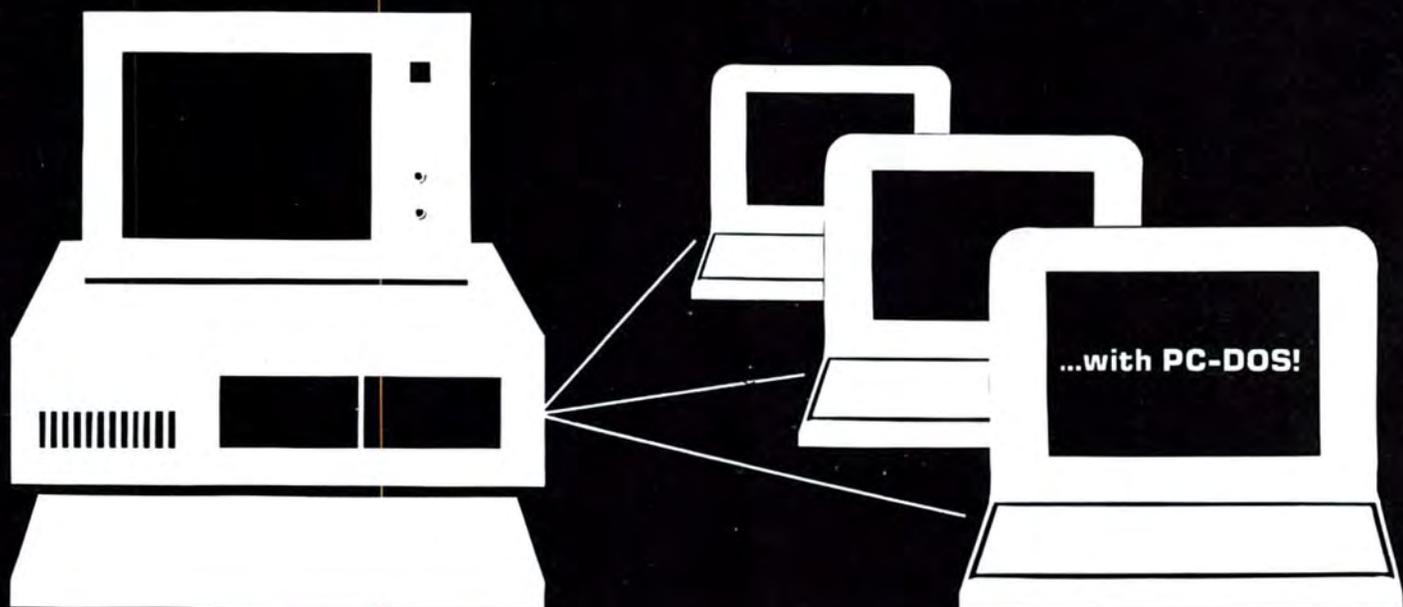
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The Help Screen

it can be very expensive. I know people who leave the PC switch on and power their entire system on and off with the switch on a power strip. My question is, is it safe to turn the PC, printer, and other peripherals on and off together with a master switch?

*Arthur T. Cannon
Saco, Maine*

A. When an electrical device is switched on, it adds a load to the power line, creating a momentary surge in the line. The bigger the load is, the bigger the surge. If the surge is large enough, it will cause sensitive electronic devices to malfunction. Users are generally advised to power on all peripherals before powering on the PC, but it's also perfectly safe to use one master switch. As long as no power-hungry device is powered on after the PC, there will be no significant surge in the line while the PC is operating.

I use a power strip master switch to turn on all my system devices at once. But I turn my printer and my color monitor on and off as needed (using their own individual power switches) and have had no problems.

Speaking to Deaf Ears

Q. *I have a question that no one seems able to solve. I use WordStar (version 3.24) constantly on an emulated drive C with other patches from PC World. Recently I bought an NEC Spinwriter 3550 printer, which I always run at 12 cpi.*

Everything works fine, except when I am writing single-spaced and have two blank lines between para-

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```
I have a question that no one seems able to solve. I use
WordStar (version 3.24) constantly on an emulated drive C
with other patches from PC World. Recently I bought an NEC
Spinwriter 3550 printer, which I always run at 12 cpi.
```

```
Everything works fine, except when I am writing single-
spaced and have two blank lines between paragraphs. Then the
printer goes haywire. It goes over to the left margin,
spins around, writes backward, changes to 10 cpi, ignores
the next line, and so on. It does different things at different
times. I found that adding a comma or a numeral sometimes
triggers the weird behavior. I have no idea what is
happening. It seems that somehow a "message" is being sent
to the printer, canceling the current printer settings and
```

```
thgim tahW !pleh esaelp
```

```
nd carriage returns. Are these
t what is happening. Other than
papers, the printer works fine.
is double-spaced. Any suggestions
```

Figure 1: Text sent to a printer that is intermittently unable to receive

graphs. Then the printer goes haywire. It goes over to the left margin, spins around, writes backward, changes to 10 cpi, ignores the next line, and so on. It does different things at different times. I found that adding a comma or a numeral sometimes triggers the weird behavior. I have no idea what is happening. It seems that somehow a "message" is being sent to the printer, canceling the current printer settings and letting the printer do whatever it wants.

Please help! What might it be? WordStar? Or the 3550? Where should I start? The WS-DOS.BAS

program in PC World discusses line-feeds and carriage returns. Are these involved? I can't figure out what is happening. Other than with single-spaced papers, the printer works fine. Luckily, most of my work is double-spaced. Any suggestions would be appreciated.

Terry F. Pettijohn
Marion, Ohio

A. The printout that you sent (see Figure 1) is a classic example of what happens when a computer sends characters to a printer that is not ready to receive. The handshaking protocol, which handles communications between the PC and the NEC 3550, is being ignored. For some reason, the signal from the printer ask-

ing the computer to pause character transmission is not reaching the PC. The problem is probably within the cable that connects the printer to the PC. Make sure that wires for all the signals required by the PC are present and that the printer is supplying the correct signals on the appropriate lines. The dealer who sold you the printer should be able to help you obtain the proper cable. ☹

Do you have any questions concerning the IBM PC or the new compatibles? Send them to The Help Screen, PC World, 555 De Haro St., San Francisco, CA 94107.

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I spent many sleepless nights trying to come up with a solution to this nightmarish situation. Then I remembered a course I had taken in decision analysis. I spent the rest of that night reviewing course material and other books I had bought on the subject. The next day, I called an emergency meeting.

Using the decision making techniques I had learned, we spent the rest of the week searching for and analysing potential solutions. The net result was that not only was the company pulled back from the brink of destruction, but we added over \$1,000,000.00 in gross sales during that off-season.

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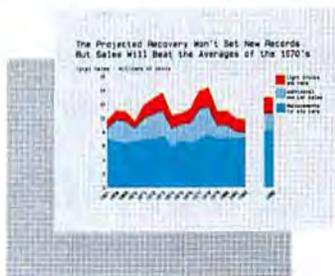
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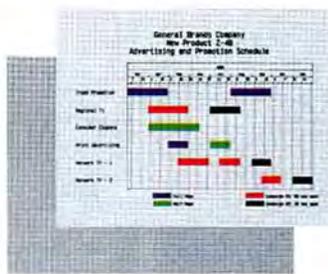
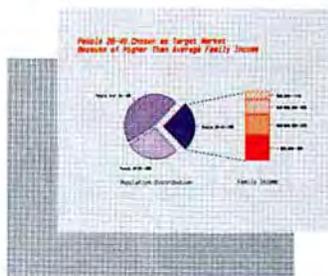
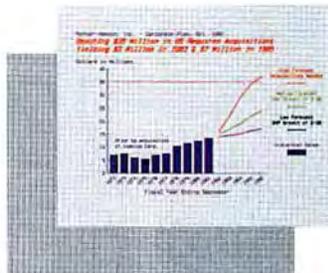
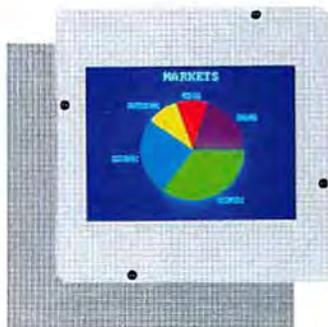
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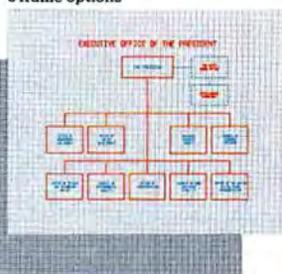


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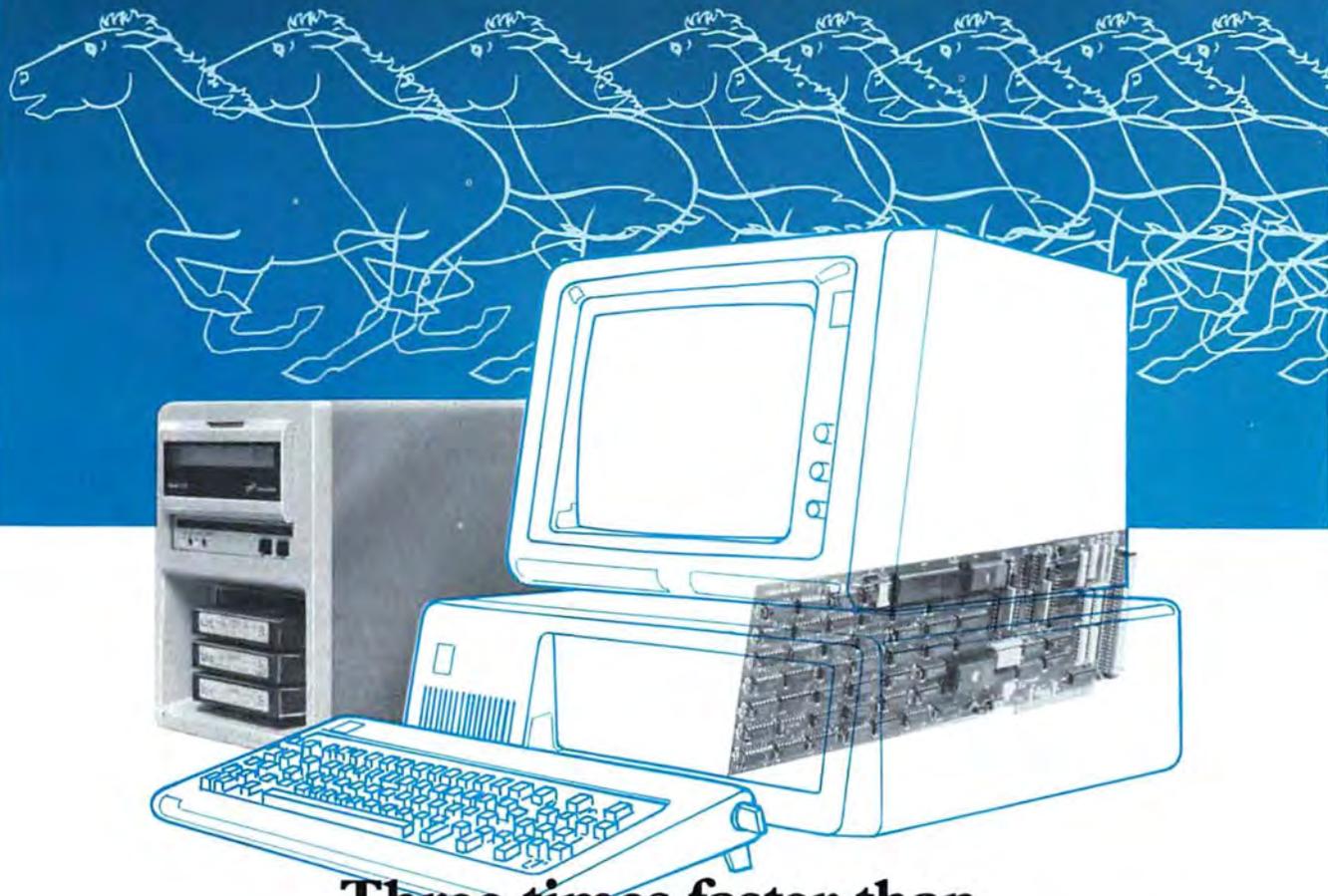
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A global exchange of personal computer discoveries

Edited by Andrew Fluegelman and Art Wilcox

We appreciate your continued interest in *Star-Dot-Star*, as evidenced by the growing volume of mail received each month. Remember, sending in your items on a PC-DOS disk in either standard ASCII or *WordStar*-readable format enables us to process this influx of discoveries more quickly.

This month's items include a tip for 1-2-3 worksheet printouts, another BASIC VAL inconsistency, a way to check for upper- or lowercase characters, and a potentially pernicious "crashbug." We also include two patches from IBM that correct a problem with BASIC's BSAVE command. Our lead item is a handy error-trapping technique that you can use with BASIC programs.

Total Error Trap

In trying to develop user-friendly applications in BASIC for the PC, I have alternately praised and cursed the ON ERROR GOTO error trap. The problem is that unless the programmer plans a unique message for every possible error (no matter how unlikely), the most unlikely error will slip through and dump the user with a BASIC error message. Nothing is less user-friendly than leaving a user staring at BASIC's command mode.

Since BASIC maintains text for error messages, but only passes the error number to the trap, there should be some way to obtain the message text for use by the trap routine. With this in mind, I located the text of the error messages in BASIC's ROM and developed a BASIC routine to locate the appropriate message (see the listing reproduced in "ERROR.BAS").

This routine is not designed to replace error handling, but to supplement the handling of errors that you specifically anticipate. Using this routine notifies you of the error and allows you to escape gracefully to some standard exit point, such as a system menu.

*Jeff McDonough
West Monroe, Louisiana*

1-2-3 Break

Andrew Fluegelman's sidebar "If Wishes Were Horses" ["The 1-2-3 Checkbook Ledger," *PCW*, Vol. 1, No. 6] states that one of the short-

<Ctrl>-<Break> will stop a worksheet printout and return you to the menu.

comings of 1-2-3 is that after giving the GO command, you may notice an error and want to stop the printout but that 1-2-3 does not allow you to do this. However, I have used 1-2-3 extensively to print graphs and worksheets and found that <Ctrl>-<Break> will stop a worksheet printout and return you to the menu. I hope that this information helps any 1-2-3 users who have had the same wish list as Mr. Fluegelman.

*Kathy Lombardo
Melville, New York*

INKEY\$ Integer

Since variable-length strings are awkward, I convert INKEY\$ to an integer with a one-line subroutine:

```
500 K$ = INKEY$ + CHR$(0):CODE = ASC(K$)-  
ASC(MID$(K$,2)):RETURN
```

CODE is positive for standard codes and negative for the extended codes. If no key has been pressed, CODE will be zero.

James Allen

In Any Case

I frequently see programmers checking for either the upper- or lowercase of a letter using the following methods:

```
2010 IF AS$ = "Y" OR AS$ = "y" GOTO 3000  
or  
2010 IF ASC(AS$) = 89 OR ASC(AS$) = 121 GOTO  
3000
```

A check for an upper- or lowercase y can also be achieved as follows:

```
2010 IF ASC(AS$) AND 95 = 89 GOTO 3000
```

When the ASCII value of a letter is logically ANDed with 95, the resulting number will be the ASCII value of the uppercase of the letter. In this example, when AS\$ = "Y" (ASCII 89), ASC(AS\$) AND 95 evaluates to 89. When AS\$ = "y" (ASCII 121), ASC(AS\$) AND 95 still evaluates to 89.

EasyWriter Script

EasyWriter 1.10 lacks superscripting and subscripting commands, and its underlining function is awkward. However, these minor problems can be overcome with the .USER and .USERn commands placed in header files tailored for a particular printer. The first step is to select symbols for

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starting and stopping the special print formats. I chose the following: Subscripts, H{2}0, and superscripts, X{2}, are \easy!

The next step is to write header files that interpret the symbols for different printers. For an Okidata 84a the following lines work (note that each line should end with a carriage return character):

```
.USER1{<Esc>J
.USER2{<Esc>K
.USER3{<Esc>L
.USER4{<Esc>M
.USER5\ <Esc>C
.USER6i <Esc>D
```

For an Epson MX-80FT the following lines work:

```
<Esc>@
.USER~0
.USER1{<Esc>S~
.USER2{<Esc>H
.USER~1
.USER3{<Esc>S~
.USER4{<Esc>H
.USER5\ <Esc>~
.USER~0
.USER6i <Esc>~
```

*Michael Carr
Princeton, New Jersey*

BSAVE Patch

I have encountered a problem in the DOS function call 27H when it is used with BASIC or BASICA to reserve a block of memory. The error occurs after INT27 is executed and followed by a BSAVE command in BASIC. The BASIC program halts and displays the messages "Syntax er-



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ror" and "Undefined line number." At this point the program is gone and cannot be listed or rerun, but if the program is reloaded (without leaving BASIC) and rerun, it will execute correctly. I found that the amount of memory restored by INT27 has a direct effect on the problem. If it is 04D0H or less, the problem does not occur.

I struggled with this problem for some time and finally decided to write to IBM for assistance. Although they did not explain what caused the problem, they did provide patches for BASIC and BASICA (see listings "BASIC Patch" and "BASICA Patch").

*L. J. Crabbe
Peoria, Arizona*

Editor's note: The following is an edited version of IBM's response to Mr. Crabbe that gives a procedure for updating BASIC and BASICA on the DOS disk. Read the instructions carefully and input only those values underscored in the listings.

First, make an exact copy of Disk BASIC and Advanced BASIC using the DOS COPY program. Put the MASTER copy of the DOS disk in drive A and a blank formatted disk in drive B. Do not use a copy of DOS. Then copy the file BASIC.COM to a blank formatted disk on drive B using the following command:

```
A> COPY BASIC.COM B: <Enter>
```

Now copy the file BASICA.COM to the formatted disk on drive B using the following command:

```
A> COPY BASICA.COM B: <Enter>
```

Place your usual DOS disk back in

```
A>DEBUG B:BASIC.COM <Enter>
-EDS:27E9 <Enter>
xxxx:27E9 BE.BF 80.00 <Enter>
-EDS: 27EC <Enter>
xxxx:27EC BF.B9 F7.0E 01.04 B9.33
xxxx:27F0 50.C0 00.FC FC.F3 F3.AB A4.8C B8.C8 00.8E F6.D8
xxxx:27F8 8E.BE D8.80 BE.00 9A.BF 06.F7 BF.01 00.B9 00.80
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xxxx:2808 8E.BE D8.9A 8C.06 OE.BF 02.00 07.00 E8.B9 44.8E
xxxx:2810 02.00 BF.F3 3F.A4 07.06 B9.1F 6F.8C 00.OE 33.02
xxxx:2818 CO.07 FC.E8 F3.39 AB.02
-W <Enter>
Writing 2C80 bytes
-Q <Enter>
```

BASIC Patch

```
A>DEBUG B:BASICA.COM <Enter>
-EDS:3C4E <Enter>
xxxx:3C4E BE.BF 80.00
xxxx:3C50 00.00 BF.B9 F7.53 01.04 B9.33 50.C0 00.FC FC.F3
xxxx:3C58 F3.AB A4.8C B8.C8 00.8E F6.D8 8E.BE D8.80 BE.00
xxxx:3C60 9A.BF 06.F7 BF.01 00.B9 00.80 B9.00 8E.F3 00.A4
xxxx:3C68 FC.B8 F3.00 A4.F6 8C.8E CO.D8 8E.BE D8.9A 8C.06
xxxx:3C70 OE.BF 02.00 07.00 E8.B9 BD.8E 02.00 BF.F3 3F.A4
xxxx:3C78 07.06 B9.1F 6F.8C 00.OE 33.02 CO.07 FC.E8 F3.B2
xxxx:3C80 AB.02
-W <Enter>
Writing 4180 bytes
-Q <Enter>
```

BASICA Patch

drive A. You now have an exact copy of BASIC.COM and BASICA.COM in drive B.

The DEBUG prompt is a hyphen. All typed input will be after the hyphen or the period prompt. All changed DEBUG values in listings "BASIC Patch" and "BASICA Patch" are underscored. Immediately after entering each pair of hexadecimal digits following the period prompts,

you must press the space bar to move to the next byte. Note that the 'xxxx' variable in the listings will be filled with the appropriate memory addresses.

Listing "BASIC Patch" updates the file BASIC.COM. Remember that the DOS disk should be in drive A and the exact copy of BASIC.COM in drive B.

```

10 'MENU.BAS
20 DIM FILE$(20),DESC$(20):DEFINT A-Z
30 DEF FNCEN$(V$,X)=SPACE$(X-LEN(V$))/2)+V$
40 READ T$,N
50 FOR I=1 TO N:READ DESC$(I),FILE$(I):NEXT
60 KEY OFF:CLS:LOCATE 1,1:COLOR 0,7
70 T$=FNCEN$("GAME #2",80): T$=T$+SPACE$(80-LEN(T$))
80 PRINT T$:COLOR 7,0
90 FOR I=1 TO N
100 LOCATE I+2,3:PRINT CHR$(64+I);" "+DESC$(I)
110 NEXT
120 LOCATE 25,3,0:PRINT "ENTER SELECTION (ESC TO EXIT) ";
130 K$ = INKEY$:IF K$ <> "" GOTO 130
140 LOCATE 25,33,1:K$=INPUT$(1):IF K$=CHR$(27) GOTO 200
150 L=INSTR("ABCDEFGHIJKLMNOPQRST",K$):IF L<>0 GOTO 170
160 L=INSTR("abcdefghijklmnopqrst",K$):IF L=0 GOTO 190
170 IF L>N GOTO 190
180 CHAIN FILE$(L)
190 BEEP:GOTO 130
200 CLS:SYSTEM
210 ' DISK TITLE, NUMBER OF MENU ITEMS
220 DATA "GAMES #2",12
230 ' MENU ITEMS: DESCRIPTION, FILE NAME
240 DATA "METEOR GAME","METEOR.BAS"
250 DATA "SNAKE GAME","SNAKE.BAS"
260 DATA "ANOTHER SNAKE GAME","SNAKE1.BAS"
270 DATA "SLOT MACHINE","SLOT.BAS"
280 DATA "HANG MAN","HANGMAN.BAS"
290 DATA "GOLF","GOLF.BAS"
300 DATA "BIORYTHM CHART","BIORYTHM.BAS"
310 DATA "BLACK JACK","BLACKJACK.BAS"
320 DATA "MAZE GAME","MAZE.BAS"
330 DATA "PC PONG","PCPONG.BAS"
340 DATA "LONE RANGER SONG","WILLTELL.BAS"
350 DATA "MAGDALEN (BY BACH)","MAGDALEN.BAS"

```

MENU.BAS

If at any time you do not see the data exactly as it appears in this procedure, you did something wrong, and you should start again by typing `Q <Enter>`. This returns you to DOS.

Listing "BASICA Patch" updates the file BASICA.COM. Remember that the DOS disk should be in drive A and the exact copy of BASICA.COM in drive B.

More Menus

The *.* item "BASIC Highlights" [PCW, Vol. 1, No. 6] included a menu program that I found very interesting. I have developed my own menu program that allows menu items to be more descriptive than the normal program name and selective listing of the programs on disk. You should note that data statements beginning at line 220 in listing

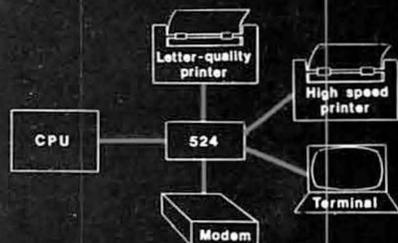
"MENU.BAS" include the disk title name, the number of menu items desired, and the actual menu item descriptions and program names. Once the data statements are set up, you can easily add, delete, or rearrange items in the list.

*Vernon F. Keszler
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Keyflags for COMPAQ?

The KEYFLAGS program [*.*, PCW, Vol. 1, No. 7] would most likely be of great help to users who have IBM PC compatibles such as the COMPAQ. However, the COMPAQ BIOS must use different addresses. I wonder if the author (Morton Kaplon of Pomona, New York) or a reader could provide the necessary changes to adapt the program to the COMPAQ or clues as to where to look myself. I entered the BASIC program and got it to run without errors. Striking any key causes the correct symbols to appear; unfortunately, it also causes the keyboard to lock up. At this point, pressing <Ctrl>-<Alt>- does not effect a reboot. Anyone have any ideas?

Henry A. Kingsley
Houston, Texas

VAL Mischief Again

The *.* item "Bug Hunt" [PCW, Vol. 1, No. 4] uncovered a problem with the VAL function when it is used with alphanumeric strings containing the characters E, D, or %. This month George Clowes of Mt. Prospect, Illinois, found another VAL bug in BASICA 1.10. The bug occurs when the VAL function is used in an IF...THEN test that determines if a string contains numeric values. Normally, the VAL function returns a zero result if a string contains only alpha characters. However, when values between 1.0E+38 and 1.7E+38 are PRINTed in a program, the IF

test fails to find zero as the value of the string. The following program illustrates this problem:

```
10 PRINT 1.0E+38
20 AS="test"
30 PRINT VAL(AS)
40 IF VAL(AS)=0 THEN PRINT"OK" ELSE
   PRINT"BUG"
```

The exponential PRINT statement somehow causes a glitch in the VAL function. Unfortunately, the problem also affects a program run directly after the first one, even if the second program doesn't contain an exponen-

The exponential PRINT statement somehow causes a glitch in the VAL function.

tial PRINT statement. After running the previous program, try running it again without line 10. The bug can then be cleared, strangely enough, by adding a numeric value (+1) to the VAL statement (line 30). Run this version of the program:

```
10 PRINT 1.0E+38
20 AS="TEST"
30 PRINT VAL(AS)+1
40 IF VAL(AS)=0 THEN PRINT"OK" ELSE
   PRINT"BUG"
```

If you don't want the VAL string value to print out in line 30, a LET statement will work equally well. This problem does not occur with

PRINTed numbers less than 1.0E+38 on the monochrome monitor. Why the VAL statement is affected by this and why it is "corrected" in such an unconventional way is something we leave to later *.* bug hunts.—A.W.

CrashBug

Try the following pesky critter for a quick surprise.

```
10 J=.0998334
20 PRINT USING "The system has crashed
   #####"; J
John K. Gotwals
W. Lafayette, Indiana
```

Editor's note: This bug indicates an error in the routine that converts numeric values for PRINT USING statements that specify more than seven digits of precision. This bug is quite serious, as it causes a system crash that renders <Ctrl>-<Alt>- ineffective. We reported this problem to IBM, but as of press time we had received no official response to our inquiry. ☹

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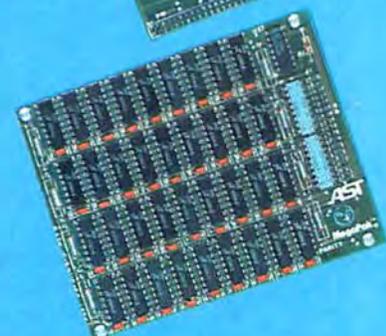
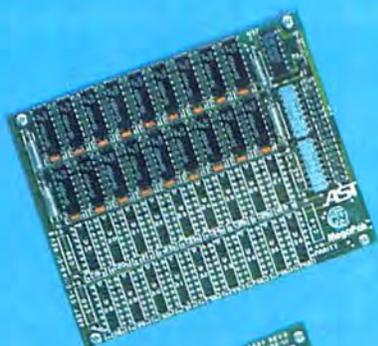
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The pictures show the optional 256k MegaPak™, the 128k version, and the new game pak. These boards mount "piggyback" on the MegaPlus II. The 256k MegaPak gives the old style PC's with only 64k the ability to add 512k of memory in one slot. The 128k MegaPak is for the new machines that can hold 256k on their PC's motherboard. This board along with the 256k on the MegaPlus II gives you the total of 640k, the maximum usable under 2.0 DOS. Now you can create disk drives in memory up to 360k, set aside plenty of space for print spooling, and still have plenty of memory for your biggest programs. There is a new game port MegaPak option. It uses any IBM compatible joysticks or paddles. It plugs onto the pin connectors just above the edge connector so you can add one even if you have one of the memory MegaPaks.

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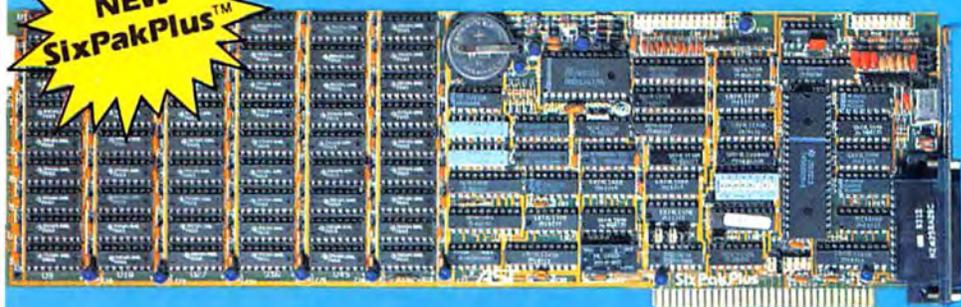
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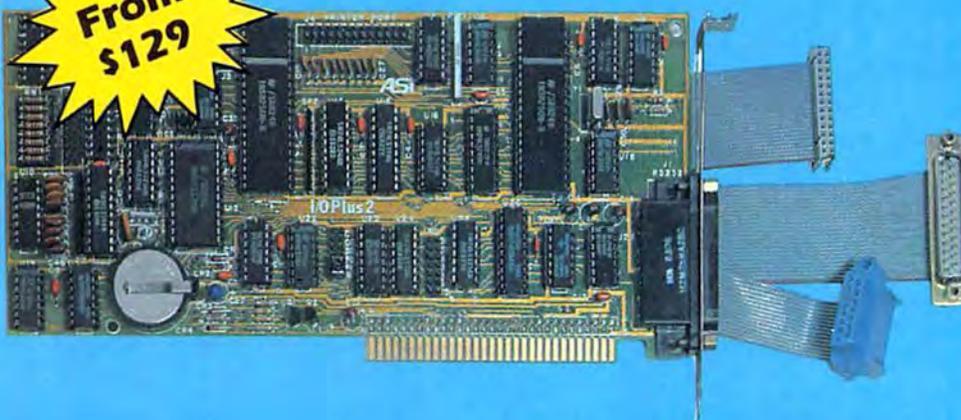
Since the introduction of PC DOS 2.0, the capabilities of the PC have been increased with the ability to address up to 640k of memory. With the current PC having 256k available on the computer motherboard, you need another 384k to reach 640k. Great you say, but multi-function boards only have room for 256k on them. Enter the SixPakPlus™. Not only does it

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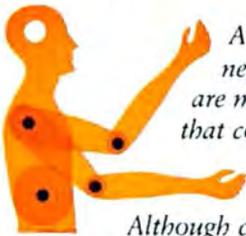
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Ergonomics Is Good Business

Anita Micossi



As personal computers proliferate the negative sides of this new technology are making themselves felt. Studies show that computer operators suffer far more than their share of eyestrain, muscle aches, and other maladies.

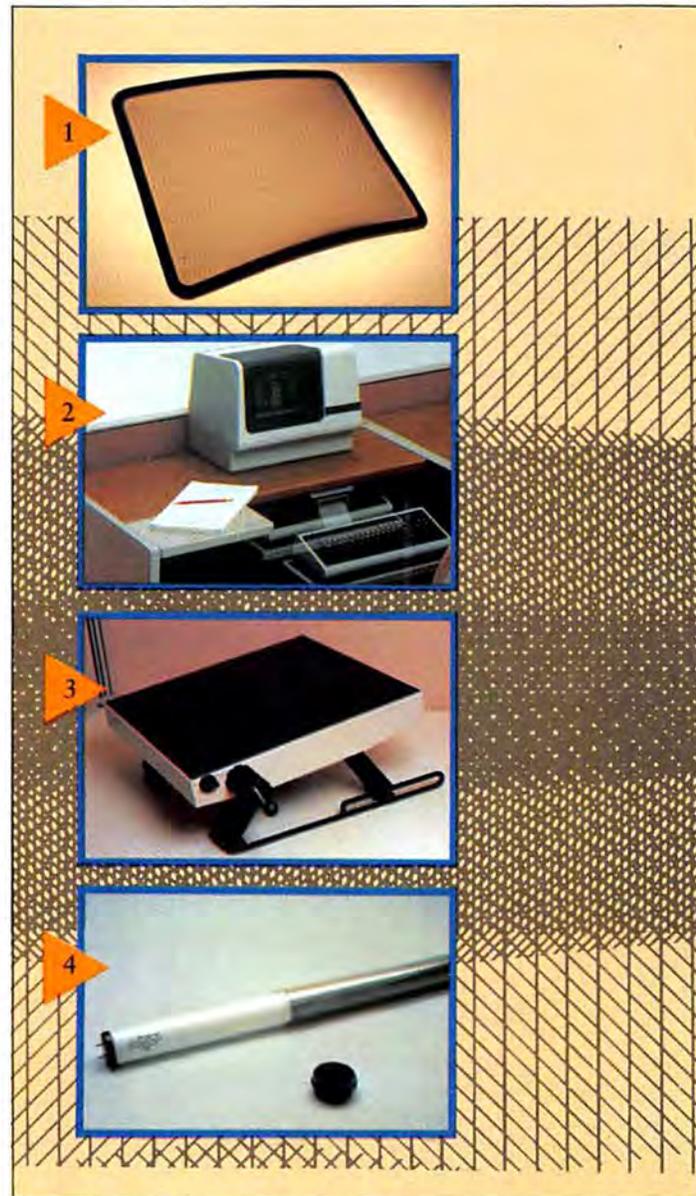
Although controversy still surrounds questions about long-term health effects, many workers' physical and psychological complaints can be remedied by making use of relatively simple and inexpensive technology.

As an undergraduate I used to enjoy studying in those small cubicles wedged between the stacks of the main library. I would sit for hours at one of those cramped desks imagining myself in a medieval monastery composing lyrics with quill and parchment.

Actually, I didn't get much work done. Great for daydreaming and catnapping, those cubicles were not conducive to long sessions with thick books. With their poor lighting, drab colors, stale air, claustrophobic dimensions, and pitiless chairs, those cells were ergonomic disasters.

Ergonomics (from the Greek *ergon*, meaning work, and the English word *economics*) is the study of people in relation to their work. I prefer the homier definition: keeping people comfortable and healthy while they're working with a specific tool.

Inset: (1) antiglare screen overlay, (2) adjustable keyboard shelf, (3) adjustable monitor pedestal, (4) fluorescent bulb enclosed in light-intensity filter. Background (5): section of fluorescent bulb filter shown at full size; the computer-generated pattern changes the distribution of light as the plastic cylinder is rotated. Foreground (6): adjustable swivel-tilt chair with back-support contours.





Antiglare screen overlay courtesy Screen Data Corporation; all other equipment courtesy Steelcase Inc.

Community

The modern science was born in Britain during World War II. The focus was military, and research questions sprang from a new kind of complex technology that put unprecedented demands on the user. How, for example, do you illuminate an instrument panel without interfering with pilots' night vision as they look out of the cockpit?

Today, ergonomics, or human factors engineering as it is called in the United States, engages the talents of engineers, architects, physiologists, behavioral scientists, physicians, and designers. These diverse professionals investigate the capacities and limitations of the human being and apply their findings to the design of tools, tasks, and environments. The goal of the discipline is an optimum balance between productivity and well-being.

Since the effectiveness of people, workplaces, and tools are interrelated, changes in one can disrupt the harmony of the whole system. Few new devices have affected so many people so swiftly and profoundly as the microcomputer, and ergonomically speaking, this new kid on the block comes with an army of potential problems and hazards.

Eye Problems

The most obtrusive element in the system is probably the video display terminal (VDT). In part because the design of most VDTs was modeled on that of TV sets, which are intended for casual use from a distance rather than prolonged, detailed work, VDTs are a prime source of potential health hazards.

The seriousness of the threat to vision from VDTs is a matter of contention. E. Grandjean and his associates at the Swiss Federal Institute of Technology found that 55 percent more VDT operators than typists report "almost daily" eyestrain and pain. According to this study, VDT operators have 5½ times as many visual complaints as traditional office workers. Studies by the National Institute for Occupational Safety and Health (NIOSH) corroborate the European findings. The NIOSH team reports that VDT operators have substantially more vision problems than control subjects, including burning, irritation, blurring, and even some change in the ability to see colors.

However, a report issued recently by the National Research Council, while supporting findings of widespread and significant worker discomfort, found no evidence that VDTs cause any permanent vision impairment. The research council panel concluded that most of the problems associated with VDT use are relatively easy to remedy and are caused by the way in which VDT technology has been implemented, rather than by anything inherent in the technology.

While the research council report was intended as an authoritative, comprehensive review of the existing research on the subject of VDTs and health, its optimistic findings have failed to lay the subject to rest. The report has been criticized by labor advocates who believe that not enough research has been done on this subject to justify the report's conclusions. One member of the research panel, Lawrence W. Stark, professor of physiological optics at the University of California at Berkeley, wrote a dissenting opinion objecting to the report's tone, which he found overly complacent and open to misinterpretation.

Even NIOSH, which commissioned the report, has announced that it is dissatisfied. Barry Johnson, director of NIOSH's biomedical and behavioral science division, said, "We believe there is sufficient evidence to warrant continuing research."

Of the generally recognized eyestrain factors, those of poorly designed monitors include low contrast between character and background luminances, poor image sharpness, and high oscillation of phosphorescent characters, which produces an annoying flicker. Environmental factors include glare (which leads to diminished concentration, headaches, and reading errors) and high contrasts between the screen and hard-copy source documents and between the screen and surrounding elements such as windows, lighting fixtures, and white or brightly colored walls.

The American National Standards Institute recommends illumination levels of between 750 and 1600 lux for a general office environment, while NIOSH suggests levels of between 500 and 700 lux for VDT work stations. You don't need to know what "lux" measures to grasp the problem.

Back and Neck Pain

Though someone may stick out the workday with sore eyes and a case of Visine, an aching back is something else. Back disorders are the number-one cause of absenteeism in the work place and account for 93 million lost workdays in the United States each year plus \$5 billion worth of medical treatment.

Chiropractors and orthopedic surgeons have long known about "secretary's syndrome"—the tight shoulders, tingling arms, stiff neck, tendinitis, and spinal misalignments that accompany prolonged desk work. A good many of these health practitioners feel that the physical complexity of the microcomputer work station will exacerbate this already-epidemic situation. Indeed, 81 percent of the clerical VDT operators in the NIOSH study complained of painful or stiff necks or shoulders—almost 50 percent more than the control subjects.

What's to blame? In addition to poorly designed chairs that restrict blood flow and limb movement while failing to support the lumbar region properly, the VDT

Federal Guidelines and Pending Legislation

As a result of its own research, the National Institute for Occupational Safety and Health (NIOSH) has come up with a number of recommendations to reduce or eliminate some of the main ergonomic hazards associated with the VDT work station. The NIOSH recommendations cover the following concerns.

Flexibility. Work stations and devices should permit operator control over keyboard height, screen height, and tilt (a viewing angle of 10 to 20 degrees below the horizontal plane at eye level is considered optimal); screen brightness and contrast; viewing distance (18 inches is recommended); work station illumination levels; and chair adjustments (seat height, backrest height, and tension).

Illumination. General levels should be 500 to 700 lux, with individual lighting provided for jobs with higher visual demands.

Screen glare. Several methods are suggested to reduce glare: covered windows, proper positioning of the VDT, screen hoods, antiglare filters attached to the screen, recessed lighting and/or baffles for fixtures, and indirect lighting systems.

Rest breaks. Operators working under high visual and/or work load demands should have a 15-

minute break every hour. Those working under moderate conditions should take 15 minutes every 2 hours.

Visual testing. All operators should be given a thorough ophthalmological exam initially and subsequent annual testing.

Six states—Massachusetts, Maine, Connecticut, Washington, Oregon, and Illinois—have legislation pending to put these or similar guidelines into law. New York is currently conducting public hearings on the issue. Labor advocates in Massachusetts are calling for a \$1000 per day fine for offices that fail to comply. The Massachusetts bill was written by Joseph Faherty, president of the Boston Edison Clerical Union, and is supported by Nine-to-Five, a national association of female office workers.

Nine-to-Five was founded in Boston in 1973 and was “the first to see that the electronic office was a mixed blessing,” according to Janice Blood, the group’s director of public information. With a hot line to provide information and record complaints, the organization is currently fighting workers’ high exposures to VDT risks. “What we would like to see,” said Blood, “is good equipment manufactured and work designed more humanely.”

worker faces a number of peculiar structural problems: keyboards that are too high, source documents that are too low, inadequate rest supports for forearms and hands, insufficient space for knees and legs, and nonadjustable screens that force operators to hunch over, tilt backward, or slouch.

Other Problems

Then there are the problems created by noise. Unlike our eyes, our ears are always open, even if we are not aware of what they are receiving. Incoming aural stimuli affect blood pressure, heart rate, metabolism, and muscular tension. The computer printer is a noisy machine. It can put strain on the auditory sense and contribute to tension and distraction.

Another hidden hazard is the radiation emission from the display terminal. NIOSH asserts that exposure during VDT use to X-ray, ultraviolet, and visible forms of radiation, as well as to electric and magnetic field strengths is “well below current occupational exposure

standards, and, in many cases, below the detection capability of the survey instruments.” Nonetheless, many scientists are cautious about unknown long-term effects of exposure. Even NIOSH, which is uneasy about the number of birth defects and spontaneous miscarriages reported among VDT operators, is investigating the feasibility of doing a study on this subject. (The subject of radiation hazards will be covered in depth in an upcoming *PC World* article.)

Finally, a number of subtle variables can create discomfort, if not significant health problems. Electronic equipment produces heat that can upset the thermal environment if it is not properly ventilated. Human beings, on the other hand, often produce smoke, which can upset the machine—and we all know who loses when the machine gets upset. Even the size, shape, color, and surface texture of the computer can affect the well-being of the operator in minor ways.

Community

Taken together, these factors have a cumulative effect and can endanger psychological as well as physical health. Dr. Michael J. Smith and a team of biomedical and behavioral scientists at NIOSH discovered that operators of VDTs report higher levels of anxiety, depression, anger, fatigue, and confusion than control groups. Of clerical VDT workers, for example, 80 percent complain of chronic irritability. The researchers conclude that "The machinery becomes a source of misery for...workers rather than [a] helpful tool."

Solutions

Faced with these hazards, the first decision one must make concerns hardware. One should choose with health and safety—not just function and financing—in mind.

The IBM PC, although not the ultimate in human factors design, offers many ergonomically sound features. The screen generates high-resolution, well-formed characters and uses one of the most persistent types of green phosphor (P39 with a decay time of 400 ms), which has a very low oscillation factor. The screen surface is etched, which affects focus and clarity somewhat since it diminishes background-to-image contrast, but which also reduces glare.

The monitor's brightness and contrast levels are adjustable, and although the position of the monitor itself is not adjustable, support accessories are available that make it so.

The PC's low-profile keyboard is compact and detachable, giving users complete freedom of placement. The keys have a substantial touch, and the matte finish gives the caps a pleasant tactile quality. On the other hand, the keyboard layout is the subject of controversy, and according to some expert evaluators, is the weak link in the system.

Besides addressing neuromuscular and visual health issues, the PC has fine aesthetics; its soft curves, non-reflective finish, and neutral colors have a positive psychological impact.

Several hardware engineers have estimated that the inclusion of ergonomic features in a system adds only 5 to 10 percent to the manufacturing cost. The marketing edge that good design gives a manufacturer may more than offset this investment. Incentives may also be forthcoming from a different arena: six states have bills pending requiring the implementation of NIOSH-recommended standards (see "Federal Guidelines and Pending Legislation"). Since offices having substandard facilities may shortly be forced to upgrade or face stiff fines, manufacturers who are already attentive to provisions such as adjustable keyboards and low flicker factors may be rewarded for their ergonomic-mindedness.

Europe, which is 5 years ahead of the United States in human factors research, has pioneered the application and legislation of scientific findings. Germany, for example, will not allow microcomputers with a fixed station design to be imported.

Furniture

Most people spend a lot of time investigating hardware before they invest the several thousand dollars required. Then they bring home the new baby and plunk it down on the dining room table. Even large corporations that buy VDTs by the dozen think nothing of placing them on standard desks.

Conventional writing desks are about 30 inches high, while 26 inches is recommended for keyboard placement. The 4-inch difference accounts for the sore wrists and arms reported by almost 50 percent of VDT operators.

Scores of furniture manufacturers have leapt into the breach with lines of "electronic work stations." At one end of the spectrum is the budget home model by Bush, a simple, split-level, pressed-board table that costs a little over \$100. At the other end is the elegant, hardwood, handcrafted desk created for the IBM PC by Williams & Foltz, of Berkeley, California, which sells for \$875. Top-of-the-line, high-tech office pieces are also available from veteran manufacturers such as Steelcase and Herman Miller, who have been hip to ergonomics for years.

For \$850 IBM offers its own compact Synergetix work station that features a swing-out cabinet to bring hardware components and software supplies within easy reach. For greater flexibility, an adjustable terminal base with a tilt platform for the VDT is available for \$710.

What all these support stations try to do, with varying degrees of success and aesthetic appeal, is provide various spaces and levels for the components of the microcomputer system. The top equipment of companies like Steelcase offers total flexibility within the work station; not only are surfaces for keyboard, terminal, and hard-copy documents separate, but each can be adjusted independently to the most convenient individual height and tilt. And the furniture is beautiful—a great psychological perk for the hardworking operator.

For those who can't afford the top of the line, many companies offer adjustable VDT stands for under \$200. These stands are placed on a desk and can achieve the same ends in terms of functionality, if not aesthetics, as the higher priced models. Palm rests and footrests for about \$20 and \$35 respectively are accessories that can make the difference between comfort and aggravation.

While you can jerry-rig a stand on a flat surface and put a phone book under your feet, there's no way to fake a well-designed chair. This is the piece of furniture most often mentioned by designers and users as critical to job comfort.

Access Information

The following is a list of manufacturers and products mentioned in the article.

CT101 Personal Computer Center
Bush Industries
312 Fair Oak St.
Little Valley, NY 14755
716/938-9101
List Price: \$109

Herman Miller Inc.
1700 Montgomery St.
San Francisco, CA 94111
415/433-2900

PC Workstation
IBM
IBM Direct
1 Culver Rd.
Dayton, NJ 08810
800/631-5582, 201/329-7000
List Price: \$850

Panel Film (antiglare filter)
3M Company
Industrial Optics Dept.
3M Center, Bldg. 223-4N
St. Paul, MN 55144
612/736-2240
List Price: varies with screen size

Glare/Guard
Optical Coating Lab, Inc.
2789 Northpoint Pkwy.
Santa Rosa, CA 95407
707/545-6446
List Price: \$99

Polaroid CP70 (antiglare filter)
Polaroid Corporation
Polarizer Division
1 Upland Rd.
Norwood, MA 02062
800/225-2770, 617/762-1990
List Price: varies with screen size

Steelcase Inc.
505 Sansome St. #200
San Francisco, CA 94111
415/956-2470

Voltfree (antiglare, static control filter)
Sun-Flex Company, Inc.
20 Pimentel Ct.
Novato, CA 94947
415/883-1221
List Price: \$65

PC6 Workstation
Williams & Foltz Computer Furniture
1816 Fourth St.
Berkeley, CA 94607
415/644-2022
List Price: \$990

The most important theme of the good chair is the same as that of all hardware and support equipment—flexibility. The basic features to look for are adjustable seat and backrest heights, a back-tilt mechanism with variable tension, sturdy lower back support, a contoured seat bucket with a waterfall edge to reduce pressure on the thighs, a four- or five-star base, and firm padding. A chair like this costs \$125 and up, but the payoff is substantial. Recall that backaches keep people at home more than any other ailment. On the job a bad chair limits the amount of time an individual can sit and perform. That means lots of up and about and subsequent loss of labor.

Lighting problems can usually be corrected by reducing overhead intensity or masking bright sources (e.g., windows) to make the VDT screen easier to read, and by adding a task light to illuminate hard-copy documents. The task light can be as simple as one of those high-intensity, focused lamps popular with students, or as sophisticated as work station fluorescent lamps with hoods and adjustable filters. Other recommended solutions to eyestrain and fatigue include installing indirect lighting, applying nonreflective colors and textures to walls facing the operator, and using source document holders to reduce the angle between screen and copy (thus reducing the labor of the eye muscles).

Optical Coating Laboratory, Polaroid, and 3M are among the companies that offer self-attaching screen filters to cut glare without interfering with character focus or brightness (see "Access Information"). Originally developed for aerial reconnaissance, Optical Coating's Glare/Guard is, at \$99 retail, a cheaper solution than buying new drapes or redesigning your lighting system. (It is, by the way, built into IBM's high-end products.)

Sun-Flex offers an interesting "holistic health" feature on its Voltfree antiglare filter. The literature notes that the high electrostatic charge on all cathode ray tube (CRT) type display screens attracts negative ions and repels positive ions. Negative ions are thought by many people to influence human mood states in a positive way while positive ions do the opposite. Some scientists believe that negative ion depletion is part of the reason air traffic controllers, who spend lots of time in front of CRTs, are so often cranky. The Sun-Flex filter neutralizes negative ion depletion, allowing the negative ions to float freely around the environment. The filter retails at \$65.

To cut down printer noise many companies offer special padded boxes in the \$300 to \$450 range.

● Community

Large businesses and high rollers can, of course, use interior designers, who will come in, assess the situation, and in cooperation with the staff create a total work environment from carpet to cable management. These people know their ergonomics and are able to identify problems users suffer from but of which they are rarely conscious.

"Our job," states architect Ken Morrison of Gensler Associates in San Francisco, "is to design an environment that responds to the needs of the company." Most clients specify function and economics as their top priorities, according to Morrison, "but ergonomics and productivity go together."

Do It Yourself

The home user or small-business person can take advantage of a number of do-it-yourself improvements to reduce ergonomic hazards.

- Position the terminal so that you can watch it without undue neck strain.

Ergonomically designed furniture can increase productivity by 10 percent. In less than 11 months the furniture pays for itself.

- Keep ambient lighting low and the VDT turned at a right angle to windows and light fixtures to avoid glare. Keep windows shuttered or draped, and have the wall behind the screen painted in a soft, neutral shade.

- To cut noise try putting the printer in a closet.

- Set seating so as to permit your feet to rest flat on the ground with knees at a 90-degree angle. Don't forget to place the keyboard low enough so that your wrists are straight and your arms do not tilt upward (an old typewriter table will do the trick).

- Everyone who labors at a terminal, whether at home or in the office, would do well to heed the universal advice of chiropractors and orthopedic surgeons: get up now and then and exercise! This means a couple of jumping jacks in addition to the usual hikes to the coffee pot. The body is not meant to sit all day; sitting relaxes muscles that are needed for support.

Although ergonomics is a sophisticated science (ergonomists design space capsule interiors as well as hammer handles), the key principle is simple: comfort and good health in service of alertness and efficiency.

The individual is the best judge of what makes him or her comfortable, and most solutions to ergonomic problems are matters of common sense.

Payoff and Challenge

The average computer customer is not concerned with ergonomics. Even large corporations that purchase quantities of VDTs tend to overlook health considerations in favor of what they perceive as economics and functionality. Employees who work at stations, however, unanimously agree that comfortable office furniture and surroundings influence productivity. This was confirmed in a recent study sponsored by Steelcase, the largest manufacturer of conventional and electronic furniture. The study found that ergonomically designed furniture can increase productivity by 10 percent. In less than 11 months the furniture pays for itself.

Dr. Marvin J. Dainoff and his associates at the U.S. Department of Health and Human Services undertook one of the first empirical investigations of ergonomic deficiencies in VDT work stations. The researchers alternately put subjects to work in "best designed" and "worst designed" environments, while offering an incentive pay system based on keystroke speed and accuracy. They found that productivity increased by almost 25 percent at the well-designed station.

Some experts contend that attention to the "human factor" should not stop at a good chair and clear display characters. Karen Kessel, editor of the *Ergonomics Newsletter*, published in Santa Monica, California, observes that "You can only go so far in hardware ergonomics, while in software there are still so many possibilities for improvement." Her suggestions essentially boil down to making programs ever more friendly. "Users don't want to learn about computers," she says. "Whether it's bookkeeping or ticketing, they just want to get their jobs done."

Certainly clearer and cleaner software sells more software and reduces anxiety, the villain of many organic health problems. However, "friendly" usually translates to "familiar," and today's computer-literate third grader is already on pretty friendly terms with tech talk.

A more serious and difficult challenge concerns the nature of work life in the electronic office. Although chiropractor Jerry Behymer treats the physical ailments, he feels that, "It is the rhythm and structure of the work that needs to be changed rather than the design of the work station."

Dr. Smith's NIOSH team reached more precise and frightening conclusions: for clerical VDT operators the machine is not a tool that can be used to enhance the end product so much as it is "part of a new technology that takes more and more meaning out of their work."

As computers are able to make more decisions, many skilled and semiskilled clerical jobs are being replaced by low-paying and fairly mechanical data-entry-type positions.

The NIOSH study traced the extraordinarily high stress levels reported by VDT operators to such Big Brother tactics as computer monitoring of workers' production and error levels. Some companies go so far as to adjust workers' salaries from month to month on the basis of their computer-monitored productivity levels.

Although the hardware itself can be rough on the body, most of the techniques for reducing visual and neuromuscular hazards are available and need only be implemented. The way in which the technology is being applied and the social and psychological aspects of work are what really trouble many researchers and medical practitioners.

For the independent professional the personal computer can enhance work and offer a feeling of control. Thomas Albright, art critic for the *San Francisco Chronicle*, recently wrote about the freedom his new word processor gave him: "I can carry out my business by staying two or three days a week in the city to visit museums and galleries, and then with the help of a computer and a telephone, do all the writing part of the job somewhere

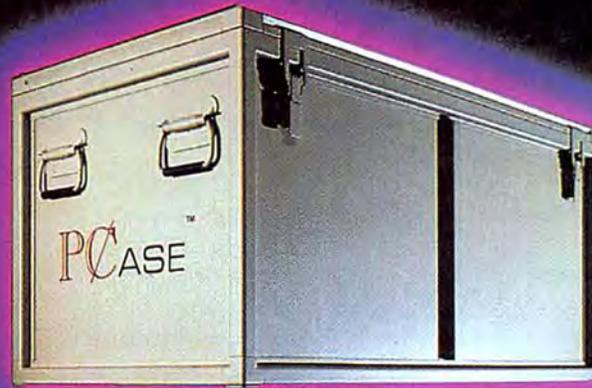
else." He happened to be typing those lines while reclining under a tree on a quiet hillside in the country.

But the more familiar sight of rows of VDT clerics conjures up our worst Orwellian fears: a work system in which human workers serve the computer instead of the other way around. With the exploding enthusiasm over the potential of computers, people often get lost in the shuffle. The consequences are resentment of and resistance to the technology and heightened stress that impairs performance.

The solution? Dr. Smith and company advise that "the design of computerized office systems cannot be left solely to computer experts who are concerned mainly with the capabilities and needs of the machinery." We need experts whose primary interest is the "people component" at every stage of the design process: hardware, software, environment, and office systems. Dr. Smith's advice is sound ergonomics and good business. ☹

Anita Micossi is a Boston-based writer and sociologist.

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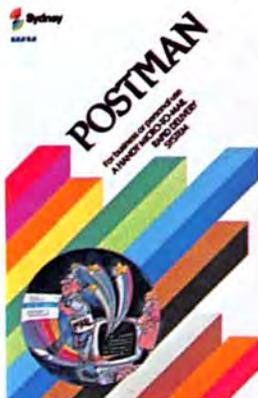
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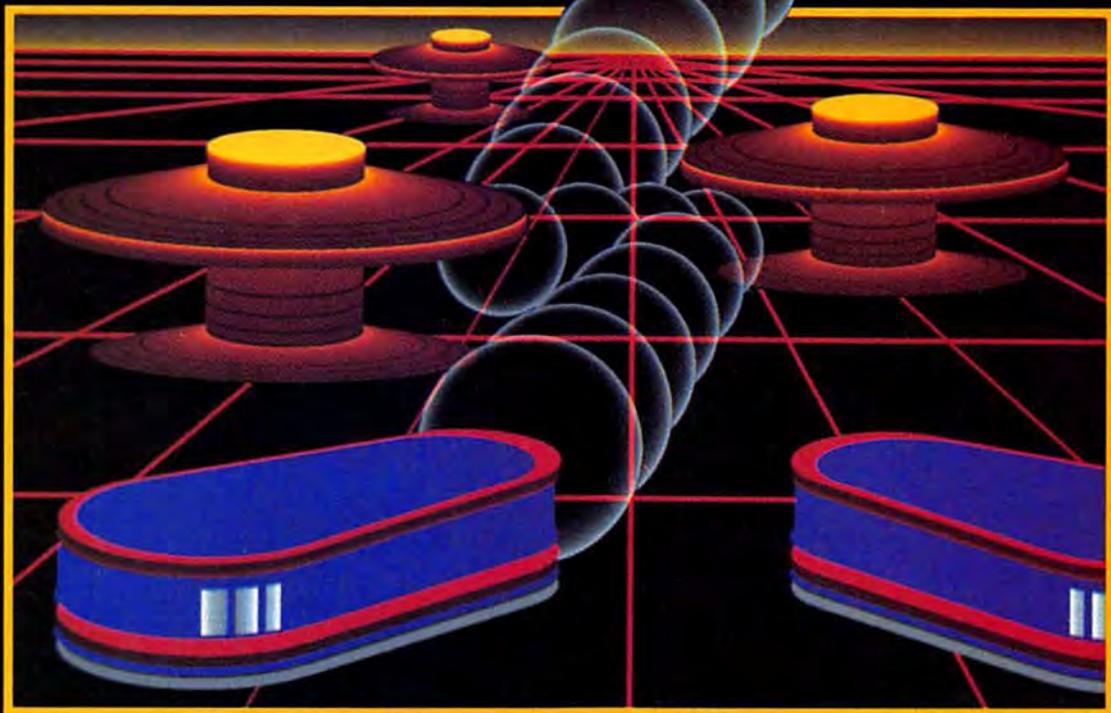


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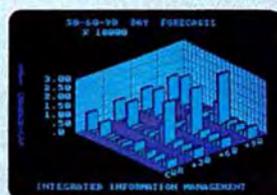
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PC at the Olympics

When the athletes go for the gold, IBM PCs will be there at the finish line.

Larry Press

How do you manage 10,000 athletes, 8000 reporters, 44,300 employees, 7 million spectators, 23 sporting events, and \$472 million? With a PC, of course.

The Los Angeles Olympic Organizing Committee (LAOOC) is using a variety of computers to plan and run the 1984 Olympic Games. But the PC figures prominently in the day-to-day planning for next year's biggest sporting event.

IBM is one of the 30 to 35 corporate sponsors of the 1984 Olympic Games. Included in Big Blue's \$4 million cash, equipment, and support service contribution are 100 PCs, so we visited the LAOOC headquarters to see how the computers are being used.

Surmounting All Obstacles

Mike Mount has lots of plans to make. Even more importantly, he has lots of plans to carry out. Mount is the LAOOC vice-president for Support Operations. Support Operations has responsibility for the overall planning—everything from security to hot meals for athletes—for the 16-day summer event. In addition, Mount is directly responsible for technology, press and TV operations, and accreditation (badging) for all athletes and employees during the Games.

Forty-year-old Mount began his job on October 1 of last year, but he has been working with the LAOOC since June of 1979. Mount was an organization consultant with Arthur Young and Company, the auditing and consulting firm hired by the LAOOC. Committee members liked Mount's work and enticed him into leaving the accounting firm.

"It was a chance to build a large organization in a short period of time," Mount explained. "It meant installing an entire computer system in a year to a year and a half, training a lot of people, and having everything work smoothly during that two-week period. I looked at it as an exciting managerial challenge."

The Games Plan

Mount's office is in the LAOOC's headquarters, located in a new building on the edge of the UCLA campus. The building has the atmosphere of an aerospace programming shop—security guards and badges, modular office furniture, and a temperature-controlled environment. Nearly every desk has a PC or an IBM Displaywriter on it.

"We made a decision to grow much more slowly than other Olympic Committees," Mount said, noting that the committee staff for the 1988 Games in Seoul, South Korea, is already larger than the present LAOOC staff. But the Los Angeles

organizing committee is bound by law to run a tight ship—the voters of Los Angeles approved a city charter provision in 1978 that forbids any capital expenditures by the city on the Olympics that would not, by binding legal commitment, be paid back.

"We are avoiding what happened in Montreal," Mount said. The 1976 Olympic Games in the Canadian city were budgeted at \$225 million but wound up costing \$1.2 billion. Montreal taxpayers will be paying for the Games until 1996. The Los Angeles Games are budgeted at \$472 million.

With such money-saving consciousness it is not surprising that budgeting and record keeping are among the main duties of the Olympic PCs. In fact, the PCs are used to manage and track the LAOOC's financial lifeline, its investment portfolio from the TV rights, tickets, and sponsorship monies. The nature and deadline of the committee's work necessitates that these be short-term investments. Each committee department produces its budget reports and performs "what if" analyses on the PC; *Multiplan* is the preferred spreadsheet program. Budget control at the 23 sports sites and two Olympic Villages will be handled by on-site PCs during the Games.



Mike Mount

● Community

One of the early uses Mount found for the PC was to model ticket prices for the approximately 7 million tickets that will be sold for the sporting event. Mount explored various ticket-pricing options for four to six weeks before finding a system that met both the International Olympic Committee and the LAOOC requirements. Tickets for the events range from \$3 to \$95, with an average price of \$17.

Mount said he is proud of the ticketing scheme. He pointed out that ticket order forms became available simultaneously across the country in mid-June. (Seventy percent of the tickets will be sold to people in the United States.) Sixty days after mail-order forms were accepted, a random drawing was held to allot tickets for high-demand events; tickets to other events will be sold in the order in which forms are received. Mount had to fill out a ticket order form like all potential spectators. "There are no freebies for employees, executives, or 'special' people like Frank Sinatra," he said. An IBM System 38 is being used to keep track of ticket sales.

East Meets West

The committee found an early use for the PCs several months ago when Olympic national committee representatives of participating countries met at the Biltmore Hotel in Los Angeles to sort out details such as the number of people coming with each Olympic team, arrival time, point of entry, and village and room reservations. PCs were used to enter and store each nation's data and allowed LAOOC members to do the necessary schedule juggling and bargain making that such a project requires.

PCs were also used to demonstrate how teams can reserve training sites by electronic mail during the Games. The electronic message system will be handled by the official telecommunications sponsors, AT&T and several of its subsidiaries.

Tracking the Course

Another use for the PC is in personnel and task management. Full-time, paid LAOOC staff now numbers between 500 and 600 people but will grow to 1300 by the time of the Games. An additional 43,000 people will be short-term or contracted employees and Olympics volunteers. Comshare's *Profile* program is used to match the committee staff resources and needs.

A PERT (program evaluation and review technique) chart produced on a PC gives Mount and other LAOOC executives detailed analyses of the Olympics preparation activities. The scheduling chart displays the information sequentially, showing the relationship among the activities so that jobs are done in a logical and time-saving manner. Originally Mount set up a mainframe-based project control system, but it turned out to be too cumbersome and difficult to operate.

Dry Run

The LAOOC coordinated seven world-class competitions at Olympics facilities in Southern California from May through September of this year. The events—swimming, diving, water polo, synchronized swimming, cycling, canoeing, and rowing—provided a good opportunity to test the new facilities built for the Games and to fine-tune preparations for next summer. PCs were used, as they will be in 1984, for seeding certain events. LAOOC workers also discovered that the PC at the velodrome could be used in the cycling races. One of the members wrote a program for the PC that computes racers' mph speed based on lap time. Mount said that it was the first time such speeds had been posted in cycling events.

PCs will also be assisting in the archery contests. Judges will examine targets and mark points on scanner cards, which will be read and tabu-

lated by PCs equipped with Chatsworth Data Corp.'s OMR 2000 Optical Card Readers. "Archery is certainly not the most technological sport, but the results will come five times faster with the computers," Mount said.

Large Computers

The LAOOC appears to have found a computer for every task. McDonnell-Douglas Automation Co. (MC Auto) is the official supplier of results computer services for the 1984 Games and as such will process data and tabulate results for all individual and team events.

Accounting is among the services the Transamerica Corp. computers are providing. Transamerica installed and is operating a general ledger, accounts payable, accounts receivable, and inventory control system for the LAOOC.

AT&T is providing approximately 2000 terminals at the Olympic Villages and sports venues for the electronic message system and Telex services for reporters and Olympics and team officials. And IBM will provide an audio distribution system that digitally records telephone messages left for athletes and officials.

So what happens after August 12, 1984? "We close the door, go home, and recuperate," Mount joked. The winding down and mopping up operation will begin as soon as the Games are over, he said. The staff will dwindle to 100 people by next December, and by then much of the equipment will be returned to the sponsors and suppliers. But Mount admitted that he hasn't taken much time to plan that phase of the operation. "We are all focusing on what it takes to get the job done now." ●

Larry Press is a Contributing Editor for PC World. He is president of a Southern California microcomputer consulting firm.

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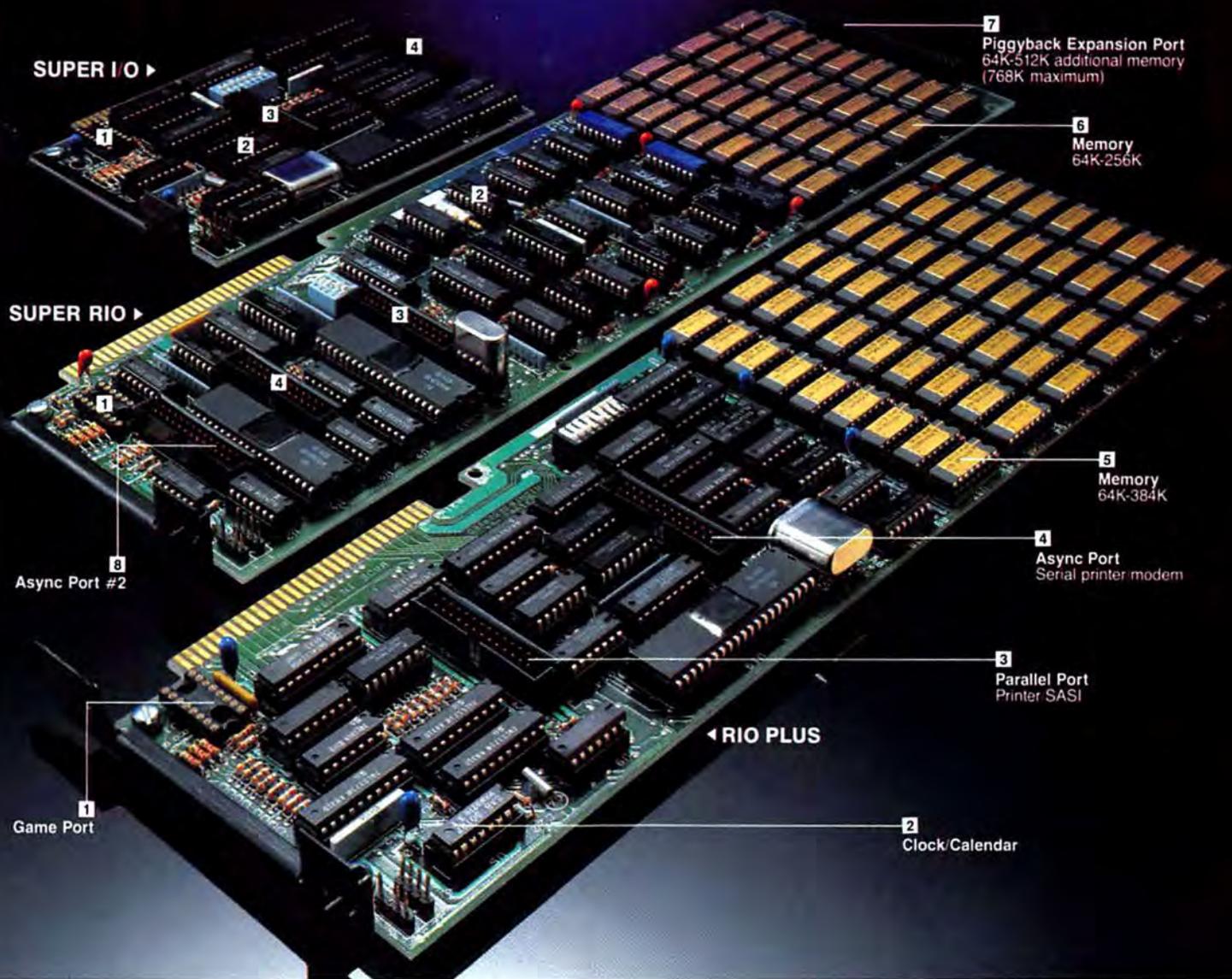
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The California Challenge

A summer institute at Stanford helps prepare teachers for California's computer giveaway.

Linda V. Williams

Summer used to be the time kids went swimming and teachers worked on their tans. These days parents pack the kids off to computer camp, and school districts hustle the teachers off to summer computer institutes.

This summer at Stanford University 200 teachers gave up their chance to bask in the sun and spent a summer month peering at the luminous green glow of the computer screen—in many cases the screen of an IBM PC. For most of the teachers, especially those from California, the institute had a special importance and urgency.

National attention is focused on California's computer giveaway.

In California, 1983-84 will provide the test of whether schools can effectively integrate computers into their programs. Changes in that state's tax laws are encouraging corporations to donate computer equipment to the schools, and educators and lawmakers across the country will be watching the results of this experiment. The teachers at the Institute on Microcomputers in Education were

anxious to learn how to make the best use of the new equipment.

The institute was sponsored jointly by the Stanford University School of Education and Interactive Sciences, Inc. (ISI), a nonprofit organization devoted to the study of the role of computers in education. The sponsors had originally planned to give the program an international focus, but events in California last fall convinced the organizers to shift their attention closer to home.

A Computer in Every School

In September 1982 the California State Legislature passed Assembly Bill 3194, which offered corporations a tax break for donating hardware and software to schools. With this incentive many corporations began making plans to provide schools with some of the hardware that educators have long proclaimed that they needed but could not afford.

Yet the donated equipment is a mixed blessing for teachers. Now that they have the computers, the pressure is on to demonstrate that the schools can make effective use of them.

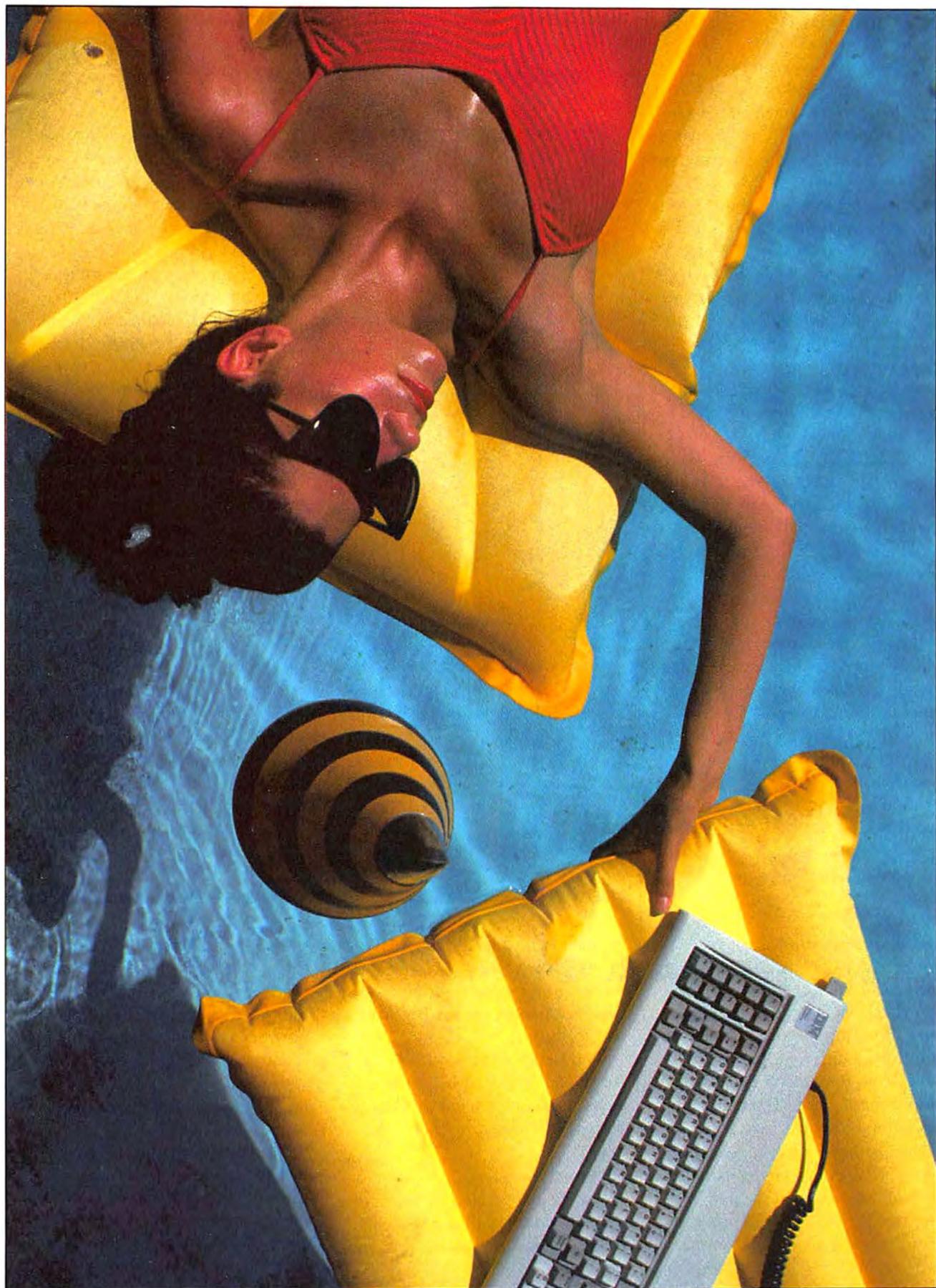
National attention is focused on California's computer giveaway. Success or failure will influence policy

makers in other states and at the national level. At a time when school budgets are threadbare and resources are overextended, do the schools have the human resources to match the mechanical ones?

People to Match the Computers

The ISI staff and the Stanford faculty decided to use this summer's institute to prepare teachers to meet the challenge of the new equipment. They recognized that in schools where teachers had little or no experience with computers, the new equipment would end up in the custodian's closet or be "captured" by a single aggressive teacher.

One way to prevent that unfortunate situation was to make sure that as many districts as possible had teachers capable of integrating computers into the total school program. The institute's sponsors made special efforts to attract California teachers to the international program in July, and a second month-long institute aimed specifically at California educators was planned for August. Knowing that many of the districts that needed help the most lacked the funds to send teachers to the institute, ISI President Joan Targ and Vice-president Jeff Levinsky coaxed California foundations into granting scholarship money.



Donors came up with over \$170,000; \$130,000 of the scholarship funds were earmarked for educators from schools that participate in the Mathematics, Engineering, Science Achievement (MESA) program, which provides enrichment opportunities for minority students and their schools. It includes 130 high schools as well as the junior high schools whose students later attend MESA high schools.

Planting Seeds

Preparing teachers to make optimal use of computers requires a good deal more than a couple of courses in BASIC or Logo. The institute's goal was to train "seed" teachers, resource people capable of advising their districts on a range of computer-related issues and formulating and carrying out long-range plans.

Becoming a seed demands both specific skills and a broad overview of the field; the summer institute provided both. Mornings were devoted to individualized hands-on instruction in programming BASIC, word processing, computer-assisted instruction (CAI) evaluation, and spreadsheet analysis. During the afternoons participants heard speakers and panels on a variety of topics, took field trips, and watched demonstrations of both hardware and software.

Learning from the Kids

For the hands-on instruction, the institute staff used the peer tutoring approach they had developed with students at Jordan Middle School in Palo Alto, California. In fact, students from Jordan and Palo Alto High School provided the initial instruction for the teachers.

During the first week of each institute, educators were paired with students who tutored them in one of three areas: BASIC, word processing, or spreadsheet analysis. After that, participants were divided into teams of three, organized so that each

Hungry for Educational Software



IBM's Robert Rowe addresses teachers at the summer institute

Dr. Robert Rowe, who is involved in IBM's Strategic Software Planning for the PC, has made the trip to Stanford for two summers to address the Institute on Microcomputers in Education. Last year he was besieged with questions about software for the PC. After working on PCs loaned to the institute by IBM, the teachers were hungry for software that would make the PC an educational computer.

In 1982 Rowe was forced to admit that there really wasn't much educational software available. In 1983, just a year later, his answer was more encouraging. "We're really off and running in terms of getting a good body of educational material out there," he reported.

Being off and running in only one year is an impressive accomplishment, but for IBM and Robert Rowe the race didn't begin in 1982. Rowe has spent most of the last 20 years at IBM working on educational applications for computers, and for most of that

member had studied a different area. In subsequent weeks each member was responsible for tutoring the other two members in the subject he or she had studied.

By the end of the institute each participant had studied all three areas and had firsthand experience with peer tutoring.

Superstar Speakers

Providing an overview of a field that changes almost daily is a real challenge. The institute solved the prob-

lem with a list of speakers from the superpowers of the computer industry. Robert Rowe of IBM came all the way from Boca Raton. Adam Osborne of Osborne Computer Corporation was among the speakers, along with representatives of Xerox, Hewlett-Packard, American Bell, and Atari.

The computer heavies were joined by panels of professors from Stanford University who discussed the social impact and international use of computers. Nuts and bolts issues such as how to convince administrators to support computer education were also part of the program.

time he was waiting for a machine like the PC to come along.

Rowe told the teachers that in the middle of the 1960s IBM produced a unique educational computer-assisted instruction (CAI) hardware system, the IBM 1500. The company made only 25 of these systems, and they were used for research in CAI.

That research convinced IBM that CAI was not yet practical. The hardware was too expensive, and software was considerably more complex to produce than researchers had expected. According to IBM's estimates, it required from 100 to 1000 hours of work to produce one hour of course material.

With the introduction of the personal computer 15 years later, affordable hardware was finally available, and IBM was ready to tackle the task of providing educational software for the PC. Rowe explained that the company is not relying solely on its own resources to achieve that objective.

"The quantity of what's required in the marketplace is staggering," he explained. Even IBM

doesn't have the resources to produce materials in all areas. However, the company is developing and marketing some materials itself. Rowe gave his audience a preview of one such program, *Writing to Read*, developed by Dr. John Henry Martin. That program is in its second year of nationwide evaluation by the Educational Testing Service and IBM. It uses a voice synthesizer and the graphics capabilities of the PC to teach young children reading and writing.

In addition, the company encourages individuals both inside and outside IBM to develop and submit software to run on the PC. The software is tested and evaluated, and if accepted is marketed by IBM.

A third major source of software is the individuals and publishers who develop or adapt materials to run on the PC. "A lot of what's available today was developed because people decided they wanted their programs to run on the IBM PC," Rowe asserted. He cited Houghton-

Mifflin's reading and language arts programs for grades three through eight. Those programs consist of 240 disks.

Rowe reminded teachers that despite the rapid progress being made in the educational uses of computers, the field is still at a very early point in what will be at least a 5- to 10-year learning curve. Most of the materials available are drill and practice exercises because they are the easiest to produce.

Tutorials that teach new material and simulations that help students integrate information and develop problem-solving skills will come more slowly because they are more difficult to produce.

For a field in its early phases educational software is growing amazingly fast. And although many of today's products may seem crude in 5 years, at the moment they demonstrate impressive gains for the industry. For teachers at the institute, IBM's progress in the field was good news indeed.

Participants ventured into the wilds of Silicon Valley to visit the Xerox PARC Research Laboratory, Hewlett-Packard, and the Computer Tutor Camp. Dr. John Chowning, director of Stanford's Center for Computer Studies in Music, took them behind the scenes just prior to a concert for a computer music demonstration.

In addition to high school tutors and superstar speakers, participants found another invaluable resource at the institute—each other. During the

intensive month of study, they found time to share ideas, experiences, and problems.

The relationships developed at the institute laid the foundations for a network of professionals who will assume leadership roles when they return to their communities. That network will be another important factor in strengthening the impact of institute participants on the educational system. Horace King of Riverside, California, summed up this perspective: "It's not just working with computers, but working with people."

Time Will Tell

The summer institute will almost certainly have a major impact on what the 200 participants do in their classrooms next year, but will it affect the larger educational community? Will the teachers become the seeds California and other states so desperately need to move their educational systems into the computer age? Time will tell.

There is, however, good reason for optimism. Last spring ISI conducted a poll of the participants at its 1982

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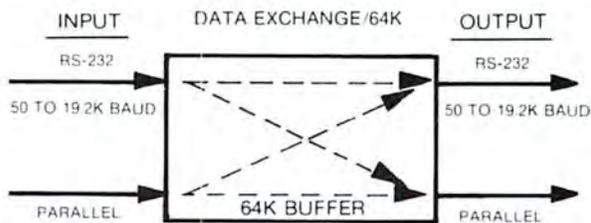
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Community

summer institute, and Joan Targ reports that the 40 educators in that program have become active advocates of computer education. They are teaching computer classes, but often their activities go far beyond that.

They have started computer centers, become resource specialists for districts, served on advisory committees, and conducted workshops and in-service training for other teachers.

The relationships developed at the institute laid the foundations for a network of professionals.

They developed curricula and wrote grant proposals, software reviews, and articles for papers and magazines. Many report attending conferences and taking additional computer courses.

That's an impressive list of accomplishments, especially since many of the participants had little or no experience with computers prior to attending the institute. If the 200 educators who attended this summer's programs show the same initiative, their districts will be in a good position to take advantage of California's computer giveaway. ☉

Linda Williams is an educational consultant and the author of Teaching for the Two-Sided Mind (Prentice-Hall, 1983), a book that explores the implications for education of recent brain research. She is currently writing a book on EasyWriter II.

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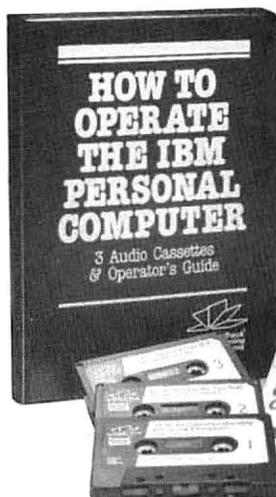
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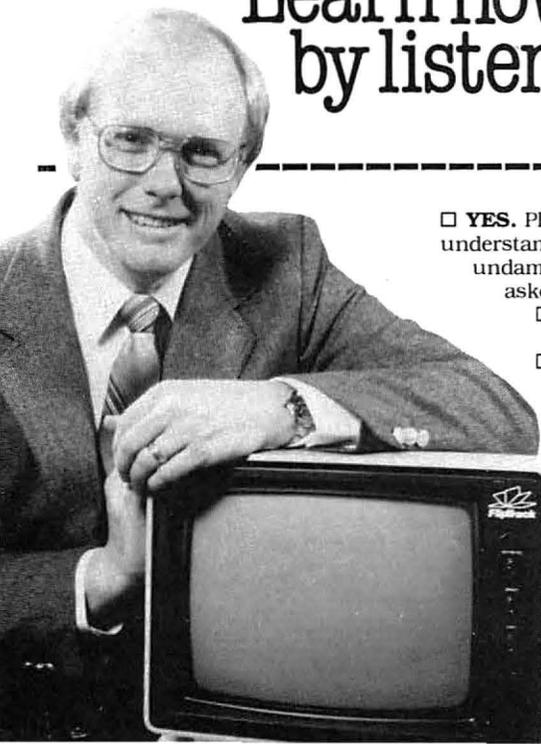
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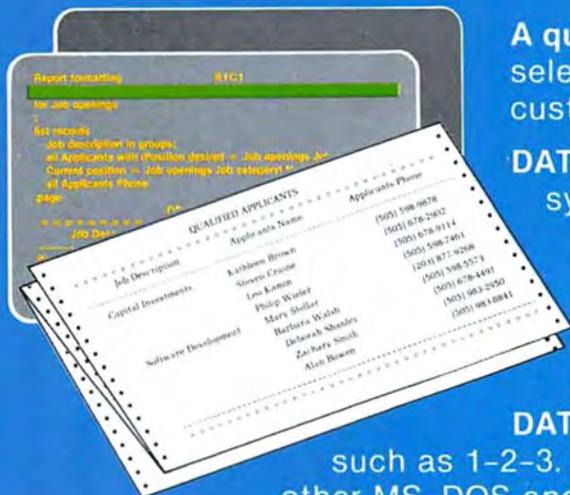


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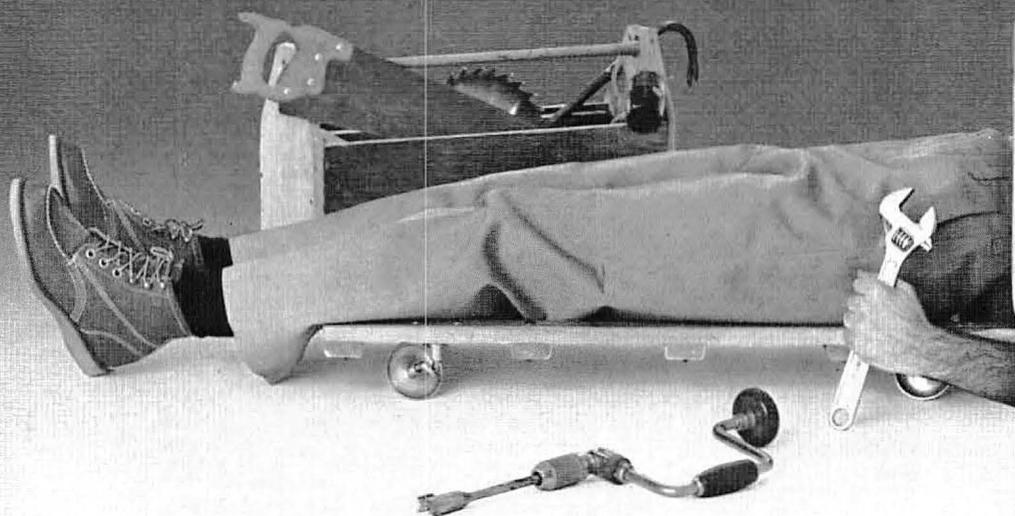
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BBS Watch

A slightly different wire service

Les Cowan

BBS Watch has a new look. This column will present the news, information, and gossip that we find on the bulletin boards. In other words, we will present the news that you are making.

CONNECT...

? = *HELP*. Warnings are appearing on more than one BBS of late stating that if the phone company catches you using your modem, they'll sock you with extra charges. Southwestern Bell is hitting customers with a \$50 per month surcharge for "data grade service." Similar surprises have been reported from the bailiwicks of Mountain Bell and Southern Bell.

Bulletin board users are not taking this outrage lying down. Most bulletin boards across the country are abuzz with indignant messages and calls to arms urging computer owners to write letters to legislators and public utility and FCC commissioners. The FCC is deliberating this matter as Docket CC 78-72.

In the Houston area they're organizing MUGers (Modem Users' Group) to fight Ma Bell. Chuck Lott at the Weekender BBS (713/492-8700) is the person to contact.

Dickinson's Movie Guide, a BBS in the Kansas City area (913/432-5544), has some useful tips on what and how much information you are required to give the telephone company about communication devices such as modems. One tip tells callers that they are required by law to register modems with the phone company if they have direct-connect modems. This regulation does not apply to acoustically coupled modems.

A *Wall Street Journal* story reported that Robert Braver, an Ok-

lahoma City modem user, is taking the matter to court. According to the article, Braver's case will probably question the constitutionality of the phone company monitoring telephone lines for carrier signals. Bravo Braver!

More?

BBS guru of the month. All the modem uproar brings us rather neatly to David Hughes of Colorado Springs, Colorado. His BBS, Country Kitchen (303/632-3391), is a 'round-the-clock affair, and the mountain folk who are regular Country Kitchen callers are also mobilizing to fight the phone company.

The Country Kitchen offers callers a certain amount of folksiness. Just take a look at some of the items from the Kitchen's main menu:

```
<G>eneral Message Center ... POST OFFICE
<E>lect-Mail (Private)... PONY EXPRESS
<N>ews... OLD TOWN BULLETINS AND
ELECTRONIC NEWS
<I>nfo & Spec Features... TOWN HALL AND
CITY CLERK
<B>ank... TOWN'S INFORMATION BANK-
VAULT
<V>arious Computers... WAGON PARK
<D>rinkin' and Discussin' Politics... ROGER'S
BAR
<P>urchase or Peruse... GENERAL STORE
<W>riter's Corner... OPERA HOUSE
<S>chool Bell... L'IL RED SCHOOLHOUSE
<U>ser Log... MAN-WANTED POSTERS
<C>hat with SYSOP... MEET THE MAYOR
<Q>uit this call... SKIP TOWN
```

Hughes is something of a maverick. At this very moment he may be sitting with a brew and a Radio Shack TRS-80 Model 100 in his favorite Rocky Mountain saloon composing something for his electronic magazine, *Source Trek*. *Source Trek* is

called up by the command PUBLIC 152 DIRECT and Hughes gets a nickel from The Source each time it's called. The electronic magazine is a grab bag of short items, messages, and jokes from David's fertile mind. His BBS's latest sign-on quote is, "If government can provide highways for people's bodies, why not provide them for their minds?" An intriguing thought, but then my mind is definitely a subcompact model.

Hughes, by the way, was celebrated in a long summer story in the *Wall Street Journal* (they sure have discovered electronic bulletin boards over at the *Journal*). To quote Mr. Hughes: "Electronic communications are going to make us use more vivid metaphors and a different style of prose writing to make up for the lack of personal contact...electronic novels are a lot of #&\$%\$%@!" David is ex-army, and he knows that top row of keys.

More?

Wds to lv by. I'll say one thing for the Country Kitchen: its BBS menu items may be folksy, but at least they are comprehensible. Abbreviating in the name of limited memory is fine, but it can get out of hand. I am so pleased that you agree. I just happen to have a short glossary of terms for all of us acronymic morons:

PMS—people's message system (BBS software)

RBBS—remote bulletin board system (more BBS software)

MSG—message

SIG—special interest group

SO—sexually oriented

SYSOP—system operator

UG—user group

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BBS Watch

Of course, new codes are added daily, so BBSers read your MSGs on the BBSs and talk with your SYSOPs and UG members for new SIG info about your PCs—OK? EOF!

More?

~S to suspend. Don't invite to the same teleconference: David Hughes and members of the Armadillo Media Service. This good ol' BBS out of Houston (713/444-7098) has a joint-effort novel going (and judging by the way the story reads that pun may not be unintentional). So far the story concerns a commercial jet pilot, his poly-dialectical copilot, and an English grande dame who collects cigarette lighters. I'm sure there's more, but I switched to messages as soon as the plane touched down at Heathrow. I kept yawning—must have been jet lag.

Armadillo has some no-holds-barred debates about grammar, news coverage of traffic accidents, the ethics of phone-phreaking, and other topics critical to the perpetuation of western civilization. Recommended for all those nights when "Dallas" and J.R. aren't exciting enough and y'all are jes' dyin' to know what's goin' on in Houston.

Oh yes, Armadillo also has a joke contest. I don't want to discourage you from checking it out, but here's one of the groaners. A farmer who was having trouble keeping animals out of his watermelon patch bought a large, long-haired dog to guard his crops. When his wife saw him come home carrying this canine, she asked why he had purchased the pet. The farmer proudly announced to her, "This is my melon collie, baby!"

Don't say you weren't warned.

More?

MSG from Wes Merchant's Capital PC Club BBS out of Annandale, Virginia (703/560-0979): According to a displeased Mike Truffer, IBM has released several patches to the Peachtree accounts receivable package but is not notifying registered owners. These patches were announced, says Mike, in a memo to dealers back in January. According to Truffer, some IBM Product Centers will loan customers disks that include the patches or fix customers' disks if they bring them into the stores.

More?

SO what! If you've checked the user logs of any of the meet-a-date BBSs, you may have noticed that almost all the advertisers are men. Is this another example of the much-publicized belief that women do not take to computers? I can't believe that all the women who want dates have them. (Yes, I know. I only check out SO boards out of curiosity, too.)

More?

English-language SIG. Vivid simile of the month honors to Harry Krause, who checks in with "slick as bear guts on a doorknob." Is this kind of thing really going to take the place of human contact? Harry by the way opines that "Volksuriter is for writers who like to think; WordStar is for computer operators who think they can write."

More?

E-reviews. Another item from the Capital PC Club BBS: Bill Silverman comments on two products recently purchased by his company from MPPi, Ltd. "PC Lock I...a chip that goes on the [older style] system board of PCs and completely locks

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BBS Watch

the thing up when someone tries to boot the system [without the password]. PC-Lock II takes up an expansion slot and is more complex to use. A super user has access to everything and doles out read-only and read-write access to everyone." PC-Lock I costs \$99; PC-Lock II, \$349.

More?

Odds and ends. If you are a chess voyeur, you might like watching the game in progress (as of this writing) on the BBS in San Lorenzo, California (415/651-4147). Would this make you an E-kibitzer?...No nukes is good nukes: the Conference Tree (415/948-1474) is sponsored by the Stanford Arms Control and Disarmament Forum (SACDF). The SACDF C-tree is an information resource and host for computer-based conferences on nuclear weapons issues.

More?

SIGs here and there. Yes, Virginia, there are non-computer-specific bulletin boards. Here is a short list to show you the diversity.

- 703/759-5049 Literature and politics
- 301/460-0538 Federal and medical SIG
- 301/972-2456 Scuba diving
- 301/371-6271 Medical
- 914/221-0774 Sports
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BBS Watch

More?

^Q to quit. The messages on the Akron Digital Group BBS (216/745-7855) read like a soap opera script. So much drama, so much pathos, so much confusion! Will Tricia fall for Noyfb's indecent suggestions? Or will she go pee-wee golfing with loyal but forgetful Brian? Have the Peeks and Poker Chips really seen the last of mischievous Joshua? Do any of these people really exist? Is Joshua the Mad Programmer (aren't they all) of Armadillo Media Services? Dial in next month when we will do our best not to address these and other weighty matters.

NO CARRIER...

Les Cowan is a freelance journalist, technical writer, and sometime programmer based in San Francisco.

IBM PC Bulletin Boards

Following is a partial listing of the IBM PC bulletin boards on-line in the United States and Canada. The list is updated as we receive information about new bulletin boards.

201/783-6976

NY PC Users Group
SYSOP: Donald David
24 hrs, 300/1200

202/362-2707

Washington, D.C.
SYSOP: Mike Todd
24 hrs, Novice Special Interest
Group, 300

203/289-6321

East Hartford, Connecticut
SYSOP: Scott Maentz
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all day Sun, download &
upload, messages, 300/1200

203/521-1991

Hartford, Connecticut
SYSOP: John O'Boyle
10 p.m. to 5:30 p.m. Mon to
Fri, evenings Sat & Sun,
download & upload,
messages, 300/1200
(Passwd = IBMPC)

203/966-8869

New Canaan, Connecticut
SYSOP: Whit Wynat
24 hrs, download & upload,
messages, 300

213/371-8825

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24 hrs, download & upload,
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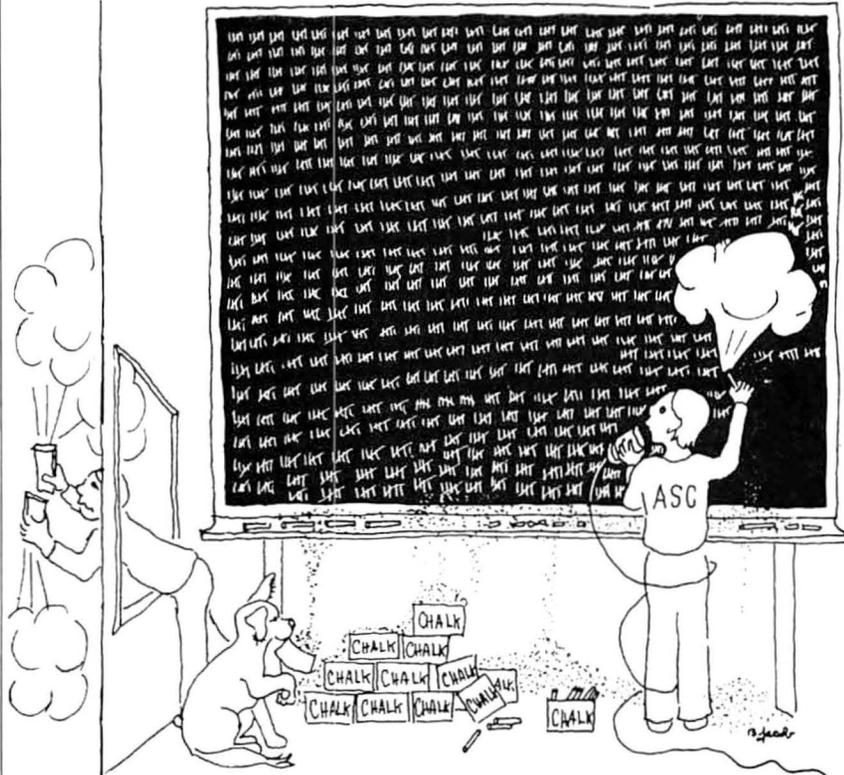
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300
(Passwd = IBMPC)

703/560-7803
Vienna, Virginia
ABBS with IBM PC
Conference
24 hrs, download & upload,
messages, 300

703/560-0979
Annandale, Virginia
SYSOP: Wes Merchant
Download, messages,
bulletins, 300

703/680-5220
Dale City, Virginia
Dale City Info Exchange
SYSOP: Tim Mullins
24 hrs, news, new product
reviews—all PCs, 300

703/978-9592
Fairfax, Virginia
SYSOP: Don Withrow
24 hrs, download & upload,
tips, 300/1200
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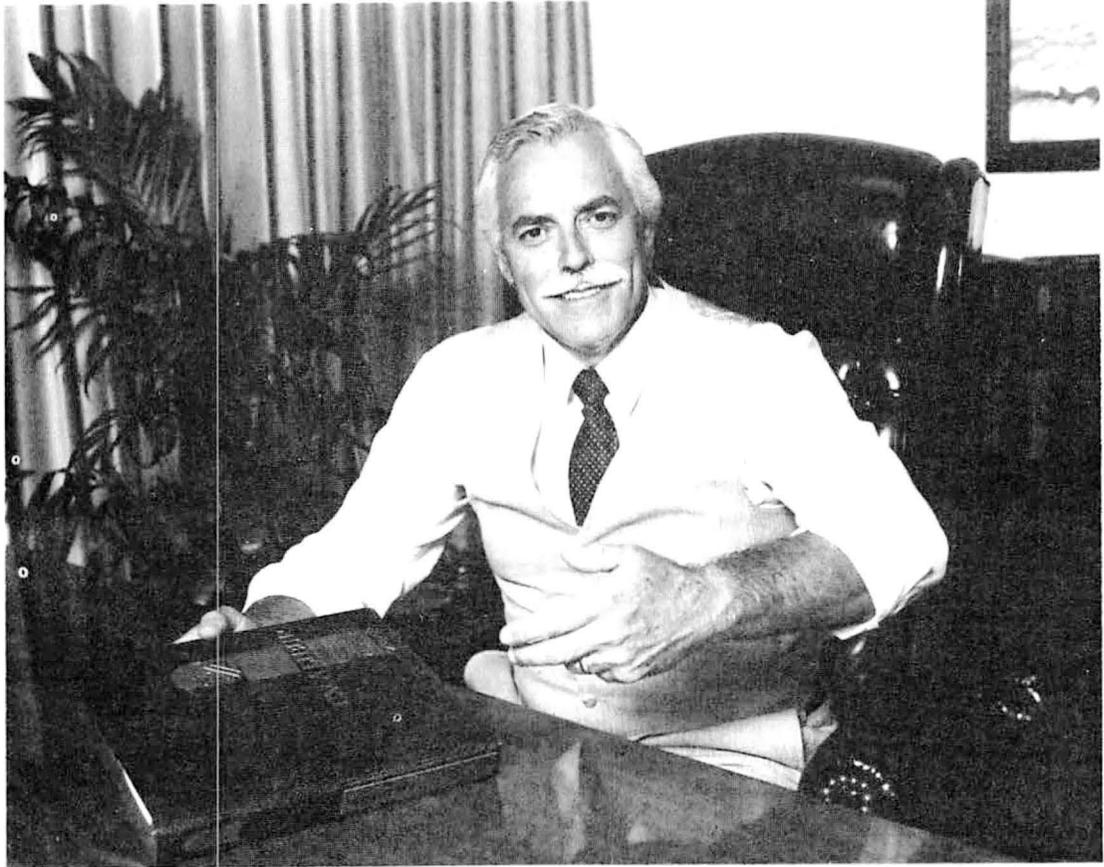


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dBASE WINDOW is a full-fledged dBASE II Application Generator. Working from your design, dBASE WINDOW generates and runs record keeping applications of all kinds, quickly and effectively. Just draw your input screen and report formats and dBASE WINDOW will create your application for you.

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dBASE WINDOW and dBASE DOOR have the unique capability to build upon a relation between two independent databases. Here's how:

Job Records				
ADDRESS	FIRST NAME	LAST NAME	EMPLOYEE NUMBER	DEPARTMENT NUMBER
Personal Records				

Any two databases can be linked by a common field. In this example, the field 'last name' establishes a relationship between the personal records file and the job records file. Using dBASE WINDOW or dBASE DOOR, you may now print reports which contain data from *both* databases!

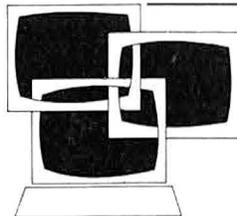
Compare the features of dBASE WINDOW with any program generator:

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MasterCard and Visa accepted.

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BBS of the Month

This month we are featuring the PC BBS in Charlotte, North Carolina (704/365-4311). One of its public domain programs, *Program Squisher*, is reprinted below. *Squisher* compresses program code so that it takes up less space in memory.

```

10 DEF FNI$(A$)=CHR$(ASC(LEFT$(A$,1))+32*(LEFT$(A$,1)>"Z")):
  DEFINT B-K,S-Z:A=0:AZ=0:A$="":C$="":D=0:DS=100:DT=0:G1=0:
  G2=0:G3=0:G4=0:G5=0:G6=0:HH=0:I$="":IP$="":J$="":LN=0:
  L$="":L1$="":N$="":P=0:PJ=0:PP=0:PV=0:Q$="":R=0:RD=0:RE=0:S=0:S1=0
20 SD=0:SQ$="":SV$="":T=0:T1=0:T2=0:V$="":X=0:XC$="":XS$="":XP$="":ZC=0:
  DIM REF(DS*2),PRO(DS):SCREEN 0,0,0:WIDTH 80:COLOR 11,0:KEY OFF:
  CLS:LINE INPUT"ENTER THE NAME OF THE PROGRAM TO BE SQUISHED: ";SQ$
30 XS$="N":IP$="N":XC$="N":XP$="N":PRINT:LINE INPUT"ENTER THE
  NAME FOR THE FINAL SQUISHED PROGRAM: ";SV$:PRINT:LINE INPUT"WOULD
  YOU LIKE EXTRA SPACES DELETED? (Y/N) ";XS$:IF XS$="" THEN XS$="N"
40 PRINT:LINE INPUT"WOULD YOU LIKE REM STATEMENTS DELETED? (Y/N)
  ";IP$:IF IP$="" THEN IP$="N"
50 PRINT:LINE INPUT"WOULD YOU LIKE TO COMBINE LINES? (Y/N)
  ";XC$:IF XC$="" THEN XC$="N"
60 PRINT:LINE INPUT"WOULD YOU LIKE TO PROTECT ANY LINES? (Y/N)
  ";XP$:IF XP$="" THEN XP$="N"
70 ON ERROR GOTO 560:XS$=FNI$(XS$):IP$=FNI$(IP$):XC$=FNI$(XC$):
  XP$=FNI$(XP$)
80 IF XS$="N" AND IP$="N" AND XC$="N" AND XP$="N" THEN RUN
90 IF XP$="Y" THEN INPUT"ENTER LINE NUMBER TO PROTECT (0 TO EXIT)
  ";PRO(PV):IF PRO(PV)>0 AND PV<DS THEN PV=PV+1:GOTO 90
100 OPEN SQ$ FOR INPUT AS #1
110 IF EOF(1) THEN 240
120 LINE INPUT #1,A$:IF ASC(A$)>58 THEN COLOR 12,0:PRINT:
  PRINT"**** ' ' ;SQ$;' ' IS NOT AN ASCII FILE ****":PRINT:COLOR 11,0:END
130 G1=1:G2=1:G3=1:G4=1:G5=1:G6=1
140 D=4:T=INSTR(G1,A$,"THEN"):IF T THEN G1=T+D:GOTO 210
150 T=INSTR(G2,A$,"GOTO"):IF T THEN G2=T+D:GOTO 210
160 T=INSTR(G3,A$,"ELSE"):IF T THEN G3=T+D:GOTO 210
170 T=INSTR(G4,A$,"GOSUB"):IF T THEN D=5:G4=T+D:GOTO 210
180 T=INSTR(G5,A$,"RESUME"):IF T THEN D=6:G5=T+D:GOTO 210
190 T=INSTR(G6,A$,"RUN"):IF T THEN D=3:G6=T+D:GOTO 210
200 GOTO 110
210 A=VAL(MID$(A$,T+D)):IF A THEN FOR HH=1 TO R:IF REF(HH)<>A
  THEN NEXT:R=R+1:REF(R)=A
220 IF A>0 THEN T=T+D:D=1:T1=INSTR(T,A$,""):T2=INSTR(T,A$,":"):
  IF T1>0 AND (T2=0 OR T1<T2) THEN T=T1:GOTO 210
230 GOTO 140
240 CLOSE:FOR S=1 TO R:FOR S1=S TO R:IF REF(S)<REF(S1) THEN SWAP
  REF(S),REF(S1)
250 NEXT S1,S:FOR S=0 TO PV:FOR S1=S TO PV:IF PRO(S)>PRO(S1)
  THEN SWAP PRO(S),PRO(S1)
260 NEXT S1,S:OPEN SQ$ FOR INPUT AS #1:OPEN SV$ FOR OUTPUT AS #2:CLS
270 IF EOF(1) THEN 380

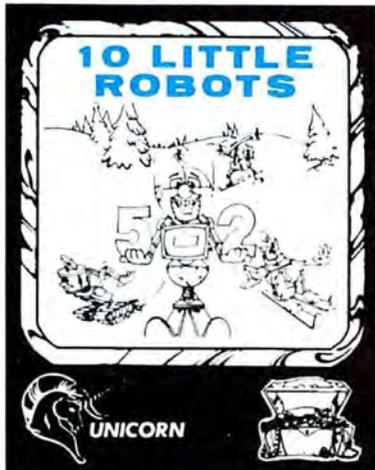
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280 LINE INPUT #1,A$:FOR HH=INSTR(A$," ") TO LEN(A$)-1: IF
MID$(A$,HH+1,1)=" " THEN NEXT
290 PP=HH:X=PP:LN=VAL(A$):LOCATE 1,1:COLOR 11,0:PRINT"SCANNING
LINE:";: COLOR 12,0:PRINT LN:PRINT:PRINT STRING$(255,32):
LOCATE 3,1: COLOR 14,0:PRINT A$:LOCATE 8,1:COLOR 11,0:
PRINT"SCANNING POSITION:      ":PRINT
300 PRINT"NUMBER OF LINES COMBINED:";:COLOR 12,0:PRINT RE:
COLOR 11,0: PRINT:PRINT"NUMBER OF SPACES DELETED:";:
COLOR 12,0:PRINT SD: COLOR 11,0:PRINT:
PRINT"NUMBER OF REM STATEMENTS DELETED:";:
COLOR 12,0:PRINT RD:COLOR 11,0:GOTO 410
310 IF XC$<>"Y" THEN PRINT #2,A$:GOTO 270
320 IF C$="" THEN C$=A$:GOTO 270
330 IF R>0 THEN IF LN=REF(R) THEN R=R-1:GOTO 370
ELSE IF LN>REF(R) THEN R=R-1:GOTO 330
340 IF INSTR(C$,"IF") OR INSTR(C$,"RETURN") THEN 370
350 V$=RIGHT$(A$,LEN(A$)-X):IF LEN(C$)+LEN(V$)<240 THEN
C$=C$+" "+V$:RE=RE+1 ELSE 370
360 GOTO 270
370 PRINT #2,C$:C$=A$:GOTO 270
380 PRINT #2,C$:CLOSE:COLOR 12,0:LOCATE 8,19:PRINT T:LOCATE
10,26: PRINT RE:LOCATE 12,26:PRINT SD:LOCATE 14,34:PRINT RD
390 LOCATE 3,1:PRINT STRING$(255,32):LOCATE 3,1:COLOR 14,0:
PRINT"PRESS 'L' TO LOAD THE SQUISHED PROGRAM":SOUND 1000,6:
SOUND 660,5:COLOR 11,0
400 Q$=INKEY$:IF Q$="" THEN 400 ELSE CLS:IF Q$="L" THEN LOAD SV$
ELSE END
410 N$=LEFT$(A$,PP):ZC=160+PP:PP=PP+1:P=0:J$="":DT=0:FOR T=PP TO
LEN(A$): L$=MID$(A$,T,1):AZ=INT(ZC/80):LOCATE AZ+1,ZC-
AZ*80+1:COLOR 10,0: PRINT MID$(A$,T,1);:ZC=ZC+1:COLOR 12,0:
LOCATE 8,19:PRINT T
420 COLOR 11,0:IF L$=CHR$(34) THEN IF P THEN P=0 ELSE P=1
430 IF P THEN 520
440 IF MID$(A$,T,4)="DATA" THEN DT=1 ELSE IF L$=":" THEN DT=0
450 IF DT THEN 520
460 IF L$<>" " OR XS$<>"Y" THEN 500 ELSE IF J$>"" THEN
L1$=RIGHT$(J$,1): IF L1$="^" OR (L1$>")" AND L1$<"0") OR
(L1$>"9" AND L1$<"A") THEN L$=""
470 L1$="X":IF T<LEN(A$) THEN L1$=MID$(A$,T+1,1)
480 IF L1$="^" OR L1$=CHR$(34) OR L1$=" " OR (L1$>")" AND
L1$<"0") OR (L1$>"9" AND L1$<"A") THEN L$=""
490 IF L$="" THEN SD=SD+1
500 IF PV>PJ THEN IF LN=PRO(PJ) THEN PJ=PJ+1:GOTO 540
ELSE IF LN>PRO(PJ) THEN PJ=PJ+1
510 IF MID$(A$,T,3)="REM" OR L$="" THEN IF IP$<>"Y" THEN
A$=N$+J$+MID$(A$,T,255):GOTO 540 ELSE RD=RD+1:IF LN=REF(R) THEN
R=R-1:A$=N$+J$+"":GOTO 540 ELSE IF J$="" THEN 270 ELSE 530
520 J$=J$+L$:NEXT:IF P THEN J$=J$+CHR$(34)
530 A$=N$+J$:GOTO 310
540 IF C$<>"" THEN PRINT #2,C$:C$=""
550 PRINT #2,A$:GOTO 270
560 IF ERR=53 THEN RUN ELSE ON ERROR GOTO 0

```


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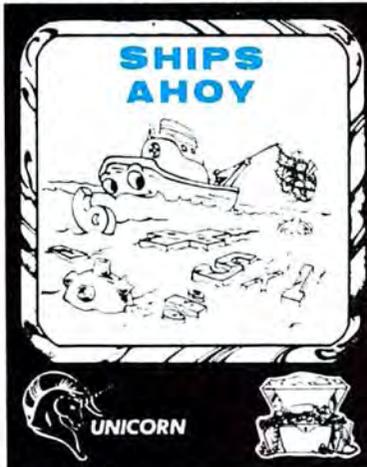


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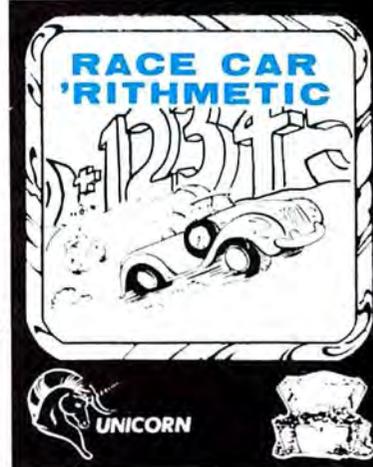


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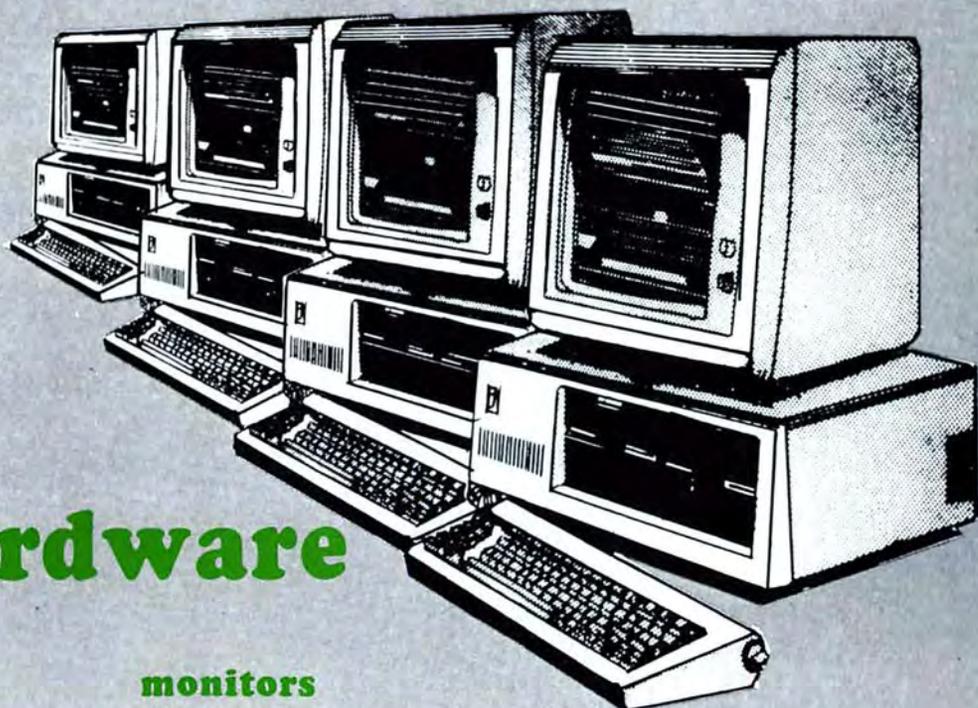
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Accounts Receivable 1. Daily Transactions Report 2. Invoices (with or without preprinted forms) 3. Statements (with or without preprinted forms) 4. Summary Aging Report 5. Detailed Aging Report 6. Itemized Monthly Transactions 7. Detailed Customer Activity Report 8. Summary Customer Account Report

Accounts Payable 1. Daily Voucher Report 2. Daily Credit Report 3. Checks with Detailed stubs 4. Check Register 5. General Ledger Transfer Report 6. Cash Requirements Report 7. Transaction Register 8. Open Voucher Report 9. Aged Payables Report 10. Detailed Vendor Activity Report 11. Summary Vendor Account Report

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World Events

A calendar of regional, national, and international events

Edited by Eric Brown

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.

November 7-11

COMPSAC '83

Palmer House Hotel

Chicago

Seventh International Computer Software and Applications Conference and Technical Show. Aimed at software programmers, designers, and managers. The first two days are devoted to tutorials on applications software. The remainder of the conference consists of seminars, speakers, papers, and panels on such issues as robotics, office automation, reliable software, tools and metrics, life cycle models, and human factors in software.

IEEE Computer Society

1109 Spring St. #300

Silver Spring, MD 20910

301/589-8142

November 8-10

The Hammer/Seybold Executive Forum

Windows on the World

One World Trade Center

New York

The topic for the forum is "Directions in Office Systems and Professional Computing." Office automation vendors will be interviewed on the future of computing and office automation. Speakers include J. T. Boyle from IBM, Fred-

erick A. Wang from Wang, Julius L. Marcus from DEC, and Frank Vigilante from AT&T. Other sessions will address multivendor integration, the role of PBX, and vendor evaluation.

Hammer and Company, Inc.

Five Cambridge Center

Cambridge, MA 02142

617/542-2261, 617/354-5555

November 8-10

Mini/Micro-West

Brooks Hall & Civic Auditorium

San Francisco

Software computer and OEM show for computer end users held in conjunction with the Wescon Convention Show.

Jeanie Oldendorph

Electronic Conventions

8110 Airport Blvd.

Los Angeles, CA 90045

800/421-6816, 213/772-2965,

800/262-4208 in California

November 8-10

Wescon Convention Show

Moscone Center

San Francisco

High-tech computer show for OEMs and test, design, and manufacturing engineers.

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November 10-13

Los Angeles Computer Showcase Expo

Los Angeles Convention Center

A regional exposition for business, professional, and corporate users of personal computers and word processing systems. Features hardware, software, peripherals, media, supplies, and services relating to mini and microcomputer environments.

Peter Young

The Interface Group

300 First Ave.

Needham, MA 02194

617/449-6600

November 14-17

14th Annual Canadian Computer Show & Conference

Toronto International Centre

Toronto

Largest computer show in Canada. 350 exhibitors and 37,000 attendees. General computer show with international exhibitors. Also a four-day conference on various computer topics sponsored by the Canadian Information Processing Society.

Industrial Trade Shows of Canada

20 Butterick Rd.

Toronto, Ontario

M8W 3Z8 Canada

416/252-7791

(continues)

World Events

November 17-19

Fifth Annual Northeast Computer Show and Software Exhibition
Hynes Auditorium
Boston
Largest annual East Coast end user computer event. 500 exhibitors of microcomputers, accessories, peripherals, and software.

Northeast Expositions
822 Boylston St.
Chestnut Hill, MA 02167
800/841-7000, 617/739-2000 in Massachusetts

November 17-20

Washington D.C. Computer Showcase Expo
Washington D.C. Convention Center
A regional exposition for business, professional, and corporate users of personal computers and word processing systems. Features hardware, software, peripherals, media, supplies, and services relating to mini and microcomputer environments.

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November 17-20

Chicago Computer Showcase Expo
McCormick Place
Chicago
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supplies, and services relating to mini and microcomputer environments.

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November 21-23

1983 Fall CPA Computer Show
New York Hilton
New York
Computer hardware and software supermarket for certified public accountants, controllers, and accounting professionals. Also computer workshops and seminars for accounting.

Flagg Management Inc.
P.O. Box 4440
Grand Central Station
New York, NY 10163
212/286-0333

November 29-30

The Office Vanishes: Exportation of Work by Computer
Waldorf-Astoria
New York
Business-oriented conference on exporting internal data processing to specialized, outside knowledge-based systems.

The Conference Board, Inc.
P.O. Box 4026
Church Street Station
New York, NY 10249

November 28-December 2

COMDEX/Fall
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December 8-10

Business & Personal Computer Sales-Expo '83 & 1983 Houston Business Show
Houston Civic Center
Houston
Two shows in one facility. Sales-Expo '83 is an exposition and sales marketplace for micro and minicomputer end users. The Business Show will concentrate on business-oriented computer applications.

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P.O. Box 2000
Bala Cynwyd, PA 19004
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- A **C86 User's Group** is being formed.

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Annapolis, MD 21403
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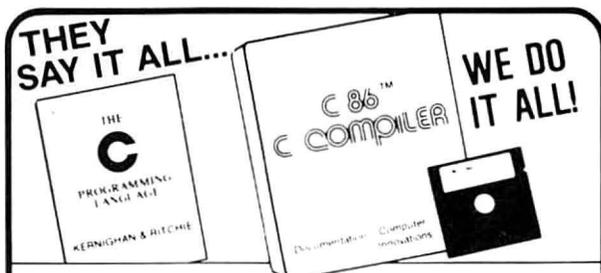
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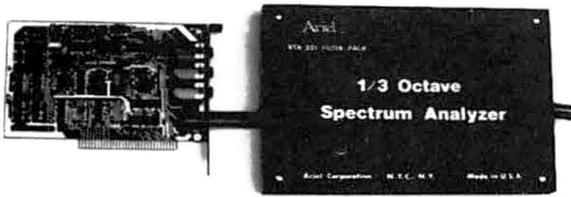
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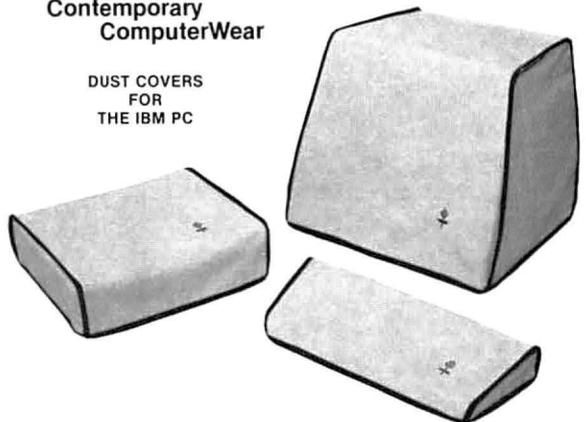
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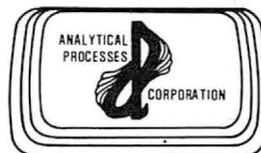
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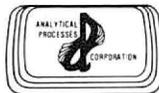
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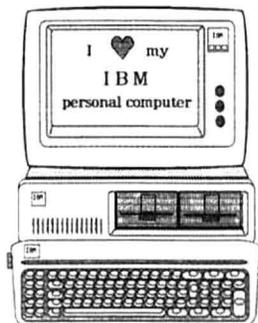
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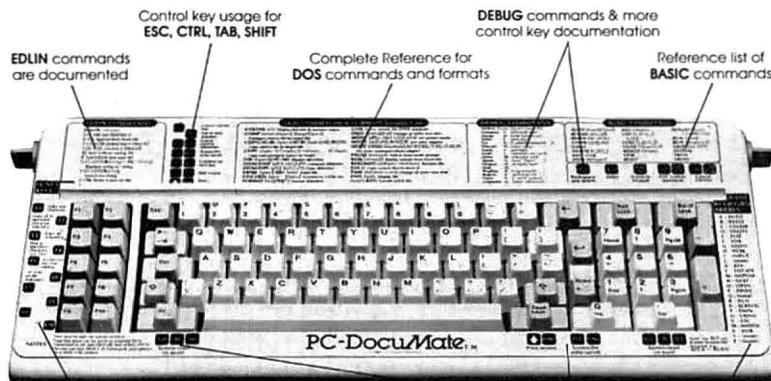
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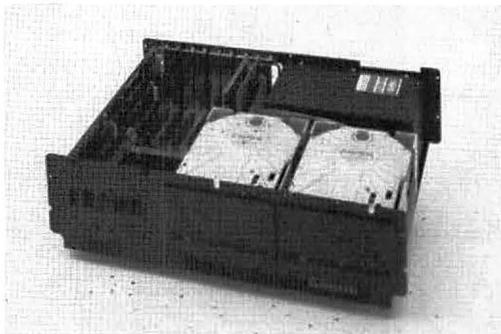
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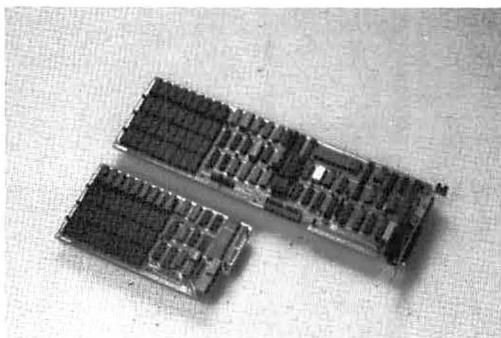
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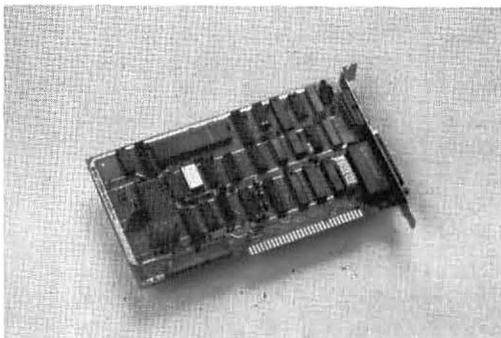
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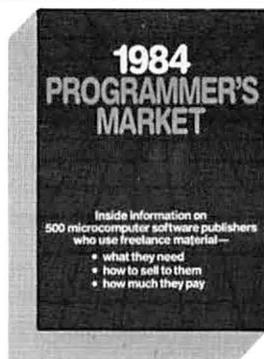
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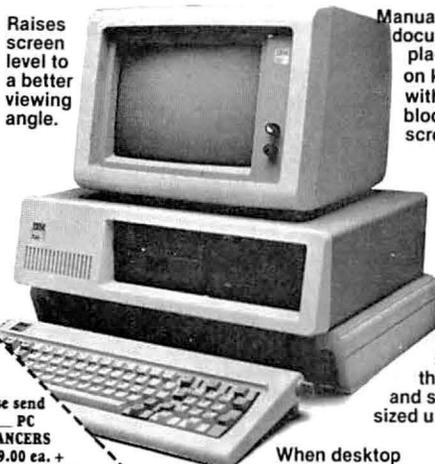
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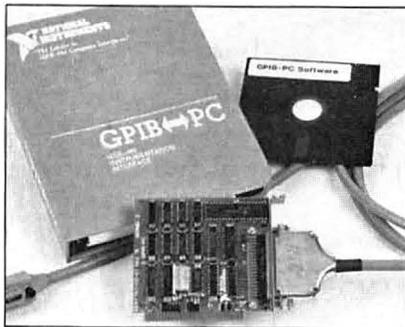
Just Announced

The wide world of PC products

Edited by Art Wilcox

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 future issues.

Hardware Boards



GPIB-PC, National Instruments

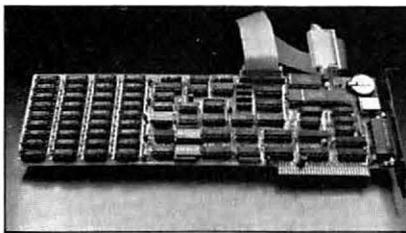
GPIB-PC

An IEEE-488 interface board that occupies only half of one slot in the IBM PC XT. The package comes with DOS 2.00 device driver software and includes machine language subroutines that can be included in applications programs. An interactive control program is also provided as a troubleshooting tool. The GPIB-PC card is implemented with the NEC 7210 GPIB controller chip and programmable array logic, which together use only eight I/O addresses. The card performs data transfers of

300K bytes per second between the GPIB and the PC's memory. List price: \$385. National Instruments, 12109 Technology Blvd., Austin, TX 78759, 800/531-5066.

RAM + 3

A multifunction board that provides up to 256K of memory expansion, a clock/calendar with battery backup, a parallel printer port, and an RS-232C serial port. It requires 64K and occupies any full-length slot in the IBM PC. The board also includes Seattle Computer's *Flash Disk* software, which allows a portion of the system memory to electronically emulate an additional disk drive. RAM + 3 is also available without any additional memory but with all other features. List price: \$320; 64K, \$395; 128K, \$470; 192K, \$545; 256K, \$620. Seattle Computer, 1114 Industry Dr., Seattle, WA 98188, 800/426-8936, 206/575-1830 in Washington.



RAM + 3, Seattle Computer

Displays

The Gorilla Monitor

A 12-inch monochrome monitor that provides an 80- by 25-character display. It requires a color graphics board. The monitor has a green, non-glare phosphor screen that has a



Gorilla Monitor, Leading Edge Products

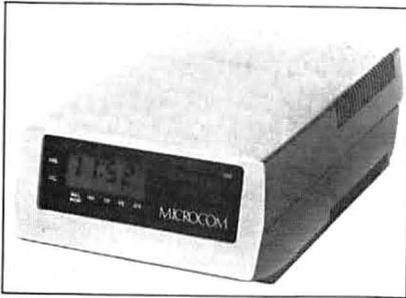
video bandwidth of 18 to 22 MHz and 800-lines-per-inch resolution. The monitor's stand allows the screen to be tilted for better viewing angles. The monitor weighs 14 pounds and measures 11.9 by 13.6 by 11.8 inches. List price: \$99. Leading Edge Products, Inc., 225 Turnpike St., Canton, MA 02021, 800/343-6833, 617/828-8150 in Massachusetts, Telex: 951-624.

Modems

Series PCS/2000 Modem

An auto-dial, auto-answer, auto-redial modem that allows data communication and transfers files over the phone line between computers. It requires an RS-232C serial port. The stand-alone modem provides full error detection/correction file transfers when used with another Microcom modem, and it also communicates with any standard 212A modem. The Series PCS/2000's on-board LCD clock and 32K file buffer enable users to do both unattended and prescheduled file transfers. The modem permits remote password-protected file access and includes an

extra RS-232C port for use with serial printers. List price: 300 bps version \$695, 300/1200 bps version \$995. Microcom, Inc., 1400A Providence Hwy., Norwood, MA 02062, 617/762-9310.



PCS/2000 Modem, Microcom

Printers

Messenger Module

A typewriter interface unit that transforms the Smith Corona Memory Correct III Messenger into an elec-



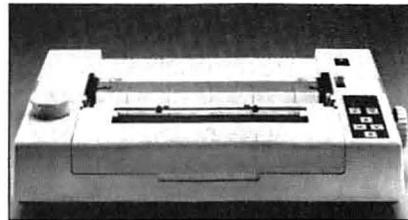
Messenger Module typewriter interface, Smith-Corona

tronic printer. The module requires either an RS-232C serial port or a parallel printer port. With the Messenger Module, the Memory Correct III Messenger provides 12 cps print-

ing, a set of 93 ASCII characters, and automatic underscoring. Keyboard commands can be used to interrupt printing, change pitch size, or input new data from the keyboard and then resume printing. List price: \$170. Smith-Corona, 65 Locust Ave., New Canaan, CT 06840, 203/972-1471.

CX-4800 Printer/Plotter

A printer and plotter that provides letter quality printing and four-color plotting. The roll-type plotter runs at speeds of 4.8 inches per second and can be moved in fine steps of 0.1 or 0.5 millimeters. It addresses a plotting area of 7.6 by 8 inches and accepts single or continuous folded



CX-4800 Printer/Plotter, Leading Edge Products

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TP-II, Smith-Corona

TP-II

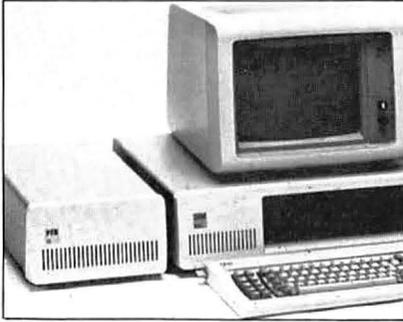
A daisy wheel, letter quality printer that prints at 12 cps and has a 10/12 pitch ASCII 93-character print wheel. It requires either an RS-232C serial port or a parallel printer port. The printer can handle XON/XOFF and ETX/ACK handshaking protocols and has a 256-character buffer. Other features include carriage return and linefeed controls, automatic underscore, and a self-test switch that automatically prints out a test pattern. List price: \$749, tractor feed attachment \$149. Smith-Corona, 65 Locust Ave., New Canaan, CT 06840, 203/972-1471.

Miscellaneous

Bug Catcher

An extended socket that helps users connect test devices such as logic analyzers to microprocessors being tested. Bug Catcher labels each pin's function on the socket to provide reliable, safe, nonshorting connections. The product accommodates 40- and 64-pin DIPs for the following processors: Z-80, 6502, 6800, 6809, 68000, 8035 series, 8648, 8748, 8085, 8086, and 8088. List price: 40-pin \$45, 64-pin \$67. Emulation Technology, 422 Ives Terrace, Sunnyvale, CA 94087, 415/960-0652.

Just Announced



PC-XTRA expansion chassis, P.C. Horizons Inc.

PC-XTRA

A bus expansion chassis that doubles the option adapter board capacity of the IBM PC. The expansion chassis requires one slot in the PC to extend the bus into the PC-XTRA. The P.C. Horizons Expansion Chassis permits any option that fits in the PC to be installed in the PC-XTRA. It provides an expansion chassis, power cable, bus expansion chassis adapter board, PC system bus adapter board, power supply, system motherboard, and seven system option slots. PC-XTRA results in a net gain of five slots. List price: \$680. P.C. Horizons, Inc., 200 N. Tustin Ave., Santa Ana, CA 92705, 714/953-5396.

System Software

Languages

Digital Research C

A machine code compiler and program development system that provides full compatibility with the UNIX version 7 C language standard. The compiler requires 128K and two disk drives. It includes programming and debugging aids, a UNIX-compatible library, and compiler command-line option switches.

It supports single- and double-precision arithmetic, and input/output redirection. The program is compatible with many programming and graphics tools from Digital Research. List price: \$350. Digital Research, P.O. Box 579, Pacific Grove, CA 93950, 408/649-5500, TWX: 910-360-5001.

\$40FORTH

A menu-driven version of the FORTH language designed for the beginning or expert programmer. The language requires 64K and one disk drive. The screen editor provides screen print and copy routines as well as function key, keypad, and keyboard commands. \$40FORTH displays the components of any FORTH word included in the Demonstration Menu dictionary. Other features include extended memory and disk dump capabilities, music and sound routines, BIOS ROM access, DOS functions and files, floating point arithmetic, and a random number generator. List price: \$40. Transportable Software, Inc., P.O. Box 1049, Hightstown, NJ 08520, 800/435-4444, 609/448-4175 in New Jersey.

Operating Systems

Coherent

A multiuser, multitasking operating system modeled after Bell Laboratories' UNIX version 7. Coherent requires 256K and one floppy disk drive (one 5M hard disk drive is recommended). The operating system's compatibility with UNIX version 7 permits code developed on other processors running UNIX to be transferred, compiled, and executed on the PC. The program contains 145 UNIX version 7 commands, including a C compiler (cc) and a text for-

matter (nroff). Coherent reads and writes PC-DOS files and also UCSD p-System files. List price: \$750. Network Consulting Inc., Discovery Park (Willingdon Site) #110, 3700 Gilmore Way, Burnaby, B.C., V5G 4M1 Canada, 604/430-3466.

Utilities

DataBurst

A program generator with full screen control that lets users manipulate up to 16 screen formats. It requires 64K and one disk drive. An on-line editor enables programmers to design a picture of the desired screen. A source code file is then generated that describes the contents and functions of various fields on the screen. Display attributes can be assigned to individual fields including underline, inverse image, and blinking. Other attributes include input, output, or constant field types, and alphabetic or numeric data types. The program allows source code generated in ASCII file format to be modified with



DataBurst, Key Solutions

any IBM PC text editor. *DataBurst* is written in assembly language for greater speed. List price: \$225. Key Solutions, Inc., P.O. Box 2297, Santa Clara, CA 95055, 408/554-6125.

Keytools

Four programs that help programmers develop applications programs faster and more efficiently. The package of utilities requires 64K and two disk drives. It includes Picasso, a multifaceted screenmaker; Emerson, a formatted data entry subroutine; Socrates, a program that builds on-line help facilities, and Youngman, a collection of one-line subroutines. The utilities are provided as commented BASIC code, Compiled BASIC, merge file subroutines, and structured listings. List price: \$40. Key-1 Computer Systems, 178 Spring St., Newport, RI 02840, 401/849-4562.

/N

A utility that removes unused line numbers from BASIC Compiler source files. It requires 64K and one disk drive. When /N is used the BASIC Compiler optimizes code more effectively to produce faster programs. Removing line numbers allows larger programs to be compiled and provides more readable listings because subroutines and branch targets stand out. List price: \$30. Sherborn Software Systems, 226 Western Ave., Sherborn, MA 01770, 617/655-6543.

Smart Cache

An intelligent disk emulator program that provides caches for two double-sided disk drives and an emulator for one double-sided disk in RAM. It requires 192K and one disk drive. The program allows users to store

data in RAM and automatically write it onto floppy disks concurrently with user processing. The program uses an adaptive rewrite algorithm to make disk writes well sequenced and less frequent. The amount of memory used by *Smart Cache* can vary in 1K increments from 100K to all available memory not being used by DOS. The program includes a display of storage status information. List price: \$59.95. EKC Inc., 6100 Shenandoah Ave., Los Angeles, CA 90056, 213/641-3390.

Applications Software

Business Management

ISO Plus

An employee stock option monitoring and reporting system designed to run on the IBM PC XT. It requires 128K and a 10M hard disk. The program tracks incentive stock options (ISOs) and nonqualified options and also provides stock plan information and employee data. *ISO Plus* computes earnings per share and income tax data including information on disqualifying dispositions. List price: \$2500. Santa Clara Software, Inc., P.O. Box 3711, Santa Clara, CA 95055, 408/969-3502.

Project Cost Management

Assists project managers in planning, scheduling, budgeting, and performance monitoring. It requires 64K and two disk drives. Originally developed for government and private sector consulting projects, *Project Cost Management Information System* has been redesigned to include construction and manufacturing projects. The program evaluates the cost implications of alternative labor mixes and

tracks cost plus fixed fee, unit rate, and lump sum contracts. It includes audit routines that compare time-sheet and direct expense data entries with project budgets. List price: \$895. Davis & Associates, Inc., 1655 Peachtree Rd. NE #1104, Atlanta, GA 30309, 404/875-0793.

Accounting and Inventory

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A complete general ledger system that allows users to record transactions into journals, post the journals to the general ledger, produce financial statements, and close the books for a period or a fiscal year. The program requires 64K, two disk drives, and a 132-column printer. *Client Manager* is designed to automate the paperwork functions of an accountant, a bookkeeper, or a small business. It maintains historical and budget data including after-the-fact payroll posting, fixed asset accounting, and bank account reconciliation. The program generates amortization schedules and includes a report writer for custom statement formats. List price: set by retailer. Systems Plus Inc., 1120 San Antonio Rd., Palo Alto, CA 94303, 800/222-7701, 800/222-7707 in California, TWX: 910-379-5060.

Communications

Intercom 100

A program that allows the IBM PC to emulate the Burroughs MT983/TD830 terminal. It requires 64K, one disk drive, and an RS-232C serial port. The menu-driven program simultaneously supports up to six addresses; four are used for concurrent operator dialogues or bidirectional

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Just Announced

file transfers, one is used for background printing, and one is saved for future upgrades. *Intercom 100* allows on-line disk file transfers at speeds of up to 9600 bps. A data communication line monitor mode lets users check the flow of all data characters, including keyboard input and escape and control codes. Two-wire direct interface is also provided. List price: \$99. Intercomputer Communications Corp., 3195 Linwood #2A, Cincinnati, OH 45208, 513/321-3199.

Micro Link II

A menu-driven program that communicates with information services, mainframe time-sharing computers, and other microcomputers. It requires 32K, one disk drive, and an RS-232C serial port. Data can be sent or received in text, object, or source code and captured to either disk or printer. Control characters, including linefeeds, can be stripped from received files, and block transfer is supported with the Xmodem protocol. *Micro Link II* allows up to 20 programmable strings to be saved for easier logon to mainframes and bulletin boards. The program allows users to view files while on line and requires no installation. List price: \$99. Digital Marketing Corporation, 2363 Boulevard Circle, Walnut Creek, CA 94595, 800/826-2222, 415/947-1000, Telex: 17-1852.

Micro-ezLNK

A program that links the IBM PC to *EasyLink*, Western Union's store-and-forward message service. It requires 64K and two disk drives. The program takes user messages on disk and automatically formats and addresses them in the style required for *EasyLink*. With the program, users can send telexes, TWXs, telegrams,

cablegrams, mailgrams, and infocom messages from the PC. *Micro-ezLNK* receives and stores electronic mail messages to disk so that the messages can be accessed by office personnel at any time. The program lets users access Western Union's FYI News Service and includes a user-built phone directory. *Micro-ezLNK*'s text editor provides full cursor movement and insert and delete functions. List price: \$150. Advanced Micro Techniques, 1291 E. Hillsdale Blvd. #209, Foster City, CA 94404, 415/349-9336.

VDTE 2

An emulation program that enables the IBM PC to operate as a Hewlett-Packard 26XX terminal. It requires 128K, one disk drive, and an RS-232C serial port. The program emulates the HP2624B, the HP2648A, and the DEC VT52 and supports the HP2624 block/format mode for most HP3000 software. It provides file transfer, seven-page scrolling, and eight programmable soft keys. Other features include cursor control arrow and scrolling keys, full printer functions, transfer speeds of up to 9600 bps, and some HP2648 vector graphics plotting functions. List price: \$200. Inner Loop Software, P.O. Box 45857, Los Angeles, CA 90045, 213/645-5162.

Financial

Business Planning Tool

A line-oriented budgeting and forecasting program that requires 128K and one disk drive. An account is defined by positioning the cursor at a desired location and typing the name. An account type is then selected and numeric data entered. An account must fall within one of the major categories of income, expenses, assets,

or liabilities. *Business Planning Tool* includes a 12-month field of display. Once a start date is set, income statements and balance sheets are automatically updated according to assumptions within each account description. *Business Planning Tool* provides horizontal bar graphs of all data or any components of an account, such as constants, interrelations, and seasonal variations. Arrow keys are used to shrink or extend a bar and thereby edit data in an account. *Business Planning Tool* generates reports and *VisiCalc*, *Multiplan*, or 1-2-3 templates complete with formulas describing the assumptions entered in each calculation. List price: \$195. Sofstar, Inc., 13935 U.S. Highway #1, Juno Beach, FL 33408, 305/627-5511.

Spreadsheets

Link Module

A program that loads data files into a *MicroPlan* spreadsheet from time-sharing services, mainframe files, and applications packages such as accounts receivable or data management software. It requires 64K, two disk drives, and *MicroPlan*. *Link Module* includes posting and cross-tabulation commands that allow data to be posted to individual or multiple rows or columns. In addition to reading files from other applications, *Link Module* also allows *MicroPlan* tables to be read by applications such as data management and word processing packages. *Link Module* allows *MicroPlan* to read DIF files. List price: \$295. Chang Labs, 5300 Stevens Creek Blvd. #200, San Jose, CA 95129, 408/246-8020, Telex: 334-431.

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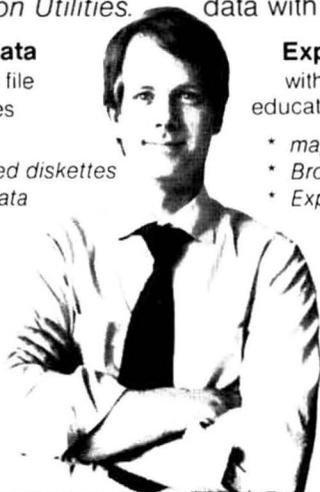
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VisiCalc IV

A program that combines *VisiCalc* and *StretchCalc* on one disk. *VisiCalc IV* provides integrated sorting and graphics and includes user-programmable function keys and keyboard macros. It requires 192K and two disk drives. The program's key-saver command allows users to recall the last 80 characters entered and define them as a macro. Users have no limit on the number of macros. *VisiCalc IV* allows rows and columns on a spreadsheet to be sorted permanently or temporarily. The program includes a data management system that allows users to sort spreadsheet data and treat a spreadsheet row as a record. List price: \$250. VisiCorp, 2895 Zanker Rd., San Jose, CA 95134, 408/946-9000.

Personal Management

Dollars & Sense

A personal finance management program that helps people who don't have accounting backgrounds keep track of expenses, balance check-books, and plan and follow budgets. It requires 64K and one disk drive. A printer is optional. *Dollars & Sense*

handles up to 12 accounts in five categories: assets, liabilities, expenses, income, and checking. The program displays financial information in color charts and graphs and can print hard copies. List price: \$165. Tronix Publishing, Inc., 8295 S. La Cienega Blvd., Inglewood, CA 90301, 213/215-0529.

Word Processing

Leading Edge Word Processor

A program for writers that allows them to view and edit in split-screen mode and makes use of the PC function keys. The word processor requires 128K and two disk drives. The program permits users to move the cursor by character, word, line, sentence, screen, page, or document. Other features include global search and replace, an undo function, capitalization/uncapitalization, special place markers, column centering, automatic letter transposition, and decimal and dot leader tabs. The program's print features include boldface, double-wide, double-high, strike-through, superscript, subscript, underline, double-underline, font selection, color selection, justification, semijustification, and print spooling. List price: \$300. Leading Edge Products, Inc., Fortune 1300 Division, 21 Highland Circle, Needham Heights, MA 02194, 800/343-3436, 617/449-6762.

Accessories

Omni-Lock

A shelf system for the IBM PC that lets users secure the keyboard, the disk drives, and the monitor with a single lock on the shelf spindle. *Omni-Lock's* shelves swivel 360 degrees to allow access to internal cards, components, and disk drives. Components can be repositioned for convenience. List price: \$339 to \$419. Micro-Metrics, Inc., P.O. Box 1812, 908 S. Claremont St., San Mateo, CA 94401, 415/342-8466. ☎

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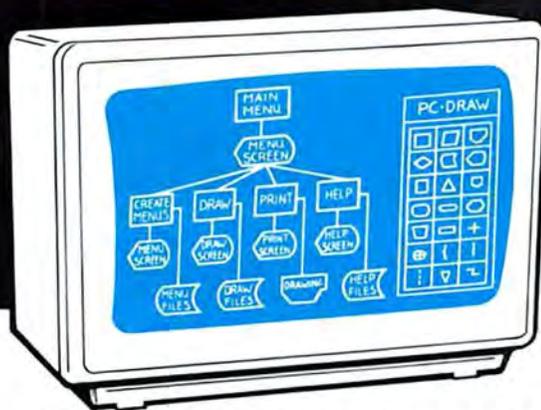
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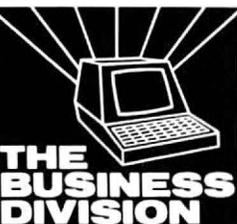
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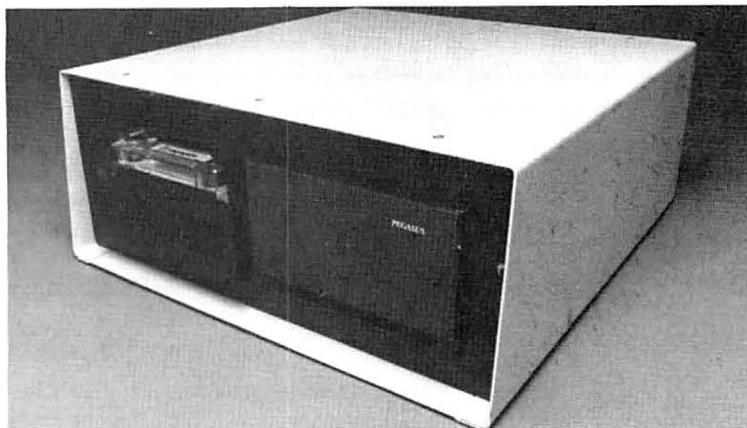
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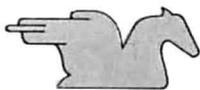
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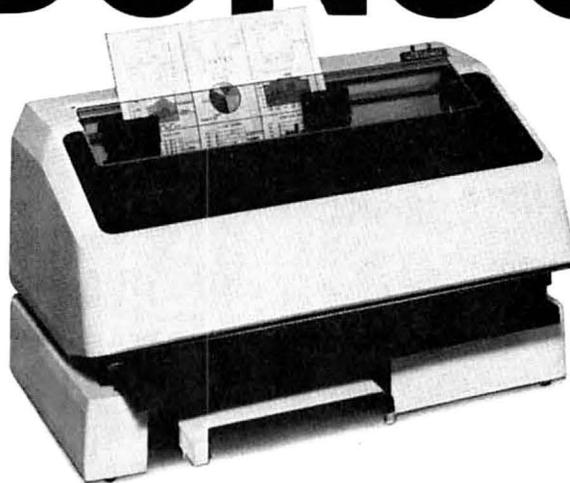
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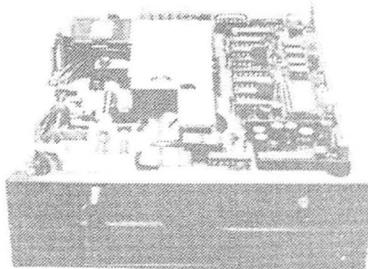
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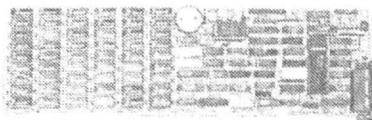
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About Our Gatefold

The image inside the gatefold cover was created by artist Mike Sullivan using an IBM PC, the Plantronics COLORPLUS card, and the *Color-Magic* graphics processor. Mike is graphics director at International Software Marketing Limited, the creators of *ColorMagic*, and for the past four months, the development site for *PC World's* back gatefolds.

Mike is clearly becoming more comfortable with the Plantronics medium. "I've cut down a lot on my work time—I finished Santa in a day. Now I really fly across the keyboard, whereas before I had to take it a step at a time. It's great being able to change modes on the fly; instead of going back to the menu each time I want to change a drawing option, I hit one key and continue drawing."

The Plantronics gatefold is a regular feature of *PC World*. Each month we ask an artist, an architect, or a designer to experiment with the 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.

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