PC WORLD

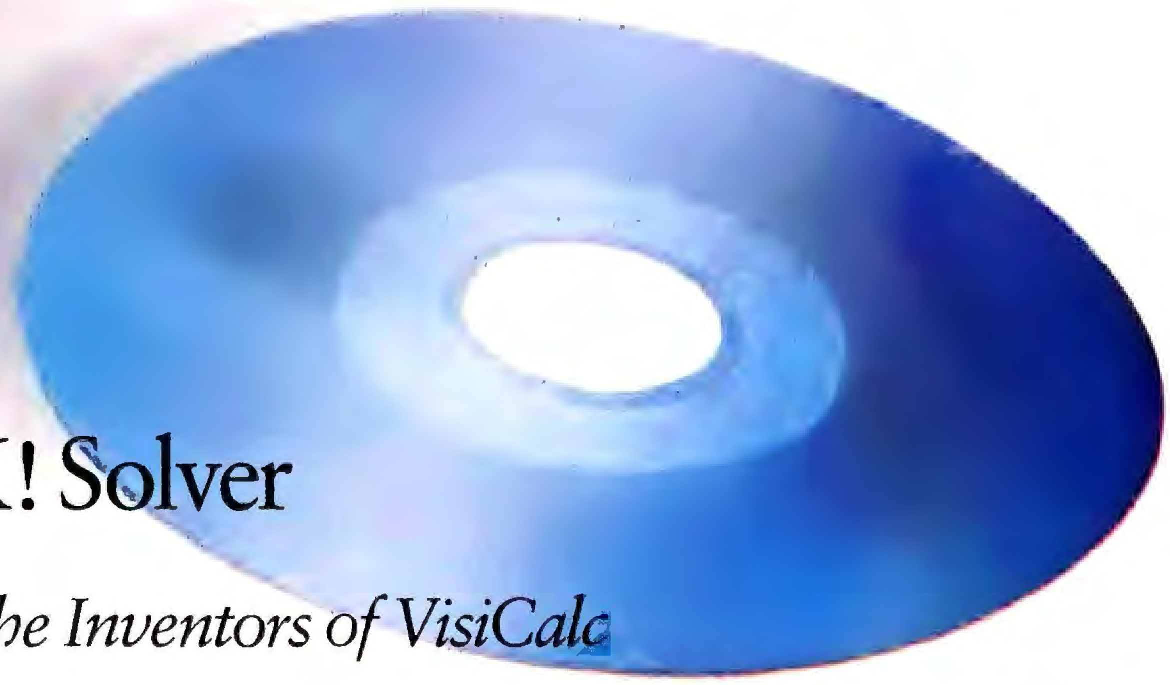
Volume 1, Number 4

The Personal Computer Magazine for IBM PCs and Compatibles

New WordStar 3.3

Faster than a Spinning Floppy

RAM Disk Software for the IBM PC



Exploring TK! Solver

New from the Inventors of VisiCalc

Writing Better BASIC
Teaching Your PC to Speak Mainframe
Tracking Bulls and Bears with Your Spreadsheet
Do You Want Your PC to Do Four Things at Once?
The Future of Concurrency and CP/M

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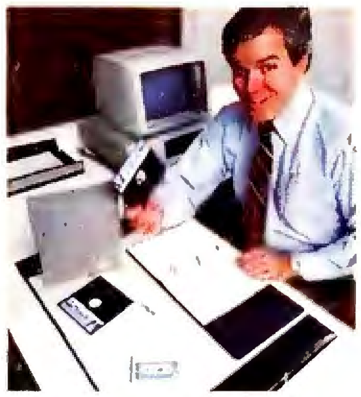

All of a sudden, there are forty new ways to help run your business with an IBM PC.

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The new COMPAQ Portable Computer. IBM compatibility to go.

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

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

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

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

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

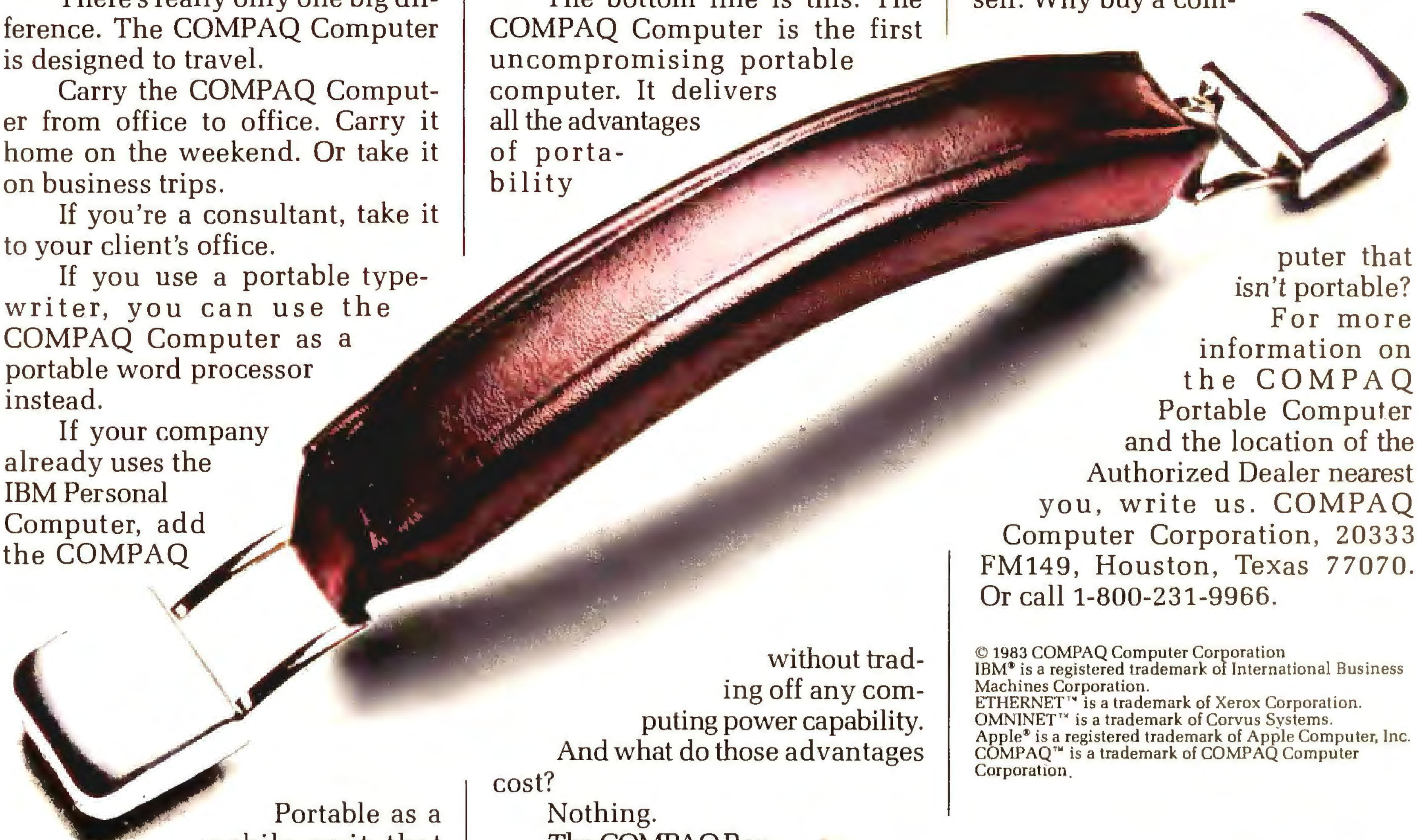
If you use a portable typewriter, you can use the COMPAQ Computer as a portable word processor instead.

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

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

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

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



And what do those advantages cost?

Nothing.

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

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

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

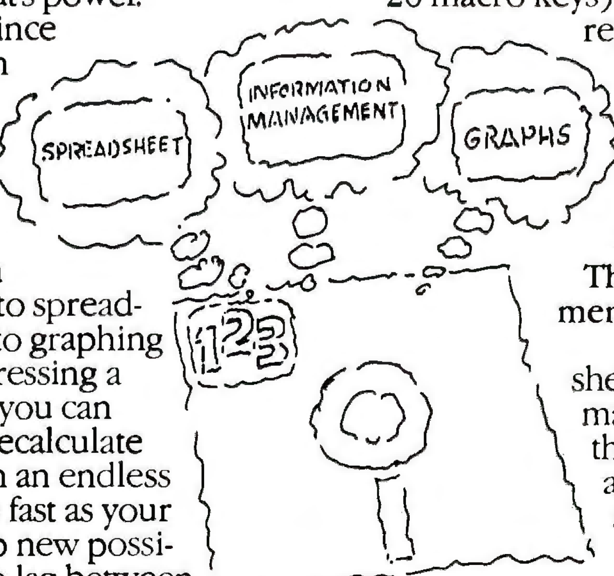
For more information on the COMPAQ Portable Computer and the location of the Authorized Dealer nearest you, write us. COMPAQ Computer Corporation, 20333 FM149, Houston, Texas 77070. Or call 1-800-231-9966.

COMPAQ™
PORTABLE COMPUTER
The most computer you can carry

INTRODUCING 1-2-3™. IT'LL HAVE YOUR IBM/PC JUMPING THROUGH HOOPS.

Meet 1-2-3 – the remarkable new software package that puts more raw power at your finger tips than anything yet created for the IBM PC. 1-2-3 actually combines information management, spreadsheet, and graphing in one program that can perform all three functions interchangeably and instantly at the touch of a key. That's power.

To explain: since 1-2-3's information management, spreadsheet and graphing functions reside in memory simultaneously, you can go from retrieval to spreadsheet calculation to graphing instantly, just by pressing a few keys. So now you can experiment and recalculate and look at data in an endless variety of ways. As fast as your mind can think up new possibilities. There's no lag between you and the computer. And that's a new kind of power – power that's greater than the sum of its programs.



Spreadsheet, graphing, information management all-in-one.

The spreadsheet function.

If 1-2-3 were just a spreadsheet, you'd want it because it has the largest workspace on the market (2048 rows by 256 columns). To give you a quick idea of 1-2-3's spreadsheet capabilities: VisiCalc's spreadsheet for the IBM PC offers 15 arithmetic, logical and relational operators, 28 functions and 32 spreadsheet-related commands. 1-2-3 has 15 operators, 41 functions and 66 commands. And if you include data base and graphing commands, it actually has 110!

In addition, 1-2-3 is up to 50 times as fast as established spreadsheets. With all the features you've ever seen on spreadsheets. 1-2-3 also gives you the capability to develop customized applications (with 26 macro keys) and lets you perform repetitive tasks automatically with one keystroke. If 1-2-3 were just a spreadsheet, it would be a very powerful tool. But it's much, much more.

The information management function.

Add to 1-2-3's spreadsheet a selective information management function, and the power curve rises at an awesome rate. Particularly since 1-2-3's information management capability reads files from other programs such as WordStar, VisiCalc and dBase II. So you can accumulate information on a limitless variety of topics and extract all or pieces of it for instant spreadsheet analysis. Unheard of before. Specific 1-2-3 information management features include sorting with primary and secondary keys. Retrieval using up to 32 criteria. 1-2-3 performs statistical functions such as mean, count, standard deviation and variance. It can produce histograms on part or all of the data base. 1-2-3 also allows for the maintenance of multiple data bases and multiple criteria.

The graphing function.

1-2-3 enables you to create graphs of up to six variables using information already on the spreadsheet. And have it on screen in less than two seconds! Once you've made a graph, three keystrokes will display it in a different form. If data on the spreadsheet changes, you can display a revised graph with one keystroke. This instant relationship of one format to another opens up a whole new application area. For the first time graphics can be used as a "what if" thinking tool!

For a full demonstration of 1-2-3's remarkable power, visit your nearby 1-2-3 dealer. For his name and address, call 1-800-343-5414 (in Mass. call 617-492-7171).

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1-2-3™

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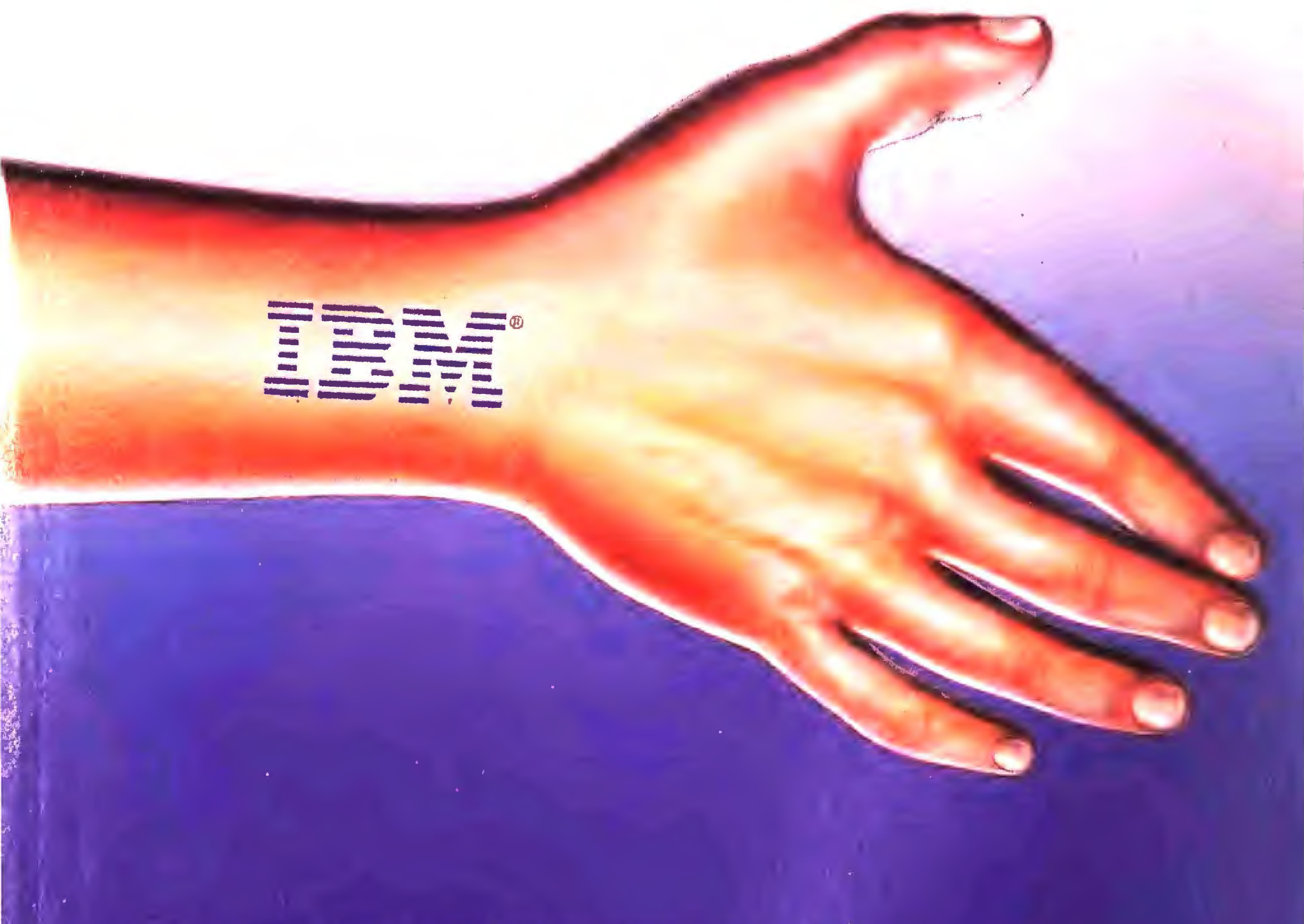
Use Apple software in your IBM PC and XT
Who said you can't mix Apples and IBMs? Innovation by Quadram makes it possible with Quadlink™. A simulated Apple computer on a revolutionary new enhancement board.

Most programs designed for the Apple II, II Plus or IIe -- including educational software and entertainment options -- are now compatible with IBM PC's sophisticated business capabilities. That's right. An Apple and an IBM. In one computer with no software limitations. Quadlink by Quadram opens a whole new world of possibilities.

Easy to use
Quadlink plugs inside IBM PCs. No conversion or reformatting of diskettes needed. Just load Apple software in the IBM and key one command. That puts you in the Apple mode. When ready to switch back, just press a different key. It's that simple. Like having an Apple 64K computer inside your IBM.

Keep the extras
Quadlink allows use of all IBM enhancements while running Apple software. Printers, buffers, monitors and more.



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When using a monitor there's no plugging or unplugging cables. Apple programs will appear on an IBM monochrome or color monitor, like Quadram's vivid RGB color monitor Quadchrome, more clearly than Apple's own screen -- even while working with Apple's high resolution color graphics.

Explore your options
Quadlink comes standard with 64K memory. Requiring only one expansion slot, it offers a parallel port designed to operate most printers and parallel devices. A serial port for connecting modems, printers and other serial accessories. And a game port for a variety of entertainment options. There's nothing like Quadlink. And nothing like reliable Quadram Quality to stand behind it.

Quadram Corporation is a division of Intelligent Systems, for over a decade an innovator in personal computer enhancements and color graphics peripherals.

Quadram products are available only through authorized dealers worldwide. Visit one and ask for a demonstration of Quadlink. Check on our other enhancements too, especially Quadboard, the original multifunction board for the IBM PC.

Priced at only $680, we think you'll like what we've discovered.

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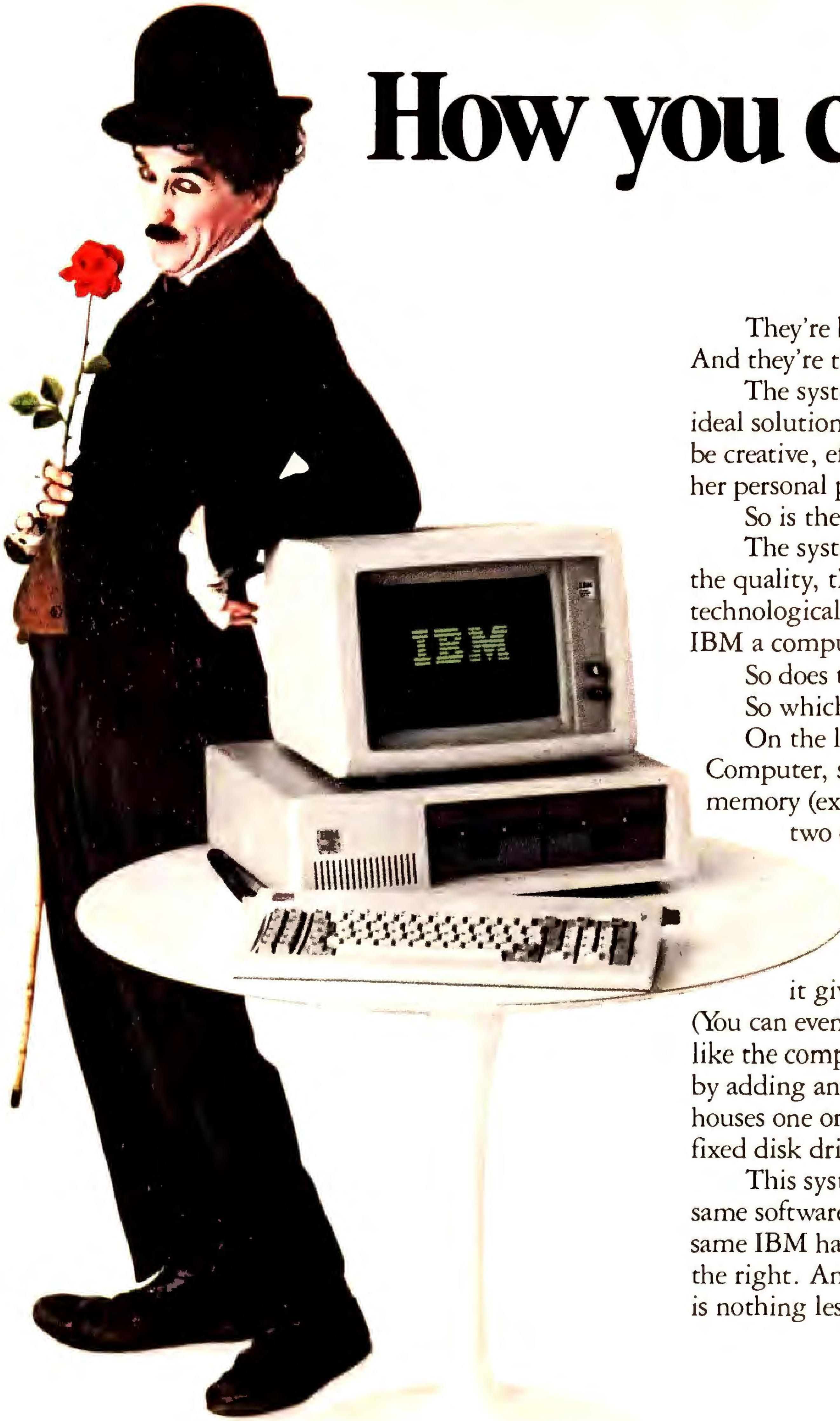
How you can tell



They're both IBM Personal Computer
And they're the same. Only different.

The system that's on the left is the ideal solution for a person who wants to be creative, efficient and improve his or her personal productivity.

So is the other one.

The system on the left incorporates the quality, the reliability and the technological excellence that have made IBM a computer leader for over 30 years.

So does the other one.

So which is which? Simple.

On the left is the IBM Personal Computer, starting with 64KB of user memory (expandable to 640KB) and two optional 5¼″ diskette drives. It can easily satisfy your computing needs at the office, at home or in school With 5 expansion slots, it gives you room to grow. (You can even make it function like the computer shown on the right by adding an expansion unit that houses one or two 10-million-character fixed disk drives.)

This system can run most of the same software and accept most of the same IBM hardware as the computer on the right. And its price/performance is nothing less than remarkable.

The IBM Personal Computer

which is which.

On the right is the IBM Personal Computer XT, starting with 128KB of user memory (expandable to 640KB), a 5¼" 360KB diskette drive *plus* a standard 10-million-character fixed disk drive that's *already* built in.

For a businessperson with heavyweight data requirements, the XT packs a lot of power, because it can store the facts, figures, names and numbers you need to know.

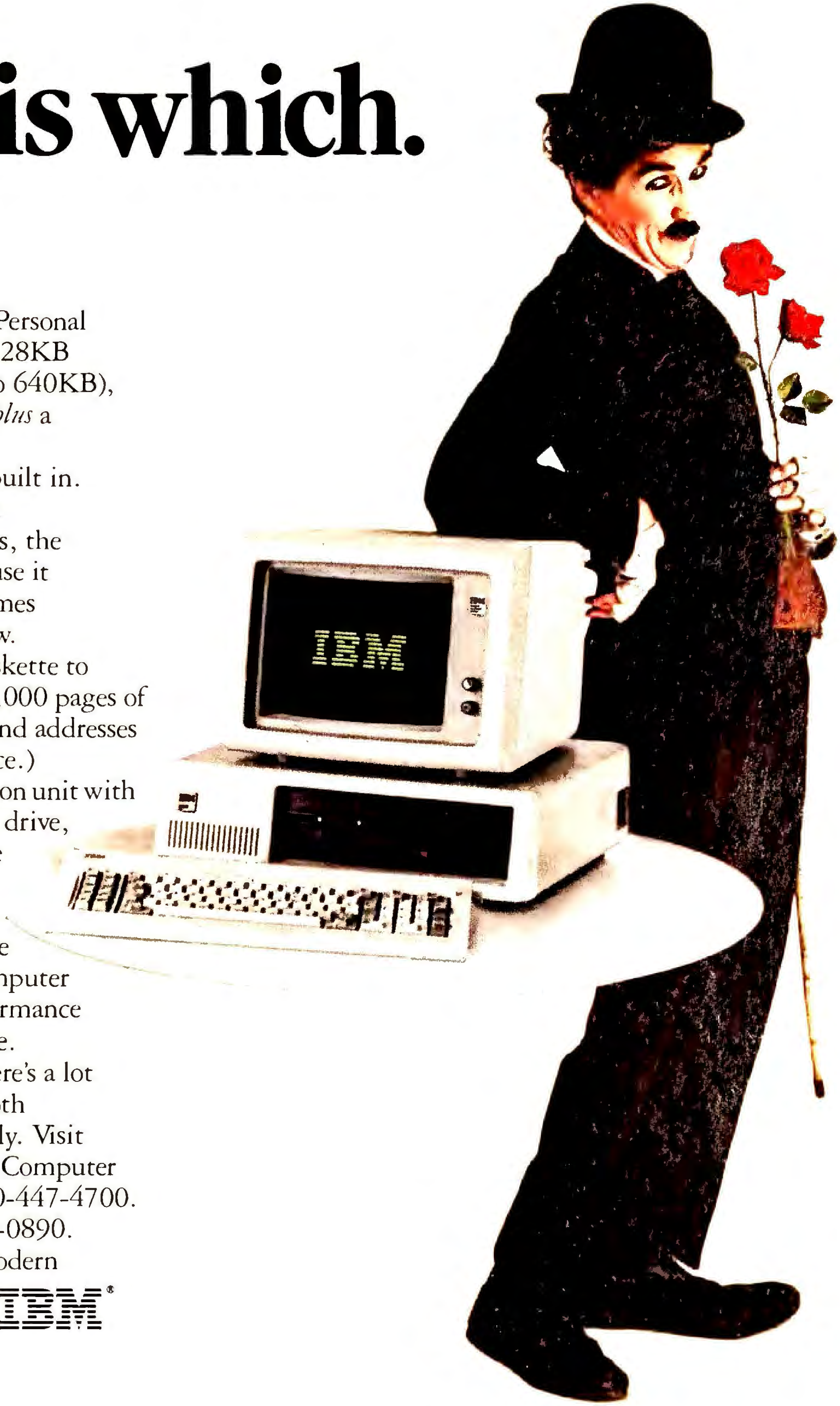
(Instead of going from diskette to diskette, you can have up to 5,000 pages of text or up to 100,000 names and addresses conveniently stored in one place.)

And by adding an expansion unit with a *second* 10-megabyte fixed disk drive, you get even more high-volume capacity from the system.

XT can run most of the same software and accept most of the same IBM hardware as the computer on the left. And its price/performance is nothing less than remarkable.

But for you to choose, there's a lot left (or right) to learn about both members of this growing family. Visit your authorized IBM Personal Computer dealer. To learn where, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.

And see which tool for modern times is right (or left) for you.



The IBM Personal Computer XT

PC WORLD

The Personal Computer Magazine
For IBM PCs and Compatibles

State of the Art

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.

Review

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Printed May 1983

Volume 1, Number 4

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PC World™ (ISSN applied for) is published monthly for $24 one year, $39 for two years, $53 for three years. Additional postage for subscriptions outside the US and Canada $48 per year surface, $101 per year airmail, by PC World Communications, Inc., 555 De Haro St., San Francisco, CA 94107. Second-Class Postage is pending at San Francisco and at additional mailing offices. POSTMASTER: Send address changes to PC World, Subscription Dept., P.O. Box 6700, Bergenfield, NJ 07621.

Editorial and Business Offices: 555 De Haro St., San Francisco, CA 94107, 415/861-3861

CompuServe 74055,412
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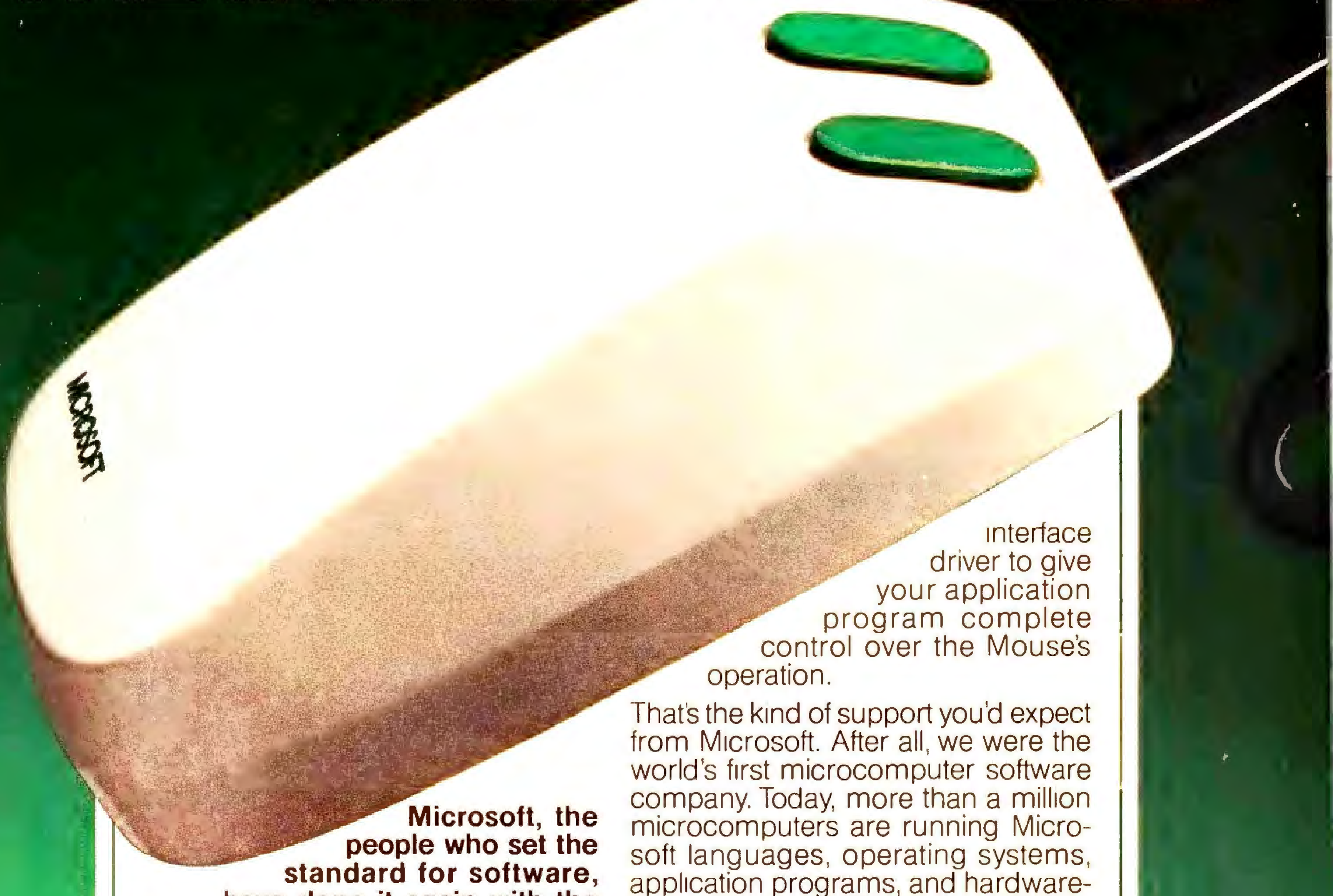
Printed in the United States of America

THE NEW STANDARD. THE MICROSOFT MOUSE.



interface driver to give your application program complete control over the Mouse's operation.

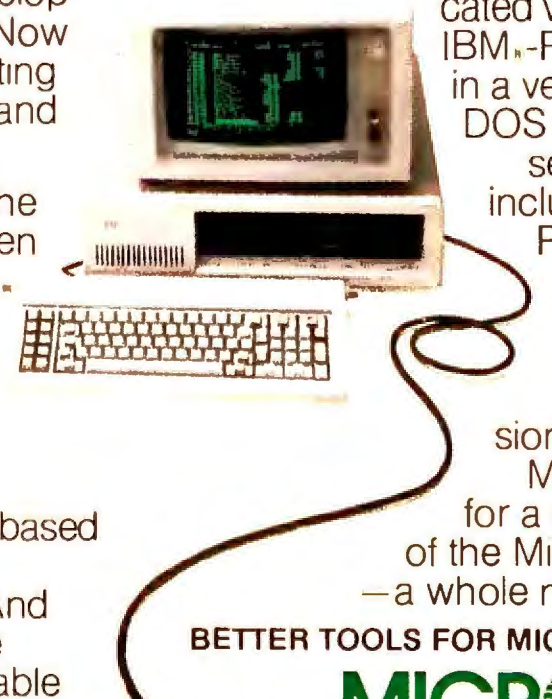
That's the kind of support you'd expect from Microsoft. After all, we were the world's first microcomputer software company. Today, more than a million microcomputers are running Microsoft languages, operating systems, application programs, and hardware-software combinations.

Microsoft, the people who set the standard for software, have done it again with the Microsoft® Mouse.

Our expertise in both hardware and software has gone into the development of the Microsoft Mouse. Now you can plug in the most exciting computer product of the year and put it to work.

The Mouse lets you move the cursor freely and naturally, then execute commands at the push of a button.

The Microsoft Mouse is a complete system. It comes with an on-screen tutorial, a practice application, and the Multi-Tool™ Notepad, a mouse-based text editor, so you can begin using the Mouse right away. And for application developers, the Mouse includes a programmable



You can get the Microsoft Mouse in dedicated versions for the IBM®-PC, PC XT, and in a version for MS™-DOS machines with serial interfaces, including the IBM-PC. The Mouse supports all versions of MS-DOS, including version 2.0. Ask your Microsoft dealer for a demonstration of the Microsoft Mouse —a whole new standard.

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David Bunnell

Taking Know for an Answer

Sasha Besher, a talented copywriter, created a clever subscription ad for us recently with the headline "Take Know for an Answer." Sasha's copy tells you that to successfully conquer the baffling challenge of using your PC to its maximum capability, you need to understand a great deal of PC-related information. It then recommends a vital reference source, namely *PC World*, and suggests not too subtly that you subscribe as soon as possible.

I mention this because, biased though I naturally am, I think Sasha's concept brings up an important point. I recently saw an advertisement in which another computer publication claims that its language is "nontechnical." "Read this magazine and you will learn how to use computers without having to know or learn computerese" seemed to be its promise.

It strikes me that for the foreseeable future, even with the advent of more user-friendly environments such as Lisa or *Visi/ON*, some level of computer literacy will be required to use a personal computer effectively.

Whether a computer publication is technical, nontechnical, or both is not the most relevant question. More

important is its level of literacy, its scope and timeliness, and the form in which its content is presented.

If the Japanese want to penetrate the American PC market, they should hire thousands of English majors from our finest universities to write their documentation and instruction manuals. Judging from the instructions that come with some of their products, the so-called invasion of Japanese personal computers lies in the distant future.

The above McLuhan-inspired philosophy applies to all information delivery systems, not just magazines. When you think about it, there is an abundance of media for PC-related information, including seminars, TV and radio, books, computer camps, and self-teaching tutorials on videocassette, audio cassette, or diskette. We are in an age of abundant choices—you can eat your computer spinach any way you like it.

One of the best ways I know of to get an intensive dose of computer literacy is to go to a computer show. There you can see the latest products, try out programs, listen to speakers, and talk face to face with manufacturers, dealers, and real or self-proclaimed computer experts. The West Coast Computer Faire is an excellent example (see "Let Me Take You to the Faire").

PCs have an amazing capacity to increase the productivity of almost anyone who uses them. The biggest challenge in personal computing today is educating new users and doing it quickly. The headlong rush to get millions of hands on the keyboard has just begun, and for the moment at least accomplishing PC proficiency without learning computerese is like trying to be a doctor without understanding medical terminology.

One way we at *PC World* hope to play a significant role in this educational process is by caring as much about the string of plain language between the jargon as explaining the jargon itself.

David Bunnell

The structure of *PC World* is as crucial to its success as its literacy. The mix of information, including tutorials, product announcements, software reviews, user profiles, and even placement of advertisements must be determined and organized.

> The biggest challenge in personal computing today is educating new users and doing it quickly.

Publishing so much useful information without giving it some form of logical structure makes reader access difficult if not impossible.

Learning about computers can teach us a lot about organization. The UNIX operating system, which we reported on extensively in issue 3, has a nifty program library that includes root directories, subdirectories, and plain old directories and files. In reading about these information units and the pathways between them, I gained insights into how we think.

It works both ways, of course; the better you understand basic thought processes, the more able you are to write programs. As has often been said, the toughest part of programming is understanding the problem. Could you teach a computer how to design a house if you didn't know how to design one yourself?

Learning to use these beasts should become easier as computers become increasingly people literate, and as people become more computer literate. However, the gap between people and computers remains vast indeed for the moment.

The Standards Game

Some 800 computers are on the market today offered by as many companies, and new ones are popping up daily. Many of the computers produced by these companies run under different or variant operating systems, different storage media and recording formats, different bus structures, and different communications protocols, often without any technical basis for the differences.

Computer manufacturers have stacked the standards deck and each user is a potential mark. It's time to even up the odds.

Rules of the Game

The object of the "standards game" depends upon whether you're playing as a manufacturer or a user. As a manufacturer, you maintain an aloof pose and regard standards as if they carried the plague. Standards are acceptable only when they are defined by and embodied in one of your products, in which case other manufacturers are penalized.

As a user, however, it is considered good form to covet standards and do everything humanly possible to support and encourage them. In fact, users have been known to cheer wildly when a new standard is defined.

While the strategy of the standards game can be both complex and subtle, the basis for the polarization between manufacturer and user is straightforward and easily understood. For manufacturers, learning about standards and incorporating them in the design of new products usually costs more than not conforming at all. Furthermore, system designers claim that standards can be an unreasonable design constraint while the marketing department insists on a product that can be distinguished from the competition.

The enormous value of standards to users is equally clear. With standards, users can get on with the business of computing without having to become technicians to realize the benefits of the computer.

Although one approach may take longer than another, standards are usually achieved in one of three ways: standards by committee, de facto, or by what has been referred to as the Lone Ranger approach. The standards-by-committee approach is practiced by various accredited and governmental organizations including the American National Standards Institute (ANSI), the National Bureau of Standards (NBS), and the International Standards Organization (ISO). Since proposed standards of this type are circulated for review and commented upon and shaped by literally thousands of people, defining a standard by committee is often a process in which progress is measured in years. When all the thrashing is over, however, a concensus of expert opinion is reached about how to perform a given technological function. An example of this type of standard is the IEEE 696 (S-100) bus.

The de facto standard is achieved when a person or company invents a way of performing a function and that process is imitated throughout an industry. De facto standards are similar to standards by committee in that industrywide emulation of a product implies a degree of concensus. The CP/M-80 operating system is a good example of a de facto standard.

REMark

The Lone Ranger approach to standards is a rare form that results when a person or organization leaves the conventions of the mainstream marketplace behind and develops a way to perform some function. Once completed, the developer returns to the mainstream and presents the accomplishment as a *fait accompli*, often directly to the standards committees. This approach seldom works unless the perpetrator has considerable political or financial clout (both are recommended). A classic example of the Lone Ranger approach is the North American Presentation Level Protocol Standard for videotex and teletext.

Playing Strategies

If you're playing the standards game as a computer manufacturer several strategic alternatives are available. First and most obviously, you can continue business as usual and do nothing to incorporate standards into your products. If you pursue this strategy, be advised that you will probably become a statistic in the first industry shakeout.

Another approach pursued by certain companies involves investing in a liberal marketing budget with the expectation that a significant market share can be captured so that your nonstandard product/design becomes a de facto standard.

A third tactic is simply to get there first. Develop a new, significantly improved way to perform a function and you will more than likely garner a significant market share, all other things being equal.

If you're playing as a computer user, you have only a single strategy and a handful of tactics available. You must use and promote existing standards in your present work, providing an economic incentive to manufacturers by favoring industry-standard products. Computer professionals, hobbyists, and general users alike can participate by joining user groups and professional organizations that contribute to the standards-making process.

Winning

Whether you play the standards game as a computer user or manufacturer, you must retain a sense of perspective. Standards are not defined so that they are enforced at the expense of innovation. Such an approach produces a lose-lose situation for users and manufacturers alike. Users must encourage manufacturers to adhere to existing standards and avoid self-indulgent variations on standards when the only objective is to produce a nonstandard, noncompatible, proprietary product.

> Computer manufacturers have stacked the standards deck and each user is a potential mark.

Because standards don't usually win general acceptance overnight, it can be difficult to tell when the standards game is over. But don't worry. When there is a relative balance between innovation and a clearly defined degree of standardization, you'll know the game is over.

Edward Rodgers is a staff consultant on information systems at a Fortune 100 corporation. He specializes in office systems and personal computers.

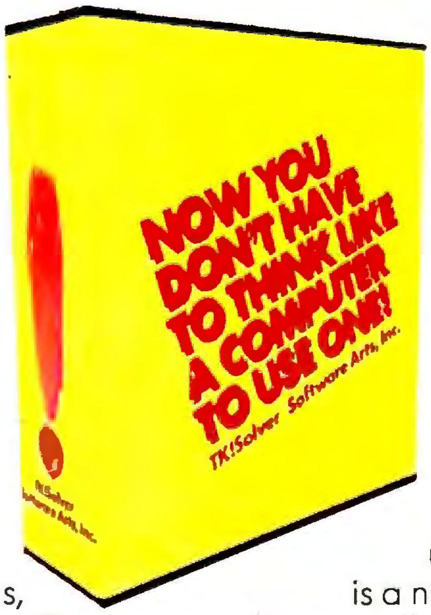
CRUNCH!

The inventor of VisiCalc,® the world's leading software product, introduces TK!Solver™—the revolutionary way to crunch problems on a personal computer.

With VisiCalc, Software Arts™ created an entirely new application for personal computers—the electronic spreadsheet.

Now Software Arts has developed TK!Solver, another entirely new and different application for personal computers—the problem solver. Business and financial problems. Scientific and engineering problems. Architectural and building design problems. Any kind of problem you can dream up, in any area.

What's so revolutionary about that? Simply this: the power of the TK!Solver program comes from the ease with which you can set up problems, vary assumptions, find solutions, and display results. All the facilities needed to solve the problems—simple or complex—are built-in, and need not be developed. Once you have stated your problem, simply enter the known values, then solve the problem with a single keystroke.



For even easier problem solving use a TK!SolverPack™ in which models for solving common problems in such areas as finance, engineering and education have already been formulated by professionals in these fields.

There is no software product in existence that solves problems as quickly, flexibly, and easily as TK!Solver—The Problem Cruncher™. In fact, no other software product even works the way TK!Solver does. It is a necessity for personal computer owners. See for yourself. Visit your nearest computer store for a demonstration and find out how much you can do with a personal computer when it thinks as flexibly as you do.

Software Arts™

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IBM
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BUSINESS GRAPHICS

Letters

Microsoft Myopia

I want first to congratulate you on your new publication, which has a very pleasant design and seems to have found a comfortable style from its very beginning.

The interview with the Microsoft people was very interesting, but one sentence made me wonder whether the computer industry is hopelessly myopic. The Microsoft people state; "With MS-DOS, from its inception we allowed 30 bits of length in the file field and that's two to the thirtieth. We can't imagine what sort of devices could have that capacity."

Well, the people at Microsoft must be very short on imagination, since such devices are already in many mainframe installations around the country. Several vendors sell disk systems, such as the IBM 3380, with capacities above a gigabyte (that's two to the thirtieth). Optical disks are very likely to be used with microsystems and to have capacities above the Microsoft limit. An optical disk might be a special problem, too, because it might be used to distribute data bases. In that case the entire disk might very well be a single file.

I don't really want to criticize Microsoft on this point. Its use of 30 bits was reasonably liberal when they made the choice. Widespread use of such devices is still some time off, and entirely new operating systems may become prevalent in the interim. But I would like to suggest that they not boast without more careful consideration.

Scott E. Preece
Urbana, Illinois

Folk's Flack

As a subscriber I must protest your publication of an introduction to *Visi/ON* ("VisiCorp's Windows on the World," Vol. 1, No. 2) written by none other than VisiCorp's own Roy Folk.

This, with no evidence that anyone from *PC World* had seen the product, and following David Bunnell's self-righteous condemnation of Apple's refusal to provide a Lisa to *PC World* for a "completely fair and unbiased" test!

I hope that this outrageous piece of flackery, whether meant as such or not, will not prove to be typical of your editorial judgment.

Bruce Dodds
Middlefield, Connecticut

The articles in "State of the Art" describe the latest technology for the benefit of our readers, often covering products that are so new that the PC World *staff cannot research them. These articles are not intended as reviews.*

In the case of the Visi/ON *article, both Publisher David Bunnell and Technical Editor Steven Cook tried the product and felt that it would be of interest to our readers. We invited Roy Folk, who was in a position to provide the most accurate description in the shortest time, to prepare a draft, which was then edited by Steven Cook. Folk's connection with VisiCorp was clearly stated in the introduction to the article. We think our readers got a good deal, and we plan to do other such articles in the future—Ed.*

Column Comment

A comment on David Bunnell's column in Vol. 1, No. 2, about VisiCorp's *Visi/ON* vs. Apple's Lisa. First, I saw Lisa at a show last weekend and was suitably impressed. Secondly, regarding your inability to get a prerelease look at Lisa, it sounds funny when Bunnell says, "(We) thought Apple would jump at the chance to have Lisa featured in a leading personal computer magazine." On your cover you bill *PC World* as "The Personal Computer Magazine for IBM PCs..." With all due respect, since when does the president of General Motors send a GM car to Ford's president for constructive comments?

Richard K. Thompson
Fairfield, Iowa

Our magazine is completely independent from IBM, so your General Motors-Ford analogy does not hold. We focus on PCs, but we are interested in personal computers of all stripes. Personally, I think Lisa is a fascinating machine and I'd love to get my hands on one. During the past several years I have had the opportunity to become familiar with many personal computers, including the Altair, Sol, Radio Shack TRS-80, Commodore Pet, Apple II, Compucolor II, and Osborne, as well as the IBM PC.— David Bunnell

Counterpoint

In "Color Discrimination" (*REMark*, Vol. 1, No. 2) Lawrence J. Magid made a point. I should like to make a counterpoint.

It is very common for users to want the best of all worlds at an affordable price, but it is very rare to see such demands satisfied. In this case, I happen to be on the opposite side of the fence from Mr. Magid—I'd use a high-quality text monitor only if it could display several colors and graphics. Therefore, I am using a color monitor which does not provide characters that are as good looking as those seen on the IBM

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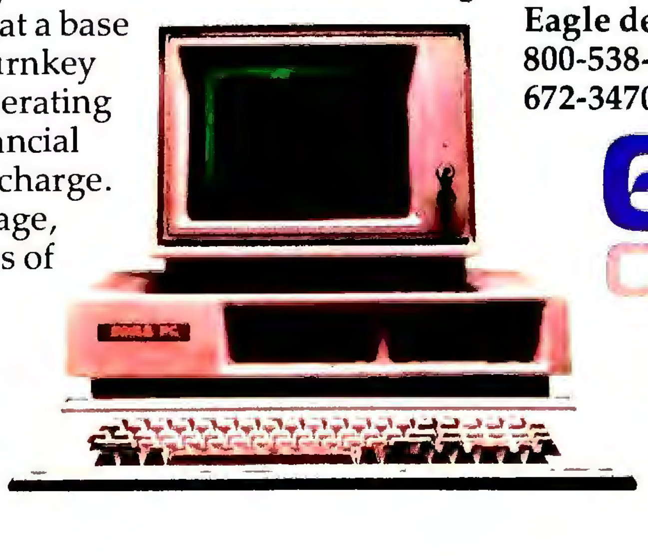

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Monochrome Display. Notice I said "good looking," not "legible." I believe that these 8 by 8 pixel characters are fully as legible as the 9 by 14 characters Mr. Magid prefers, but I readily concede that they are not as pretty.

Mr. Magid and I differ on two other points. First, the IBM Monochrome Display is not a standard, but a single product. Second, IBM did not make a mistake by producing two display adapters but supporting graphics on only one. The monochrome display and adapter use several design tricks to provide sharp characters at a very low cost. It is not directly compatible with other displays on the market because producing the same quality on a standard monitor would cost a lot more and would be incompatible with TVs or TV-like monitors.

The computer graphics marketplace is clearly and irreversibly committed to color-raster as the dominant technology. Capabilities are improving rapidly while costs simultaneously decline. Therefore, IBM chose, quite correctly, to rely on "standard" displays for graphics, not the unique IBM Monochrome Display. Transforming support from 640 by 200 to 640 by 400 is a trivial matter, with little effect on applications programs, but it would double the display resolution. The programming change required to support a 720 by 350 format would be more difficult; however, the even more severe problem would be to continue from there. The design tricks used in the monochrome adapter were really engineering decisions—compromises, in fact. Changing the capabilities and costs of display components realigns the collection of facts on which these decisions were based, probably rendering them invalid.

For what it's worth, one might thumb through issue 2 of *PC World* counting the screen photos that show the monochrome monitor and those that show a monitor driven by the color graphics adapter. My count found 60 color photos, versus 38 monochrome.

David F. McManigal
Stormville, New York

Our count was 65 to 25, but this probably reflects the fact that color screens make flashier ads, rather than the actual display preferences of PC users.—Ed.

Mixed Review

Your new publication is commendable but merits mixed reviews at this stage. For example, in Vol. 1, No. 2, Emil Flock's "WordStar Made to Order" sets forth precisely the type of information many readers need (this letter is written with *WordStar*). The author obviously knows his material and presents it well.

But other articles in the same issue show a curious lack of editorial review. In "Travels with COMPAQ," the author devotes a substantial percentage of his product review to his personal customizing of the machine and on how to carry it on board airplanes. Why not more info on the machine itself?

"Snake in the Glass," a short but rather sophisticated program written in IBM BASIC, was not line renumbered. And the statement in Charles Kelly's "Digital Dialects" that IBM BASIC suffers from "glaring deficiencies such as line lengths limited to 255 characters" borders on the bizarre. One of the outstanding features of IBM BASIC is its long line length. Has the author worked with other micros? Perhaps he would benefit from Emil Flock's article if his tastes run to commonly acknowledged poor programming practices such as unduly extended code lines.

Notwithstanding the above criticisms, please enter my subscription for 39 issues.

Robert L. Richardson
Woodbridge, Virginia

Fresh Air

I would like to thank you personally for the beautiful, professional job that you've done on your new magazine. It is by far the most useful and pleasant computer magazine I've ever read.

Congratulations for providing practical information in an entertaining manner to an audience ranging from nontechnical readers to seasoned computer professionals such as myself. Your topics are well chosen, and your articles reveal how simple everything really is at its essence. This is in sharp contrast with the old world mentality that insists that everything is so complex that only computer heavyweights can understand it.

Please keep up the excellent work. The professionalism and care you've shown are like a breath of fresh air.

Dennis Pasadis
Glen Ellen, California

Local Info

Your magazine supplies some of what I have been looking for. "How the PC Thinks" is the first basic explanation I have read that I can relate to. I have been working in the computer field for over 15 years (mainframes).

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Recently I attended a local 1-day seminar for business people about selecting small-business computers. The response far exceeded what the university expected. The instructors emphasized that the participants did not need to learn all about computers to buy and use them. I felt, though, that many of those business people left wanting help in selecting and setting up computers for their businesses. Computer store personnel aren't the best ones to help these people, as salesmen's interests are served in selling equipment. What business people need are support consultants who can communicate well with them in defining their needs and uses.

I began searching for thorough information about micros several months ago and found there is no place to get comprehensive information. Publishing runs behind development, and most publications are trying to serve two different markets. The first is the novice who wants simple explanations to allow him or her to use a machine without having to fully understand it. The other is someone interested in fully understanding the equipment, who wants detailed information on all parts of the machine and its potential.

A recent article in *InfoWorld*, "Surviving the Harrowing Hell of Buying a Micro," makes an excellent point about the industry— it is highly unorganized and very hard for beginners to deal with. The manufacturers and vendors are telling the public to buy without understanding, and then they don't deliver or can't service what they've sold. Business people don't have the time and money to learn the hard way. The industry needs people in the local area who know enough to bridge that knowledge gap.

With all the publications I'm reading I gain only a few bits and pieces each week. It will be months, maybe a year, before I have enough information. This is why in your first questionnaire I have indicated the need for more technical articles. The industry needs to get the technical information out for those, like myself, who will create that much-needed local support.

P.A. Smith
Portland, Maine

Looking for DR LOGO

I would appreciate any information you might have or be able to find about the possibility of getting the programming language LOGO for the IBM PC. As far as I know, it is now commercially available only for the Apple, TI, and TRS-80 computers.

As a teacher and an owner of an IBM PC, I am very much interested in being able to use this excellent, educational computer language. It seems as if LOGO is beginning to get some coverage in the magazines devoted to the PC, which makes it all the more frustrating since it cannot yet be run on it! Any source of information on this topic would be greatly appreciated.

Gregory A. Harvey
San Francisco, California

LOGO was one of our prime interests when we spoke with Digital Research this month (see "The Future of Concurrency" in this issue). When DR LOGO is available on the PC in July, we'll review it.—Ed.

Multi-Rumors

I have had *Multiplan* on order since late December through my local computer store and have been told that IBM is now distributing its own version, that they have discovered an error in the program and are working to correct it, and that no copies will be released to the public until the problem is resolved. Would you be kind enough to shed some light on the problem?

Your magazine provides useful information for my continuing education about microcomputers and the IBM PC. Best wishes to you and your staff for a successful publication.

James C. Poindexter
La Canada, California

Microsoft distributes its own version of Multiplan *that runs on MS-DOS and can be configured for the COMPAQ or the IBM PC. Microsoft has licensed IBM to release an IBM version with slightly improved editing and screen painting capabilities.*

IBM says it knows of no bugs in its version, but that it has been delayed filling orders because of the great demand for the product.—Ed.

Software Review

I am a computer professional, having first programmed the IBM 650 in 1955. The last few years I've been in data communications, but I am just now getting experience with micros.

I can't tell you how exciting your premier issue is. I read every page, cover to cover. The only article that had no direct bearing on some aspect of my life was "The 8088 Is My Copilot."

We got our PC in early January of this year. Having paid a dear sum for the hardware, we are finding out that you can go broke buying software. Consequently, we are being very careful and going slowly. Books are $15 to $20 apiece; software is usually $100 to $500 apiece. The only real bargain is *PC World* (we have a 3-year subscription).

Our next task is to get a word processor. We are borrowing *WordStar* to try it out. But there seems to be no way of comparing programs to test ease of use and functions vs. cost and need. You could supply a major need by putting out an annual or semiannual compendium of software for the PC by type, giving differences of features and costs so that those just getting into a certain area would have some basis to start their selection process.

Comment on compatibility, or rather portability. I am afraid that programs such as *WordStar* that run on various operating systems may not take advantage of some of the significant strengths of the PC.

Glad you are putting out *PC World.*

Aaron Paxson

We will be publishing the PC World Software Review *this fall. Look for details in this issue.—Ed.*

X-rayted

I have several comments regarding Andrew Fluegelman's excellent article on the COMPAQ ("Travels with COMPAQ," Vol. 1, No. 2). The lack of information in COMPAQ's Operations Guide on how to remove the cover and set the switches is not accidental. When I asked for help from the Sears Business Center where I bought my COMPAQ, they called COMPAQ in Houston. The COMPAQ representative said that the information was intentionally left out of the manual in order to encourage people to buy add-ons only from their authorized dealers.

Regarding carrying the COMPAQ on an airplane, there should not be any problems. I have flown with it many times and have never been asked to check it. The rule is that any carryon that goes under the seat must be less than 45 inches in overall dimension—the COMPAQ is about 43. I get a middle seat on the plane and rest my feet on top of the unit in relative comfort.

Finally, what was the reason for hand-checking the COMPAQ at the security areas? It will fit through the x-ray machine without any damage to the unit.

D. Sumner Chase, III
Dallas, Texas

If you've accidentally left a disk in the computer's drives (which you shouldn't do), the x-rays might destroy data. COMPAQ says the machine itself won't be harmed, but we don't like to sit under x-ray machines unless we have to.—Ed.

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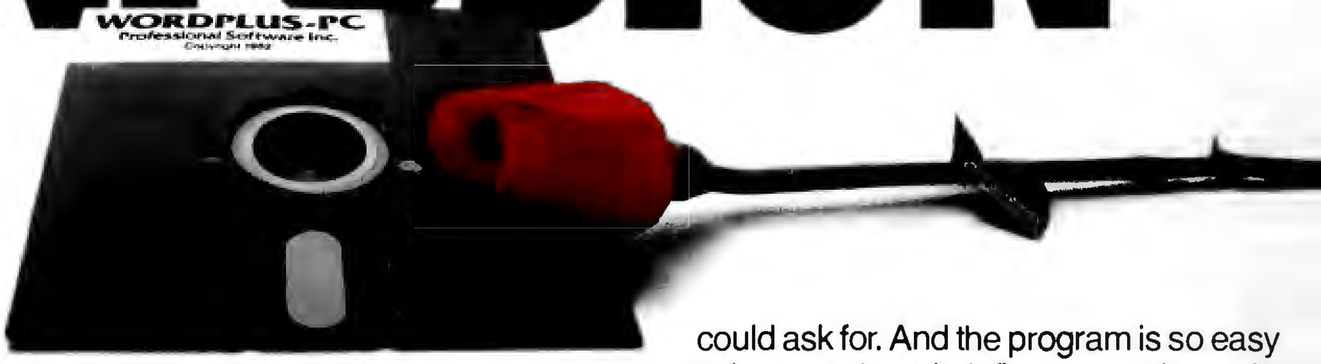

It's one confusing business, choosing a word processor. All those companies assuring you theirs is the most fantastic one of all. And leaving you to cut through all the smoke and hopefully whittle them down to the best one for you.

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

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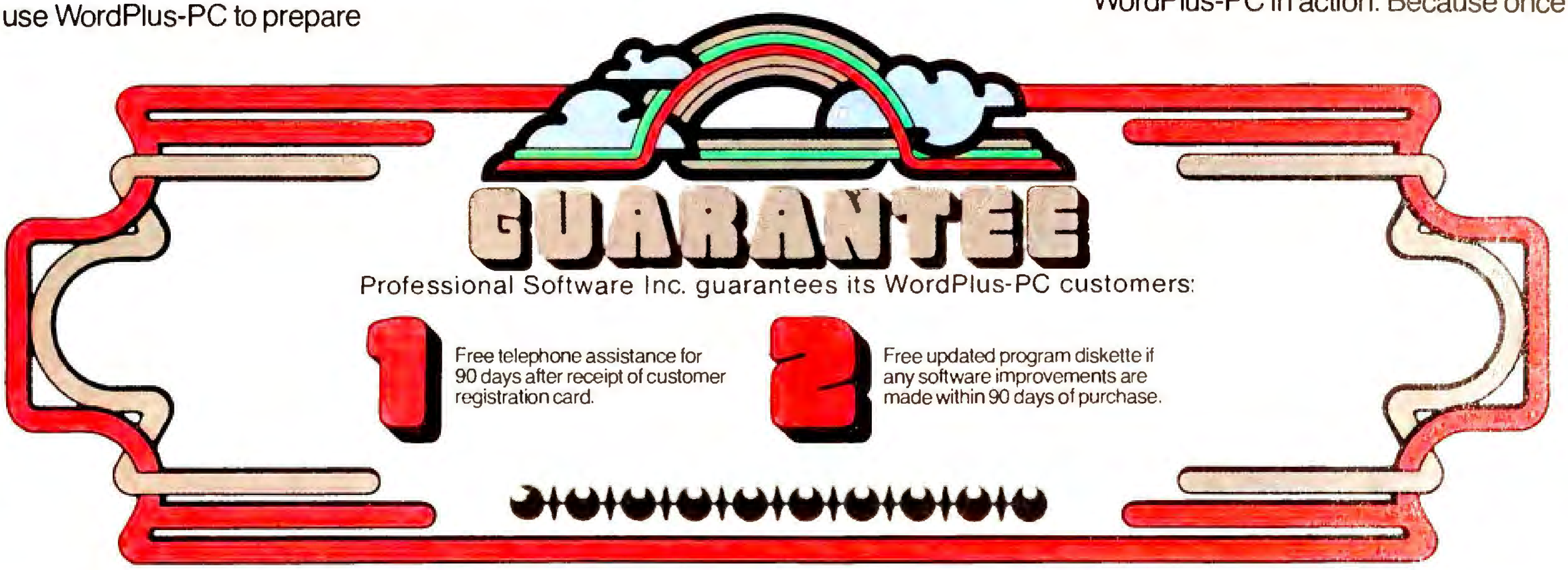

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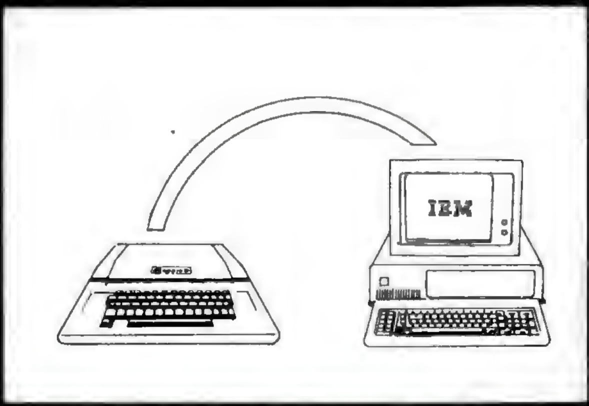

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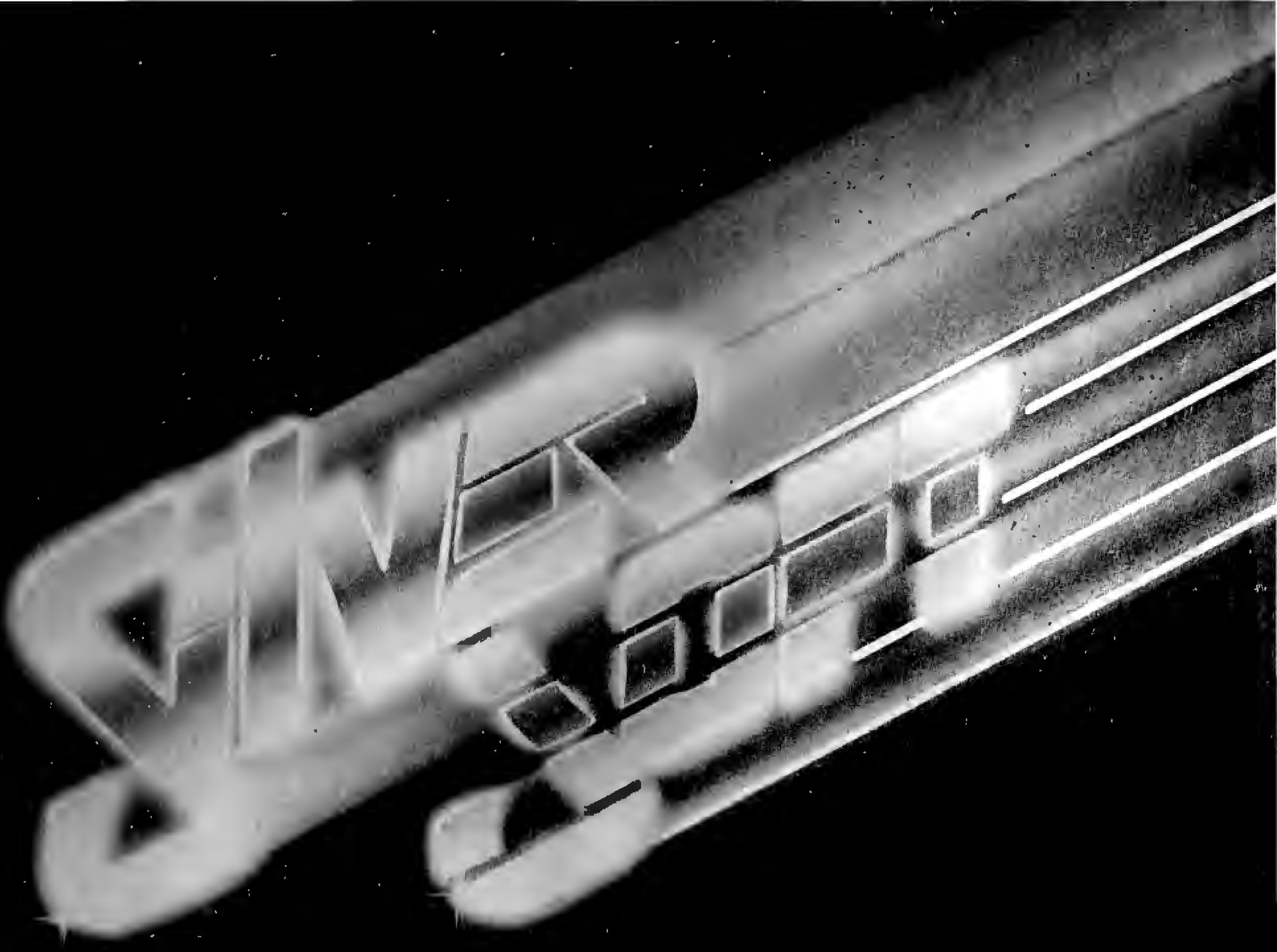

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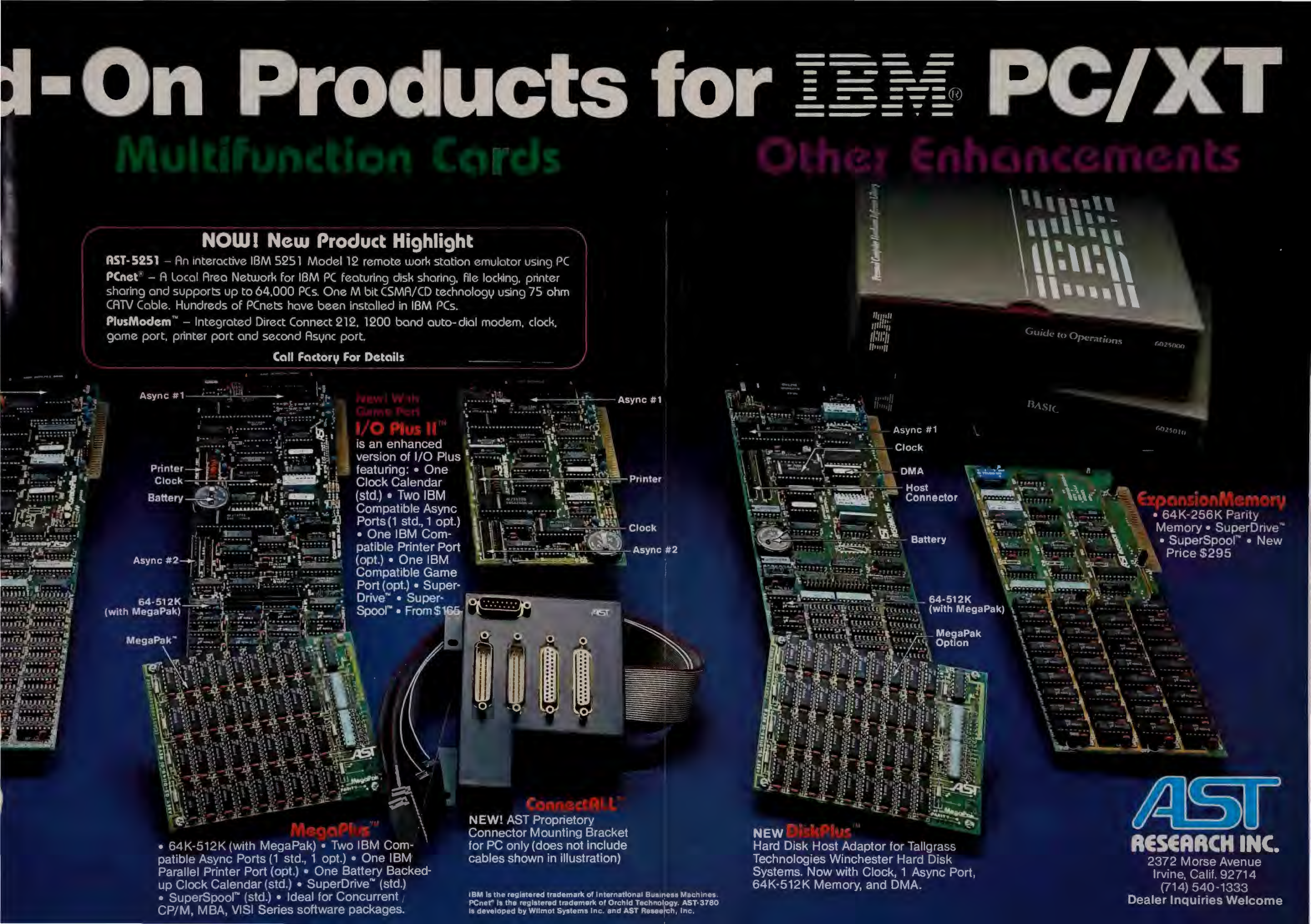

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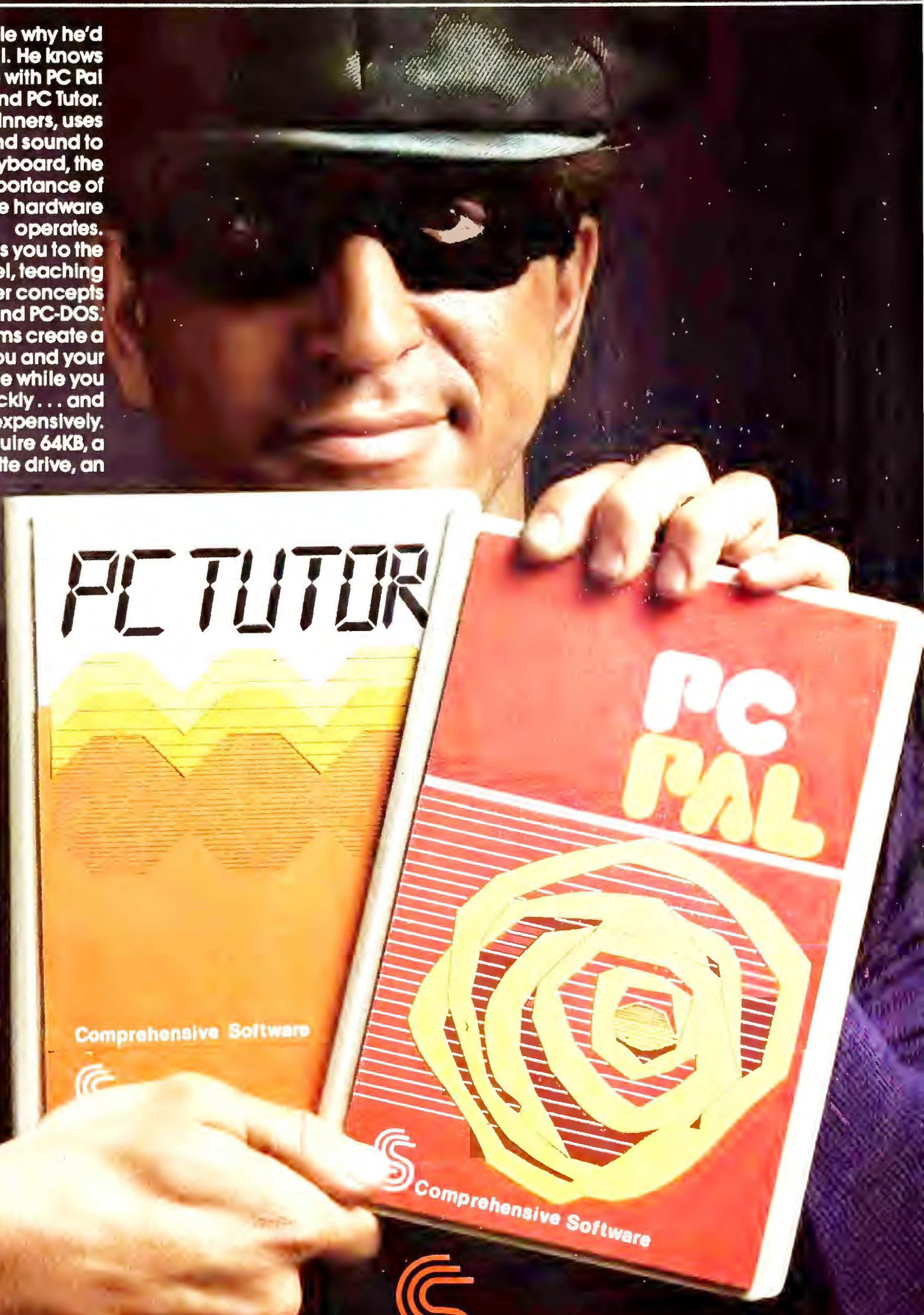

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Learning to Speak Mainframe

Arlin Torbett and Harry Miller

To communicate with mainframes, PCs will have to use data communications protocols. This article discusses what they are and what it takes to implement them.

Mainframes are far from being on their way out. While the microcomputer revolution will clearly have an effect on the way mainframes are used, it will be a positive effect. When PCs are used in place of intelligent terminals in mainframe networks, the mainframes can run faster and more efficiently. Freed from the burden of constant interaction with a large number of time-sharing users, the mainframe is left to do what it does best: high-speed data crunching and large-scale data storage and transfer. Most of the editing and browsing of programs or data files can be done on the PCs under local processing power without tying up the mainframe processor. The more PCs are used as work stations, the quicker the response time of the mainframe. In addition, many people will find useful the ability to work at home on their PC and still have access to the data stored on the company's mainframe.

> The messages transferred in data communications take the form of combinations of bits.

No matter what the motivation, the numbers of people wanting to use their PCs to communicate with mainframes is large and growing constantly. There are, however, a few hurdles to be crossed before the communication can take place. Mainframes use very precise standards of high-speed data communication, to which PCs will have to conform. PCs and IBM mainframes use different codes to refer to each character as it's stored or transferred. A mainframe also expects to exchange data with the type of terminals it knows about, and IBM hasn't yet provided systems software for mainframes to recognize the PC. So to communicate successfully, PCs must be made to emulate the standard terminal types.

The technical terms used in mainframe communications can pose equally troublesome hurdles. This article will outline and review many of the important concepts in mainframe communications protocols.

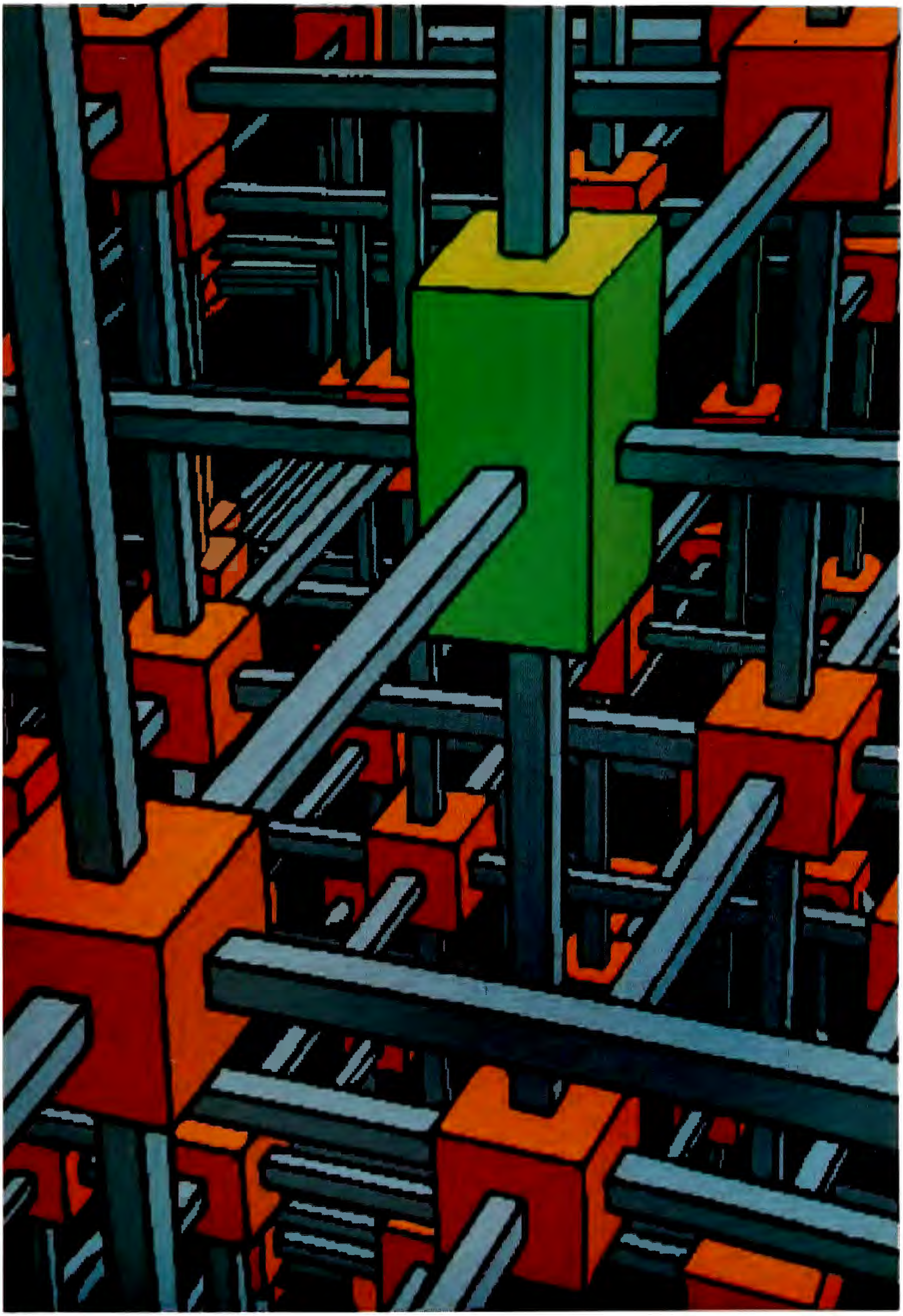
Data Communications

Figure 1 illustrates the relationship of the elements that are normally required for the data communications process. A transmitter (or source of information) sends a data message over a physical (electrical) binary serial interface (such as the RS-232C that the PC uses). Once a physical connection is made, the message flows over an established communications channel (or link) to a receiving device. In a mainframe network, the CPU host, front-end controller, and standard terminals take turns as the transmitter or receiver of messages.

Bits, Bytes, Characters, Packets

The messages transferred in data communications take the form of combinations of bits. A bit, or binary digit, is a unit of data in binary notation. In the binary number system only two marks (0 or 1) are used. Each of these marks is a bit. A bit can also be thought of as a single electrical pulse in a group of pulses: a 1 is a higher voltage pulse and a 0 is a lower voltage pulse.

Bits can be grouped into a code that represents a character. A character is an element of notation that represents letters, numbers, or symbols by a set configuration of bits. In most data communications a character is represented by a byte (8 bits equal 1 byte) of data. The two most common character codes, ASCII and EBCDIC, are described later in this article.



Some public data networks use packet switching. In that arrangement a packet, a short block (128, 256, or 512 bytes) of data that is prefixed with addressing and other control information, is used to carry information through the network.

Serial Interface

The message signals must have a way to travel from the transmitting device to the receiver. When they are moved around inside a device, they are transferred in parallel form; if the message character is 8 bits long, it uses eight wires, 1 bit per wire. To communicate with the rest of the network the device needs a serial interface to convert that parallel signal into a series of high and low voltages (corresponding to 1's and 0's) so that the signal can be transmitted over a single data wire. In other words, the 8-bit message would be transmitted bit after bit over a single wire. The next consideration is for the receiving device to know when to start counting bits as part of a character, and then when to stop.

Communications Channel

The network uses one of three basic types of communications channels: simplex, half duplex, and full duplex. A simplex channel, analogous to a one-way street with a one-way bridge, is often used by teletype wire services and only transmits information in one direction. A half-duplex channel, which is like a two-way street with a

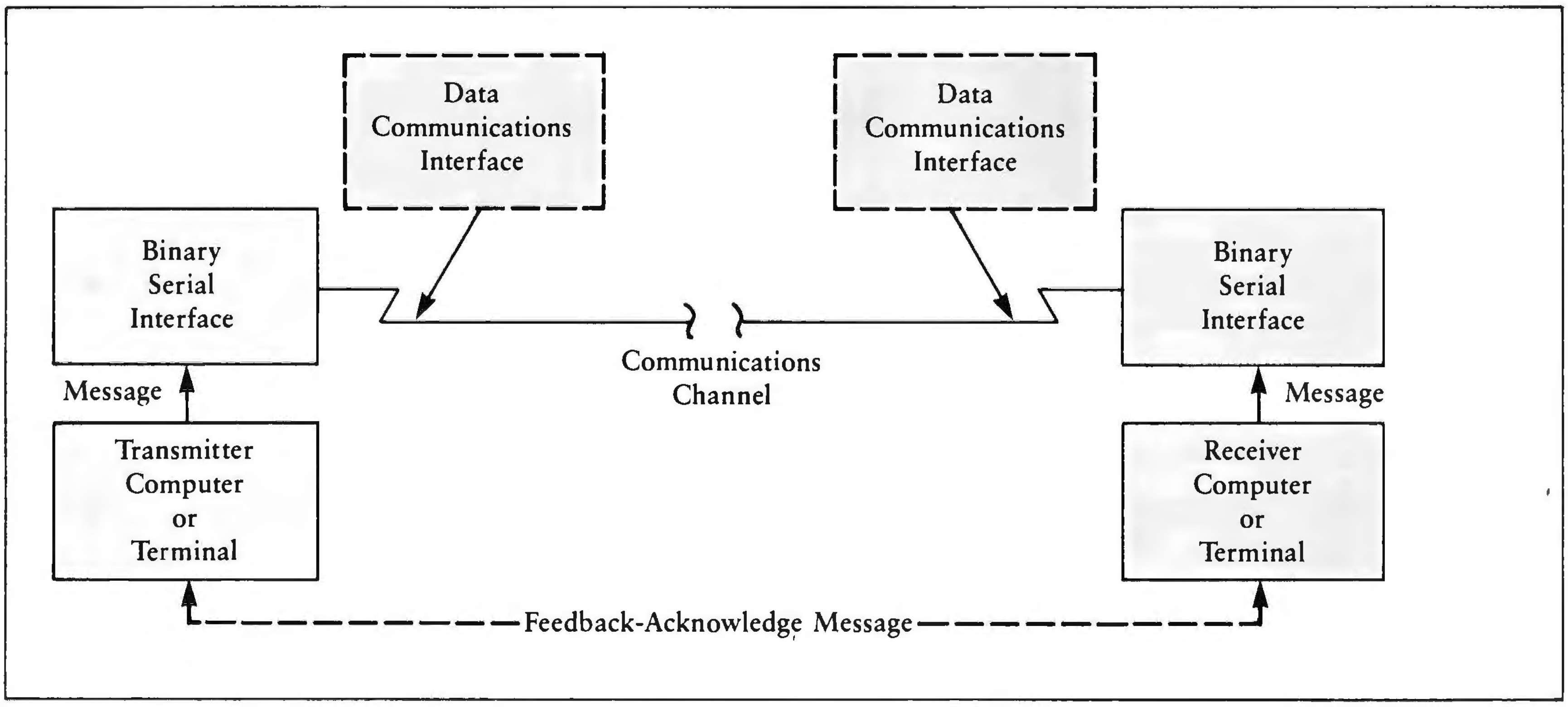


Figure 1: Elements of the Data Communications Process

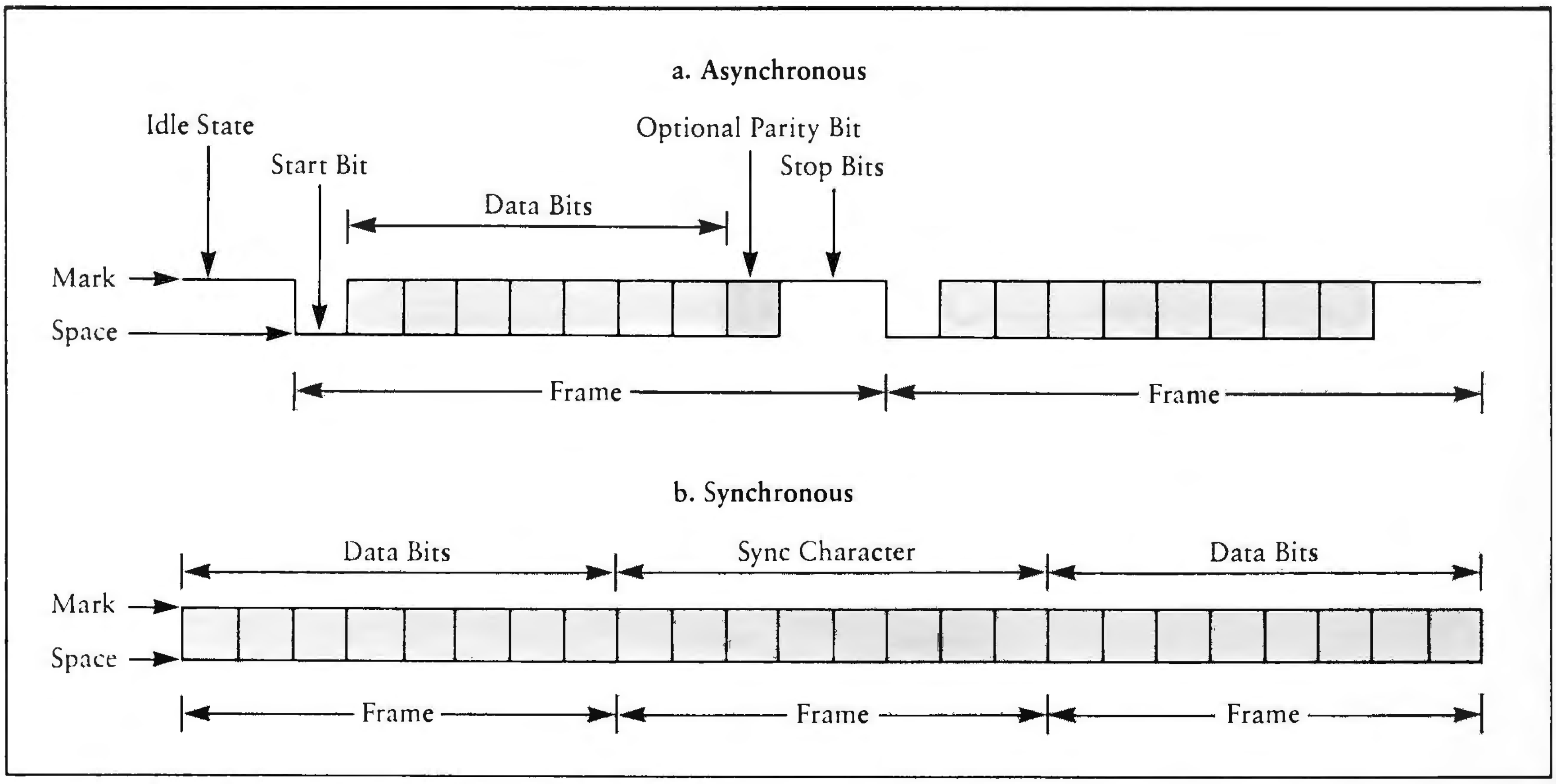


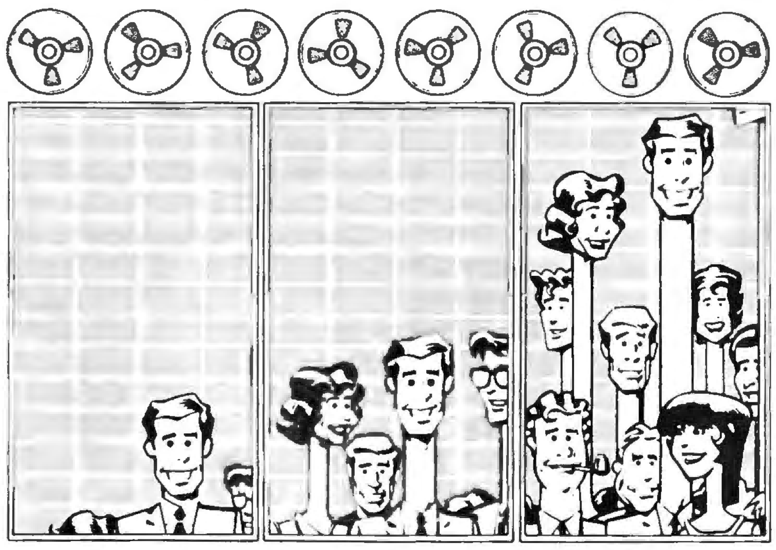
Figure 2: Asynchronous vs. Synchronous Transmission

one-way bridge, is used by most asynchronous terminals and can transmit in both directions but only in one direction at a time. A full-duplex channel, which, to follow the analogy, is like a two-way street with a two-way bridge, is used by intelligent synchronous terminals, multiplexers, and computers, and can transmit in both directions simultaneously.

The transmission across a communications channel may be either in asynchronous or synchronous timing mode. In asynchronous transmission, each transmitted character is preceded by a start bit and followed by a stop bit. Thus, the interval between characters in asynchronous transmission may vary. The receiving device knows that when it gets a start bit, the next 8 bits are going to be a character.

In synchronous transmission, on the other hand, each character consists of 7 or 8 information bits (depending on the code structure). There are no start or stop bits. Timing is derived through synchronizing characters at the beginning of each message or block of data. Eliminating the start and stop bits increases the speed by cutting down on the "overhead." Once the receiving device gets the special "sync" character, it knows that every 8 bits it receives constitute a character.

Choice of the proper timing mode depends directly on the application. Asynchronous transmission is used mostly with human-machine interfaces (where the transmission is irregular) whereas synchronous transmission offers the high speed and continuous data flow necessary for machine-machine communications. Figure 2 illustrates the typical flow of data in each type of transmission.



The CPU Break

It was the same process day after day. If you got to work at 8:30 or 9, the response time on the mainframe was acceptably fast. Around 10:30, as the rest of the company was logged on, the system would slow down a bit. By 11 it was barely usable.

Once we resigned ourselves to the necessary adaptations (important work had to be done at night or on the weekends), we devised a rating system for the system's response time. The office space was a large open room with "modular" walls and furniture organized as cubicles. When the system slowed down, heads would pop up as $40- to $60-per-hour programmers discussed football, home towns, fashions, motorcycles, and computer fantasies while they waited for the system to "come back." The theory was that you could gauge the system's speed by counting the number of heads you could see talking over the cubicle walls—taking a CPU break.

Communications Codes: ASCII and EBCDIC

All computer communications use codes to represent the characters of data being transferred. Almost all computers (including the IBM PC and PC compatibles) use the ASCII (American Standard for Computer Information Interchange) code system. IBM mainframes use the EBCDIC (Extended Binary Coded Decimal Interchange Code) system. Although the systems are different and data stored in ASCII can't be read by a system that uses EBCDIC, there are enough similarities to make translation between the two systems a manageable task.

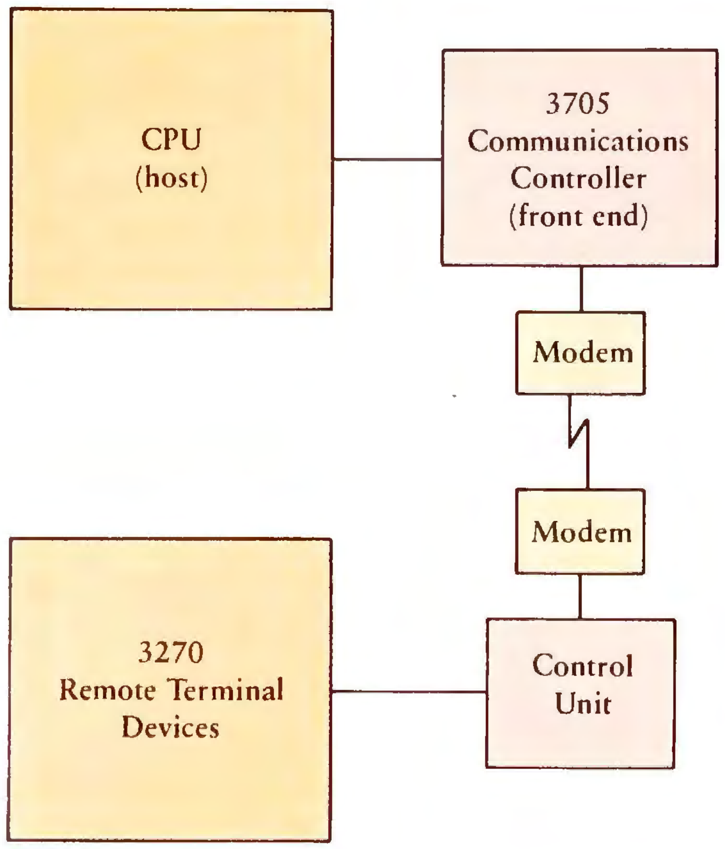
The examples in Table 1 demonstrate the correspondence between the binary representations of the ASCII and EBCDIC codes for characters. Each zero and 1 in the binary representation is 1 bit of data. Unfortunately, the correspondence is not exactly one-for-one. Some of the representations don't follow the pattern, and some characters exist only in one set of codes and not in the other. In any case, the most common way to accomplish code set translation when it is necessary is through a lookup table. Whenever a character is received using one set (ASCII or EBCDIC), it gets filtered through the lookup table and translated into the corresponding character from the other code set.

	ASCII		EBCDIC	
Character	HEX	BINARY	HEX	BINARY
A	41	01000001	C1	11000001
B	42	01000010	C2	11000010
C	43	01000011	C3	11000011
D	44	01000100	C4	11000100

Table 1: ASCII and EBCDIC Characters

Communications Protocols

A protocol is a standard followed by software and hardware so that different devices can transfer data between them. The standard is required because two devices couldn't send or receive data at the same time or perform either function out of sync. The protocol provides a



A Typical Mainframe Remote Communications Network

The CPU contains software called VTAM (Virtual Telecommunications Access Method), which is a way of controlling communications throughout the entire network.

The 3705 Communications Controller "polls" each of the control units in sequence to determine whether they have any messages to send to the host CPU.

When the operator at a 3270-type terminal hits ENTER, the message is transmitted to the local control unit. That message waits at the control unit until it is polled by the 3705, at which time the message is sent through to the host.

There is a difference between remote and local communications. In local communications a channel that comes off the CPU can have disk or tape drives connected to it. There is another channel that is connected to the local control unit and the terminals. When an operator presses ENTER on a terminal in a local network, it generates an interrupt signal that goes right to the CPU. When the CPU has something for the terminal, it just sends it right back.

This would seem to be an ideal communications arrangement, if not for the 2000-foot limit on local communications. Thus, for communications further than about a block away, a remote communications scheme is necessary.

method for synchronization of the devices, a way for one device to say, "I'm talking now, you have to listen," or "Go ahead and talk, I'm listening."

Protocols, in general, are sets of rules for controlling the transmission of data over a communications channel or link. Layered protocols, such as the Consulting Committee for International Telephone and Telegraph (CCITT) X.25 and the IBM Systems Network Architecture (SNA), are used to provide synchronization of more than the flow of bits across a communications channel. The International Standards Organization's Model for Open System Interconnection (see "Seven Layers of Protocol") is a good example of a layered protocol.

Data Link Control Protocols

A data link includes the modems, the serial communications interface, and the communications channel. Data link controls are needed to operate the data link but not the computers, terminals, or input/output devices at each end of the link. While Data Link Control is only part of the network communications picture, it is the place where the major differences in protocols are most evident.

The Data Link Control level of protocol (or line discipline), has several basic functions. It establishes and terminates a connection between two stations. It also assures the integrity of messages by using error detection, requests for retransmission, and positive or negative acknowledgments. Data Link Control also identifies the sending and receiving stations through polling or selection. It handles special control functions such as requests for status, station reset, reset acknowledge, start, start acknowledge, and disconnect.

Data Link Control protocol rules are designed to solve operating problems in the following areas:

Framing the data. Determining which groups of 8 bits constitute characters and then which groups of characters make up messages.

Error control. Includes the detection of data errors, the acceptance of correct messages, and the request for retransmission of faulty messages.

Sequence control. Uses the numbering of messages to eliminate duplication, avoid losing messages, and properly identify messages that are retransmitted by the error control system.

Line control. Determines which station on a half-duplex or multipoint line will transmit and which will receive.

In addition, the Data Link Control level must control startup, to get transmissions started in a communications system that has been idle, and Timeout, to deal with a sudden cessation of message flow.

At the Data Link Control level, the available protocols can be categorized as character oriented, byte-count oriented, or bit oriented.

Seven Layers of Protocol

The International Standards Organization Model for Open Systems Interconnection (see below) is made up of seven layers of protocol, the first three of which comprise the CCITT X.25 protocol. Each layer provides a certain subset of services to the overall set of network functions.

Physical Link layer. Controls the electrical and mechanical aspects of establishing, maintaining, and disconnecting the physical medium for transmitting data. This layer includes hardware, such as modems and communications lines, as well as systems software to drive the hardware.

Data Link layer. Sets up a communications path (or channel) between network nodes and manages access to and use of that channel. The Data Link frames the data in the transmitted messages, assures the proper sequence of transmitted information, and checks the integrity of received messages.

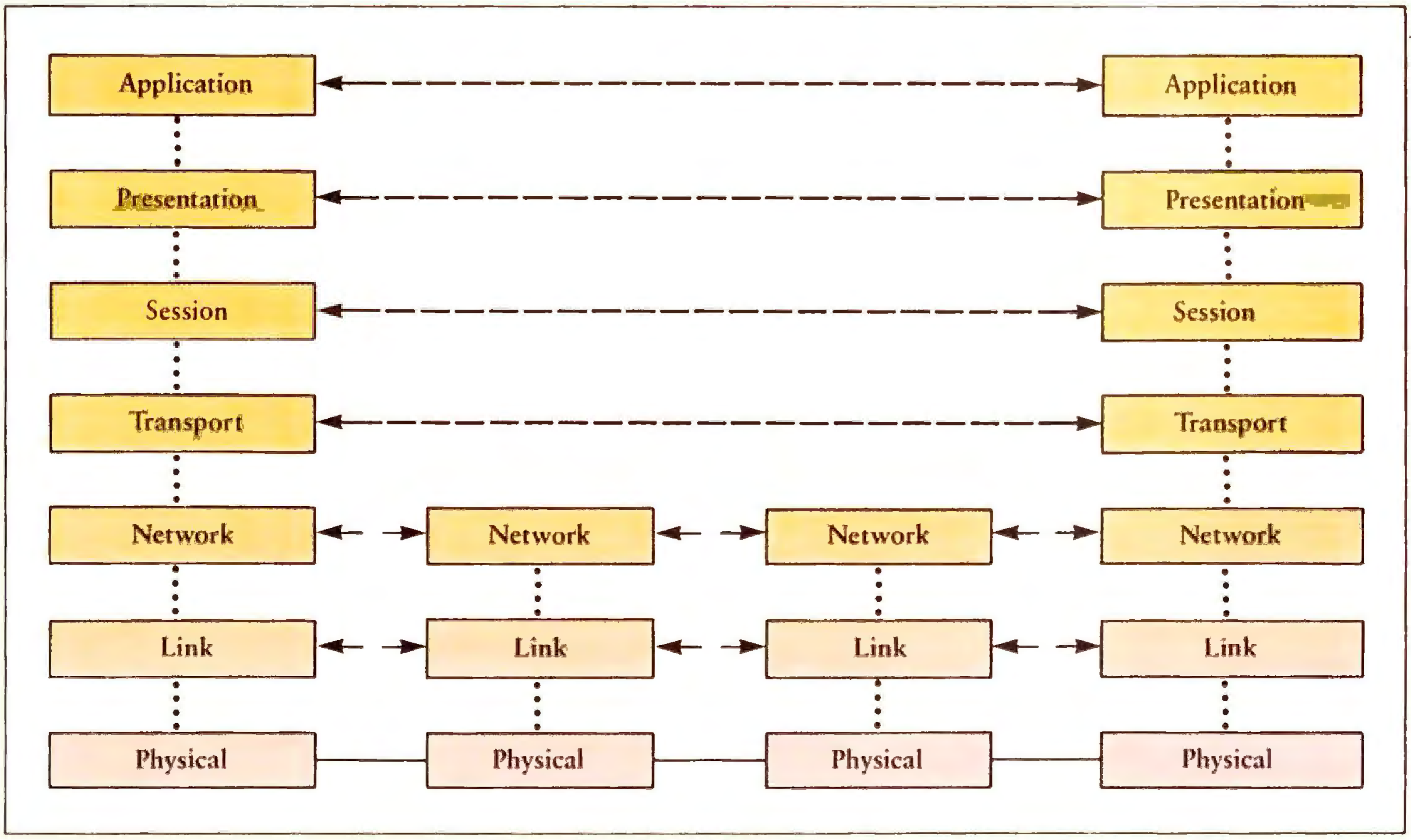
Network Control layer. Addresses and routes messages between communicating nodes on the network; it controls the flow of messages between nodes.

Transport layer. Controls the communications session between nodes once the path has been established. The transport layer allows processes to exchange data sequentially and reliably, no matter which systems are communicating or where they are in the network.

Session Control layer. Manages the logical connections between the communicating applications processes. It sets up and controls the system-dependent aspects of communications between specific nodes in the network. Among the services that the Session layer provides are the establishment and termination of connections, end-to-end session data unit control, dialogue control, message-unit flow control, and signaling nonrecoverable errors. The session control layer bridges the gap between the services of the transport layer and the logical functions running under the operating system in a communicating node.

Presentation Control layer. Translates encoded data that has been transmitted and converts it into display formats that can be used by terminal screens or printers. The presentation layer also provides data compaction or expansion, data encryption and decryption, data structure (for file transfer), and command translation (for virtual terminals). This level puts the data into forms that can be understood and manipulated by the user.

Applications or User layer. Supports user and applications tasks and systems management. Resource sharing, file transfers, remote file access, data base management, and network management are examples of applications provided at this level.



Character-Oriented Protocols

A character-oriented protocol uses special characters, such as SYN to synchronize the transmitter and receiver ends of the communications link, STX to indicate the start of text (message), and ETX to indicate the end of text. One of the most widely used character-oriented protocols is IBM's Binary Synchronous Communications protocol, known as BISYNC or BSC. This half-duplex protocol has been in use since 1968 for transmission between IBM computers and batch and video display terminals. Figure 3 shows an example of the point-to-point BISYNC used in batch operations. Figure 4 shows a similar example for the polled, multipoint BISYNC. Multipoint BISYNC allows the host CPU to communicate with a controller that has many terminals or devices connected to it.

Binary synchronous, or bisync, protocol operates on an acknowledgment basis. When device A signals the start of a message, and device B acknowledges receipt of the signal, device A knows it can continue to send data. If B acknowledges the data, A can send some more, and so on. When A signals the end of the message and B acknowledges it, then B is free to initiate a message and will expect A to acknowledge it.

How does a device acknowledge a signal received from another device? There is actually a signal called ACK (short for acknowledge) that is sent back and forth on the line. Devices alternate the types of ACK signal they send (called ACK0 and ACK1) so that the sending device will know which data the receiving device is acknowledging. If device B doesn't receive the data that A sent, B will send a negative acknowledgment (NAK) and A will have to retransmit the message.

Byte-Count Protocols

When BISYNC was introduced, the speed of half-duplex transmission was adequate for the batch mode operation that was prevalent. The trend toward interactive systems and distributed data processing, however, created the need for protocols that could accommodate full-duplex transmission.

Other problems associated with BISYNC were its inflexible structure and nontransparent nature. *Transparency* refers to the ability to send strings of bits that may not be recognized as normal characters, such as control characters. Transparency is the ability of the protocol to say to the receiving device: Take the next several bits literally; don't try to make a character out of them. It is possible to devise a protocol which, by keeping track of the byte count, solves the transparency problem of BISYNC without the use of control characters. One of the widely used protocols that does this is Digital Equipment Corporation's DDCMP protocol.

Byte-count-oriented protocols use a header that includes a beginning special character, followed by a count that indicates how many characters follow in the data portion of the message, and some control information

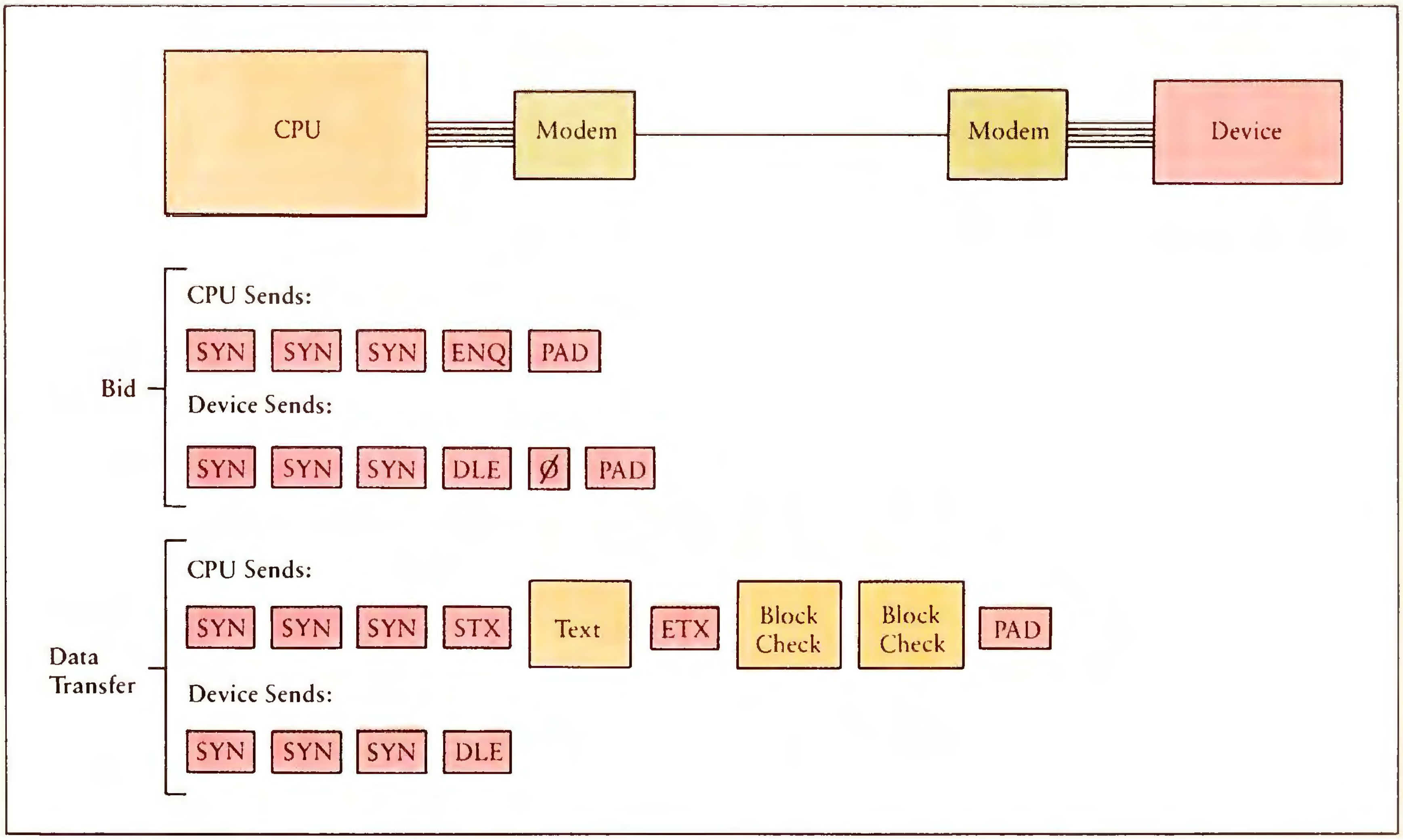


Figure 3: Point-to-Point BISYNC

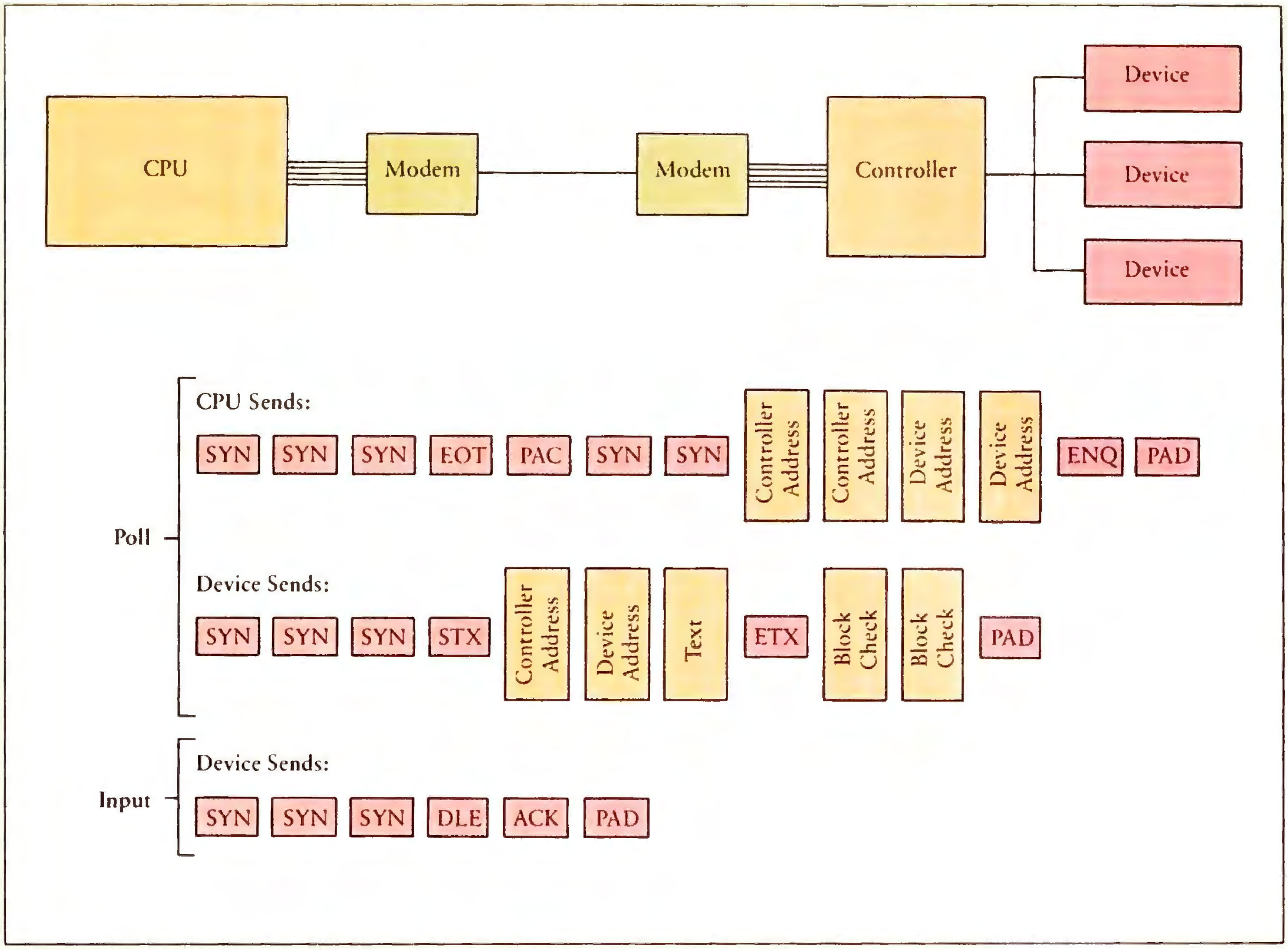


Figure 4: Multipoint BISYNC

such as which messages have been received correctly to date. The data portion that comes next is the specified length and is followed by block-check characters.

Byte-count-oriented protocols are an improvement over character-oriented protocols for batch operations; however, for interactive operation the larger header for transmitting a few characters makes the byte-count-oriented protocols rather inefficient.

Bit-Oriented Protocols

The next generation of Data Link Control protocols to evolve was the bit-oriented protocols operating in full-duplex mode. These protocols were designed to remove the limitations inherent in character-oriented protocols. Bit-oriented protocols share some common characteristics: codes, line configurations, and peripherals are independent of each other. Positional significance of bits within a message frame is used instead of control characters or character counts. One standard frame format serves for all messages. Half- or full-duplex operation is possible. Information transparency is achieved through inserting and deleting zeros. A complete frame is used for error checking.

Bit-oriented protocols separate the bits that constitute messages with a special flag character such as 01111110. These protocols specify that there will never be six 1 bits in a row except for the transmission of the flag. Thus, when the receiving station receives a flag character, it knows that the previous 16 bits were the block-check characters and that the bits between those 16 and the previous flag constitute the message.

If a message contains 6 or more 1 bits in a row, the transmitter "stuffs" a zero bit after every fifth 1 bit transmitted; the receiver removes the stuffed bit, restoring the bit stream to its original configuration. Figure 5 shows a typical bit-oriented, protocol frame format.

The most common bit-oriented protocols are the IBM Synchronous Data Link Control (SDLC), the American National Standards Institute Advanced Data Communications Control Procedure (ADCCP), and the CCITT and International Standards Organization High-level Data Link Control (HDLC). Other bit-oriented synchronous protocols are currently offered and supported by Burroughs, National Cash Register (NCR), Control Data Corporation, Univac, Digital Equipment Corporation, and Honeywell. Those protocols include Burroughs Data Link Control (BDLC), NCR Bit Oriented Data Link (BOLD), CDC Communication Protocol (CDCCP), Univac Data Link Control (UDLC), DEC DECNET Link Protocol, and HIS DSE Link Protocol. Each of these protocols are implemented on the respective manufacturer's own network architectures. All these protocols are subsets of HDLC, and thus all are somewhat similar.

Acceptance of the bit-oriented protocols has been held up in the past by user resistance to the adoption of the new network architectures. A substantial installed base of terminals and systems still use character-oriented protocols, primarily IBM BISYNC. However, with the growing prevalence of SNA and X.25 networks, the use of bit-oriented protocols is accelerating. Nevertheless, IBM BISYNC will be around for a long time to come, and protocol conversion will continue to be needed.

Higher Level Protocols

Higher level protocols are responsible for functions such as message buffering, code conversion, recognizing and reporting faulty conditions in terminals or lines, direct communications with the host mainframe, and management of the communications network. Such protocols are implemented by software packages such as IBM's Systems Network Architecture (SNA) and the Consulting Committee for International Telephone and Telegraph (CCITT) X.25.

The design philosophies of IBM's SNA and CCITT's X.25 are very different. SNA was implemented as a computer network in which users establish "sessions" with applications programs that reside on a host computer within the network. Once the session is established, the Network Control Program, which runs on the IBM 3705 front end processor, controls the information flow between the user and the applications program.

X.25, on the other hand, was conceived as a data communications network in which data packets are moved into and out of the network based on "virtual circuits." Virtual circuits are identified by their end points and are utilized only when there is data to be sent.

The users and the applications programs on the host are external to the X.25 network. The principal job of the X.25 protocol layers is to move data from an entry point to an exit point of the network, whereas, in SNA, the layers establish and manage sessions between users and applications programs.

With that overview, here are more detailed explanations of the two protocols.

IBM's SNA

IBM's SNA is a high-level implementation of a layered protocol. As Figure 6 shows, SNA builds upon the Physical Control layer with the Data Link Control (DLC), Path Control (PC), Transmission Control (TC), Data Flow Control (DFC), and Network Services Manager layers.

On the Physical Control level, SNA coordinates with the physical units of the nodes in the network to establish a switched connection or verify the existence of a nonswitched (continuous) connection. At the bit, character, and frame levels, errors are removed by retransmission. At the Data Link Control level SNA uses SDLC to synchronize adjacent nodes in the network.

The Path Control layer is responsible for routing messages to the proper destination node and segmenting messages to match the memory buffer size of the receiving node.

> Emulation is the process of giving a device the characteristics and behavior of another device.

Zero Insertion/Deletion & CRC Accumulation

Flag	Address	Control	Information	FCS	Flag
01111110	1 or more 8-bit chars	1 or 2 8-bit chars	0 or more characters*	16 bits CRC-CCITT inverted remainder	01111110

Any number of bits for ADCCP/HDLC. Must be multiple of 8 bits for SDLC.

The control field takes on any one of three formats depending on whether the field is to indicate:

- Information transfer
- Supervisory commands/responses
- Nonsequenced commands/responses

Figure 5: Bit-Oriented Protocol Frame Format

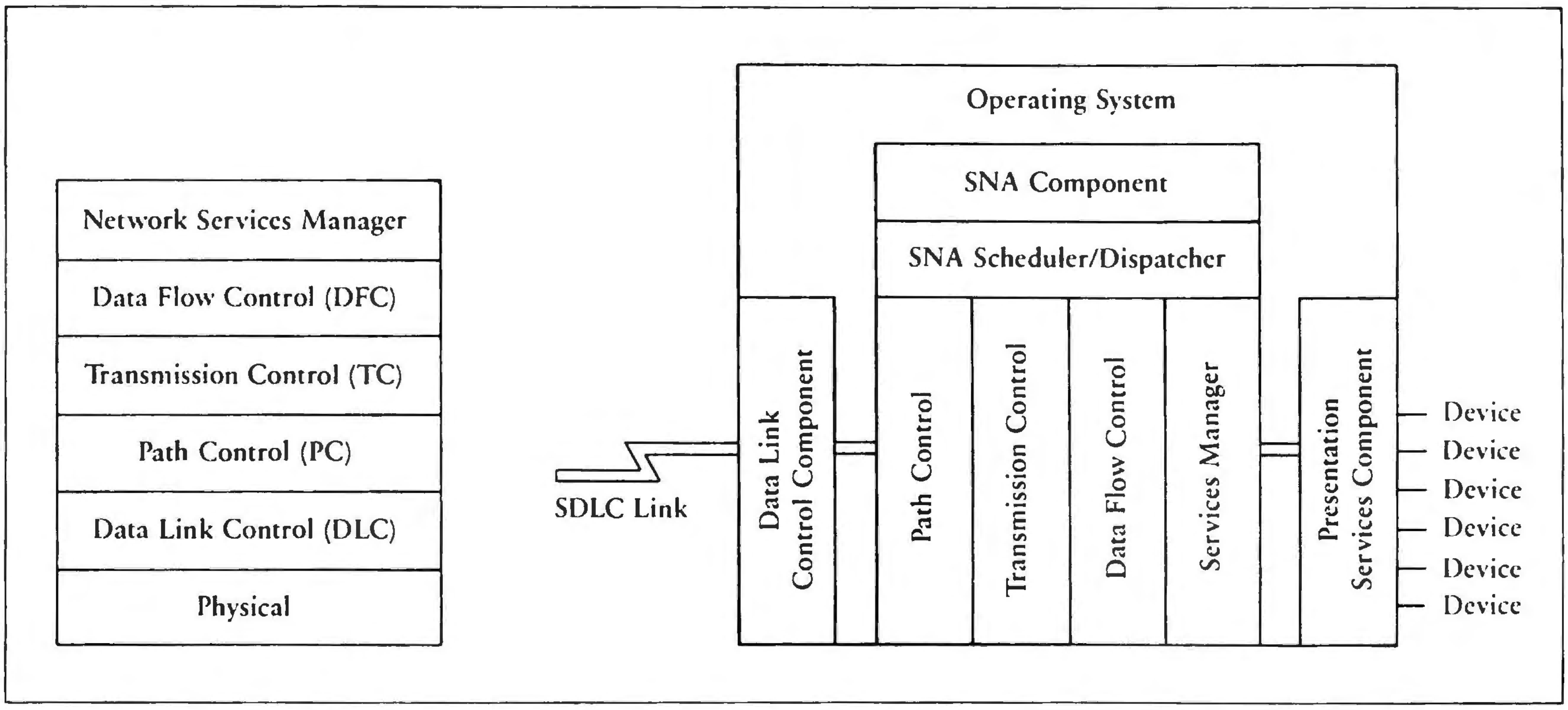


Figure 6: Structure and Function of SNA

Transmission Control paces the message flow to assure synchronization at the processing speed level. TC also works at the protection level to build message transmission headers and prevent the synthesis or duplication of network addresses.

The Data Flow Control layer maintains the integrity of the data flow within an SNA session between a pair of network addressable units although some parts of this task are performed by the Transmission Control layer. The DFC layer controls whether the half-session can send, receive, or concurrently send and receive. DFC is also responsible for delimiting transactions and controlling the correlation of requests and responses.

The Network Services layer manages the network, coordinating the physical configuration with the network address assignments and correlating network addresses with network names. It also modifies the physical configuration of the network in response to session initiation or termination requests from the nodes and resolves conflicting requests.

X.25 Packet-Switching Protocol

As public data networks emerged throughout the world, the need arose for a common protocol to describe how the networks operate internally and how the networks communicate with their customers' equipment. In 1976 the CCITT standards organization adopted its Recommendation X.25 as the international standard protocol to be used by Data Terminal Equipment (DTE), such as host computers to interface with public data networks (PDN). That protocol was enhanced and revised in 1980.

The X.25 protocol defines the DTE-PDN interface on three levels: the Physical (or electrical) level (which is RS-232C compatible), the Frame (or Link) level, and the Packet level.

The Physical Level of X.25 defines the electrical interface between the Data Terminal Equipment (DTE), the host, front end,.or intelligent terminal, and the Data Communications Equipment (DCE), the node. The Physical Level is defined by CCITT Recommendation X.21. The protocol also accepts the use of Recommendation X.21bis, which is equivalent to EIA RS-232C, which the PC uses.

The Frame Level of X.25 is responsible for transferring packets of data between the DTE (user) and the DCE (node) without error. Messages to be sent across the network are chopped into packets that usually contain 128 characters. Some X.25 networks use 256- or 512-character packets. Packets are delivered in sequence without loss or duplication. The Frame Level performs error detection and recovery. It includes procedures for link setup, information (packet) transfer, and link disconnect. Framing formats for BISYNC (character-oriented) and HDLC (bit-oriented) protocols are provided.

The X.25 Packet Level defines procedures for establishing and clearing calls for Switched Virtual Circuits (SVC). Procedures for the transfer of data and for initializing (restarting) all logical channels at the DTE/DCE interface are also specified.

Terminal Emulation

Once the protocols are met and the character sets match, the next consideration is making the host CPU think that it is communicating with a terminal it recognizes.

Emulation is the process of giving a device the characteristics and behavior of another device. Characteristics might be features such as a buffered screen and screen addressing on a terminal, and behavior would be the way a terminal communicates.

Protocol Conversion Products

Adrian Mello

Products that contribute to protocol conversion can take the form of an expansion board, a free-standing hardware device, and even a software disk. A product may simply allow one PC to emulate some of the features of a terminal or may serve as a conversion device for a large number of PCs.

Potential buyers searching for a product that permits them to operate their PCs in conjunction with a mainframe computer should know what operations they want the PCs to perform, the type of protocol they need to match, the type of terminal they wish to emulate, and how many PCs they want to use as terminals. The following represent the range of products that allow the PC to communicate with mainframes.

AST Research
AST-SNA is a product line based on the SNA 3270, a board that mounts inside the IBM PC System Unit and allows the PC to emulate an IBM 3270 terminal. An optional card called the SNA 3270P can be placed in the PC with the SNA 3270 board and permits up to three additional PCs to emulate 3270 terminals. The additional computers can operate as either 3270 terminals or independent work stations as long as the host PC with the AST SNA board remains in SNA mode. Software is provided with both products.

Another option, the SNA 3270C, permits an alternative compatible terminal design to be used for the additional terminal display stations instead of IBM PCs. An IBM 3770 Communications Terminal can be emulated for batch data transfer operations with SNA 3770 Batch.

The AST 3780 board and software allow the IBM PC to emulate any IBM 2780/3780 RJE work station using BISYNC point-to-point communications protocol. In the terminal mode the PC keyboard and screen can be used with communications software such as HASP, JES1, POWER, or RES. Any storage device used with the PC can be used in BISYNC mode. AST Research, Inc., 2372 Morse Ave., Irvine, CA 92714, 714/540-1333.

Commtex, Inc.
The MDS-8070 freestanding unit uses ASCII asynchronous communications procedures to allow up to 25 IBM PCs to be connected to one or two IBM host computers. PCs are not assigned individual ports but share with the assistance of a rotary port selection feature. Users can access separate mainframes, networks, or mainframe applications software with short commands due to the presence of dual host interfaces. Commtex plans to make SNA/SDLC protocol available by the end of the summer. Commtex, Inc., 2411 Crofton Ln., Crofton, MD 21114, 301/721-3666.

Datastream Communications
The T-7 permits up to 15 PCs to emulate an IBM 3277 terminal using BSC or SDLC to communicate with the host computer. Another protocol converter, the T-8, provides SNA/SDLC communications and comes with either 8 or 16 attachment ports. Datastream Communications, Inc., 1115 Space Park Dr., Santa Clara, CA 95050, 408/727-2980.

Gateway Communications
IBM PCs attached to the Gateway processor emulate 3278 terminals attached to host computers. Protocols supported by software for the Gateway Processor include SNA, X.25, 3270 BISYNC, 3780, and 2780. Up to 16 PCs can be attached to the Gateway Processor in increments of 4 to every communications board placed in the processor unit. Each PC is attached via a serial interface and cable. Gateway Communications, Inc., 139 E. Alton Ave., Santa Ana, CA 92707, 714/957-0763.

IBM
The 3270 Personal Computer Attachment allows a 3278 terminal to attach to an IBM PC sytem unit. Data can be transferred between the host and the independent 3278 terminal operating as an independent work station in conjunction with the PC system unit. An adapter is installed by IBM at the customer site for the 3278, and the user installs an I/O panel and cable attachment to allow the PC system unit to use the display and keyboard of the 3278.

The IBM 3101 Emulation Program allows the PC to operate in place of an IBM 3101 Model 20 except for the loss of some 3101 features. The emulator does not provide support for local mode, transparent mode, program mode and ATTR keys, interfaces other than EIA RS-232C types, foreign languages, and certain display features.

The Binary Synchronous Communications Adapter provides the ability to attach the IBM PC to host systems or other IBM PCs via switched or leased-line networks using BSC protocols. The adapter board is installed in the PC system unit and communicates with other computers by modem.

The Binary Synchronous 3270 Emulation version 1.0 allows the PC to emulate a 3270 device using BSC when it is used with the BSC adapter.

The Model 7426 Terminal Interface Unit allows up to four IBM PCs to attach to IBM 8100, 4331, and 4321 systems. IBM Corporation, Systems Products Division, P.O. Box 1328, Boca Raton, FL 33432, 800/447-4700, 322-4400 Illinois, 447-0890 Alaska, Hawaii.

ICOT

The ICOT Model 352 Virtual Terminal System is an external unit that allows up to 12 PCs to emulate 3278 display stations using 3270 BSC or 3271 SDLC communications protocol. The Model 352 is available in three host line configurations: one BSC host line, two BSC host lines, or one BSC and one SDLC host line. Complete SNA/SDLC support will be available by the end of the summer. ICOT Corporation, 830 Maude Ave., Mountain View, CA 94039, 415/964-4635.

Intelligent Technologies

The PC Express II allows PC users to exchange files with IBM and DEC mainframes by providing 327X emulation and VT-100/52 emulation. The product includes a board that fits inside the IBM PC system unit and software that provides SNA protocol conversion. The PC can act as a single 327X display terminal or a cluster controller for up to four PCs. Intelligent Technologies International Corporation, 151 University Ave., Palo Alto, CA 94301, 415/328-2411.

Local Data

The DataLynx/3274 is an external unit that allows up to 9 IBM PCs to connect to the IBM host computer and emulate 3278 terminals. The unit supports BISYNC or SNA/SDLC protocol conversion.

Another unit, the DataLynx/3270 allows two IBM PCs to communicate with a 3780 host computer. The PCs emulate either two 3277s or one 3277 and one 3287-2 using BSC. Local Data, 2701 Toledo St. #706, Torrance, CA 90503, 213/320-7126.

Persyst

A combination of two products from Persyst that allows one IBM PC to emulate a 3278 terminal for remote job entry. The DCP88 board is placed in the PC and is used in conjunction with the IBM HASP software to support the following protocols: Async, HDLC, SDLC, and BISYNC. Personal Systems Technology, Inc., 15801 Rockfield, Ste. A, Irvine, CA 92714, 714/859-8871.

Protocol Computers

PCI 1071 is an external unit that converts BSC protocol for up to seven IBM PCs. The 1071 provides emulation of the IBM 3271 and can be upgraded to provide SNA/SDLC protocol conversion.

The PCI 1076 allows up to seven IBM PCs to emulate 3278 terminals using SNA/SDLC protocol.

The PCI 1067 serves as an alternative to NTO (Network Terminal Option) that saves memory space in the 3705 controller by providing all of the NTO functions. The 1067 unit allows up to seven IBM PCs to operate as terminals for a 3767 host using SNA/SDLC protocol. Protocol Computers, Inc., 6150 Canoga Ave. #100, Woodland Hills, CA 91367-3773, 800/423-5904, 213/716-5500.

TAC

IRMA is a board that fits inside the IBM PC and permits attachment of the PC to most 3270 controllers. The board allows a single PC to emulate a 3278 terminal. Technical Analysis Corporation, 120 W. Wieuca Rd. NE, Atlanta, GA 30042, 404/252-1045, Telex: 54-9600.

IBM mainframes use several types of terminals. Currently, the most popular are the 3270 family of devices. As successive improvements are incorporated, the model numbers are assigned sequentially. Thus, 3277s are older than 3278s or 3279s. Since each has different capabilities, characteristics, and behavior, the control unit must know which of the devices is connected. Terminals use unique combinations of escape code sequences to control characteristics, such as function keys, cursor movement, and formatted screens. Thus, a terminal emulator must translate those escape codes.

Achieving Compatibility

The earlier sections of this article described some of the common protocols found on IBM mainframes. Based on that framework, you next need to know how to get the PC to conform to those standards.

Protocol conversion involves the transformation of data characteristics at several levels. Descriptions of these levels vary, but the important point to recognize is that Data Link Control protocol conversion is only part of the process involved in achieving compatibility between a PC and a mainframe computer.

Protocol conversion is the process of creating compatibility between peer protocols at the Data Link level. Strictly speaking, protocol conversion refers to conversion at the Data Link Control level, which does not assure compatibility in all cases. Nor does protocol conversion mean that, for example, providing an asynchronous ASCII port on a PC will be sufficient to emulate an IBM 3270. For practical purposes, terminal emulation is required to assure compatibility between a PC and a mainframe computer, especially if the PC is to be used as an interactive terminal. Therefore, to assure compatibility, conversions of protocols, character sets (ASCII to EBCDIC), terminal escape sequences, and transmission methods (asynchronous to synchronous) must be successfully completed.

Depending on the requirements of the PC user, compatibility can be achieved by one or more levels of conversion. Because conversion at a higher level (e.g., Data Link Control protocol level) assumes conversion at lower levels (e.g., Physical Connect (RS-232C) or Character Set level) consideration should be given to current and future compatibility issues in deciding on a protocol conversion option. For example, a current environment might require conversion only at the Data Link Control layer, allowing a PC user to transfer ASCII file data to a host using a point-to-point BISYNC protocol. This level of conversion may be sufficient for current applications, but any future applications requiring full-screen formatting and editing functions, for example, would be beyond the scope of the Data Link Control protocol conversion. Full-screen formatting and editing would require terminal emulation to appear as a particular type of device (e.g., an IBM 3276 Model 12) to the host-resident application.

To summarize, the protocol converter (terminal emulator) must provide characteristics at one or more of the following levels as a minimum requirement:

Link characteristics. Defines electrical characteristics and signal configurations together with their physical pins on the connector.

Communications code. Defines the code set of the PC (ANSI ASCII) and the conversion required into a

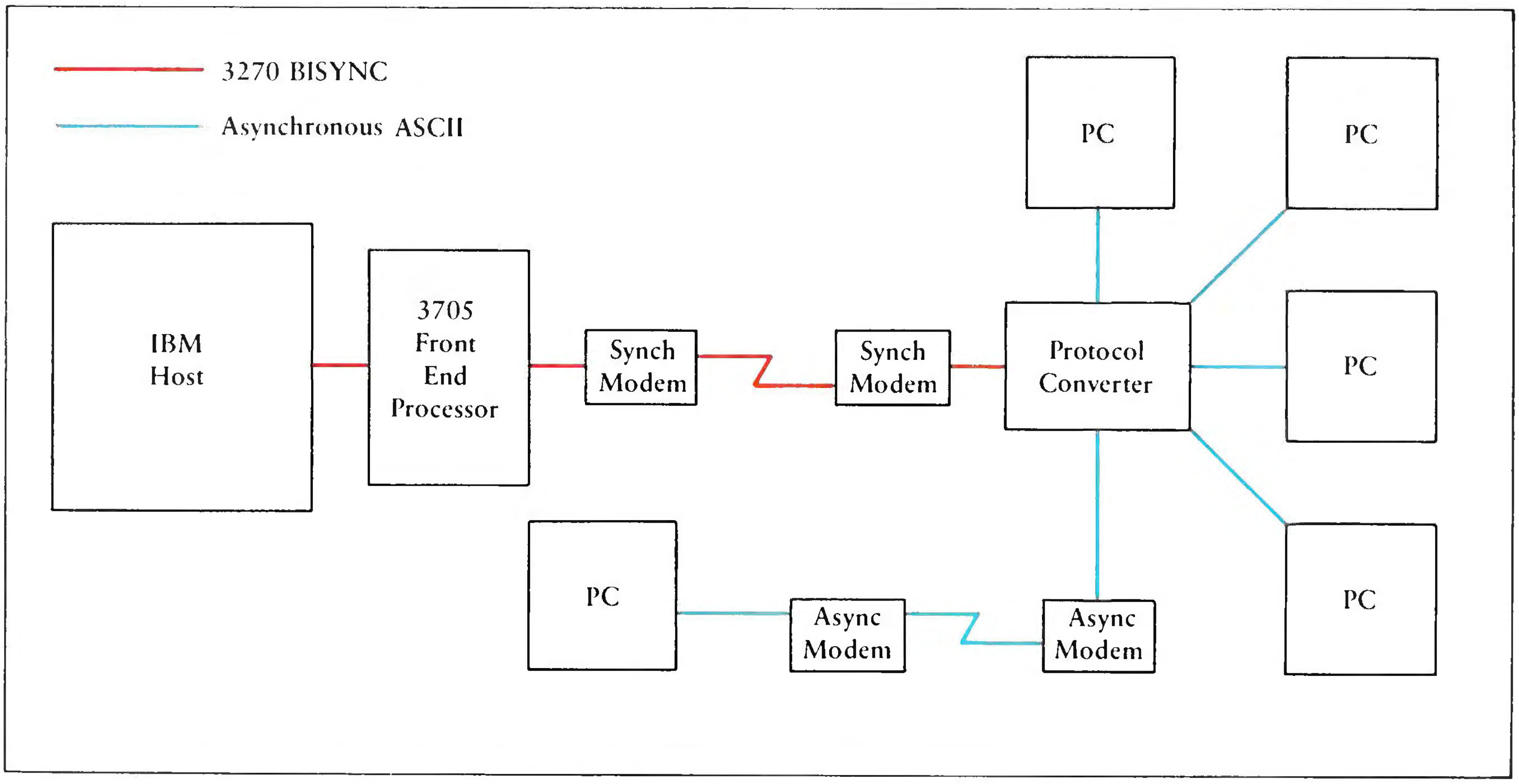


Figure 7: Asynchronous ASCII to IBM 3270 BISYNC Protocol Conversion

character set recognized by the host (e.g., IBM ASCII, EBCDIC, etc.).

Communication protocol/transmission. Maps data from PC protocol and transmission mode into that supported by the host, and acknowledges transmission.

Device type. Recognizes the device constraints (i.e., record size, block size, etc.) and reformats data to accommodate the emulated device.

Terminal emulation is required to assure compatibility between a PC and a mainframe.

Device characteristics. Interprets command and control codes of the PC and transforms them into those required by the host.

The fundamental message, therefore, is that selection of a protocol conversion option should be integrated into an overall data communications plan, not based on an isolated need.

Protocol Conversion Options

There are several protocol conversion and terminal emulation options currently available to PC users. These include software packages for the host and/or the PC, printed circuit boards with firmware modules that plug into the PC, and stand-alone microprocessor-based protocol converters that provide a virtual terminal capability for the PC.

The software for the host consists of a package that runs on the 3705 front end and supports the IBM 3101 ASCII terminal. To make use of that software, the PC requires emulation software to make it look like a 3101.

Applications of protocol conversion and/or terminal emulation vary in complexity, but most commonly involve converting asynchronous ASCII protocols to IBM BISYNC protocols and converting asynchronous and character-oriented synchronous protocols to bit-oriented protocols (SDLC, HDLC).

The asynchronous ASCII to IBM 3270 BISYNC (BSC) conversion, shown in Figure 7, is the major market for protocol converters, resulting from the basic economic rationalization that BISYNC has the largest currently installed user base. However, the conversion to a bit-oriented protocol is receiving greater attention because of the increased emphasis on SNA and X.25 communications networks.

With the numerous options available, selecting the best one requires a careful understanding of the needs of the PC user and his or her company.

Vendor-supplied software packages and user-written software may be viable alternatives in some protocol conversion situations. The primary advantage in the software approach is that it is adaptable. However, with the continuing shift to hardware-based microprocessor products for handling protocol conversion and other communications functions, the advantage of the software approach is rapidly dwindling, particularly if a license fee is charged for each PC using the software package.

A printed circuit board that plugs directly into the PC bus and contains modules for protocol conversion and/or terminal emulation may also be a viable option. However, like the software approach, a cost is incurred for each PC. The significant point is that the number of PCs to be supported is a primary consideration from a cost as well as a performance standpoint. If each PC interfaces directly with the host, the host front end may run out of available ports.

Multiple microprocessor-based protocol converter products provide a number of value-added features and functions not available with other approaches. These added capabilities include:

- Simultaneous multiple-device support of different types (different vendors or manufacturers) of PCs, KSR terminal, CRTs, receive-only printers, graphics terminals).
- Simultaneous support of multiple protocols.
- Simultaneous support of multiple hosts.
- Simultaneous support of multiple sessions.
- Use of dial-up lines instead of dedicated synchronous lines.
- Elimination of the need for coaxial cables.
- Elimination of the need for host emulation software (e.g., IBM Network Terminal Option for ASCII support).

The trend toward bit-oriented synchronous protocols for SNA and X.25 networks and the attention given to the efforts of various standards organizations will, in the long run, promote compatibility between different vendors' communications protocols. Despite these trends, compatibility is still well in the future, and the need for protocol conversion will continue, although the cost of protocol conversion will decrease as microprocessor-based solutions are more widely used.

Arlin Torbett is Director of Systems and Technology at ICOT Corporation in Mountain View, California. He has extensive experience in computer communications networks dating back to early ARPANET days and has taught computer simulation courses at Stanford University and San Jose State. Harry Miller is an Associate Editor at PC World.

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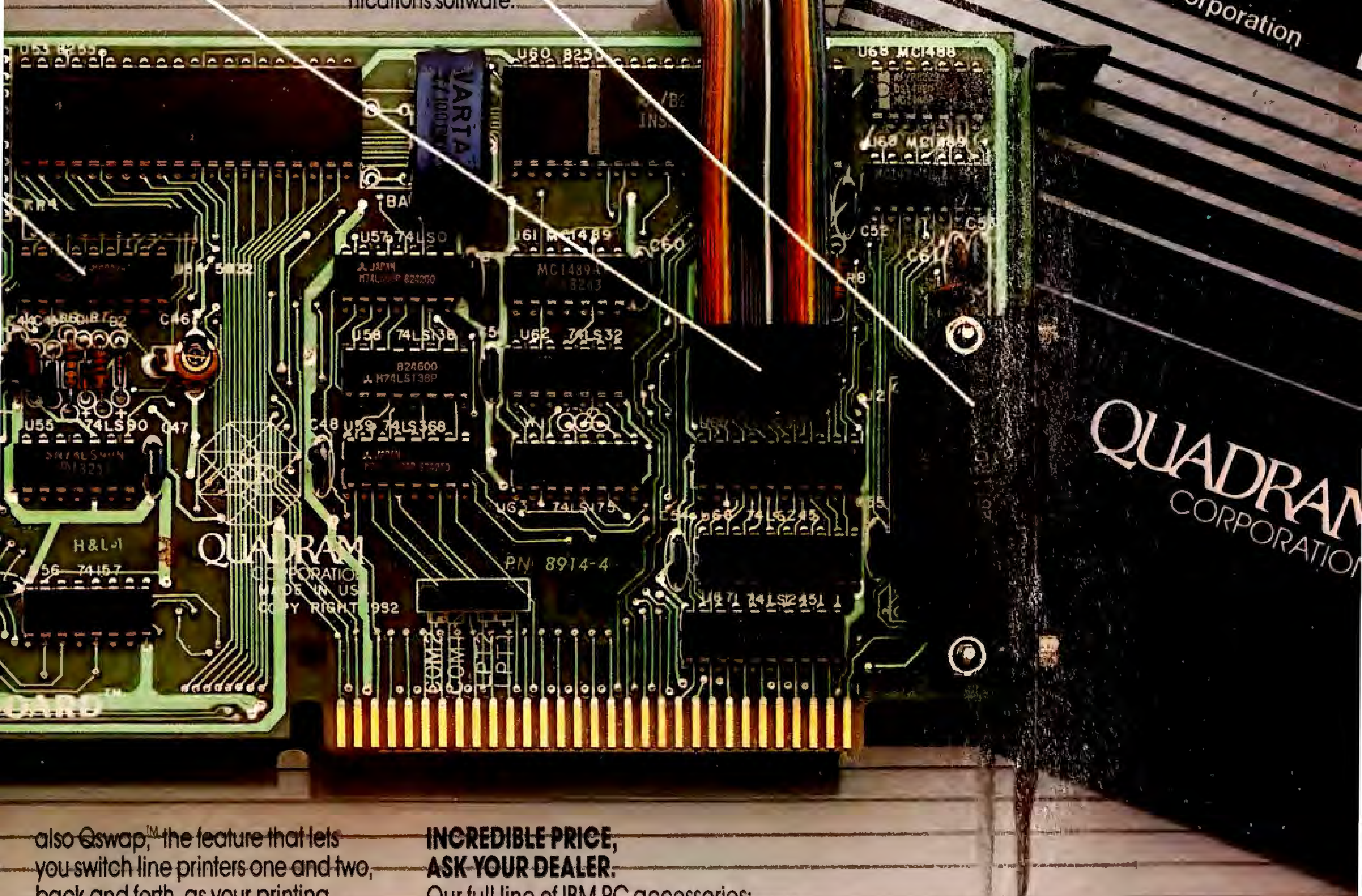

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The Future of Concurrency

PC World talks with Digital Research, creator of the CP/M-86 operating systems.

Edited by Andrew Fluegelman

PC World Editor Andrew Fluegelman and Associate Editors Kearney Rietmann and Harry Miller went to Pacific Grove, California, the home of Digital Research. Dominant in the world of 8-bit computers, Digital Research is working to apply concurrency and program integration to 16-bit personal computing. *PC World* discussed these issues with Gordon Eubanks, General Manager of Digital Research's Commercial Systems Division. The following is an edited version of that discussion.

PCW: Digital Research gained its strong position with CP/M-86 for 8-bit computers. What's the future of your operating systems in the 16-bit world?

DR: During the last 12 months the industry has recognized that with IBM's entry into the market with the 8088 chip there's a different capability in the hardware. We believe, however, that the 8-bit market is alive and well and a viable market. It isn't as though the 8-bit market is going to disappear. We believe the 16-bit market is also a viable market, but with a different set of capabilities. This is something that's really important to differentiate.

So we have to worry about an integrated operating system strategy. We have to be able to migrate between 8-bit and 16-bit and from single-user through multiuser systems, and to have a strategy with which we can network the products together.

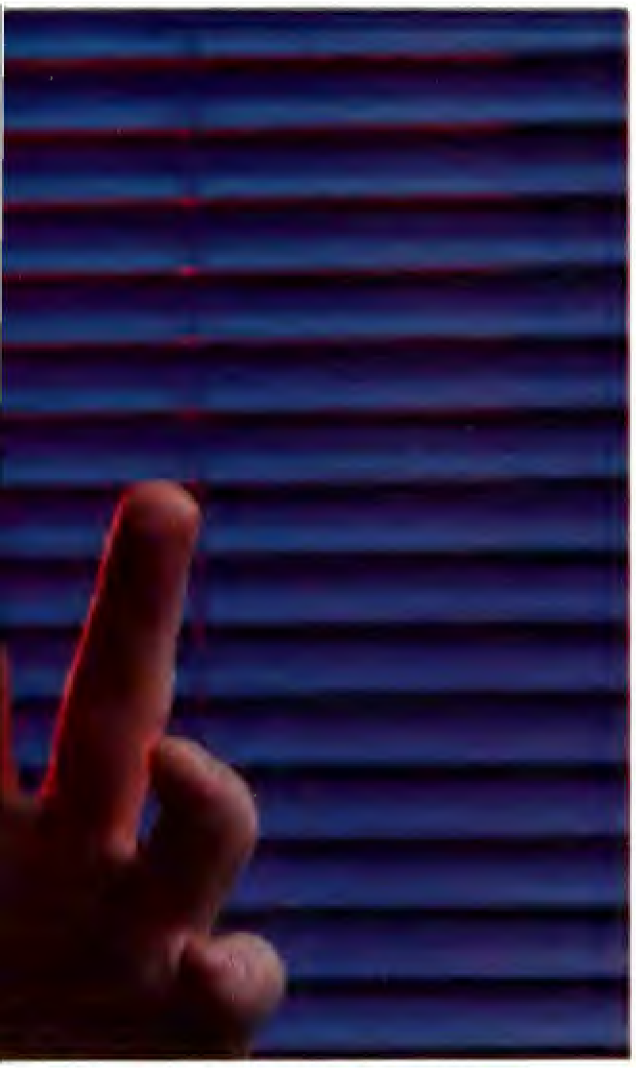
PCW: What's the 16-bit portion of that strategy?

DR: When we look at hardware like the IBM PC or the DEC Rainbow, we see a lot of memory, we see an integrated display, and we see some good graphics—not great graphics yet—but good graphics. Our strategy on the 16-bit systems is to provide an operating environment that takes advantage of the additional memory and the integrated display. And that's where Concurrent CP/M-86 enters the picture.

About 2 years ago Gary Kildall, Tom Rolander, Frank Holsworth—a whole bunch of our technical people—said "Ok, we have CP/M-86 out on the street with a multiuser system, but that doesn't fit the IBM PC at all!" That's how Concurrent came about.

PCW: Can you describe how Concurrent CP/M-86 works?

DR: Concurrent allows you to run several applications programs simultaneously. It lets you do this because in a 16-bit system you've got a lot of memory and you've probably got a video map going right out to the screen. Normally you have your application tell the operating system to put information on the video map via a system call. Whatever is in the video map is then displayed on the screen.



What Concurrent really does, simplistically, is make mirror images of the screens. Then you can have multiple applications working into each of the screens, and you can choose the one that will appear. You have multiple programs using the various screens, and you have a real-time operating system that allows you to maximize the additional memory capability of the hardware.

PCW: Is screen switching the way that things are managed, or are you looking at screen splitting?

DR: Right now on the IBM PC we implement a full screen for each job, or task, that's running. But the operating system is certainly capable of doing windowing or any kind of sophisticated user interface of the four tasks.

Screen splitting would be just fine, except we feel that right now if you try to do it with the IBM PC, you use up a lot of memory. We do know of manufacturers that are designing hardware where the screen may be split—that will open more opportunities for such interfaces.

I think you'd be surprised if you looked at who's going to be shipping CP/M-86 versus who's going to be shipping PC-DOS.

My opinion is that while it sounds great to run four applications on the screen at once, I would rather have the full screen for the application I'm working on, with the status line to tell me when I need to give attention to another one. With Concurrent, it takes just a keystroke to switch to another program.

PCW: I'd presume that concurrency has a great effect on working styles.

DR: Of course it does. The classic situation is when you're in the middle of word processing—writing an article—and someone calls up to send you some information for your data base. You're not going to want to save your article, get out of the word processor, go into telecommunications, receive the data, call up the data base, copy the information in, go out of the data base, back to your word processor, call up the article again, and start writing. You just won't do it—I've found that out.

I used to feel guilty that I never really used computers. I was always using them for development, but switching to another application was just too difficult. With Concurrent you just hit a button and you change applications.

People don't understand that Concurrent is not a gimmick; it's truly multiple tasks running together. It's exciting to see people when they first realize what concurrency can do.

PCW: What do you see as the best applications of Concurrent?

DR: Running four independent programs is just the rudimentary use of concurrency. The next step will be when software vendors use concurrency to get an integrated set of applications working together.

For example, with independent applications you do a spreadsheet and then transfer the information onto the graphics program and create a graph. If you go back to the spreadsheet and change a number, the graph doesn't know you've changed it. Concurrent allows communication between applications, not just through a file system, but through interprocess communications. The operating system supports the ability for programs in memory to communicate directly with each other through mechanisms called queues. They can actually synchronize.

It's not just that you can buy *WordStar, SuperCalc,* and *dBASE II* and run them all on Concurrent. You can do that now—that's what we demo. That's great—they're all fantastic products. But the next step is to have a total environment controlled by the applications, integrated through the operating system. We're seeing that with *1-2-3,* Lisa, and *VisiON.* These products are just the beginning of a trend for highly integrated applications.

PCW: You said four tasks. Is that a technical limit, or a limit you decided on for the present?

DR: There's no technical limit per se, but there's a realistic limit. Each screen you run takes up memory, so the amount of memory becomes a limit. On the PC, if you figure that each program takes about 80K and you have four programs, that's 320K. If you have large programs doing a lot of work, pretty soon you're up to a half megabyte [500K] of memory.

PCW: Once you solve the memory management question, could you put a large amount of memory into your computer, start up the system at the beginning of the day, and let applications run for the rest of the day on their own?

DR: Yes you could, but the real value of concurrency is the ability to interact with the computer. That's what micros have brought to the world. A sophisticated 8086 system with 1 megabyte of memory and a hard disk is very much like a minicomputer or an early mainframe. But what the micro gives you over a mini is total interaction with the computing environment. You get instant update on the screen. Even on a mainframe it would be hard to do *VisiCalc*-type products with a high level of screen intensity.

Concurrent is a natural for an interactive environment because it gives you instant response when switching from one task to another—almost instant gratification.

PCW: You can still keep a calculator next to a computer.

DR: Sure, but you could probably create a good calculator program that runs on your computer. When you wanted to add a few numbers, you'd just hit a button.

But why stop there? Why not integrate applications so you can do the calculation and send the information back to the task where you were? If you're in the middle of a report, and you say, "These numbers don't look right," you ought to be able to add them and put them right into the report.

PCW: You're envisioning the independent software vendors having applications that pass information back and forth interactively. Are you supporting those software developers? When they get Concurrent CP/M-86, do they get documentation that shows them how to do the interaction?

DR: Yes and no. The answer should be, "It's all explained in the program documentation." The answer right now is that we're not doing near what we will do. We are working on a plan to target these independent software vendors and focus on the fact that perhaps they don't know how to produce integration with Concurrent.

PCW: It's one thing to provide an environment in which someone can design an integrated application if they want to do their own graph, spreadsheet, and word processing. But are you going to be able to define the environment enough so that someone could work on just one of those applications and send the information into the operating system so that another application would be able to use it?

> Our strategy on the 16-bit systems is to provide an operating environment that takes advantage of the additional memory and the integrated display.

DR: We're working on that. The first stage will be people running disjointed applications under Concurrent C/PM because there's a definite productivity gain. I think you could sell Concurrent on that alone.

The second stage is that software vendors will see that using Concurrent is an opportunity for them to gain a foothold. If you look at what a program like *1-2-3* does, you can imagine the opportunities possible in developing highly integrated programs.

For stage three we will work very hard to define the data interchanges and file formats to allow people to have separate applications work together.

Right now we have an end-user product called *Graph*, which is an integrative graphing product. It's very nice—you enter data and *Graph* produces bar graphs and multiple graphs, Right now the program takes data from *VisiCalc* and *SuperCalc*. The next release will take data from *Multiplan* and *Microplan*. The process is endless, however, because if a program accepts n formats, there's always $n+1$ that you want it to accept. We want to have the program take the standard format, whatever we call it, and accept it in the *Graph* program. That's the third stage.

PCW: Will your "stage three" really benefit the independents?

DR: Let's face it, while many companies have integrated packages, most companies have only one or two real winners. If you get to stage two and never get to stage three, all you do is shut out the garage shop programmers, because they think, "Hell, people want integrated applications. I could do a great spreadsheet, but I can't do all the other applications." So the industry as a whole benefits from a standard interchange. The problem is to get all the big people—large companies that don't necessarily benefit quite as much—to agree on the format.

PCW: Can you accomplish that?

DR: That's something Digital Research can show leadership in, because we don't take the position that we're going to be a sole source of products. We will be involved in developing operating systems, languages, and applications—we will be working in all areas. We will show leadership in standards, but we are not—I'd like to say arrogant—dumb enough to say that we will be a sole source of software in what's going to be a multi-billion-dollar industry. We want to encourage standards, and we will be successful if we can help define them.

PCW: From the user's point of view, what do you see the market looking like over the next several years? Do you see people making use of a number of operating systems for different tasks, or do you think that there will be different segments of the user industry—a certain group of users using one system, a certain group using another?

DR: My guess is that suppliers of applications will settle on certain operating systems. There'll be a large base of CP/M, a large base of PC-DOS, and a large base of UNIX. But I don't see users thinking particularly about operating systems. They'll use the computer to solve specific problems. They may switch operating systems, but they won't consciously think about it. They might say "I'm going to do a spreadsheet." Their spreadsheet might happen to run under CP/M-86, but they won't think about that.

For instance, when we sell our LOGO product, it will be shipped with the operating system on the disk. You'll just plug LOGO into the PC and it will come up running CP/M-86; that fact will be irrelevant to most of the users who want to learn about computers through LOGO. Later, if they want to get more advanced and take a look at files or use other languages, they will have a standard CP/M file system.

PCW: There's a lot of interest in DR LOGO. What's the release date?

DR: It will probably be on the shelves in July.

PCW: You're going to get a lot of people trying LOGO when you come out with it, and you say CP/M-86 will be on the disk. So they'll just boot up and be running CP/M. Will they then have that operating system available to them, or will it be so integrated that it won't stand alone?

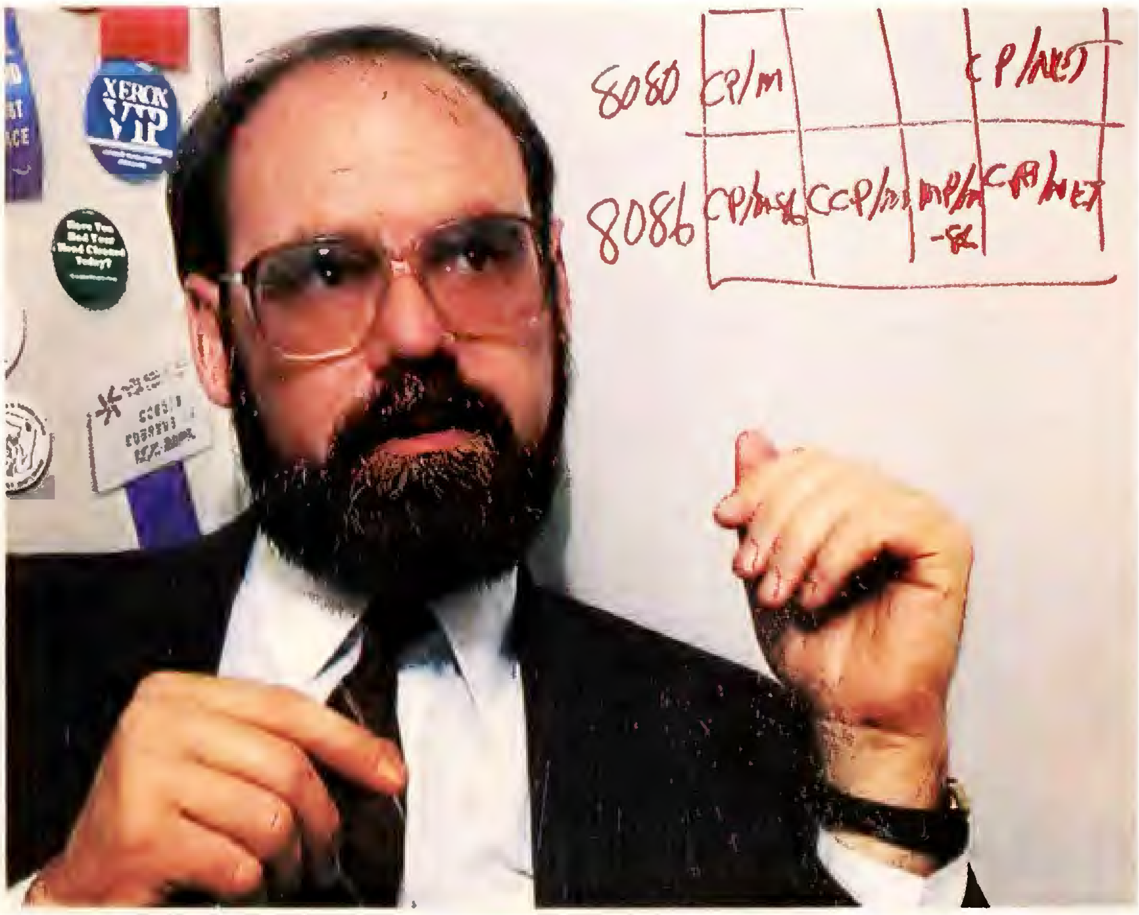
DR: It depends on how much they know. CP/M-86 on the LOGO disk will be stand alone enough that someone can actually stick a disk in, load a drive, and run another application. Generally, with CP/M-86 priced at $60, people buy products so they can get the user manual, support, and everything else. The point is not to put CP/M on the market. The intent is to look at the market that LOGO's targeted at and lower the resistance people have to getting used to a new product, to using computers.

You know, Gary Kildall has a real interest in getting people away from thinking in computer terms. He is really into that—how do you get kids into computers? How do you get people to feel good about computers? LOGO is a very interactive language. Gary has a good way of explaining it. He'll say, "Now this is a turtle and I'm moving it around." But of course you can't talk about turtles with businessmen, so it becomes a pointer.

For the person who really wants to get involved, he built in interactive debugging with windows. In one window is the LOGO program where you can edit; in another window you can interactively debug the program; and another window shows the output.

PCW: Is LOGO a language that people will build applications software on, or is it just something people will program?

DR: Both. I think people could do applications. LOGO's not going to run as fast as some languages, but you can definitely build applications under it.



PCW: What kind? Traditionally, LOGO's been used in education.

DR: You can build almost any kind of business graphics. Gary gives demonstrations with business graphs. Personally, I think LOGO is very powerful, but it's so powerful that it isn't that much easier to use than BASIC. Gary and I kid each other about that. LOGO's a very sophisticated language with a great deal of extendability. You can define little routines and make them part of your LOGO and build on that. It's really a very user-friendly LISP in disguise. We think LOGO will be extremely successful for Digital Research, but we also hope that it sets some trends in education. We see a tremendous school market for LOGO.

PCW: Let's look at the IBM PC market, which is not the only market, but it's the one we write about the most. The fact is that right now if you go to a user group meeting and ask how many people are running a Digital Research operating system, only a small percentage of them are doing so.

DR: It's incredible, though, that it's a noticeable percentage— that you can actually count the hands when they raise them. If you think about it, the fact that we've got 4 or 5 percent penetration is incredible, considering we have just launched a major retail program aimed at the IBM PC market.

PCW: What do you think explains your current market share?

DR: It's based on the fact that IBM decided they wanted everyone to use PC-DOS by having all IBM applications on PC-DOS. We're working very hard with IBM on a number of levels, but IBM is not the only market. You see, your magazine is *PC World*, but it's not IBM PC World, and I predict that within 6 months you'll have a DEC column, or at least coverage of the DEC.

PCW: Interesting.

DR: I talked to the product manager for the DEC Rainbow recently, and he gave me the ship rates, which I cannot give you, but which astounded me. And the Rainbows are all running CP/M-86 as the shipped operating system.

PCW: But they announced it over a year ago. They've been back ordered for a year.

DR: They did have some trouble getting the Rainbow out, but they have just begun volume shipments, and it's a damned nice machine.

I think you'd be surprised if you looked at who's going to be shipping CP/M-86 versus who's going to be shipping PC-DOS. Microsoft says that the whole world is buying MS-DOS—that everyone is going to be shipping it. We don't feel that the world is that way at all. We have over 120 CP/M-86 contracts—more than twice the number Bill [Gates of Microsoft] reports having.

> We're very optimistic that 6 months from now your magazine will be looking at PCs in a totally different way.

We see that the use of CP/M-86 is going to increase, and that there's a level up to which IBM can ship only so many PCs a month. They're shipping a lot—30,000 or so. We feel that 12 months from now we can reach more than parity with MS-DOS with the contracts we have in the bag today, and that does not include our expected penetration of the IBM market.

We're very optimistic that 6 months from now your magazine will be looking at PCs in a totally different way than you're looking at them now. And it has nothing to do with IBM. IBM's done a fantastic job. The PC is not a record-setting machine, but it's a good machine, it's well-positioned, it's well-supported, and it will be here for a long time. But so will DEC, so will NCR, so will Sony, NEC, and Fujitsu. Fujitsu is the largest computer company in Japan. They totally endorse Concurrent CP/M for the 8086.

PCW: Is Concurrent their only operating system?

DR: Either CP/M-86 or Concurrent CP/M is the operating system they ship, and they are the ones DEC and NEC are shipping.

PCW: Will all these machines be compatible in the sense of data compatible, program compatible, graphics compatible, and keyboard compatible?

DR: They won't be keyboard compatible. We believe, however, that in terms of being data compatible and object code compatible, CP/M-86 has the best compatibility track record.

PCW: And how do you see CP/M-86's position in the personal computer world?

DR: We believe that people who are configuring systems are going to need functionality, networking, and concurrency. We think this will lead people to choose our underlying system software because it's got the technological lead. We've never had anyone say that concurrency is not the right technology for the 8086. If it weren't for IBM shipping PC-DOS, it would never be an issue.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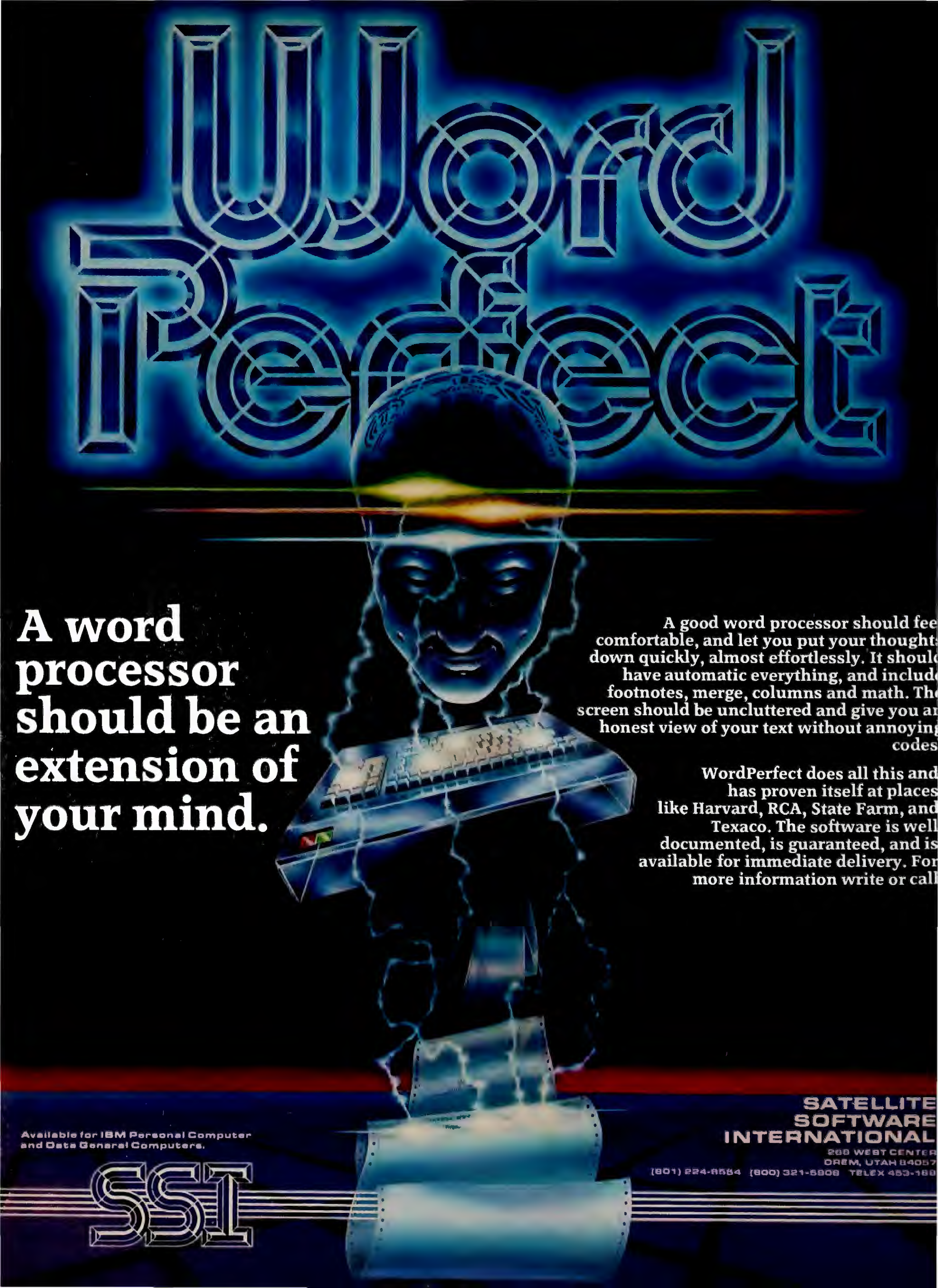
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PC WORLD View

News and Notes for the Computing Community

Miriam Medom

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

Grapevine

Color to Come?

Now that IBM's color monitor is brightening up the PC and XT, a few of our clandestine correspondents have taken a close look at this device. Their findings: the tube inside the monitor is made by sometime-IBM-rival Hitachi.

Another observer noted that the IBM color display has a switch that is capable of increasing the resolution of the device. Our correspondent interprets this presently unused capability to mean that IBM may be preparing a new and better color graphics board for the PC and XT.

Pastries and Pinstripes

IBM's announcement of the XT was a major event, and we joined about two dozen computer journalists to learn about the new machine and to verify or debunk the rumors we'd been hearing for months. By now all the details of new hardware and software have been confirmed and interpreted, and the predictions of sales figures and market effects have been made. But what about the really important stuff? What kind of spread does a multinational corporation put on for a Tuesday morning press conference?

Well, for its San Francisco celebration of the XT, IBM chose the elegant but slightly ostentatious

surroundings of the Hyatt Regency Hotel. The press met XT in the Fountain View Room, which can only be reached by walking through the hotel's large atrium lobby with its flowing-stream fountain and half acre of potted fig trees. As the members of the press arrived in ones and twos, they were directed to a side entrance of the conference room, where they were greeted by several cordial IBM representatives. Two XTs with color displays and two 19-inch Sony color TV sets were spread out in the room beyond the foyer, where a few more IBM people chatted with the press and watched a continuous demo program about the XT.

Back in the foyer, where the first item on the day's agenda was food and drink, waiters wheeled in carts with coffee and tea, Danish pastries, and a large mound of cut melon and other fresh fruit. Not surprisingly, the journalists hit the coffee more heavily than the food, though they did a respectable job on the sweet stuff, too.

Most of the guests grasped the coffee cups as daintily as possible and moseyed into the conference room. Even without their cups the guests were easily distinguishable from the hosts because every one of the nine IBM representatives wore the company color—blue. With one exception, the hosts (eight men and one woman) wore navy blue suits in understated stripes or solids; the exception, a programmer, wore a light blue plaid sport coat and dark slacks. He also answered more questions than anyone else in the room.

So much for food and fashion. The only other noteworthy event of the day (excluding the XT, of course) was the stir our colleague John Dvorak (editor of *InfoWorld*) caused with his NEC 8201 lap-sized computer. (This machine is not sold in the United States, but it is quite similar to Radio Shack's new portable, the TRS-80 model 100. As soon as the presentation was over, about half the room crowded around John to see the little battery-operated machine he'd been taking notes with. And at least half the bodies around John were wearing navy blue.

It's in the Box

Now it can be told. Authorized PC dealers were shipped an XT in advance of the machine's announcement, but they were cautioned to keep it under wraps. To wit: accompanying the XT's components were memos from the corporation labeled

IBM Confidential and stating that the XT must be stored in a locked room, that only the store manager could open the box, and that absolutely no mention could be made of the product's existence before it was announced by IBM.

Blissful Giving

The wedding season is upon us, and a new wrinkle in gifts for brides and grooms has appeared. Many contemporary couples are not registering for wedding gifts of the traditional sort, such as china, silver, and linens. Instead, they are signing up with their favorite computer dealer and letting friends and relatives know what electronic baubles they want, to celebrate their matrimony.

The good part of this new trend is that since both members of such couples are likely to be interested in their computer(s), neither will become a computer widow or widower. The bad part is that should they get divorced, there will be more high-tech property to fight over.

Big Blue's News

PCs Spread Out, Beef Up

IBM recently announced expansion of its network of authorized PC dealers to 770 stores, more than double the number of dealers doing business a year ago. And those stores will all be selling a technically new PC; the minimum configuration for a PC is now 64K of RAM, expandable to 256K on the motherboard (using 64K memory chips).

Looking for Mr. Goodchip

In a move predicted by industry observers, IBM has begun to offer on-site service for the PC. At present only large-volume users who buy their PCs directly from IBM may subscribe to the service; rates have not been announced. The service will be offered on a yearly contract basis and will cost approximately 25 percent more than the rates for courier pickup and delivery now available to IBM customers in major metropolitan areas. On-site service is currently offered in 38 cities where IBM maintains service and exchange centers; that number will be expanded to approximately 100 cities in the future.

In addition, IBM is reducing rates for courier, carry-in, and mail-in service for the PC by 10 to 18 percent, depending on system configuration. Both on-site and off-site service is available only for IBM components; non-IBM boards or peripherals will have to be fixed elsewhere. Thus, dealers who service all manufacturers' components and service-only organizations such as Sorbus (*PC World View*, Vol. 1, No. 2) are still likely to have plenty of fix-it business.

High School Giveaway

In an effort to improve computer education in secondary schools IBM will donate 1500 PCs to 84 public and private high schools in New York, California, and Florida. This $8 million program will offer grants to a dozen institutions in those states to provide computer instruction to teachers and students. IBM has named Educational Testing Service (the Princeton, New Jersey, firm best known for its Scholastic Aptitude Test) to help select the schools that will receive free computers.

IBM chose the three states for this program, a spokesperson said, because their schools include a broad cross section of ethnic and economic populations, and because IBM has major facilities in each of those states. The participating schools will be selected in coming months, and teachers will be trained in time for the program to begin next fall.

Higher Tech, Higher Ed

A relative newcomer on the PC products scene has been selected to supply add-in processor boards for a campus-wide computer system at Carnegie-Mellon University in Pittsburgh. The firm, Sritek, Inc., of

Cleveland, will manufacture and deliver its board, which includes both a 68000 microprocessor and the Xenix operating system, for use in several hundred IBM PC XTs slated for use at Carnegie-Mellon. At least 100 of the Sritek-enhanced XTs will be in operation at the university by this fall.

Carnegie-Mellon previously signed an agreement with IBM to develop and implement a "comprehensive computing environment" on the campus. The network of XTs with 68000 processors and Xenix (the Microsoft implementation of the Unix operating system) is intended to serve as an interim stage in this development process.

The XTs will be used in two ways at Carnegie-Mellon: as stand-alone computers and in small-scale networks that share a hard disk. The university will also allow faculty, students, and employees to purchase the enhanced XT at the bulk discounts it enjoys.

GE Rents

General Electric has seen the light, so to speak, and has begun renting computer systems to its business customers. At present GE has some 100 computers in circulation, including the PC and the XT, as well as three Apple and two Hewlett-Packard models. The company also provides peripherals and software for the systems it rents. Last year GE arranged to purchase $10.5 million in PC products from IBM; no doubt some of those machines have joined the rental fleet.

A General Electric spokesperson noted that the majority of rental systems will be placed with business and industrial customers, but individuals may qualify as renters if they pass a credit check. Additional information about the GE program is available from the company's headquarters in Schenectady, New York.

Instant Edification

In an appropriate demonstration of the virtues of electronic mail, *PC World* Contributing Editor Larry Magid recently spread the word about the IBM XT. Within hours of IBM's formal announcement and demonstration of the XT, Magid filed a 2000-word story about the new computer on The Source's *Real Times* electronic magazine. Magid garnered the details in San Francisco and sent his article by modem to the *Real Times* editors in Montreal, who immediately posted it in their electronic periodical on The Source. Although electronic publishing is not as lucrative as writing for the print media, Magid points out that he had the satisfaction of being the author of the first published information about the XT, and he got instant feedback from readers in his Source mailbox.

Computer Slanguage

It's hard to avoid reading, hearing, or speaking the words computers have added to everyday language, whatever your opinion of their impact. I still shudder every time I hear *access* used as a verb, though I take some comfort in the fact that the chief grammarian in my early life, my eighth grade teacher, is no longer around to shudder with me.

Still, computerese has produced a few amusing moments; we'd like to hear about them and pass them along. Here are two bits of slanguage that wended our way.

An old typing test has been updated for the computer age; the new version reads: Now is the time for all good men to come to the aid of the parity.

A civil court judge recently added a new phrase to the legal lexicon. It seems that a woman suffering from persistent errors and complications with the computer records of her Visa card sued for redress of the damage done to her credit rating, reputation, and personal life. In a laudable expression of solidarity with human beings harassed by computers, the judge awarded the woman $200,000 and described the episode as "computer-hearted" treatment of the victim.

Mystery of the Month

Michael J. O'Connor, owner of two PCs, contributes this fascinating and elusive tale.

When I recently purchased my second IBM PC, I was pleased to find that the newest model uses 64K RAM chips on the system board. This allows up to 256K of RAM to be installed without having to buy a RAM expansion card. My first PC, purchased nearly a year ago, uses 16K RAM chips, so the system board is limited to 64K.

The day the new system was installed, I loaded *VisiCalc* and was greeted by a singing worksheet. At first I thought there was a component failure in my Amdek V-300A monitor (the high-pitched whistle sounded like a TV set with a bad flyback transformer). Unplugging the monitor, however, did not discourage *VisiCalc*'s song. Further investigation pinpointed the sound as coming from the PC's built-in speaker.

Experimentation uncovered these clues:

Only *VisiCalc* sings. *dBASE II*, *WordStar*, *Typing Tutor*, and *TAX-CUT* are all mute.

VisiCalc sings only when a worksheet is on the screen. Scrolling with the cursor keys modulates the otherwise steady whistle to produce a chirping sound.

Moving the cursor using either the GOTO command or the Home key produces momentary silence. Likewise, *VisiCalc* is silent while the worksheet is being recalculated.

I visited a ComputerLand store and tried the program on several PCs. Those with 64K chips on the system board sing; those with 16K chips do not. The type of monitor, monochrome or color, makes no difference.

So there you have it—a mysterious interaction between software and hardware. It might be deduced from the fact that VisiCalc *can't calculate and sing at the same time that it sings a mindless song. Can anyone produce the culprit or a fix?*

PC World View *welcomes contributions from readers, and we'll pay up to $50 for the items we use. Please include your name, address, and phone number with your contributions. Send them to* PC World View, PC World, *555 De Haro St., San Francisco, CA 94107.*

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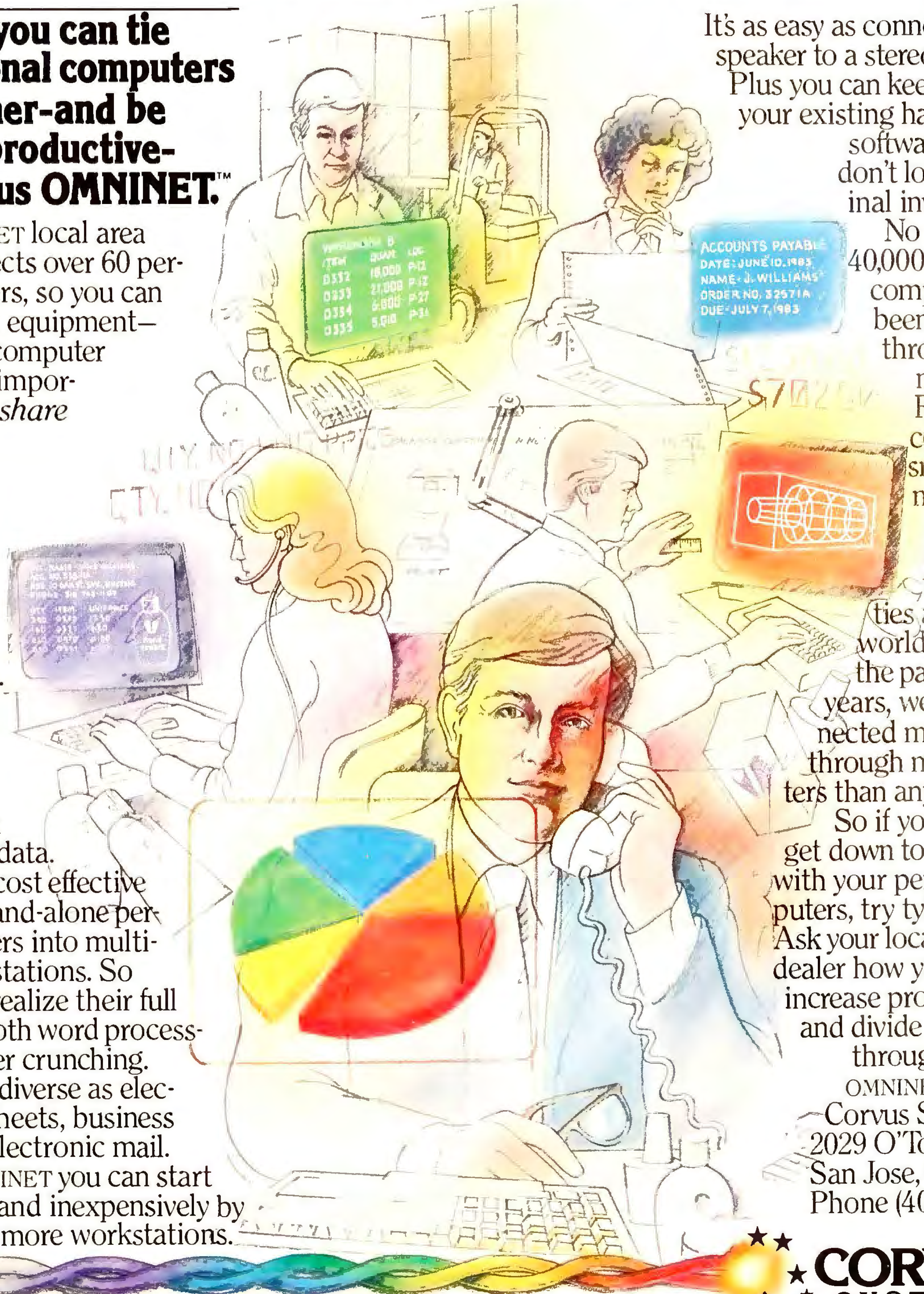

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No wonder over 40,000 personal computers have been connected through Corvus networks in Fortune 1000 companies, small businesses, professional offices and educational facilities around the world. In fact, over the past three years, we've connected more people through microcomputers than anyone else.

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CORVUS SYSTEMS

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*OMNINET currently ties together Apple II, Apple II CP/M, Apple III, IBM PC, and the Corvus Concept,™ and soon the NEC PC8001, DEC VT180, Zenith Z89/90 and Z100, S-100 bus computers, and TI Professional Computer.

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Way back in 1534, a Venetian scholar wrote a text that standardized the techniques of modern bookkeeping. And up till 1979, there weren't a lot of real improvements in the way people did spreadsheets. You still had to enter all your figures by hand. Run all the totals yourself. And when you had to make a few changes, you had to run the totals all over again.

Then along came a program that let you create spreadsheets on a personal computer. Without touching a pencil. Or adding anything by hand. Best of all, this new program gave you the freedom to look at your balance sheet a dozen different ways if you felt like it. Because all you had to do was change one figure, and the computer would refigure everything else for you. Automatically.

Like most breakthrough ideas though, this original spreadsheet program had a few things that definitely needed improvement. For instance, all the columns had to be the same width. And the entire system took about 20 hours to learn.

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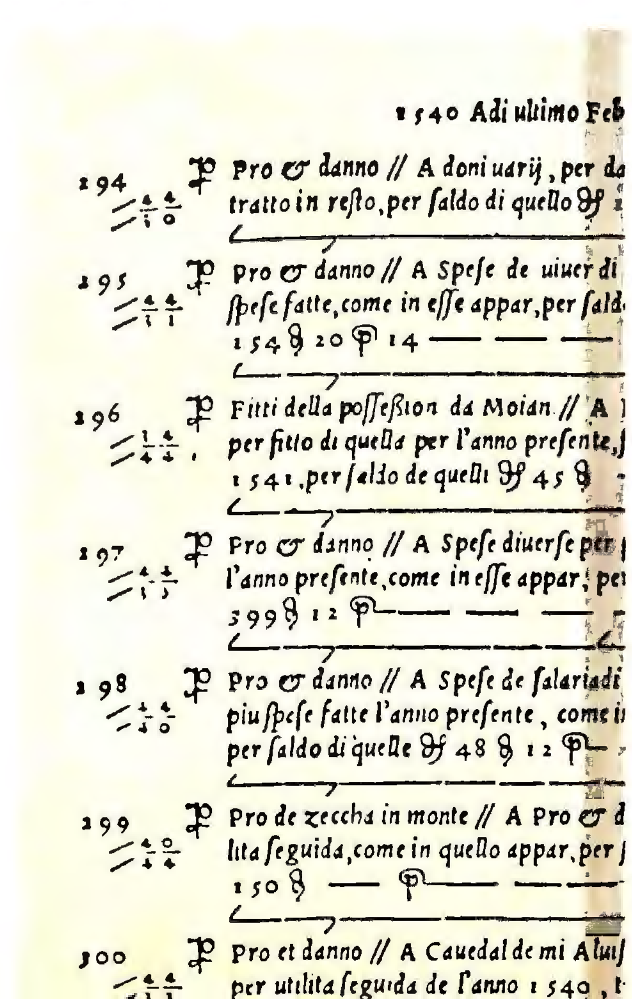
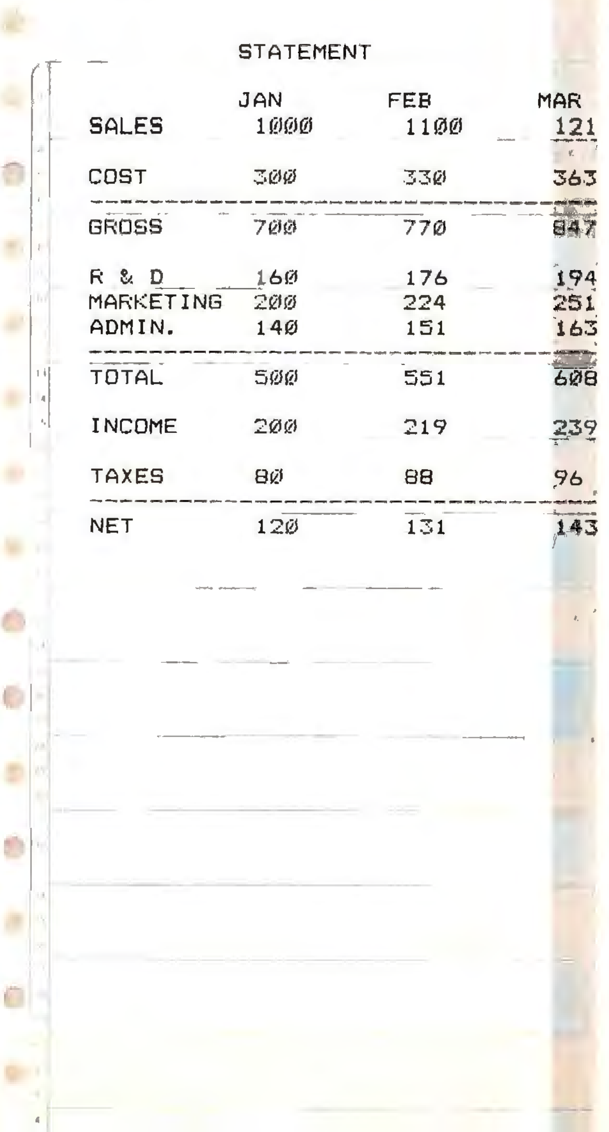
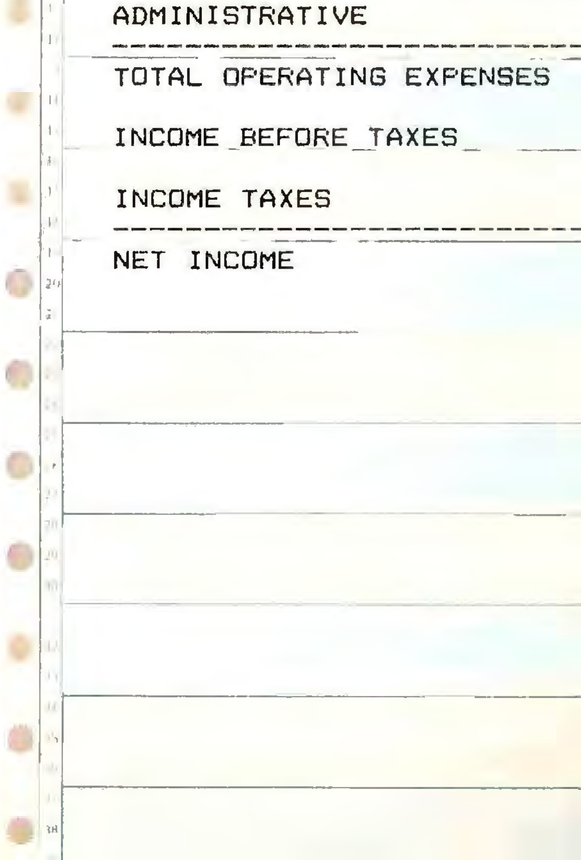


1979



1981



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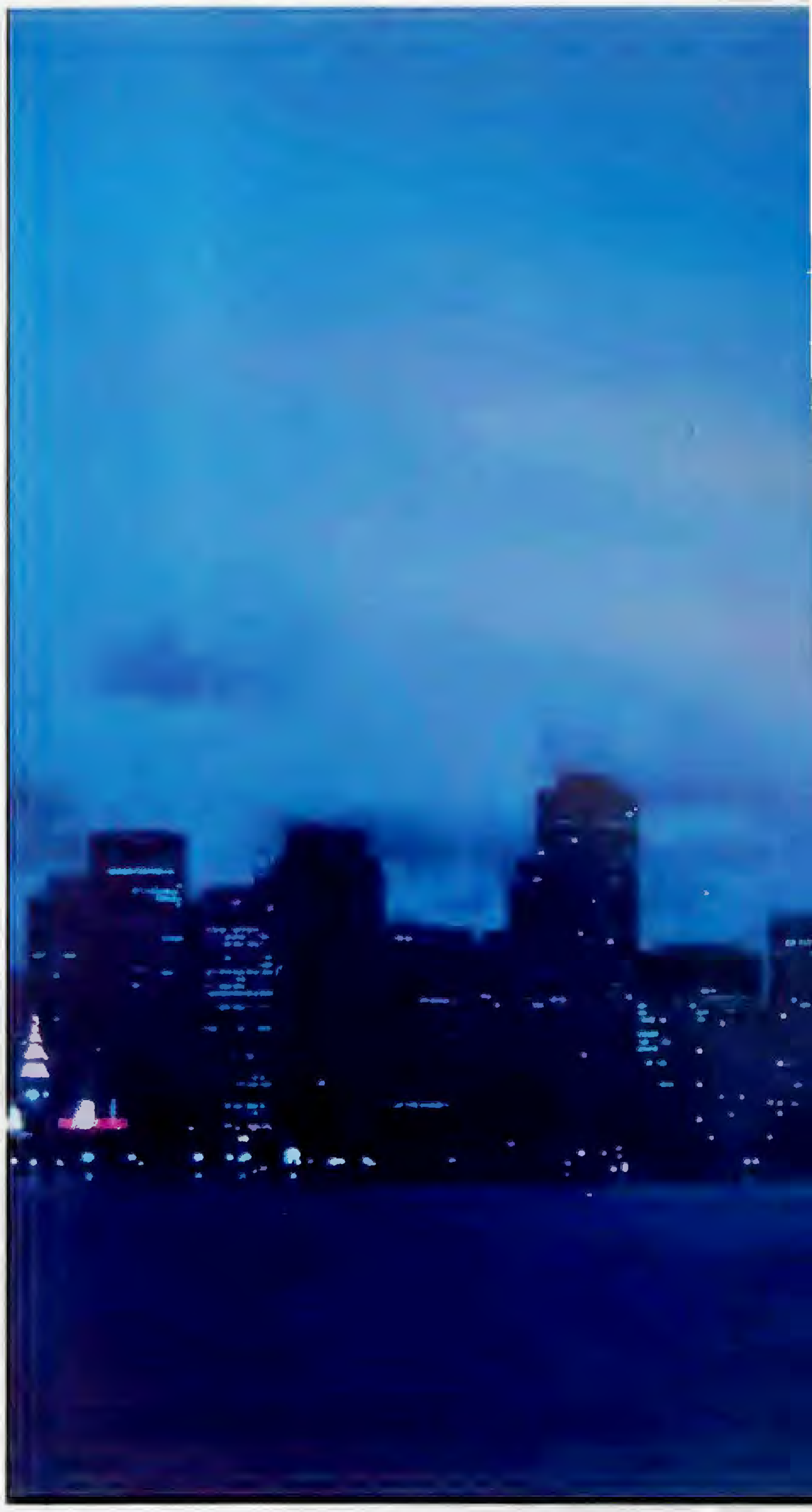
Faster than a Spinning Floppy

Steven Cook

One of the first objections voiced about the IBM Personal Computer concerned the capacity of the disk drives relative to the amount of RAM. "What are you going to do with more data in memory than you can store on a disk?" was a remark frequently heard from detractors intent on finding a Big Blue blunder. But the PC community was quick to answer that question, showing the critics that "excess" RAM has all kinds of uses. One of the most versatile uses is emulating disk drives.

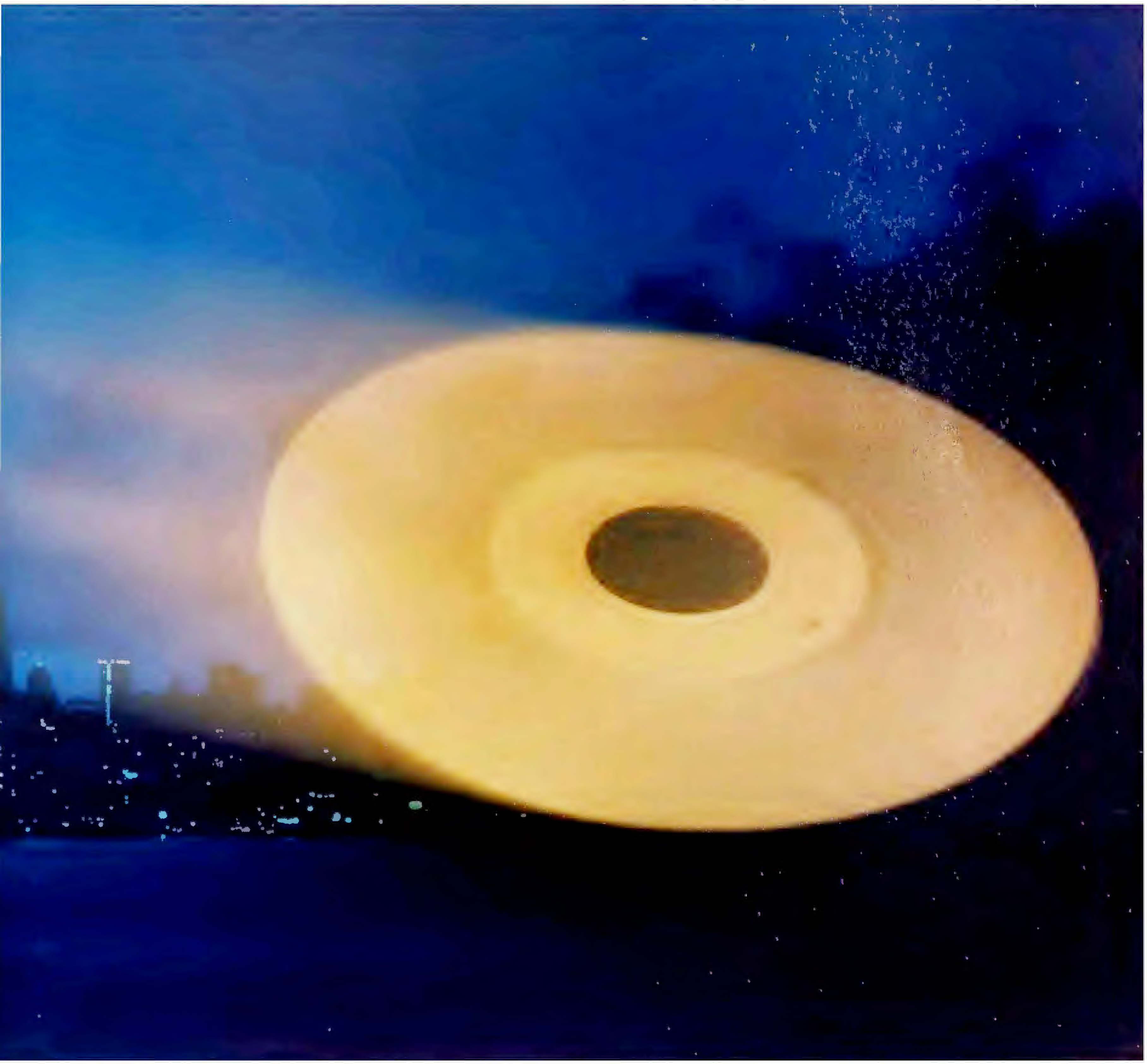


Disk emulation is implemented with a program that causes the DOS to treat an area of memory as if it were a disk drive. When the DOS writes data to the emulated disk, the data goes into memory instead. Likewise, when the DOS reads data from that disk, the data actually comes from memory, formatted to appear as if it came from a real disk.

Many terms are used to describe disk emulation programs; they are called RAM disks, E-disks, memory disks, C-drives, pseudodrives, and hyperdrives. The term E-(for emulated) drives will be used in this article. Regardless of the name, the result is the same: speed. Because no moving parts are involved, data exchanges between programs and E-drives occur almost instantly, typically 50 times faster than with floppy disk drives.

This tremendous speed advantage is partially offset by the potential for an equally rapid loss of information in the event of a power failure or system crash. In such cases data stored on floppy disk remains intact, but information in RAM is lost forever. Due to the proliferation of E-drives and the danger of losing data, battery operated standby power supplies are becoming increasingly popular (see "Battery Backup").

A number of E-drive programs are available for the PC. Some may be purchased as separate software products, while others are included with the purchase of a



RAM board. RAM board manufacturers offer the software as an incentive for buyers to select their product, and this can be a powerful inducement if the E-drive has more features than programs offered by competing companies. You should consider this when you select a memory board, but remember that you might be able to purchase an E-drive separately and obtain the same features at lower cost.

By nature, E-drive programs create a nonstandard version of DOS. Carefully written E-drive software minimizes the differences, but there is no way to avoid the fact that E-drive programs create incompatibilities. If you want to use a hard disk drive and an E-drive at the same time, you may be out of luck because the hard disk and E-drive programs are probably mutually exclusive. The only exceptions are E-drive programs provided by hard disk manufacturers. As discussed later, MS-DOS 2.00 is designed to prevent these incompatibility problems.

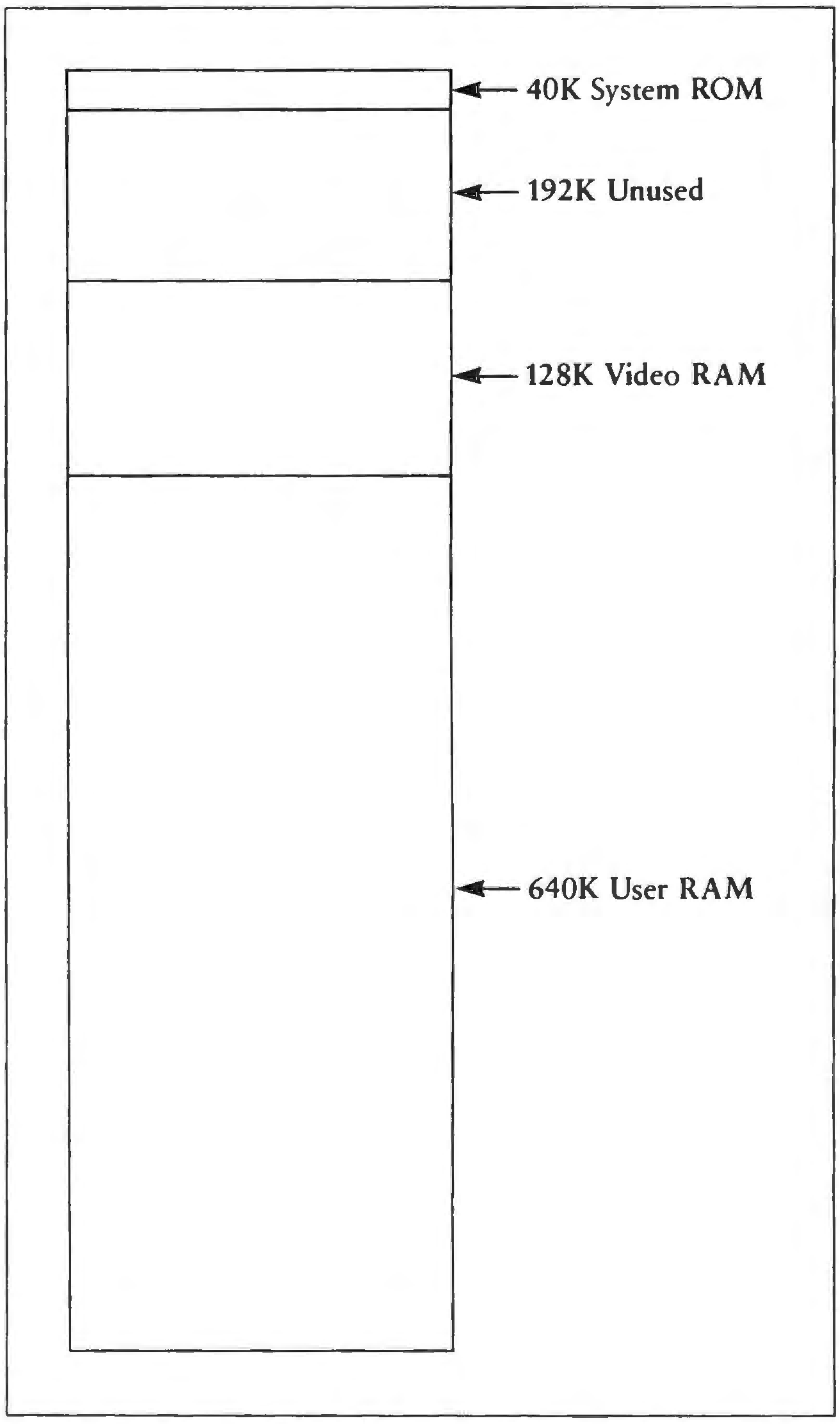


Figure 1: System Memory Map

Product	SuperDrive 3.0	PC Accelerator
Manufacturer	AST Research	SBT Systems
Drive designation	A–D	A–D*
Drive size (K)	4–640	10–320
User memory	Yes	No
Short drives	Yes	Yes
Max # of drives	4	1
Replace drive	Yes	No
Insert drives	Yes	Yes*
Modify DOS	No	No
Spooler	Yes	Yes
Autoexec	Yes	Yes
Low memory	Yes	Yes
High memory	Yes	Yes
Noncontiguous	Yes	Yes

*With the aid of SWAP program included
**Drive D will be replaced if present

Table 1: Comparison of E-drive Program Features

E-drive Features

Ideally, E-drive programs should be designed to operate on any PC, regardless of memory size or configuration. The fewer assumptions program designers make, the more flexible programs will be. Flexibility pays for itself each time you change the configuration of your PC or acquire new software, but it can also mean a lengthy and complex installation. The best programs have default conditions that are used unless you specify differently.

Following is a discussion of various E-drive features. For an overview of the features of several E-drive programs that were submitted to *PC World* for review, see Table 1.

Drive designation. In PC-DOS, disk drives are referred to by letters, usually *A* and *B* on a two-drive system. When additional drives are added they are assigned the next letter in sequence up to the letter *D*, which is the limit of DOS 1.10. A good E-drive program allows you to specify which letter will be used to refer to the E-drive, even beyond the normal DOS limit.

Drive size. DOS 1.10 supports two types of disk drives, single-sided and double-sided. Single-sided drives can store 160K bytes, double-sided drives 320K. In addition to standard single- and double-sided sizes, some E-drive programs let you specify the exact number of bytes to be allocated for disk emulation.

User memory size. When memory is used to emulate disk drives, it is no longer available for use by programs. You may want to reserve a certain amount of memory for use by programs and let the remainder be used to emulate disks. Some E-drive programs allow this (*JFORMAT*, for example), but most require that you specify the exact size of emulated disks, leaving the remainder available for program use.

QuadRAM Drive	RAM Drive	Ultrafast	Electronic Disk	JFORMAT	SpeedDisk	InstaDrive	PDQ
QuadRAM	Microsoft	Daystar Systems	Ensign Software	Tall Tree Systems	Tecmar	Persyst	Xebex
B–D	C–E	A–D	C–D	A–F	A–Z	C	B–E
32–320	64–320	5–322	4–320	64–2560	64–512	4–320	32–320
No	Yes	No	No	Yes	No	Yes	No
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1	1	4	2	1	2	1	1
Yes**	No	Yes	No	Yes	No	No	No
No	No	No	No	Yes	Yes	No	No
No	Yes	No	No	Yes	Yes	Yes	Yes
No	No	No	Yes	Yes	Yes	Opt.	No
Yes	No	Yes	Yes	No	No	No	No
Yes	No	Yes	Yes	Yes	No	Yes	No
No	Yes	Yes	No	Yes	Yes	No	Yes
No	No	Yes	No	No	Yes	No	Yes

Short drives. This feature refers to a program's ability to emulate a disk even though the system might not have enough memory. Disk sectors that cannot be emulated due to lack of memory can be logically marked as in-use and will not be assigned to files you create. All the E-drive programs listed in Table 1 support short drives.

Number of drives. If your PC has enough memory, you may want to use two or more E-drives simultaneously. This would be especially handy if, for example, you needed to sort a file that was over 160K bytes long. With only one E-drive, there would not be enough room for two copies of the file (unsorted and sorted). The best E-drive programs can emulate more than one drive at a time.

Replace existing drives. Some applications programs require all data to be stored on drive B; no way is provided to inform the program to use an E-drive called drive C. In this situation, the ability to emulate a drive in place of drive B is very useful. Some E-drive programs allow replacement of physical drives, enabling you to trick an applications program into using an emulated disk.

Insert drives. This feature lets you logically place an E-drive between existing drives, changing drive designations automatically to make room for the new drive. For example, inserting an E-drive as drive B would cause the real drive B (the floppy drive) to become drive C. If the system had a third floppy disk drive, it would become drive D. You could also insert an E-drive to be defined as drive A.

Modify DOS. Some E-drive programs modify the DOS that is stored on the disk you use to start the computer. The major disadvantage of this technique is that you must place the nonstandard DOS on every disk you use to start the computer. Programs that do not modify the DOS stored on the disk allow you to start the computer using any standard DOS disk and execute the E-drive program, even if it is stored on a different disk.

By nature, E-drive programs create a nonstandard version of DOS.

Another problem with this kind of disk emulation program is that the E-drive is always present, using memory that might otherwise be available for your programs.

Print spooling. This feature has nothing to do with disk emulation per se, but it is a useful addition to the computer and is often included with E-drives. Print spooling software intercepts data sent to the printer and stores it in memory at high speed. It simultaneously forwards the data to the printer at the slower rate printers require. The result is programs finish "printing" very quickly, enabling you to use the computer for other tasks.

AUTOEXEC capability. The most practical way to use an E-drive program is to place the proper command into an AUTOEXEC batch file so that the E-drive is

A Short Course in Disk Emulators

Larry Press

The design of a computer system or program involves many trade-offs. One of the most fundamental trade-offs is between memory size and execution speed. Generally speaking, speed can be increased by using more memory, or memory can be saved by sacrificing speed.

Since memory prices are falling rapidly and the IBM PC is able to address more than 1 million bytes of memory, we can look forward to increased memory capacity and faster computers. In fact, multitasking operating systems such as Concurrent CP/M and *Visi/On*, and integrated software packages such as *1-2-3* and *MBA* are designed to achieve speed by using large amounts of memory. But these products are just arriving in the marketplace and they are largely untested. In the meantime, there is an abundance of software already on the market that was designed for relatively small memories.

While multitasking operating systems with dynamic memory allocation may become the standard in personal computers someday, disk emulators are with us today, and using them provides immediate results. Disk emulators not only improve the execution speed of individual programs, but also cut the time needed to make the transition from one task, such as editing a document, to another, such as running a spelling checker or updating a file.

Disk Emulators

A disk emulator is a program that modifies the operating system so that part of the computer's memory can be used as if it were a disk. The emulator divides the system's memory into two sections. One section holds the operating system and whatever applications program is running. The second section of memory is used to emulate a disk drive.

When a program needs to read or write a disk file, the disk emulator performs a little sleight of hand. The instructions to read or write the disk are intercepted and the data transfer takes place between the two sections of memory, rather than between the actual disk drive and memory.

This saves time because transferring a file from one portion of memory to another is faster than transferring a file between memory and a disk. Reading or writing a disk may seem fast, but since a mechanical operation is required, it is slow by computer standards. In contrast, moving information from one portion of memory to another requires no mechanical operation; it is purely electronic.

How Much Faster?

To get an idea of how much emulated disks speed up the operation of programs and the transition between tasks, I tried some simple experiments using a PC with 576K of RAM and several disk emulation programs. The following comparison shows the execution times for three jobs using disk emulators and conventional double-sided floppy disk drives.

Task	Floppy Disk (min./sec.)	Emulated Disk (min./sec.)
Pascal compile	6:38	2:42
File copy (84K)	0:14	0:01
Spelling check	2:34	1:07

As the results indicate, the disk cut execution time by more than 50 percent in each test. The Pascal program that was compiled was 306 lines long and consisted of ten short procedures. The file copying was done using the DOS COPY command to copy an 84,000-character file. The spelling check example was run using MicroPro's *SpellStar* program to proofread and mark a 19,328-character (2893-word) document. I repeated the tests several times using different disk emulators, but since the programs' differences were minor, only the average times are shown.

These times indicate the best results that an emulated disk can provide, because the amount of RAM allocated for the emulated disk in my system was large enough to hold all the files and programs used in the tests. For the Pascal compilation, the compiler, linker, library, source, intermediate, and object files all fit into the emulated disk space; for the spelling check it held the document to be checked, the spelling program, the dictionary, and the output document.

The disk emulator has another advantage not reflected in the test results. Since an emulated disk's storage capacity can be larger than a floppy disk's, several entire programs and files can be loaded into the RAM disk, thus eliminating the disk swapping that would normally take place if only floppy disks were used. Using a disk emulator saves time and the frustration of waiting while a floppy disk whirs and chortles through its operations.

On the Other Hand ...

Of course, nothing is free, and a disk emulator will require additional memory. In deciding how much memory you need, you will have to know how you will be using your PC.

If you will be using the system for word processing, a program such as *Wordstar* with spelling checker and dictionary will require about 225K of memory. Add to that the space for a document file, a backup copy, a buffer to be used during execution, and perhaps some data files, and you might need a 512K system.

Another possibility is to use the system for software development. In this case the IBM Pascal compiler, loader, and library total about 320K of memory. Add to that the memory required for the source and object programs, an editor, and intermediate files that the compiler produces, and you can easily exceed a 512K system. In short, you should make careful estimates of your program and file sizes when deciding how much memory to buy.

When you plug that extra memory into the PC, you will notice that the time delay between turning power on and the system's beep grows noticeably longer (assuming that you also changed the memory-size switches). This delay occurs because the PC automatically checks the installed memory (up to a maximum of 544K) for hardware malfunction. This slight inconvenience amounts to more than a minute on a fully loaded system.

Time is also required to copy the programs and files onto the emulated disk and to copy files back out after a job is finished. Of course, a batch file can often automate this copying. Furthermore, if some enterprising manufacturer produces a bubble memory board for the PC, this copying will be unnecessary since bubble memory does not lose its contents when the power is turned off.

Power fluctuations are another potential problem when you are using a disk emulator. If a storm or brownout causes the computer to lose power, the contents of memory, including everything on the emulated disk, will be lost. In a conventional system, files that have been saved on disk will still be there after a power failure. If power is unreliable in your part of the country, you will have to make precautionary backup copies of your disk files at frequent intervals. Another source of protection against power failures is a battery-powered backup power supply for the PC.

If the cost of additional memory and the possibility of power fluctuations do not dissuade you, a disk emulator will let you take advantage of large memory capacities, even if your software was designed with a smaller system in mind.

Within the next year, 256K memory chips should be widely available, and personal computers with a megabyte or more of memory will be common. If you select one of them, keep disk emulators in mind as a means of exploiting this memory power.

installed automatically when you start the computer. Most programs allow the various parameters to be entered on the command line next to the program name, but a few display a menu of choices and require the user to make the appropriate selections before the program continues. E-drives that modify the DOS on disk are permanently installed and cannot be installed with an AUTOEXEC batch file.

High memory, low memory, and noncontiguous memory. Think of the memory installed in a PC as divided into three groups, as shown in Figure 1. Low memory is RAM below the address indicated by the S2 switches on the system board. If more RAM is installed than the switches are set to reflect, the RAM above the address indicated by S2 is called high memory. High memory is not tested during the power-on self-test, but it may be used for disk emulation. The third area of memory is called noncontiguous memory because it is separated from the low memory by RAM that is dedicated for use by the video displays. Up to 192K of RAM can be installed in this otherwise unused part of the system memory and used for disk emulation.

> Ideally, E-drive programs should be designed to operate on any PC, regardless of memory size or configuration.

Some E-drive programs use low memory only, others use high memory only, and some make use of noncontiguous memory. The most versatile E-drives use all three memory areas. The design of the PC allows low memory to be used for any purpose, including disk emulation. The advantage of using high memory is that the computer starts faster because the S2 switches are set for less memory than is actually installed. Noncontiguous memory is designated "reserved" by IBM; using that area may someday cause a problem because that space might be allocated to a future product. If you want to use noncontiguous memory, be sure that another memory area is also available.

DOS 2.00 Considerations

Programs such as E-drives are called device drivers. DOS 2.00 has a new way for device drivers to be installed that allows E-drive programs to be used together with hard disk drives and similar peripherals. However, the programs must meet certain criteria. None of the programs listed in Table 1 meet those criteria yet, but hopefully they will soon.

Battery Backup

Christine Whyte

When using an IBM Personal Computer, especially one with electronic drives (where volatile RAM memory is used to simulate a disk drive), you run the constant risk of garbled or lost data resulting from problems with the computer's source of AC power. These problems may include a temporary reduction in power (brownout), a power failure (blackout), or short-term disturbances to the power line.

Power Troubles

In the case of a sudden blackout or even momentary brownout, you stand to lose any data that hasn't been saved by copying it from RAM to a disk. Even if you save files frequently, you may lose any data entered since the last save, or even worse, you may be caught unaware in the middle of saving a file.

Short-term voltage drops, often called dips or sags, may also result in lost or garbled files. Dips are usually caused during power load switching by the power company. The PC can accommodate a voltage drop less than 10 percent from normal, but any greater amount of undervoltage will cause problems.

Even if your power is free of dips or sags, your files may suffer from overvoltages. A short overvoltage lasting less than a microsecond is called a spike or a transient. A longer overvoltage is called a surge. The main causes of spikes and surges are lightning, power load switching, and even the starting and stopping of nearby air conditioners or refrigerators. "Noise" on the line occurs from high-frequency signal interference picked up by the power line. If the PC interprets noise signals as data signals, your files may be error ridden.

If you use the PC at home strictly for balancing your checkbook or other personal applications, losing data may not be a major crisis. But if your use of the PC involves extensive time and effort for preparing business reports (especially under tight deadlines), programming, or putting the finishing touches on the last chapter of your novel, you should seriously consider purchasing some means of power protection.

File Insurance

Different types of products for the PC offer varying degrees of "file insurance," and costs range accordingly. Choosing the right product for your needs means anticipating power supply problems and understanding how each product is designed to prevent harmful consequences.

One such product is an uninterruptible power system (UPS). Worthy of its name, a UPS delivers an uninterrupted supply of electricity via a battery and an inverter, rather than directly from an AC wall outlet. The inverter converts DC battery voltage to AC power. A battery charger keeps the battery sufficiently charged at all times so that it can run a PC by itself in the event of power failure.

An additional benefit of some UPS units is that they "condition" the power line to prevent any harmful effects to data from line disturbances. To do so means that the battery charger must always keep the battery charged as well as provide adequate power to run the PC. A typical PC system with 64K, two disk drives, and a monitor operating at full capacity requires from 120 to 200 watts of power. With a printer or extra memory, 200 watts is minimum.

Although this type of UPS provides sufficient power to run the PC, it does so even though AC power is also available to do the job. Some manufacturers regard this as an oversupply of power. To make lower cost, more efficient use of battery power, some UPS units, more accurately called standby power systems, route AC power directly from the wall outlet to the computer during everyday use. Only during power failure does the battery supply power to the PC.

The battery remains charged but idle until as little as ½ cycle (10 milliseconds) of AC current is missed. The PC can withstand up to 50 milliseconds without loss of data, so the battery provides some slack time. When the battery springs into action, it simultaneously switches on the inverter and relay mechanisms to power the PC for an extra 5 to 15 minutes. When the normal AC power supply resumes, the inverter and relay return to their off positions and the battery is recharged.

A standby unit, unlike a true UPS, usually does not condition the power line as well as provide battery backup. However, better standby units such as Cuesta Systems' Datasaver condition the line by filtering line noise and suppressing spikes or transients.

Datasaver in Action

The Datasaver unit is contained in a small, rectangular box that conveniently fits on top of your desk. No technical expertise is required for installation. Simply plug it into the wall outlet and connect the PC to the Datasaver.

An indicator light on the unit's front panel stays green as long as there is adequate AC power. An alarm buzzer, which can be heard in an adjoining room, warns you when the power fails, so that you will be aware that the PC is running on auxiliary battery time. The light changes to red and blinks every 5 seconds to indicate 2 to 15 minutes of remaining battery backup time. When the light blinks every second, less than 2 minutes remain—it's time to hustle and save those files.

To increase backup time by 1 to 3 hours, you can buy an ordinary car battery and hook it up to the Datasaver. Don't forget to check the water level, just like in your Chevy. Although the apparatus is somewhat inconvenient, this purchase can provide additional peace of mind.

Although the cost may seem unnecessarily high at the outset, a UPS or standby power system is your insurance policy for that unforeseen emergency. If you value your files, your time, and your labor, you may decide that this is one of the most useful products you can buy.

Datasaver
Cuesta Systems, Inc.
3440 Roberto Ct.
San Luis Obispo, CA 93401
805/541-4160
List Price: 200-watt model $695

Other manufacturers of standby power systems:

General Power Systems
1400 N. Baxter St.
Anaheim, CA 92806
714/956-9321

SAFT America
Portable Battery Division
931 Vandalia St.
St. Paul, MN 55114
612/645-8531

Topaz Electronics
9192 Topaz Way
San Diego, CA 92123
619/279-0831

If you are using or plan to use DOS 2.00, be sure you check the manufacturer's policy regarding software updates or you may end up buying useless software.

If you are not using DOS 2.00, you can make use of one of these programs immediately. Once you do, you'll wonder how you ever got along without it.

AST Research, Inc.
2691 Richter Ave. #104
Irvine, CA 92714
714/540-1333

STB Systems, Inc.
1701 N. Greenville #703
Richardson, TX 75081
214/234-8750

QuadRAM Corporation
4357 Park Dr.
Norcross, GA 30093
404/923-6666

Tall Tree Systems
1036 Los Altos Ave.
Los Altos, CA 94022
415/941-8748

Tecmar, Incorporated
23600 Mercantile Rd.
Cleveland, OH 44122
216/464-7410

Microsoft Corporation
10700 Northrup Way
Bellevue, WA 98004
206/828-8080

Daystar Systems, Inc.
10511 Church Rd.
Dallas, TX 75238
214/341-8136

Ensign Software
7337 Northview
Boise, ID 83704
208/378-8086

Xedex Corporation
Route 59
Suffern, NY 10901
914/368-0353

Persyst, Inc.
15801 Rockfield
Irvine, CA 92714
714/859-8871

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(519) 884-4690

Exclusive European Distributor
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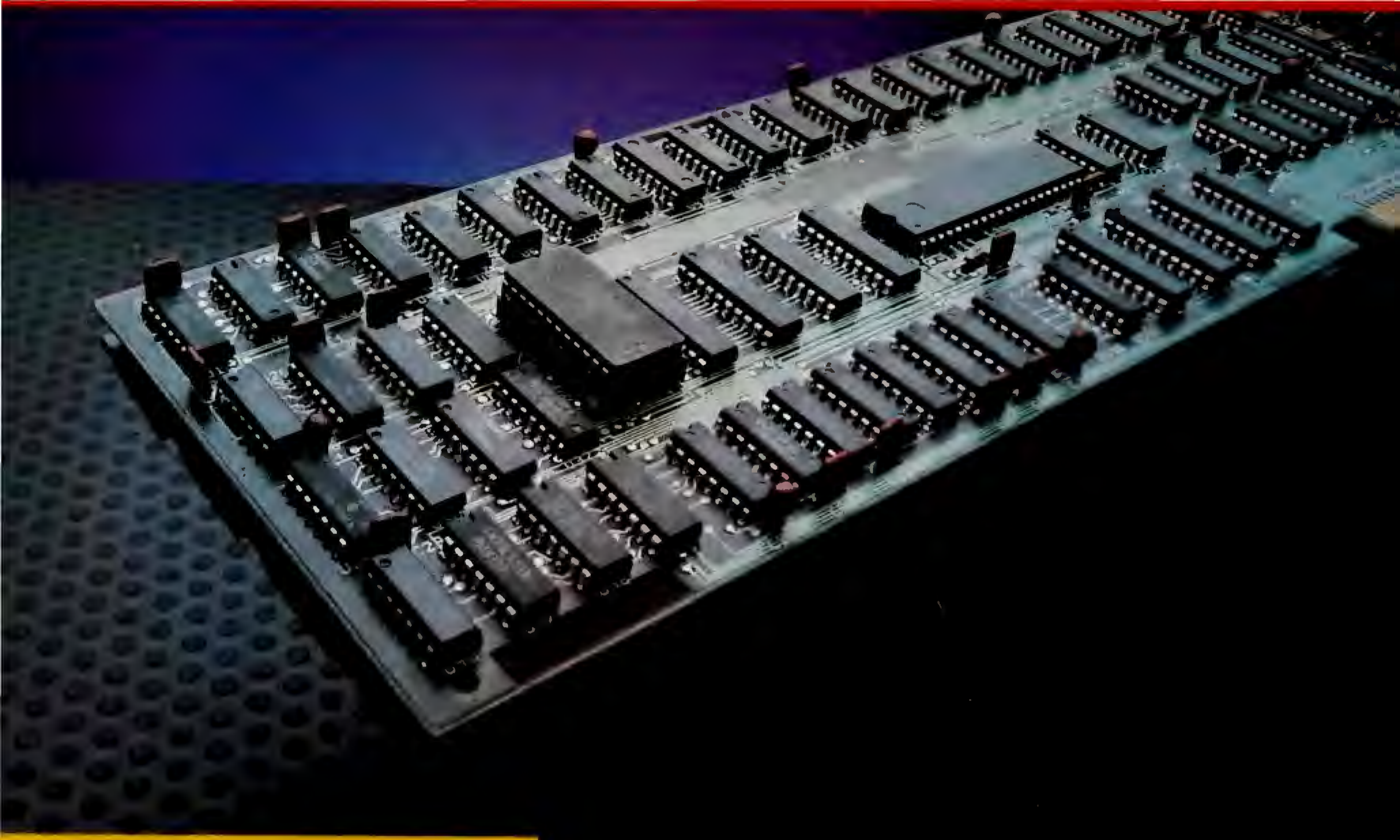
Birmingham,
England B27 6B H
(021) 7073866

Tallgrass Technologies Corporation

11667 W. 90th, Overland Park, KS 66214, (913) 492-6002
Telex: 215406 TBYT UR



The TK! Avant-Garde

TK!Solver: a new concept in problem-solving software

Edward Rodgers

VisiCalc and the electronic spreadsheet concept, introduced in 1978 by Personal Software (now VisiCorp), was innovation; it virtually spawned a new industry. Second-generation spreadsheets, such as Microsoft's *Multiplan*, while considerably enhanced and easier to use than *VisiCalc*, are but refinements of the original spreadsheet concept.

If you missed the hoopla in 1978 when *VisiCalc* entered the market, here comes a second chance for you to grab a little piece of computing history. *TK!Solver*, a package described as the algebraic equivalent of an electronic calculator, promises to be as big as *VisiCalc*.

OK!Whatizit?

TK!Solver (*TK*) is a tool for professionals who now depend on calculators to solve equations for analysis, design, and planning. Using this innovative program you can solve equations, convert units of measurement, plot graphs, and make tables, concentrating on the problem without being a master of the computer. In *TK*, which stands for tool kit, one or more equations, such as Profit = Sales-Expense, are entered into *TK*'s worksheets along with values for some of the variables. When the action key (!) is pressed, *TK* solves for the unknown variable(s) using whatever equations it finds necessary,

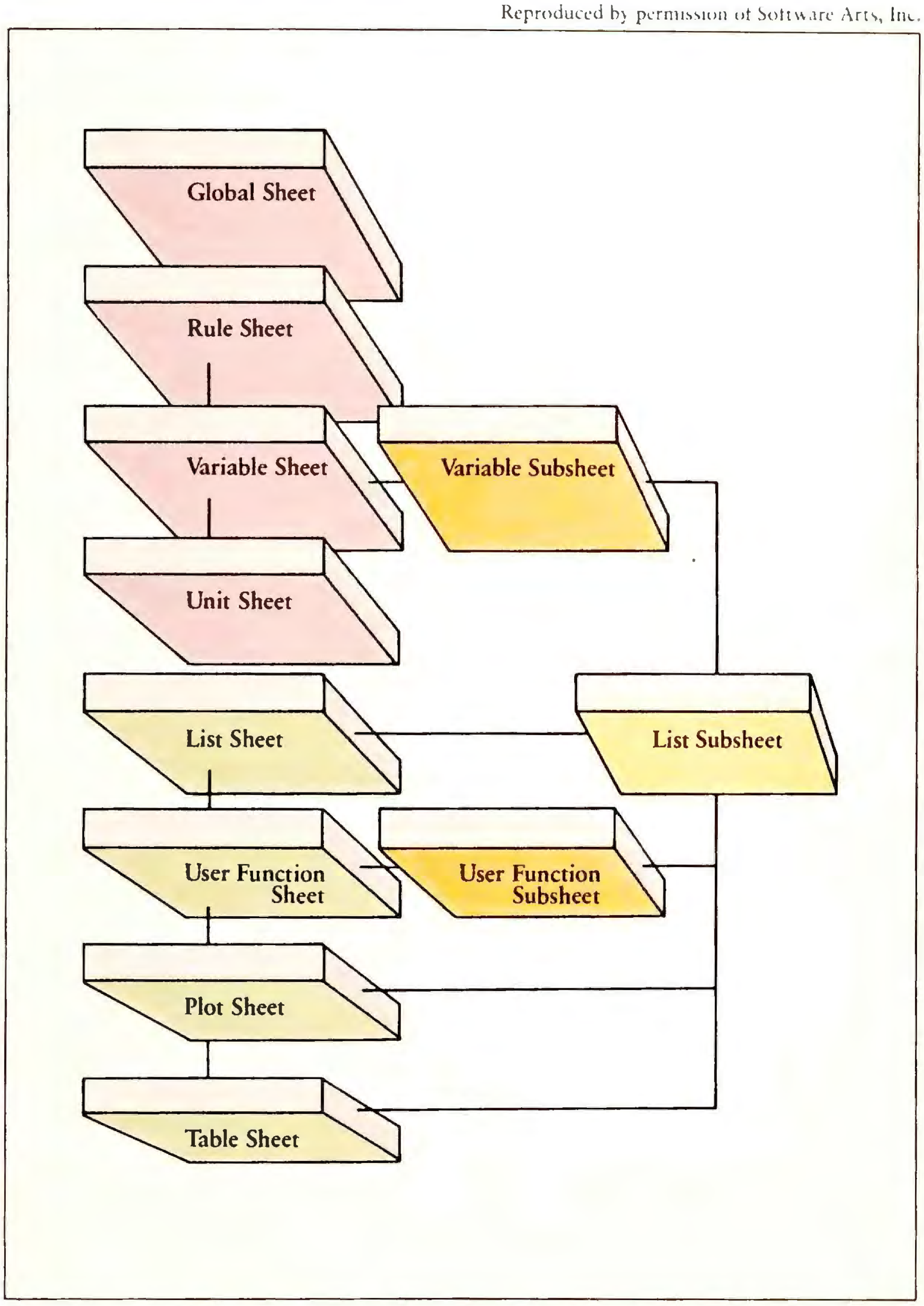


Figure 1: TK!Solver Sheets

or if it can't solve the equation, it tells you what information is missing. This innovation, so simple in concept yet so complex to develop, is what distinguishes *TK*.

TK!Solver Worksheets

Figure 1 shows the names and relationships of the various worksheets that can be used in the equation-solving process. To demonstrate *TK* I'll use several of these sheets to develop a model called "Travel" that finds the length and cost of an automobile trip by using three equations to define the relationships between mileage, speed, distance, gas price, and the total cost of the trip.

After *TK* is loaded, the screen is blank except for the headings of the Variable and Rule sheets, which divide the screen into two equal windows (see Figure 2). *TK*'s cursor, actually an inverse video bar, is positioned on the Rule sheet. You begin to construct the model by typing the formula mlg = d/gas (mileage = distance/gas) on the Rule sheet.

As the equation is entered, *TK* scans it, identifies the variable names, and posts them to the appropriate field on the Variable sheet as indicated in Figure 3. The *S* in the upper left corner of the Rule sheet heads the status column field, which indicates the status of the equation on each line. The asterisk by the equation on the Rule sheet indicates that the equation is unsatisfied because no values have been entered yet.

One of *TK*'s unique characteristics is its ability to interpret the equals sign as what it is, rather than as an assignment statement. *TK* can easily and correctly interpret the original mlg = d/gas equation as mlg*gas = d. Although *TK* can do much more than this, the ability to interpret and solve mathematical expressions as equations is the foundation on which the package is built.

The following equations are required to complete the Travel model: s(peed) = d(istance)/t(ime) and cost = gas*pr(ice).


```
(1r) Rule:
For Help, type ?
______________ VARIABLE SHEET ______________
St Input    Name   Output    Unit      Comment



______________ RULE SHEET ______________
S Rule
```

Figure 2: TK!Solver Screen

```
(1r) Rule: mlg = d/gas

______________ VARIABLE SHEET ______________
St Input    Name   Output    Unit      Comment
            mlg
            d
            gas

______________ RULE SHEET ______________
S Rule
*mlg = d/gas
```

Figure 3: Constructing the Equation

```
(7m) Multiply By: .44

______________ VARIABLE SHEET ______________
St Input    Name   Output    Unit      Comment
            mlg
            d
            gas
            s
            t
            cost
            pr

______________ UNIT SHEET ______________
From       To         Multiply By    Add Offset
mi         km         1.609
mi/h       km/h       1.609
mi/gal     km/l       .4251
gal        l          3.785
h          min        60
C          F          1.8            32
$          DM         .44
```

Figure 4: Defining the Unit Sheet

As with the previous equation, variable names are posted to the Variable sheet as the equation is entered. Before values are provided for any of the variables, however, the unit of measurement for each variable must be defined; otherwise, it is unclear from the model whether miles per gallon or kilometers per liter are being calculated, or whether US dollars or deutsche marks are the monetary unit. This unit information is supplied in two ways using the *TK* Unit sheet and Variable subsheet.

Deutsche Marks and Dollars

The Unit sheet is where the definitions that enable *TK* to convert values from one unit of measurement to another are entered. Since *TK* can display only two sheets at once, you have to replace one of the currently displayed sheets. Pressing the equals key followed by U causes the Unit sheet to overlay the Rule sheet (see Figure 4).

All fields on the Unit sheet are user defined, including the conversion factors. After the information on unit relationships has been entered, you can return to the Rule sheet by typing =R. Unit names can then be entered in the appropriate unit filed on the Variable sheet along with any comment you wish to include in the comment field.

The second of the two sheets required to define the unit of measure for listed variables is the variable subsheet (Figure 5). This subsheet is accessed from the variable sheet by typing the DIVE command (>). Of particular interest on this sheet is the ability to differentiate between display units and calculation units. This permits you to solve an equation in deutsche marks, for example, and to convert and display the result in dollars automatically, provided both unit types have been entered on the Unit sheet. You can return to the variable sheet by typing the less-than symbol (<).

After assigning and entering values for the mlg, cost, and pr(ice) variables, pressing the action key (!) produces the results displayed in Figure 6. Notice that on the Variable sheet the variables t(ime) and s(peed) have not been solved. Likewise, the asterisk in the status column on the Rule sheet indicates that the related s=d/t equation is underdefined. You correct the condition by supplying a value for one of the undefined variables in the equation.

```
(7i) Input: 1.19

_______________ VARIABLE SHEET _______________________
St  Input   Name   Output      Unit   Comment
    28      mlg                mi/h   mileage
            d      282.35294   mi     distance
            gas    10.084034   gal    amount of gas
            s                  mi/h   speed
            t                  h      time (hours)
    12      cost               $      cost of trip
    1.19    pr                 $      price of gas

_______________ RULE SHEET ___________________________
S Rule
  mlg=d/gas
* s=d/t
  cost=gas*pr
```

Figure 5: Variable Subsheet

```
(s) Status:
_______________ VARIABLE: mlg ________________________
Status:
First Guess:
Associated List:
Input Value:
Output Value:
Display Unit:          mi/h
Calculation Unit:      mi/h
Comment:               mileage

_______________ RULE SHEET ___________________________
S Rule
*mlg=d/gas
*s=d/t
*cost=gas*pr
```

Figure 6: Solution Results

The Plot Thickens

Extending the Travel model further, assume that you were interested in looking at the effect of different driving speeds on mileage and trip cost. Instead of inputting a single value for speed, you can input a list of speed values. To create the list put an *L* in the status field on the Variable sheet to define the mileage, speed, and cost variables as List variables. Then call up the List subsheet for the speed variable and fill in the slowest and fastest speeds (5 and 75 miles per hour, for example). With the Fill List command the intermediate speeds are entered automatically (see Figure 7). As the list of speed variables is evaluated, *TK* calculates corresponding variables for cost and mileage and places the values in cost and mileage lists.

You now have three ways to look at the Travel model data. You can, of course, look at each list (speed, cost, and mileage) individually, although correlating the significance of the results is hampered because you can display only one list at a time. You can also use *TK*'s Table sheet, which permits you to consolidate multiple List sheets and display them as a table (see Figure 8). Finally, the data can be viewed using the Plot sheet (see Figure 9), which is a graphic representation of the data points and relationships described on the Table sheet.

```
(15v) Value: 75

________________ LIST: s ____________________________
Comment:
Display Unit:          mi/h
Storage Unit:          mi/h
Element  Value
_______  _____
1        5
2        10
3        15
4        20
5        25
6        30
7        35
8        40
9        45
10       50
11       55
12       60
13       65
14       70
15       75
```

Figure 7: List Subsheet for Variable S (Speed)

Speed vs. Mileage and Cost

s	mlg	cost
5	4.7807175	49.7833223
10	10.23667	23.2497482
15	15.0879575	15.7741696
20	19.33458	12.3095511
25	22.9765375	10.3583928
30	26.01383	9.14897960
35	28.4464575	8.36659538
40	30.27442	7.86142228
45	31.4977175	7.55610307
50	32.11635	7.41055568
55	32.1303175	7.40733421
60	31.53962	7.54606428
65	30.3442575	7.84332917
70	28.54423	8.33793730
75	26.1395375	9.10498130

Figure 8: A Table Prepared Using List and Table Sheets

Algebraic Sleuthing

TK uses two methods to solve problems: Direct and Iterative. Each method, or "Solver," uses the given input values to find all the variables possible within one solution of a problem. According to Software Arts, *TK* always attempts to use the Direct Solver first. To be solved by the Direct Solver an equation must meet the following conditions: first, values must be given for all variables except the one you're solving for; second, the variable you're solving for must appear only once in the equation; and finally, the variable you're solving for cannot be what is know in mathematics as the argument of a function without a unique inverse.

If a problem doesn't meet these criteria, don't despair. For equations that can't be solved by the Direct Solver, *TK*'s Iterative Solver, which applies a kind of guessing technique to equation solving, can be applied to the task. A *G* (for Guess value) is entered for the unknown variable on the Variable sheet status field and then entered in the input field(s). The Iterative Solver starts when you type /!. Using the Guess input value as a starting point, *TK* repeatedly applies various numerical analysis routines in an effort to converge on an approximate solution to the problem. Iteration continues until the solution lies within the error range limits you specify or until the number of iterations you indicate has been exceeded.

Unlike the Direct Solver, *TK*'s Iterative Solver results can be somewhat ambiguous. More often than not, solutions derived using the Iterative Solver require careful interpretation. If, for example, you're working with polynomial equations of order 2 or higher (such as $ax^3-bx^2+cx+d=0$), it is helpful to know that more than one solution exists. Different solutions can be reached if you start with different Guess values.

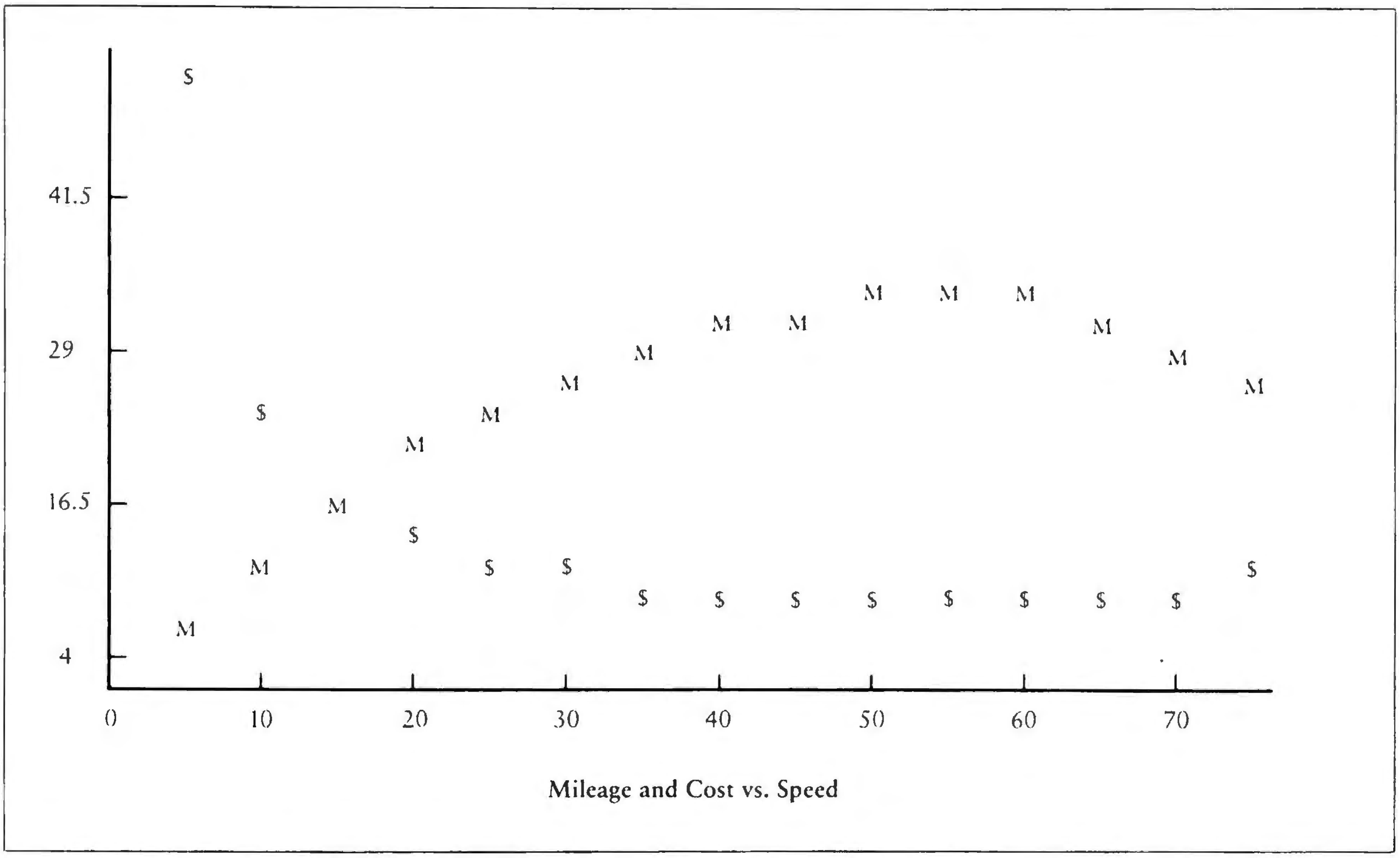


Figure 9: Mileage (M) and Cost ($) vs. S (Speed) as Plotted from Table in Figure 7

Human Factors

One of the least satisfactory aspects of *TK* is the user interface. Regrettably, Software Arts has repeated the mistake originally made when designing the *VisiCalc* command interface: only the first letter of any command is displayed on the screen. Users are left to grapple with yet another cryptic command alphabet (see Figure 10).

While the slash required before each command is consistent with other Software Arts/VisiCorp products, the differences among the applications and the variety of command names suggest that this consistency serves appearance only and lacks functional benefit. Like *VisiCalc, TK* is a brilliant crystalization of an innovative concept, but certain areas lack polish.

Unlike *VisiCalc,* however, there will probably be few imitators of *TK.* While *VisiCalc* is a relatively straightforward product in both concept and implementation, the implementation of *TK* is less obvious. Software Arts has developed proprietary artificial intelligence and numerical analysis algorithms especially for *TK.* As a result, the internal workings of *TK* cannot be easily deduced from its external behavior. Another problem with *VisiCalc* that plagued Software Arts and encouraged imitators was unavailability. *VisiCalc* simply wasn't portable to a variety of computers. To minimize this characteristic in *TK,* Software Arts has developed its own internal computer language, subsets of which are readily adaptable to different machines. Users will have access to the real McCoy well before the *TK* clones become available.

Documentation

What *TK* lacks in terms of a user interface, however, is partially offset by first-rate documentation in the form of a 2-inch-thick manual. It is appropriate that such care is taken in the preparation of documentation, especially when its purpose is to introduce a product that has little or no precedent. As in the early days of electronic spreadsheets, few users will be able to understand *TK* in terms of previous experiences with a similar package—there are few (if any) analogs.

Although lengthy, the manual has three well-structured sections: a 16-page introductory pamphlet that provides a high-level overview of some of *TK*'s concepts, an instruction manual that leads you through numerous examples with frequent screen diagrams, and a subsectioned reference guide providing command summaries, cross-references, and other reference information.

An interesting and useful addition to the *TK* documentation is a 2- by 3-foot poster that summarizes *TK* commands and built-in functions and displays the *TK* worksheet topology.

> Users are left to grapple with yet another cryptic command alphabet.

The poster is a learning tool that other manufacturers of complex software would do well to borrow.

The on-line help files are comprehensive but somewhat slow in responding. I used both a dual-sided, floppy-based IBM PC and a PC XT with a 10-megabyte fixed disk in evaluating *TK* and found that the search/retrieval mechanism used in the help files could use some tuning. Typical search/retrieval responses averaged 30 seconds per screen for the floppy-based system and 20 seconds for the PC XT. Although on-line help files can be useful, delays in searching for the help files drove me to *TK*'s well-indexed and logically arranged documentation every time.

```
(1s) Status: L
/ Command: B C D E I L M P Q R S W !
_______________ RULE SHEET _______________
S Rule
  mlg = d/gas
  s = d/t
  cost = gas*pr
  mlg = -1.27990+1.27259*s-.0120933*s^2

_______________ VARIABLE SHEET _______________
St Input   Name   Output      Unit     Comment
L          mlg    4.7807175   mi/gal   mileage
   200     d                  mi       distance
           gas    7.6512448   gal      amount of gas
L  5       s                  mi/h     speed
           t      2.6666667   h        time (hours)
L          cost   49.783322   $        cost of trip
   1.19    pr                 $        price of gas
```

Figure 10: Command Alphabet

Options and Amenities

A major feature that affects the usability of *TK* and user perceptions of its immediate applicability is the variety of *TK* applications packs. These add-on programs (priced from $50 to $100) are analogous to the templates available for electronic spreadsheet packages. *TK!SolverPack* programs contain all the necessary equations, variable lists, and supporting sheets to get you up and running on a variety of problems ranging from high school science to financial analysis to mechanical engineering.

A *TK!SolverPack* for mechanical engineering was provided with the copy of *TK* used for this evaluation. To better evaluate the usefulness of the *TK!SolverPack*, I sought a second opinion from a mechanical engineer. The verdict: standard and useful. The format of the mechanical engineering *TK!SolverPack* is relatively straightforward: 13 models with appropriate equations, variables, and units defined and provided on disk packaged in a slim volume containing basic instructions, sample problems, and the contents of each sheet used. If you ever need to analyze the natural frequency of vibration in rotational systems, you'll know where to look.

Another promising addition to *TK* and one that will provide both support and information to a growing *TK* community is *TK!SATN*, the *TK!Solver* user journal. Although I have not seen the journal, the concept is appealing. Just as users have stretched the capabilities of *VisiCalc*, they will explore the potential of *TK* in as yet unimagined ways; conceivably *TK!SATN* will spread the gospel.

A useful amenity often overlooked by many users of *VisiCalc* is the Data Interchange Format (DIF) developed by Software Arts. DIF is designed to provide a standard convention for the exchange of data between programs. Because DIF files store *TK* data as standard ASCII text files, they are easily moved between disparate systems via communications. Once the structure of a given data base is known, for example, an interface can be developed that allows you to download directly to the *TK* application for use in List, Table, and Plot sheets.

Final Estimate

TK is an intuitive piece of software once you have a handle on what it's trying to do. Consequently, I think that *TK* and subsequent packages like it will increase what I believe to be the logical consequence of computer literacy: enhanced analytical capacities.

Software Arts' conceptual innovation and software engineering excellence deserve high marks. Now, if we could only get them to produce their art as prolifically as Picasso.

Edward Rodgers is a staff consultant on information systems at a Fortune 100 corporation. He specializes in office systems and personal computers.

TK!Solver
Software Arts, Inc.
27 Mica Ln.
Wellesley, MA 02181
List Price: $299
Requirements: 96K, one disk drive

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VisiCorp
2895 Zanker Rd.
San Jose, CA 95143
408/946-9000

Multiplan
Microsoft Corporation
10700 Northrup Way
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The Tailor-Made Editor

IBM's Personal Editor lets you create the right editor for the job.

Kearney Rietmann and Bill Grout

What do craftsmen who create their own tools and people who rearrange the furniture in their hotel rooms have in common? They know that comfort is a question of their own design.

No matter what your experience with computers, learning a new text editor or word processing program is uncomfortable until you grow accustomed to another person's idea of good design. The easiest program to learn and use is one you design yourself. While you may not feel you have the prerogative to rearrange the furniture in a hotel room or the know-how to design your own hand tools, the *Personal Editor* for the IBM Personal Computer, manufactured by IBM, is a tool you can craft to suit your editing needs. You can configure the program for special editing applications such as BASIC programming or word processing and, like an experienced craftsman, wield the tool that's right for the job.

The Editor's Window

The *Personal Editor* is suitable to both program editing and simple word processing tasks. Running the program requires 64K and one disk drive. The program provides screen editing so that you can enter and change text anywhere on the screen. You can search for and change text and move, copy, erase, and overlay blocks. Word processing features include tab and margin settings, word wrap, and text reformatting.

Two of the most interesting features of the program are the Define and Macro commands, which allow you to customize the program's use of the PC keyboard. With these commands you can assign keys to carry out specific functions. You can, for example, craft the features of your keyboard to fit programming tasks such as locating variables or moving blocks of code, or specific word processing applications such as formatting outlines or tables of contents.

The *Personal Editor* screen consists of text area, the command line, a status line, and a message line (see Figure 1). The text area takes up the first

22 lines of the screen, and the command line is a highlighted band on Line 23. The cursor moves back and forth between the text area and the command line with a press of the Esc key or the key you assign as the Command Toggle function key. The status line shows the name of the current file, cursor position, and whether you are using insert or replace mode (insert mode inserts characters while replace mode types over and replaces existing characters on the screen). The twenty-fifth line on the screen is a message line that responds to commands by displaying messages such as "Are You Sure?" when the Quit command is used.

You communicate with the program using any of 17 commands entered on the command line, such as Dir (to call a file directory), Edit (to open a file), Locate (to find a text string), and Save (to save a file). Sixty-three functions, all of which can be assigned to keys of your choice, carry out on-screen operations such as moving the cursor, centering lines, deleting text, and automatically changing text from upper- to lowercase and back again.

You can look at a directory of the files on drives A and B at any time during editing by typing the Dir command (see Figure 2). A 5-page help menu can be called using F4 (page 1 of the help menu is shown in Figure 3). The help menu shows the assigned function of the PC function keys, cursor movement keys, and keys assigned text marking functions.

A Personal Survey

Like a prefabricated house, the *Personal Editor* comes with many parts you must fit together. The program provides 29 cursor functions. The default version of the program has assigned 17 of these functions to the cursor pad, the Tab key, and to combinations of the cursor pad and the Ctrl key. The remaining 12 functions are left to you to assign (see Table 1). As with all *Personal Editor* functions, these can be reassigned to other keys.


```
    ===== Top of file =====

    10 INPUT "WHAT IS YOUR WEIGHT";R
    20 A = .166*R
    30 PRINT "YOUR WEIGHT ON THE MOON IS";A
    40 END

    ===== Bottom of file =====

 | QUIT                                              |
 program.bas                  4    7    Replace
 Are you sure?                Type y or n
```

Figure 1: The Personal Editor Screen

You might want to assign some of the 12 unassigned functions to keys when you begin using the program. Some of the more interesting unassigned functions are the Down 4 and Up 4 functions, which move the cursor up or down 4 lines, and the Tab Word and BackTab Word functions. These last two functions move the cursor across a line to the right or left, stopping at the first character of each word. The only problem with these operations is that the cursor stops at the end of the line and you have to use another key to continue tabbing by word into the next (or preceding) line.

The *Personal Editor* commands, generally used for file handling, are easy to use and remember. They are typed on the command line in upper- or lowercase letters, or combinations thereof. Commands are executed by pressing ENTER with the cursor anywhere on the command line, or you can assign the Execute function to a key and execute a command while the cursor is in text area.

Because the most recent command executed remains displayed on the command line, you can reexecute it repeatedly without having to type it again. When you want to save a file to disk during editing, for example, the reexecute feature enables you to avoid repetitious retyping of the Save command, the file name, and the drive designation. In another application of the function, you can reexecute the commands for locating and changing a string or variable that occurs in each file in a group of active files.

Assigning the most frequently used commands to the PC function keys makes for easy editing. In the *Personal Editor* default version four commands are already assigned to the function keys. F2 saves the current file, F3 saves the file and removes it from memory, F4 simply removes the current file from memory, and F7 prints the current file. When you press the function key for a command, the *Personal Editor* types the command on the command line. You type additional information such as the file name and then press ENTER. Or in the case of the Print and Quit commands you press ENTER to execute the command for the current file.

You can make quick changes in long programs and documents with the *Personal Editor*'s Locate and Change commands. The Locate command searches files for characters and strings of characters, be they letters, numbers, or special character symbols. Locate lets you search through a long program, for example, and quickly find a specific line number or subroutine. You can search both backward and forward from the cursor position.

The Change command, just as the name describes, replaces one character string with another. Change is useful for replacing variables in a section of code, or for changing names and addresses in a group of letters. You can make global changes (changing all occurrences of a string in a file), or you can selectively change some strings but not others. You use the Confirm Change function (assigned to Shift-F5 in the program default version) to indicate whether you want a particular change put into effect. As with the Locate command, you can search backward if you want, and the program ignores whether you type the string in upper- or lowercase.

In case your memory lapses, you can use the special question mark commands to check the status of the file you're working on. These commands give you information about tabs, margins, function assignments, and available memory. The commands ?Tabs and ?Margins display the current tab and margin settings on the command line. The ?Key command shows the functions given to a particular key. The ?Memory command provides information about the number of bytes available in memory. The information appears on the message line below the command line.

One problem with using the commands in the default version of the *Personal Editor* is that characters can only be erased one at a time with either the Delete or Rubout keys. Erasing long command strings takes time. To use the commands more efficiently, it's a good idea to assign the Erase to Beginning of Line function to a key or key combination when you first begin using the program.

=== Top of file ===

TEXT	DOC	122	1–01–80	1:13a
PROGRAM	BAS	98	1–01–80	12:25a
PAGE		2800	1–01–80	12:17a
PAGEINS		210	1–01–80	1:13a
REVIEW		2539	1–01–80	1:26a
BLOCKS		1336	1–01–80	12:13a
NEWDEFS		2764	1–01–80	1:02a
ADDRESS		225	1–01–80	12:17a
NEWFILE		64	1–01–80	12:34a
LETTER1		130	1–01–80	12:20a
LETTER2		131	1–01–80	12:24a
LETTER4		111	1–01–80	12:37a

=== Bottom of file ===

.dir 1 1 Replace

Figure 2: The Personal Editor Directory

Functions

The *Personal Editor* features a variety of functions to delete, insert, and move text. The five delete functions include Delete Character, Delete Line, Rubout (which deletes one cursor position backwards), and Erase Begin Line and Erase End Line (delete text from the cursor position to the beginning or end of the current line).

> The *Personal Editor* enables you to pick the right editing tool and create new ones.

Unlike some word processors that automatically open new lines at the end of text, the *Personal Editor* requires that the Insert Line function be used to insert lines for typing new text. Text below the current line is moved down one line when a blank line is inserted. If a word or phrase shorter than an entire line is typed, the text does not wrap back to fill up the space after the insertion. The Insert Line function works well in program editing when you want to insert a line (say Line 55) between two other lines (Lines 50 and 60). In word processing, however, this function doesn't work as well, because when editing documents, you often insert text to join lines that follow, such as adding an adjective or a phrase in the middle of a sentence. In this case, a feature is needed that wraps text back up to the insertion.

Another line editing feature is the Split function, which divides a line by moving text to the right of the cursor to the beginning of the next line. Similarly, two lines can be combined using the Join function to append the lower line to the current line. If the newly formed line is longer than 255 characters, however, extra characters at the end of the line are erased as the line is truncated to fit the space. Irksome as this is, the lost text of truncated lines can be recovered using a copy operation with a special file called the Unnamed file, which receives the last five changes in the current file.

For formatting tasks, the Center Line function centers text between the set margins, and Shift Right and Shift Left move marked blocks of text left or right. These last two functions are useful for shifting columns of information in charts or tables or for moving a program's displays on the screen.

Single lines too long for margin settings can be readjusted using the Reflow function. You must first mark a line before it can be reformatted, which makes for an awkward three-step procedure of marking the line, reformatting, and then unmarking the line. Lines too short for the current margins are unaffected by the Reflow function. Adjusting lines that fall short of the proper margins requires using the Join function to join two lines into one and then reformat using Reflow.

This tedious procedure has to be performed for every line of a paragraph. Fortunately, however, the default version of the *Personal Editor* provides an editing feature that reformats paragraphs automatically. The feature results from a combination of 11 functions assigned to the Alt-P keys and is a blessing considering that novices might spend an hour or two trying to devise this complicated feature themselves.

To smooth over editing goofs, the *Personal Editor* provides a bit of forgiveness in the form of the Undo function. As long as the cursor remains on the line undergoing changes, changed or erased words and even the entire line can be restored using Undo. In the default version, pressing Shift and F4 pops the original text back on the screen. Once the cursor moves out of the line, however, the original text cannot be restored with Undo.

The *Personal Editor* is good at hoisting sections of program code or text to different positions in a file. Blocks of text are marked at the upper left and lower right corners of the text. Once marked, the block lights up in inverse video. You can move or copy the entire block to a new position by putting the cursor in the desired spot and using the Copy Mark or Move Mark function. After the block is transferred, it remains marked and can be copied or moved again.

You can assign an editing feature for each of the 99 key combinations available on the PC keyboard.

Only one block of text can be marked at a time (this restriction applies to an entire group of active files), so the marked text must be unmarked before a second block of text can be transferred. Because you can transfer segments of text from one end of a file to the other and even transfer text between different files, the *Personal Editor* provides the Unmark function to save you from going back to the original position of the marked block to Unmark it. With the cursor in any position in a file, pressing Alt-U unmarks a block automatically, a feature that is as convenient as having two light switches for turning off a light from either end of a long hall.

Single characters, lines, and whole files can be marked and copied, moved, overlaid, or deleted. The *Personal Editor* also provides a special function called Fill Mark that fills an entire block with a selected character. For example, if a line is to


```
═══════  Top of File  ═══════

   Help Menu        p.1

 Function Keys

 F1  — Help Menu
 F2  — Save current file
 F3  — Save and Quit file
 F4  — Quit current file
 F5  — Erase contents of line
 F6  — Erase to end of line
 F7  — Print current file
 F8  — Switch active files
 F9  — Insert line
 F10 — Insert line indent

       s => Shift key

   s-F1 =      F4 = Exit

pe.hlp                     1    1     Replace
```

Figure 3: Page 1 of Personal Editor Help Menu

be entirely composed of periods across the screen, you can mark the line, initiate the Fill Mark function, and then type a period. Instantly the line fills with periods across the screen. Similarly, Uppercase and Lowercase change all capital letters to lowercase or vice versa within a marked block. This feature is helpful for hammering out inconsistencies in program screen displays or formatting headings and titles in word processing documents.

ASSIGNED		UNASSIGNED
Backtab	**Shift-Tab**	Backtab Word
Begin Line	Home	Cursor Command
Begin Mark	Alt-Y	Cursor Data
Bottom	Ctrl-End	Down 4
Bottom Edge	Ctrl-PgDn	First Nonblank
Command Toggle	Esc	Indent
Down	Down Arrow	Left 8
End Line	End	Left Edge
End Mark	Alt-E	Right 8
Left	Left Arrow	Right Edge
Left 40	Ctrl-left	Tab Word
Right	Right Arrow	Up 4
Right 40	Ctrl-right	
Tab	Tab	
Top	Ctrl-Home	
Top Edge	Ctrl-PgUp	
Up	Up Arrow	

Table 1: Personal Editor Cursor Functions

Printing

The biggest drawback to the *Personal Editor* is printing. With the Print command assigned to F7, the program default prints text exactly as it appears on the screen. The top margin begins with the first line of text, so blank lines must be inserted on screen to specify a top margin. The program continues printing until the end of the file without inserting page breaks in the text. When continuous-form paper is used, for example, text is printed to the bottom of the page, over the perforation, and onto the next page. This type of printing is unsatisfactory for printing out programs or documents in final draft form.

One way to overcome this printing inadequacy is to use the *Personal Editor* Escape function to type ASCII characters on the screen. By using the Alt-X and the numbers 012 (typed at the number pad) to insert the ASCII form-feed character throughout the text, you can signal the printer to begin printing on a new page.

Another possibility for improving the printing feature is to define keys to automatically set up margins at the top and bottom of pages. This procedure takes a little practice as you learn to count the number of lines on the screen, translate them to the corresponding number of lines on the page, and then insert lines in the text to create the right top and bottom margins.

Even though these methods work fairly well for breaking up program and document files into pages, printing out a single page or sequence of pages presents a real problem. Since you can't instruct the program to print out a particular section of a file, you can mark the block of text or code you want to print out and copy it as a new file. Of course, you'll have to carry out this copy procedure every time you want to print out any individual section of a file.

You can use Ctrl-NumLock to stop the printer temporarily so you can advance continuous-form paper to the top of a new page or insert a new piece of loose paper. Even though the program stops printing at the end of the current line, the stop print operation requires great hand-eye coordination, and the time spent watching the printer and trying to press the stop print keys at just the right moment builds a sense of anxiety similar to holding a nail that someone else is going to whack with a hammer.

Laying Out a Multilevel Keyboard

The *Personal Editor* enables you to pick the right editing tool and create new ones as well. Special features required for particular editing tasks can be created and assigned to individual keys on the keyboard. While word processing, for example, you may want the cursor to automatically skip two lines and indent when ENTER is pressed to end a paragraph. Redefining the function of the ENTER key is easy with the *Personal Editor.*

Whenever you are faced with a repetitive procedure consisting of a sequence of editing commands and keystrokes, the program provides the option of designing features to let the computer do the work. As another example, you might define a key to represent a period and two spaces, so you can begin a new sentence without spacing twice.

You can assign an editing feature for each of the 99 key combinations available on the PC keyboard. Features can range from simple insertions of letter combinations to complex procedures such as moving blocks of code or calling up help menus. Once defined, you can assign the new features to keys according to your own comfort and logic.

Features are created and assigned to keys with the Define command entered on the command line. After deciding on the feature (such as one to break a long program line into two lines) and the key to initiate it, you type Define, the key name followed by an equals sign, and the function words within brackets to represent the steps in the procedure as they are carried out manually (the *Personal*

Editor provides 63 function words that can be used as building blocks to create editing features). Pressing ENTER records the new definition in the Keydefs file, which acts as an electronic dictionary of key definitions, and the feature is ready to be used.

To define the ENTER key to insert a blank line automatically after a paragraph or a program line, for instance, you type

```
define enter=[insert line]
```

Key definitions are temporary and can be redefined any time during editing. To save the current key definitions permanently, the Keydefs file must be renamed and saved on disk.

Once you have defined a key such as ENTER, you can define features for combinations of ENTER, Shift, Alt, or Ctrl. After defining ENTER to insert a line, Shift and ENTER might be used to initiate a related feature, such as inserting two blank lines after a paragraph. A feature that uses the combination of Shift and ENTER is created as follows:

```
define s-enter=[insert line][insert line]
```

Notice that the *Personal Editor* Insert Line function is used twice to ascribe to the Shift-ENTER key combination the feature of inserting two blank lines.

Keys can also be assigned letter and number combinations so that words, numbers, program variables, or command statements used repeatedly need not be typed over and over. To have a word (or any combination of letters or numbers) appear on the screen every time a certain key is pressed, a definition is created using the word surrounded by single or double quotes. The following definition, for example, types the word *Print* when Alt-P is pressed:

```
define a-P='PRINT'
```

Although IBM BASIC already has a 22-word vocabulary that automatically prints command words during editing, the *Personal Editor* can contain a much larger command word vocabulary created by you to hold the commands most useful to you.

Key definitions can be up to 255 characters long and may use any combination of letters and *Personal Editor* functions. Creating long editing features has the flavor of programming since the exact keyboard procedure must be recreated using sequences of *Personal Editor* functions as code. A complex editing function using the F1 key and several *Personal Editor* features to call up the help menu looks as follows:

```
define F1=[cursor command][begin line]
  [erase line]'e PE.HLP'[execute]
```

When F1 is pressed the Cursor Command function first puts the cursor in the command line. Next, the Begin Line and Erase Line functions move the cursor to the beginning of the line and clear the command line of any commands or file names appearing there from previous editing. The Edit command and help file name ('e PE.HLP') are then typed on the command line, and the final Execute function enters the command. Creating editing features like this is easy, but sometimes requires a little trial and error to get the steps right.

> The ability to group three related functions around a single key offers a multilevel keyboard you can feel at home with.

The *Personal Editor*'s method of defining keys provides adequate flexibility in creating editing features. The constraint of having to pack the coding of a feature into 255 characters, however, puts a stiff limit on the complexity of the features you design. Creating a feature to draw a box around displayed text, for example, can easily require more than 255 characters of space for coding, depending on the size of the box. Half of an extended procedure could be assigned to one key and the second half to another, so that pressing two keys in a row completes the procedure, but fewer keys are then left for other editing features.

One feature the *Personal Editor* lacks is the ability to pause during a function to allow the operator to type information. Neither does the program conditionally test for keystrokes during a procedure, a capability of the WANG keyboard programming system, which enables the branching of a function to arrive at different results based on operator input. Without these abilities, you cannot create looping functions that might, for example, insert five blank lines and then ask if you want to insert five more by typing *y* for yes or *n* for no.

Despite these limitations, the key definition features of the *Personal Editor* offer more than they withhold. Because adding a personal touch is part of the joy of a craftsman, Personal is a good first name for this editor. The ability to group three related functions around a single key using the Shift, Alt, and Ctrl key combinations offers a multilevel keyboard you can feel at home with.

File Management

On a 64K IBM PC, the *Personal Editor* provides only 8K of work space for files. With more than 64K, this limitation is removed. Up to 20 files can be loaded into memory at one time, and you can quickly view any of the files in memory by pressing the edit command key (F8) repeatedly to bring a different file to the screen with each press. This switching between files is useful when you write documentation for a program. You can load the program and documentation files in memory active files, and as you write the documentation you can look back to the program easily and quickly to check on the features you're writing about.

Once made active in memory, files can be edited and then saved on disk again. An edited file is saved over the previous version of the file on disk, so if you botch the editing job on an active file, you can reload the original, unchanged version from disk and begin again.

With the possibility of working on 20 files in memory at once, you occasionally need to clear the work bench to concentrate on specific projects. The *Personal Editor* provides two options for erasing active files. The Quit command simply erases the current file from memory without saving it on disk. If the file has been changed while active, you are asked if you intend to erase it. The File command combines the Save and Quit functions by both recording the file on disk and deleting it from memory. Once all files are removed from memory using either Quit or File, the *Personal Editor* program ends, returning control to PC-DOS.

Saved files are recorded on disk in ASCII format. Extra blanks between characters are compressed to save disk space as the file is stored. These spaces are reinserted automatically when files are brought to the screen or printed out. The editor does not remove spaces after encountering a quotation mark on a line, preventing screen messages that appear between quotes in a program file from being garbled when the program is run. Files can be saved without compression of the extra spaces by specifying "Notabs" in the File or Save command. You might save a file in uncompressed format if, for example, you intend to telecommunicate it to another computer running a different editor that might not be able to read the compressed file.

You may be disappointed if you try swapping files between the *Personal Editor* and a word processor like *WordStar.* When read by the *Personal Editor,* a *WordStar* file appears on the screen in lines 255 characters long, with the carriage returns at the end of each line ignored. After resetting margins and reformatting the text, you see control codes embedded throughout the text. Editing this kind of file requires going through and deleting each code. Even using the Change command to globally replace these control codes, the advantages of exchanging files between the *Personal Editor* and a word processor like *WordStar* are probably few. *Personal Editor* files, however, can be read and edited by *Wordstar* without need for such changes.

For computer systems with limited memory, the *Personal Editor* has a spill file, which facilitates the creation of files larger than the computer memory can hold. When an active file becomes too large, the editor creates a temporary file named PE.TMP on disk to catch the overflow. A temporary spill file can be up to 128K long. When this type of extended file is saved on disk, the *Personal Editor* reassembles the spill file and the active file again. Memory limitations may restrict you to editing one file at a time, but with the spill file, it's as if the *Personal Editor*'s architecture enables you to raise the roof to fit the Christmas tree.

Internal Files

The *Personal Editor* uses three internal files: Dir, Keydefs, and Unnamed. The editor uses these files during an editing session, modifying and updating them in memory as you edit. You can look at the three internal files by calling them into active memory, but because they are continually updated while the editor is in use, you must rename them to save a permanent copy on disk.

The Dir file is used when you are displaying a directory of files. Using the familiar DOS DIR command, you can display a directory for a specific drive and compose directories of selected files. To create a directory of files related by file names or extensions, the Dir command is used with the wildcard asterisks. For example, to display a directory of all files with the extension .BAS, the command `DIR *.BAS` is entered on the *Personal Editor* command line.

The file names, sizes, and dates and times of creation are read into the Dir file and displayed on screen. The directory can be edited, for example, with comments about the contents of the files and then renamed and saved on disk or printed out. Although none of the internal files can be saved on disk under their original names, once displayed they are active files that take up memory and can be renamed and saved like other files being edited.

> *Personal Editor* files can be read and edited by *WordStar.*

The internal file Keydefs contains the blueprint for the keyboard layout. On starting up the *Personal Editor,* the default key definitions and any that you specify are stored in this file. The file can be displayed on screen when a reminder is needed about the function of specific keys. Any time a key is redefined using the Define command, the change is stored in the Keydefs file. Calling the Keydefs file into active memory, you can edit it with the definitions you've chosen and save it under a new name. The renamed file can then be recalled using the Macro command and this particular configuration of the keyboard reused.

Despite its rather tomblike name, the third internal file, Unnamed, is very useful. It is in this file that mistakes and editing changes are buried. The Unnamed file is the repository for the last five changes made during editing. The real benefit of this file comes when you have second thoughts and wish to restore deleted or changed sections of code or document text. By calling the Unnamed file to the screen, the original sections of changed text can be copied back into the file. The types of changes that go into the Unnamed file are deleted characters, words, and lines; lines that are too long; reformatted paragraphs; replacements made using the Change command; and parts of a file used in block moves.

Keep in mind that block moves of large portions of a file are stored temporarily in the Unnamed file and therefore take up memory space. If several large block moves are made, memory may be completely taken up by the Unnamed file. The temporary file must then be cleared by editing the file to delete its contents.

Another *Personal Editor* file called PE.PRO stores default key definitions and commands. When the program first starts up, the PE.PRO file is read, and the default key definitions are transferred to the Keydefs file and activated. Unlike Keydefs, the PE.PRO can be edited and saved with the same name again so that the *Personal Editor* comes up automatically configured the way you want it.

Any of the *Personal Editor* commands can be stored in PE.PRO, one per line, and as the file is read the commands are executed. For example, if you wish to automatically load a file of word processing key definitions, load files to be edited, and print a disk directory every time you load the editor, you simply enter the sequence of commands for these tasks in the PE.PRO file. With the ability to execute commands, the PE.PRO file can be used to take care of chores like setting up margins and tab stops before editing begins.

If one executable command file like PE.PRO is good, why not have many? You can. The *Personal Editor* reads any file loaded with the Macro command as a command file. If you often erase a current active file from memory and then call up a disk directory, create a command file to do the job.

You begin creating a command file by opening a new file with the Edit command. Next, type the Quit command to erase whatever file is on screen. On the next blank line beneath the Quit command, type the Dir command and a drive specification if needed. Last, save the file with a name that preferably identifies its function. Any time this file is loaded into memory with the Macro command, the current displayed file is erased and a disk directory is displayed. Assigning a function key to invoke command files makes using them even handier. Command files can be made using any of the *Personal Editor*'s 17 commands in the order you normally follow to do the task manually.

The internal file Keydefs contains the blueprint for the keyboard layout.

Documentation

Documentation for the program includes tutorial, reference section, reference card, keyboard guide, appendices, and index. No glossary is provided. Illustrations of screens and keyboard are neatly done using two colors, green and black. The general format of the text is appealing to look at, but the writing style has some rough edges. Text has been broken into many short, single-sentence paragraphs more often for how they look than how they read.

Toward the end of the tutorial a mysterious author emerges with sentences that begin "I." Explanations are a bit skimpy; in the section on changing margins, for example, you are told that the program "remembers" the margins set for each file, but are given no further information about the way the program keeps track of margins. On the next page of the tutorial in the section on changing tabs, you are told that margin and tab settings apply to the current active file and any file edited after that. You are left on your own to puzzle out whether the *Personal Editor* keeps track of specific settings as you switch between files.

After a little experimentation, you will discover that when a file becomes active, the *Personal Editor* uses the margin and tab settings previously set for that file, but when a new file is created, the margins from the last active file are applied. Several such instances of glossing over information occur, especially in the tutorial section on printing files.

Easy and Versatile

The *Personal Editor* is no substitute for a word processor, though it suffices for simple letter writing and short word processing applications. Despite a ready-made set of word processing key definitions supplied with the program, the *Personal Editor* is basically line oriented, which makes for awkward text processing.

The ease with which you can copy and move blocks, search and replace text, and switch between editing files makes the *Personal Editor* ideal for program editing. On-screen editing is simple, carried out by a variety of cursor movement functions; unlike the EDLIN program, with the *Personal Editor* there is no need for fussing with line numbers.

Editing multiple files in memory at once and transferring blocks between files is straightforward and easy to carry out. The *Personal Editor* also favors you with versatility by enabling you to define new editing features when a particular application calls for them. Being able to define the keyboard to behave the way you want it to, you are the one who dictates the editor's ease of use. The *Personal Editor* puts the design of your editor's features in the best hands—your own.

Bill Grout is a writer based in San Francisco who is currently working on a book about word processing. Kearney Rietmann is an Associate Editor at PC World.

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IBM Corporation
Systems Products Division
P.O. Box 1328-C
Boca Raton, FL 33432
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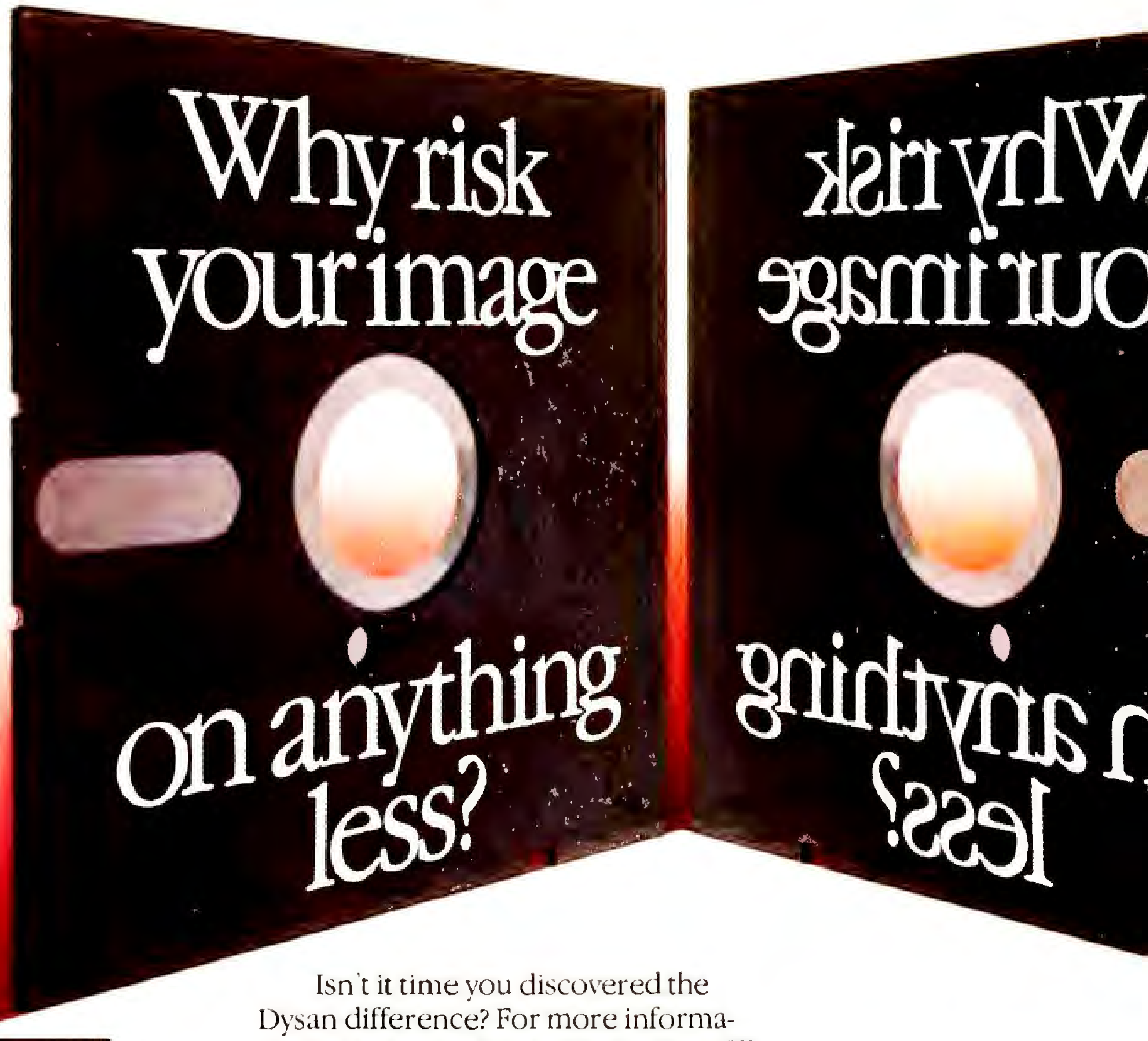

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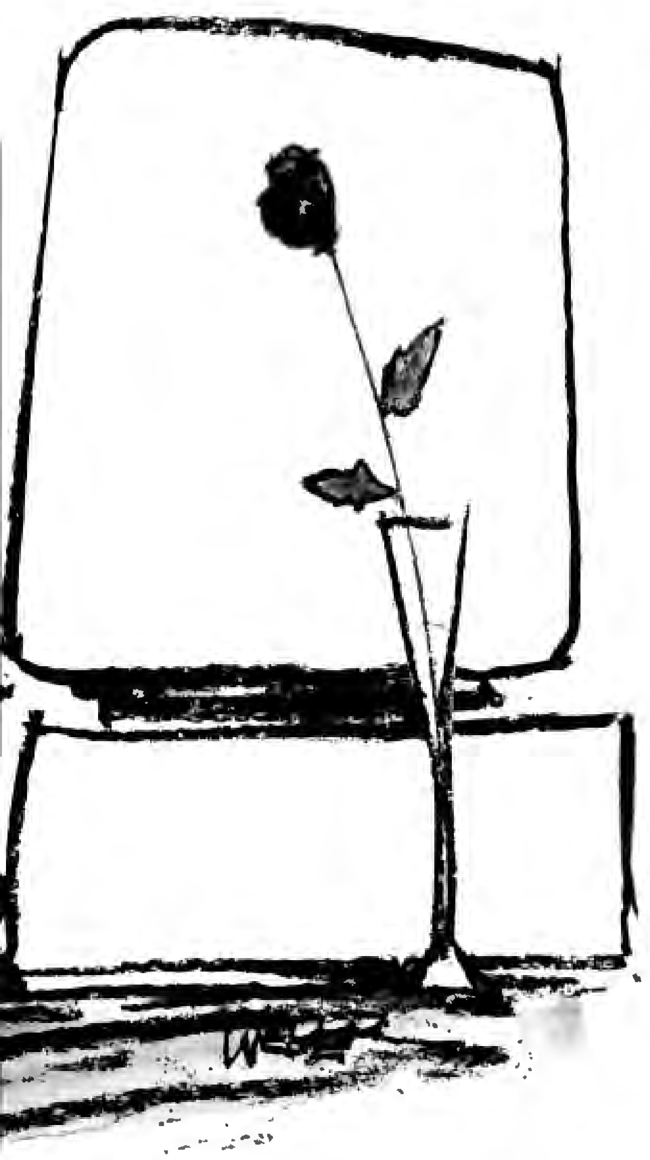

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Perhaps you too have been known to talk to your PC in moments of elation or frustration, but with *Supertalker II* you can have it talk back to you. We are used to seeing accessories such as joysticks, digitizing pads, and light pens connected to our machines. Now the microphone and loudspeaker are becoming common accessories. With *Supertalker II* you can enter segments of speech into PC memory, save them on disk, and play them back in any order.

Applications

Two of the most rewarding applications for this kind of device are aids for the handicapped and computer-assisted instruction. With suitable programming, a talking PC can benefit a voiceless person. Based on keyboard or joystick input, speech segments can be selected from storage and assembled into sentences, aiding personal communication and helping relieve the frustration of the speechless. Imagine the possibilities for teaching new skills to foreign students by speaking to them in a language they already understand.

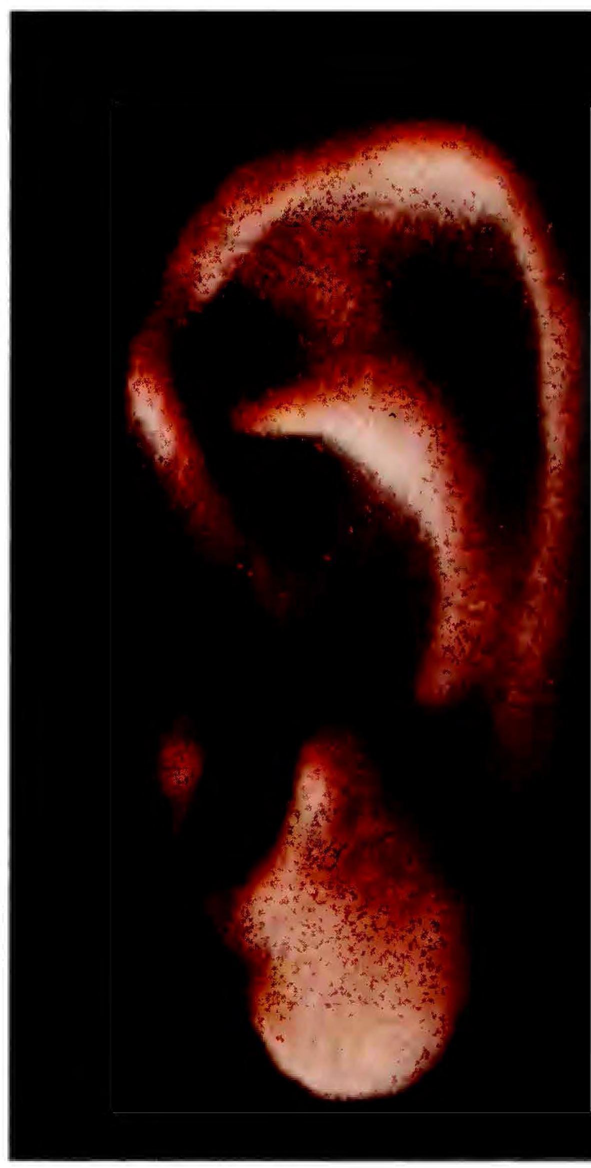
Once you start, you can't stop thinking of the many ways to use a programmable talking machine. What about word processors for the blind? Intelligent, vocal alarm systems? Sophisticated telephone answering (or maybe even calling) programs? Just thinking about it can be fascinating.

Supertalker II is a printed circuit board for the IBM PC or a compatible machine that converts audio input into digital form and back again under program control. Microphone input is converted to a stream of bytes that can be saved by the program for later use in reproducing the original sound through a loudspeaker. You can use the IBM PC's internal speaker, or you can plug in a larger one to replace or supplement it. The circuit board includes 32K of RAM available as standard memory that is not limited to speech applications.

Since the words and/or sounds you play back are the ones you recorded yourself, the emphasis and inflection are entirely your own. If your PC is monitoring the smoke and heat detectors in your theater, it can say "fire" in a way that is uniquely your own.

The package also includes an operator's guide, microphone, cable, loudspeaker, and a disk containing speech processing software. The programs may be used to record, save, and play back sound in units called phrases. Phrases are grouped in larger units called phrase tables, which may be up to 44,500 bytes long. Each table may contain many phrases, and the phrase tables may be saved as files on disk (you supply the file name; the extension is .SPT).

There is an upper limit to the duration of the speech content in a phrase table. The duration varies from about 10 to 70 seconds, depending on factors described below. Since the duration of single words averages about a half-second each, you probably won't encounter the limitation. Some planning is required, however, to record phrases such as *burglar alarm* or



supercalifragilisticexpialidocious.

Stored along with each phrase are values for the duration of silence periods before and after the phrase, a default output volume level, and the recording speed (quality) used. The *Supertalker II* software recognizes silent periods such as spaces between words of a phrase and codes them in a manner that saves storage space. During recording it also edits out silence preceding a phrase, so if you temporarily freeze in front of the mike, you won't waste storage space (as long as the silence occurs at the beginning of the phrase and is recorded in quiet surroundings).

The Coding Process

Coding a continuously varying signal like the output from a microphone is called analog-to-digital conversion. The input signal is chopped into slices of time called samples; each sample produces a binary value (a number), which is related to the magnitude of the signal at the time of the sample. The method used by *Supertalker II*, called delta coding, produces a single bit for each sample. This bit is a 1 if the amplitude of the signal has increased since the last time it was sampled, and a 0 if it has decreased. Where there is no change (as with silence), the output of the coder is a string of alternating 0's and 1's.

The quality of the coding process depends on the speed at which the input signal changes and the speed at which it is sampled. If the sampling is not fast enough for a rapidly changing signal, information is lost and reproduction is garbled and noisy. In general, the faster the sampling, the better the reproduction.

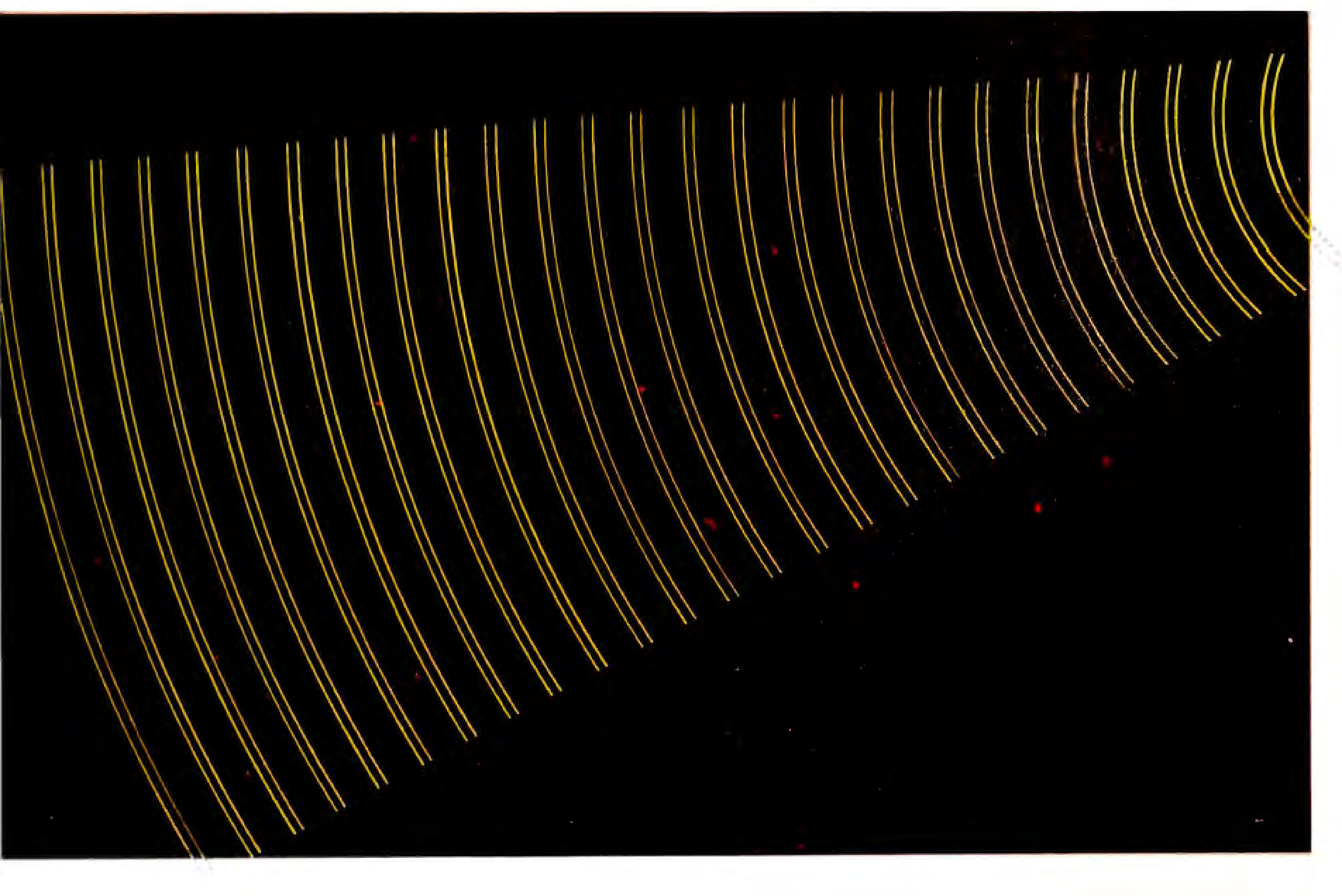
Supertalker II offers four sampling rates, of which three are supported by the software supplied:

Bits/ Sec.	Bytes/ Sec.	Quality
18,600	2325	Low
24,800	3100	Good
37,300	4662.5	Best
49,600	6200	(not supported)

The highest rate, while giving the best quality, is outside the specifications of some of *Supertalker*'s electronics, so proper operation at this speed, no matter how likely, cannot be guaranteed.

During recording the microphone input is sampled continuously, with the program accepting a byte of data (8 samples) every 214.48 microseconds at the best sampling rate. Since the easily detected alternating 0's and 1's of unchanging input (usually silence) carry no information, the program replaces these intervals in the phrase table with a silence code and byte count, which may save a great deal of storage space if there are pauses in the speech input.

Playback consists of supplying bytes of coded speech data at appropriate intervals to the *Supertalker II* decoder, which raises the amplitude of the output signal one unit for a 1 and lowers it by the same amount for a 0. When a coded silence interval in the data is detected by the output subroutine, the proper length sequence of silence bytes is passed to



the decoder instead of data from memory. The resulting high-frequency noise is filtered out by the output circuitry and you hear silence.

Quality of speech reproduction is a subjective thing. After hearing *Supertalker II* at all of its quality levels, I suggest you compare it to the telephone, which has a frequency response of approximately 300 to 3000 Hz.

If you are interested in the theory of delta coding and decoding, a good, graphic explanation of the subject may be found in *Speech Analysis, Synthesis and Perception* by J.L. Flanagan (2d ed., Springer-Verlag, New York, 1972).

Installation

The mechanical part of installing *Supertalker II* is easy if the well-illustrated instructions provided in the documentation are followed. One omission from early shipments and the instructions that go with the package is a card guide, a plastic slot that snaps into place in the PC cabinet, to hold the unsupported end of the circuit card in place. If you can't find a card guide of the proper size and shape, be sure that the loose end of the *Supertalker II* card is kept from contacting other cards in adjacent slots or parts of the PC cabinet, such as the bracket that holds the speaker.

The instructions for setting the various switches on the *Supertalker II* card might be a source of trouble. Most important is the fact that the

```
1     REM Listing 1:
10    REM BASICA PROGRAM TO DEMONSTRATE MOUNTAIN HARDWARE
20    REM SUPERTALKER 2, ADAPTED FROM SAMPLE ON MANUAL PAGE 16.
30    REM ---------------------------------------------------
40    REM Reserve 1st 20480 bytes for BASICA:
50    CLEAR ,20480
55    DEFINT A-Z
60    REM connect machine language driver
70    DEF SEG= 0:STIOSEG=PEEK(&H3C6)+PEEK(&H3C7)*256
80    STIO= PEEK(&H3C4)+PEEK(&H3C5)*256:DEF SEG
100   REM load phrase table (starting address=20480)
110   BASE=20480:BLOAD"DEMO.SPT",BASE
115   PRINT "Phrase Table Loaded."
120   REM Set stio operating parameters, coded as follows:
121   REM P1 (Mode)  P2 (Table) P3 (No.)  P4 (Volume)  P5 (Quality)
122   REM ---------  ---------- --------- ------------ ------------
123   REM  1= Play   (Phrase    Phrase #  -1= Recorded -1= Recorded
124   REM  2= Record  Table                0= Low       0= Good
125   REM             Start                1= Normal    1= High
126   REM             Address)             2= Loud      2= Best
127   REM
130   P1= 1:P2=BASE:P4=-1:P5=-1
140   REM Get time from system:
150   X$= TIME$
160   PRINT "The time is "+X$
170   HH= VAL(LEFT$(X$,2))
180   IF HH < 13 THEN PM= 0 ELSE PM= 1: HH= HH - 12
190   MTENS= VAL(MID$(X$,4,1))
200   MUNITS= VAL(MID$(X$,5,1))
210   REM Say the hour (1-12):
220   P3= HH+1: GOSUB 270
230   P3= MTENS+1: GOSUB 270
240   P3= MUNITS+1: GOSUB 270
250   IF PM THEN P3= 14: GOSUB 270
260   STOP
270   PRINT "Calling STIO with P3=", P3
280   DEF SEG=STIOSEG:CALL STIO (P1, P2, P3, P4, P5):DEF SEG
290   RETURN
300   ENDC
```

Listing 1

drawings of the switches show rectangular black spots indicating which end of the switch to press (not which end should be up). Mountain Computer uses rocker switches instead of slide switches. Another problem is that setup instructions are not supplied for systems with more than 224K of RAM.

If you have a copy of the standard diagnostic programs for the PC, running them to verify correct operation after installing *Supertalker II* is a good idea. Of special interest is the listing of installed features, for while the diagnostics can't be expected to test or be aware of the *Supertalker II* speech hardware, the additional 32K of storage should be reflected in any message listing the size of RAM.

When using the software (don't forget to make a backup copy first), be sure to use the AUTOEXEC.BAT file supplied or its exact equivalent. Failure to do so can result in "locking up" the PC so thoroughly that the only cure is to power it off (leave it off for about 10 seconds) and then on again.

Hearing, Writing, and Reading

In the 1930s Dr. Ben Wood developed the theory that children would learn reading more easily and quickly by writing first. One of his students, an educator named John Henry Martin, retired in 1975 to devote his time to proving Wood's ideas. The two men also held that the important part of writing had little to do with drawing the letters well, and that the perfectly formed characters produced by a machine served the purpose even better than hand printing.

In order to test these theories, Dr. Martin and his wife Evelyn designed a comprehensive lesson plan and asked IBM to lend them six Selectric typewriters (which don't jam when the kids press more than one key at a time). IBM, which has a tradition of supporting educational research, found the idea interesting, and a partnership was formed.

The partnership blossomed into a test project called Writing to Read, involving more than 300 learning stations with talking IBM Personal Computers equipped with *Supertalker II*, color displays, and typewriters. The equipment also includes 900 tape recorders, 2410 sets of earphones, almost 10,000 disks, 12,885 audio cassettes, and thousands of texts and workbooks. These went to over 100 schools in seven states.

This large investment is based on an excellent track record for the program that Martin started in 1977 with 17 borrowed typewriters. IBM found that the children in Martin's first program gained 26 percentile points in reading skills in a year, moving from the 44th percentile to the 70th; improvements in the program for the second year brought another group of first graders to the 82nd percentile. Other results were even more impressive, leading to the development of similar programs for older children.

Computers were the technical base for the next step in Dr. Martin's work. He developed newer, more flexible instruction sequences based on the ability of the computer to react to the students' actions.

The IBM PC equipped with voice output and color graphics plays a key role in the Writing to Read program, aided by other, more traditional tools. The voice output from the computer capitalizes on the typical 5-year-old's vocabulary of several thousand words. High-quality color graphics add to the impact of the new material in a way no child can ignore.

Much has been said and written about the promise of the computer in education, but measurable benefits have been slow in coming. IBM and Dr. Martin seem to have achieved the kind of synergy with Writing to Read that educators have been looking for. And the kids seem to be enjoying it too.

Dr. Martin with a student

Supertalker-equipped PCs

Trying It Out

Trying out *Supertalker II* is the fun part. After installing the loudspeaker and microphone, execute the *Supertalker II* Editor program (STE.BAS) using the AUTOEXEC.BAT file provided. This program loads the machine language service subroutines and allows you to build, edit, and save phrase tables. Phrases may be played back immediately after recording, and you will find yourself starting to plan speech programs in the back of your mind as you simulate their operation by controlling STE from the keyboard.

You may find it easy to fill up the 44.5K in a phrase table at the best sampling rate; if space becomes a problem, change to the next slower speed for experimenting.

There is little documentation on STE in the *Supertalker II* operator's guide, but the menu-oriented operation is easy to understand. If you are recording short phrases, don't worry about the amount of menu space (14 lines) reserved for phrase entries. The number of phrases is not limited to the entries that fill this space; the number is limited by the total size of the phrase table (44.5K bytes or 32 phrases, whichever occurs first).

Also not obvious is the fact that STE allows insertion of a new phrase between two existing phrases. Once you have completed an applications program for *Supertalker II* and need to revise it, this feature will be very useful.

Once you start, you can't stop thinking of the new ways to use a programmable talking machine.

Listing 1 shows a sample program for *Supertalker II*. The program is simple, but it points out a number of important things, most of them in the software area. SAYTIME uses a single phrase table containing the following phrases in the order listed:

(1)	Zero
(2)	One
(3)	Two
(4)	Three
(5)	Four
(6)	Five
(7)	Six
(8)	Seven
(9)	Eight
(10)	Nine
(11)	PM

The program gets the time of day using the BASIC pseudovariable TIME$ and then "says" it after adjusting for the difference between 12- and 24-hour notation (for hours greater than 12, subtract 12 from the hour and append PM to the spoken output). The output is a bit unrefined; instead of "five nine," for example, why not say "fifty-nine"?

The answer to why this program is not more clever lies more with the structure of *Supertalker II*'s software than anything else. Loading phrase tables from disk is slow, so you want to avoid it during speech output. Making SAYTIME clever enough to say "fifty-nine" instead of "five nine" would not make the program much longer or more complex, but the processing would be so slow when used with phrase tables on floppy disk that the listener might forget the hour while waiting for the minutes.

The lesson here is that complex applications of *Supertalker II* (especially at the best speech quality) either require large and fast hardware in which the supplied software is used, or need to be programmed using a different set of programming tools. No information is given in the operator's guide about how to program *Supertalker II* in assembly language or in another language that might offer more flexibility (along with greater programmer responsibility, of course). The buyer is not informed of such basics as the I/O addresses used (3E0-3EF are reserved, of which 3E8-3EC are used; there are no interrupts). Experienced programmers may find this a shortcoming and might resent having to ask the manufacturer for the kind of data they have learned to take for granted.

Supertalker II is an important and useful addition to the hardware options available to PC users. It is simple and easy to use with the software supplied. However, in order to construct systems of some size, large and fast random access storage such as hard disk may be required. The information needed to write one's own support tools would be most welcome to the serious programmer on a limited budget.

I found an interesting side effect resulting from installing *Supertalker II*. Engineers would say it was a fault, but with an earphone or an efficient speaker you can hear signs of your system operating. As this is being written, I can hear little bursts of sound that reflect both my input and *WordStar*'s (occasionally futile) attempts to process it. I like this kind of feedback; it reminds me of the days when we put a radio on the CPU and listened to work in progress.

Jack Powers is a communications systems programmer for a large research organization in the San Francisco Bay Area.

Supertalker II
Mountain Computer, Inc.
300 El Pueblo Rd.
Scotts Valley, CA 95066
408/438-6650
List Price: $565
Requirements: 64K, one disk drive

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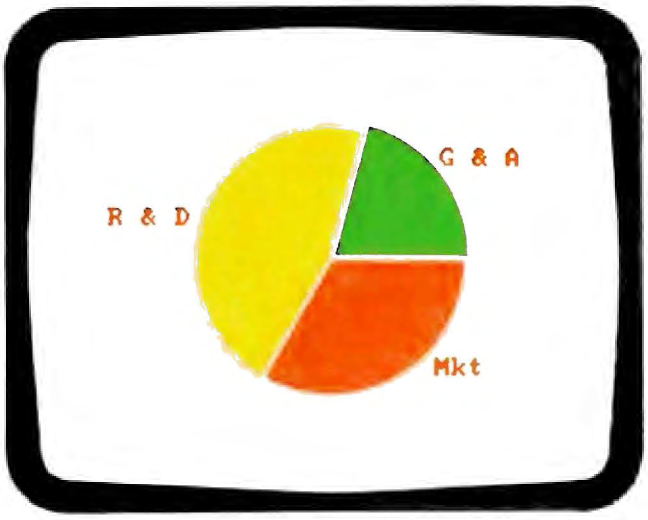

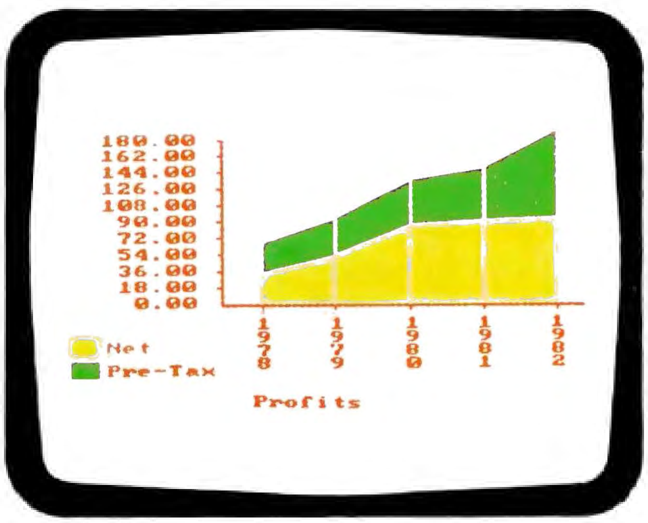

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Better Basics

Introductory books that provide organized instruction on running and programming your PC

Richard Cook

Are you tired of just reading about BASIC programming and anxious to try it instead? If so, pick up a copy of *BASIC Exercises for the IBM Personal Computer* by J.P. Lamoitier. You'll still have to read, of course, but you'll also be loading and running many new and challenging programs. Through this learning-by-doing method you'll learn programming faster, too.

Basic Exercises

BASIC Exercises for the IBM Personal Computer is not another sugar-coated beginner's introduction to BASIC; it is a straightforward, sharply focused textbook for the serious programming student. The book is divided into 11 chapters. Chapter 1 is an introductory lesson in BASIC. Chapter 2 explains flowcharting. The remaining chapters demonstrate how to set up programs to solve problems in math, geometry, data processing, science, finance, games, research, and statistics.

Each chapter uses an identical format. A problem is stated and analyzed, and the reader is challenged to devise a solution. Then a flow chart is presented, followed by the program and a sample run. Turn the page and the process is repeated.

While the writing is Spartan in the classic textbook tradition, it is correspondingly clear and well organized. Lamoitier never dwells on a point, but simply explains what needs explaining and moves on, an approach that works well for this often complex material.

The text is augmented by extensive use of examples and illustrations, mostly of flow charts, program listings, and printout results. You can type the programs provided in each chapter into your PC to see how they work.

As with any textbook, how much you learn depends largely on how much intellectual effort you expend, but be warned: algebra and calculus are used heavily in *BASIC Exercises for the IBM Personal Computer.* The concepts are not impossible for the lay person to grasp, but this book is written, as the author says, "for all readers who have a minimum scientific or technical background." Lamoitier's idea of minimum background may differ greatly from yours, so look carefully through a chapter or two before buying.

For those who have access to a PC *BASIC Exercises for the IBM Personal Computer* provides expert guidance in the hands-on method of learning how to program in BASIC. You'll like this book if you are the kind of person who prefers digging into things and figuring them out yourself rather than listening to someone explain how they work.

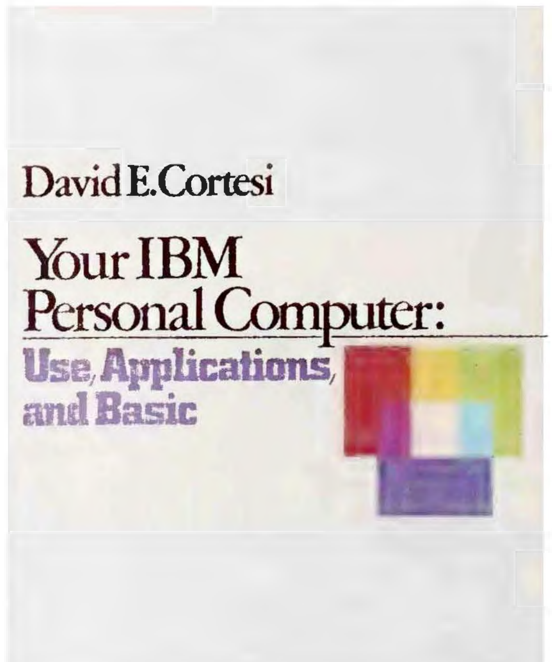
Your IBM Personal Computer

Everyone new to and curious about the world of computers faces the task of absorbing an ocean of obscure information. For many, it is easier on the psyche to ignore the entire subject than to plunge in and risk appearing a techno-peasant.

Too often those who do try to learn are inundated by a tidal wave of terminology or find themselves drowning in an attempt to learn computer operations, programming, and organization all at once. What is needed is a beacon to guide the beginner through the seas of confusion to the shores of knowledge. To that end, *Your IBM Personal Computer: Use, Applications, and Basic* by

David E. Cortesi can shine some much-needed light on the subject.

If you have just bought or are about to buy an IBM PC and find you know very little about how to use it or what to do with it, you will find *Your IBM Personal Computer* an excellent investment.



Designed as a step-by-step guide to be used in conjunction with the IBM *Guide to Operations*, the BASIC manual, and the software manuals, *Your IBM Personal Computer* provides an organized approach to setting up and using your PC.

Cortesi assumes you are new to computers and rightly begins by describing what a computer is, what it can and cannot do, and how software fits in. Next he identifies various hardware components and explains what they do and how they work with your system. Subsequent chapters cover hardware installation, the use of DOS and *VisiCalc*, and elementary BASIC programming.

You will also find a chapter on software—how it is made and sold and where to find information on it, and a chapter on creating and maintaining a disk library, including how to make and organize backup disks and how to use batch files. By the end of the book you should be able to use your PC effectively.

Your IBM Personal Computer is clearly written in everyday English with a light, friendly touch that will calm and reassure you during moments of confusion, frustration, or panic. Cortesi stresses the fact that your PC is not only a powerful tool, but is fun to use and not threatening. He's convinced that it's not difficult to master the computer if you are "willing to read software and hardware documentation, the *Guide to Operations*, and computer books and magazines," and if you "know your own work very well" so you can supply knowledgeable supervision to what your computer does.

Cortesi understands the importance of feeling at home with your PC in the physical sense too; the initial chapters provide many useful tips for setting up a well-organized, comfortable work environment.

Your IBM Personal Computer is easy to read and digest because the material is introduced in small, complete chunks that anyone can swallow. Terminology, for example, a common bogeyman for the novice, is introduced and explained as you work through the chapters, rather than dumped on you all at once. And each chapter has many examples and illustrations, including some simple programs anyone can load and run.

Books like *Your IBM Personal Computer* are greatly needed in the computer industry to provide introductory-level material for beginners who want to know about or even buy their own personal computers, and to tear away the layers of misinformation and confusion about computers that exist in the minds of many nonusers. If you are looking for a smooth road to computer literacy, *Your IBM Personal Computer* can get you well on your way.

BASIC Exercises for the IBM Personal Computer
J.P. Lamoitier
Sybex Inc., Berkeley, 1982
251 pages; $13.95

Your IBM Personal Computer: Use, Applications, and Basic
David E. Cortesi
CBS College Publishing, New York, 1982
253 pages; $16.95

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What's New, WordStar?

Except for a little cosmetic flash, the newest release from MicroPro is the same old WordStar.

Harry Miller

I was enthusiastic and hopeful as I opened the package. It looked new and different. The packaging had been completely redesigned. I knew that version 3.3 of *WordStar* would use memory-mapped video to increase the screen refresh speed (the rate at which the display screen is redrawn when you move the cursor more than a screen at a time). I could only hope that this updated version would include some sparkling new features that could make the most popular word processing program also be the best. I regretfully report that once I got past the well-designed installation procedure my hopes were not fulfilled.

C. Itoh/TEC Starwriter/F10	NEC 8023A matrix printer
Centronics 353	NEC Spinwriter 3550
Centronics 739	NEC Spinwriter specialty
Diablo 630	Okidata ML84A
Diablo/Xerox 1610/1620	Olympia ESW-102
Diablo/Xerox 1640/1650	Qume Sprint 5-9/45-11+
Epson MX80/100-no Graftrax	TI 810/820
Half line feed printer	backspacing standard
IBM Parallel printer	standard printer
MPI 88G/99G	

Figure 1: Printer Types Compatible with WordStar 3.3

Left margin	Initial help level
Right margin	Decimal point character
Number lines/page	Non-document mode
Page offset	Initial directory display
Form feeds	Initial insertion toggle
Data field separator	Justification toggle
Variable name symbol	Hyphen help toggle
System disk drive	Omit-page-numbering toggle
Function keys	Top page margin
Exit to INSTALLATION menu	Bottom page margin

Figure 2: Menu of WordStar Features

Installation

Version 3.3 includes a menu-driven installation procedure that makes it easy for any user to reconfigure the program to work with a variety of printers. This procedure also provides some flexibility in the operatior of some of *WordStar*'s features.

The installation menu covers three basic areas of configuration: terminals, printers, and *WordStar* features. Since the program comes preinstalled for the IBM PC screen and keyboard, the terminal menu is bypassed. The printer menu provides a one-key configuration of the program to be used with the specified printer. Figure 1 lists the printer options offered.

Features Menu

Certainly the most interesting and fun aspect of the installation procedure is the *WordStar* features menu. This menu provides facilities for adjusting the default values for 19 important features. The procedure for changing 17 of these features has been described in detail in Emil Flock's "WordStar Made to Order" (*PC World*, Vol. 1, No. 2). The two features not covered in that article involve the *MailMerge* program. That article also described a host of other useful changes, all of which can be patched on version 3.3. Those changes work so well because, it seems, very little of the actual code of the program has been altered to produce the new version.

The features menu (or the *PC World* patch procedure) makes a slight change in the assembly language code to change the conditions that are in effect when *WordStar* starts up. Using either method of making the changes, you could change the default settings for the program at any time. Alternatively, you could establish several versions, each set up and named differently.

The features menu in the 3.3 version lets you set the initial help level (from 0 to 3) that determines how much help information and which, if any, menus are displayed (see Figure 2). Any experienced *WordStar* user will tell you how annoying the menus are once you get used to the commands. You can also decide whether the disk directory should be displayed in the lower half of the screen when the "editing no file" (now called the "not editing") menu is shown. A related option allows you to preset the logged disk drive.

Another configuration option determines whether the program will start up in the non-document mode. The benefit of this feature is that you can type ws filename from the operating system and jump right into editing the file under the non-document mode. Similarly, you can change the defaults so that the insert mode and automatic justification are off. In the insert off mode new characters are typed over adjacent, existing characters rather than inserted before them. Automatic justification off means that the right margin will be ragged when words are wrapped around at the end of a line.

Another useful change is that the hyphen-help feature, which stops and suggests where the text might be hyphenated as a paragraph is being reformed, can be disabled. This is especially useful if you have turned justification off because the hyphen-help gets in the way and slows the operation down.

Other menu choices allow you to alter the default settings for the top (3 lines), bottom (8 lines), left (1 column), and right (65 columns) margins. You can even change the decimal character from a period to a comma to facilitate European notation.

In the area of print control, the features menu lets you set page numbering off (the equivalent of including an '.op' dot command in the text file), and change the default number of lines per page from 66 to whatever value the paper size you're using requires. In addition, the page offset can be set, indicating the number of columns to remain blank to the left of the zero setting of the left margin (the default value is 8 columns).

Very little of the actual code of the program has been altered to produce the new version.

The form-feed option allows you to establish the default condition of whether form-feed or multiple-line-feed characters are sent to the printer before page one and between pages. The normal default condition is to use multiple-line feeds (form feeds off).

Function Keys

Possibly the most significant improvement in efficiency results from the assignment of frequently used keystroke combinations to the dedicated function keys, F1 to F10. While earlier versions of *WordStar* for the PC came with those function keys predefined, the definitions may not have suited your individual needs. Before the information was released in "WordStar Made to Order" there was no simple way to change those definitions without buying a separate keyboard enhancer program. The new version includes a simple way to change those definitions as part of the features menu. Each of the function keys may be assigned a definition of up to 6 characters. It also provides a constant display of the current function key definitions at the bottom of the screen (on the 25th line).

The constant definition display could be more of an annoyance than a help, however, especially if you've been using a keyboard enhancer to redefine the function keys as I have. It's unlikely that your function key definitions are the same as the predefined ones. Of course, you could go into the features menu and redefine the function keys to match your keyboard enhancer version. But that means double work every time you want to change the definitions, and if you've been using a keyboard enhancer, you no doubt have defined each of the function keys to have extra meanings with Alt, Shift, or Ctrl key sequences. Since *WordStar 3.3* defines and displays only the ten single function keys (F1 through F10), two-thirds of the definitions can't be displayed.

The simplest solution to the function key definition display is to get rid of it. The patch to accomplish that was first published in Steven Cook's "WordStar Patches—P.S." (*PC World*, Vol. 1, No. 3). It allows you to display text on the 25th line of the PC screen. After typing

```
debug ws.com
```

respond to the DEBUG prompt ('-') by typing

```
F 248 L1 19 <ENTER>
```

Then type

```
w <ENTER> q <ENTER>
```

to save the change you just made and quit the DEBUG program.

The two *MailMerge* options on the feature configuration menu allow you to change the characters used to separate the data fields in a *MailMerge* data file (usually a comma), and to change the symbol used to denote a *MailMerge* variable when it occurs in a *WordStar* file (usually an ampersand).

Several of the useful patches described in the Flock and Cook articles are not addressed directly by the features configuration menu. In particular, the patch to shorten the redisplay delay (the amount of time the messages remain on the screen), serves to speed up the operation of the program. And the word-wrap toggle and line-spacing default setting add a satisfying dash of flexibility.

Color

MicroPro has also provided a little Advanced BASIC program to change the color of the background and the characters in both the text and the menus when *WordStar* is used with a color display monitor. The program (including source code) is supplied as a free addition to *WordStar.* You can run the program at any time so that you're not stuck with the choice you make at the first installation. The color choices for either background or foreground (characters) include none (black), blue, green cyan, red magenta, yellow, and white. In addition, you can decide to have the characters in the text or the menus highlighted. In fact, you can also use this program to change the highlighting on a monochrome display to make the normal text dimmer and the menus (and marked blocks) highlighted.

Editing

While the configuration of features from a menu makes the program easier to use and customize to your needs, the memory-mapped video feature makes *WordStar* significantly more pleasant to use. The program operates in the same manner as it always has, but everything happens faster.

It has often been said that perception of speed distorts when you start using computers. The first time you see the computer perform a time-consuming task, it seems like a miraculous accomplishment. It doesn't take long before you are impatiently waiting for the computer to complete the same task and asking how the process can be sped up. At any rate, while your perception of speed may be personal and subjective, one phenomenon is almost universal: once you've seen the computer perform quickly, accepting a slower pace is difficult.

This phenomenon is certainly borne out by my experience of the speed of *WordStar 3.3.* While I was quite satisfied with the speed of the old version running on an electronic disk, I am impressed by the speed increase of the new version. The memory-mapped version scrolls a screen at a time two to three times as fast, while a line-by-line scroll of a single page of text takes about 30 percent less time. Moving the cursor a screen at a time goes as fast as is useful—it's as close to instantaneous as a person can take advantage of.

Speed is especially important for writers. No longer will program execution interfere with the creative flow of ideas. (I guess I'll have to find some other excuses for occasionally losing my train of thought.)

Although I haven't had a chance to test it extensively, it looks like my least favorite *WordStar* bug may have been corrected in the new version. The problem came up in the old version when you tried to save a large file to an already full disk. Under some circumstances *WordStar* would impolitely kick you out to the operating system and send the fruit of your painstaking labors into text hyperspace. What it should do (and what it does now) is give you a warning message and force you back into the file you're editing while you change to a floppy disk that is not as full.

The only other difference you'll find when editing with the new version is that some of the menu entries and error messages have been revised to be a bit more understandable. For example, the cryptic "no file" menu is now called the "opening menu," and the toggles currently read "now ON" or "now OFF" instead of simply "ON" or "OFF."

Packaging

Although it may at first seem somewhat trivial or superficial, the new design of the manual and packaging will make a big difference in the way the program is perceived, especially by first-time users. The new package presents the manual in the standard IBM format (6- by 9-inch pages in a looseleaf binder that comes in a box).

The documentation, as always, includes a reference manual, a training manual, and an installation guide. The training manual, which has proven reasonably successful in past versions, has been reprinted in what seems to be a verbatim copy. It is now bundled as a section in the binder, rather than the flip-over chart format of earlier versions.

The reference and installation manuals have been completely rewritten and distributed in a typeset form printed on high-quality paper. Illustrations adorn almost every page. The *WordStar* manuals are finally usable. Some of the industry's most infamous documentation has been transformed.

The visual effect and the organization are significant improvements. Each page is indexed using a printed black bar at the edge of the page (much like a dictionary-style edge index). The subject headings are "outdented" in the left margin, and the page headers are specific enough to be useful. The new documentation package will make *WordStar* more accessible, especially to the novice.

The new manual also includes two important aids to understanding the program that were lacking in previous versions. A schematic diagram shows the relationships of the various menus, and a single page reproduces all the menus.

Although the new manuals are much better than their predecessors, my praise for them is not unrestrained. The reference and installation manuals both suffer from embarrassingly weak attempts at cartoon art, as well as from a hokey system of graphic attention getters. Different symbols are used to mark phrases where caution is required, where there is something you should remember, or where there is a phrase that you should keep in mind. The distinction between the last two categories was certainly not clear from the way they were used. Admittedly, these criticisms are vastly overshadowed by the magnitude of the improvement.

When you look behind the pretty packaging, you're left with some small improvements and some corrections of earlier bugs. If you're already using a keyboard enhancer to simplify the program's operation and have implemented some of the *PC World WordStar* patches, all that the latest version really offers is faster screen refresh. It doesn't offer split-screen capabilities, and it requires three steps to append part of one file into another file. *WordStar* still requires the purchase of extra software to do form letters or to create an index or a table of contents, and it still uses the high-order bit when it stores a character so that a separate program is required to convert a *WordStar* file to standard ASCII or vice versa.

And even though the speed is a nice upgrade to an already good program, it remains to be seen whether it's enough to maintain *WordStar*'s leading position in an increasingly competitive marketplace.

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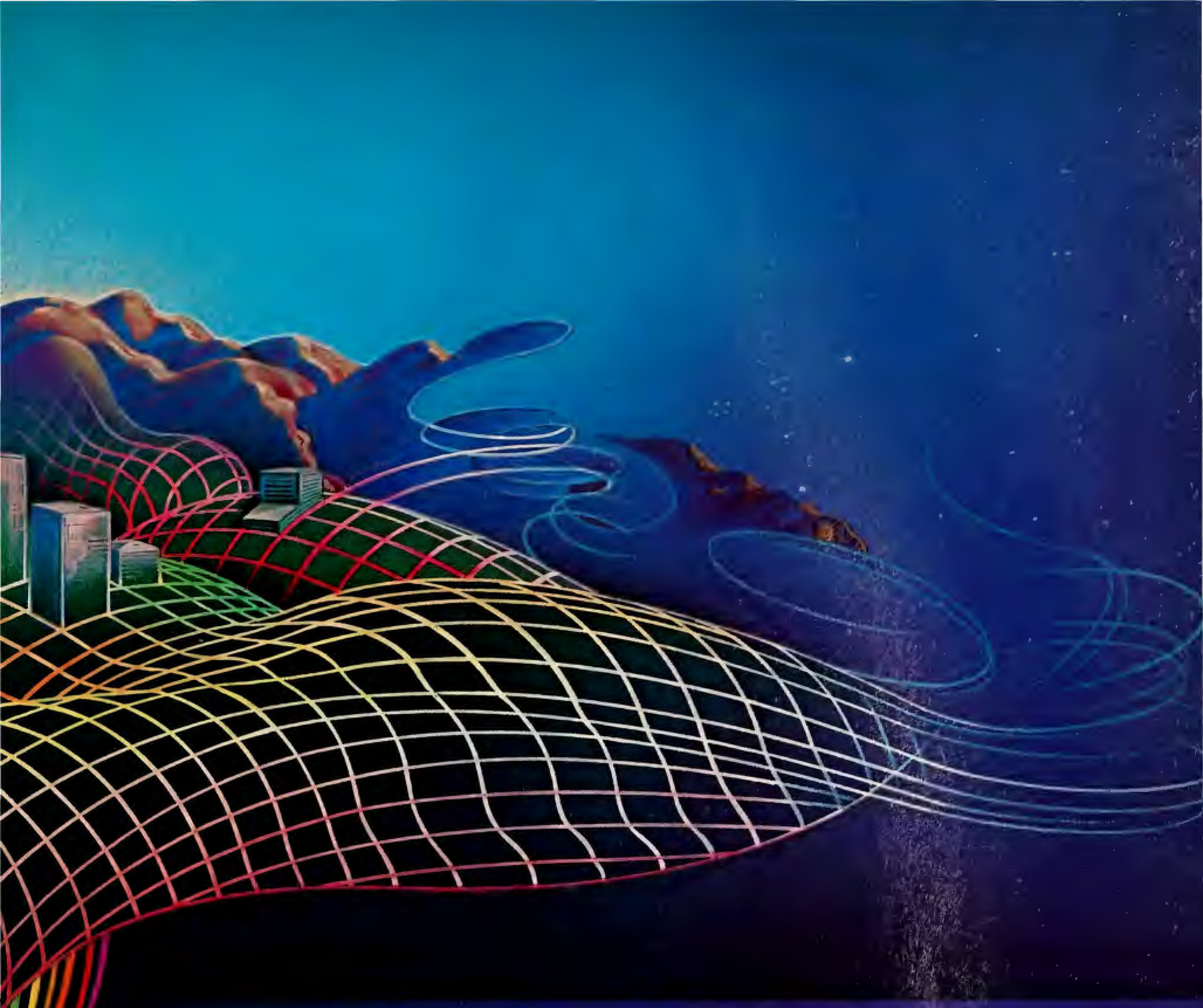

Optimizing for BASCOM

Dan Rollins

The Microsoft BASIC Compiler can improve the performance of almost any BASIC program. For many applications it is indispensable, increasing the speed of a program so that a task may be accomplished within an allotted time. There are many steps a programmer can take to help the compiler do its job. The steps described in this article are easy to implement, and all of them will be useful to those who must squeeze a little extra performance from their programs.

BASCOM, Microsoft's BASIC Compiler for the IBM Personal Computer, is a tool every serious BASIC programmer needs. A BASIC program may be written and debugged using the BASIC interpreter and then compiled into speedy, 8088 machine code. In addition to the speed advantage of compiled programs, the source code is protected; coding secrets remain the property of the software author. Also, compiled programs can take advantage of the expanded memory available with the PC.

Programmers who wince at the thought of BASIC, preferring more structured languages such as Pascal or C, should take a good look at Compiled BASIC. Many of the disadvantages of Interpretive BASIC do not apply to the compiled version. For example, you can leave plenty of remarks and clarifying spaces in the source code without causing a slowdown at run time. Program lines need not start with line numbers except when needed as labels for GOTO or GOSUB statements. Program lines are not limited in length, so nested IF...THEN statements can be formatted nicely and made clearly readable.

There are certain drawbacks to using the compiler: the generated code is often much larger than its interpreted counterpart, certain BASIC commands work differently when compiled, and the debugging process can be painfully slow. In cases where the compiler's speed advantage is needed and the only alternative is writing in assembly language, these disadvantages lessen in importance.

Speed is the essence of compiler programming. A short program I wrote to delete remarks and extra spaces from BASIC programs (to make them run faster with the interpreter) was taking 20 minutes to do its job. The same program, once compiled, did the same job in under 3 minutes. The program used a lot of string memory and was spending time doing string garbage collecting. Also, the interpreter was so slow to process an input line that the disk would stop spinning before the line was ready to be output. This caused a delay for each input as the disk drive was started and brought up to speed. The compiled version had neither of these problems.

A graphics-oriented game program I wrote would have been ridiculously slow in Interpretive BASIC. By compiling the code and CALLing assembly language routines at critical points, I was able to make it fast enough to be usable.

Programmers should take a good look at Compiled BASIC.

In the case of the game program, I needed to squeeze as much speed as possible from the compiled code. There also came a point when the program would no longer fit in a 64K system, and I needed to do some size optimization to make it marketable. This article describes some of the techniques I used to accomplish these ends, but first a few of the differences between Interpretive and Compiled BASIC.

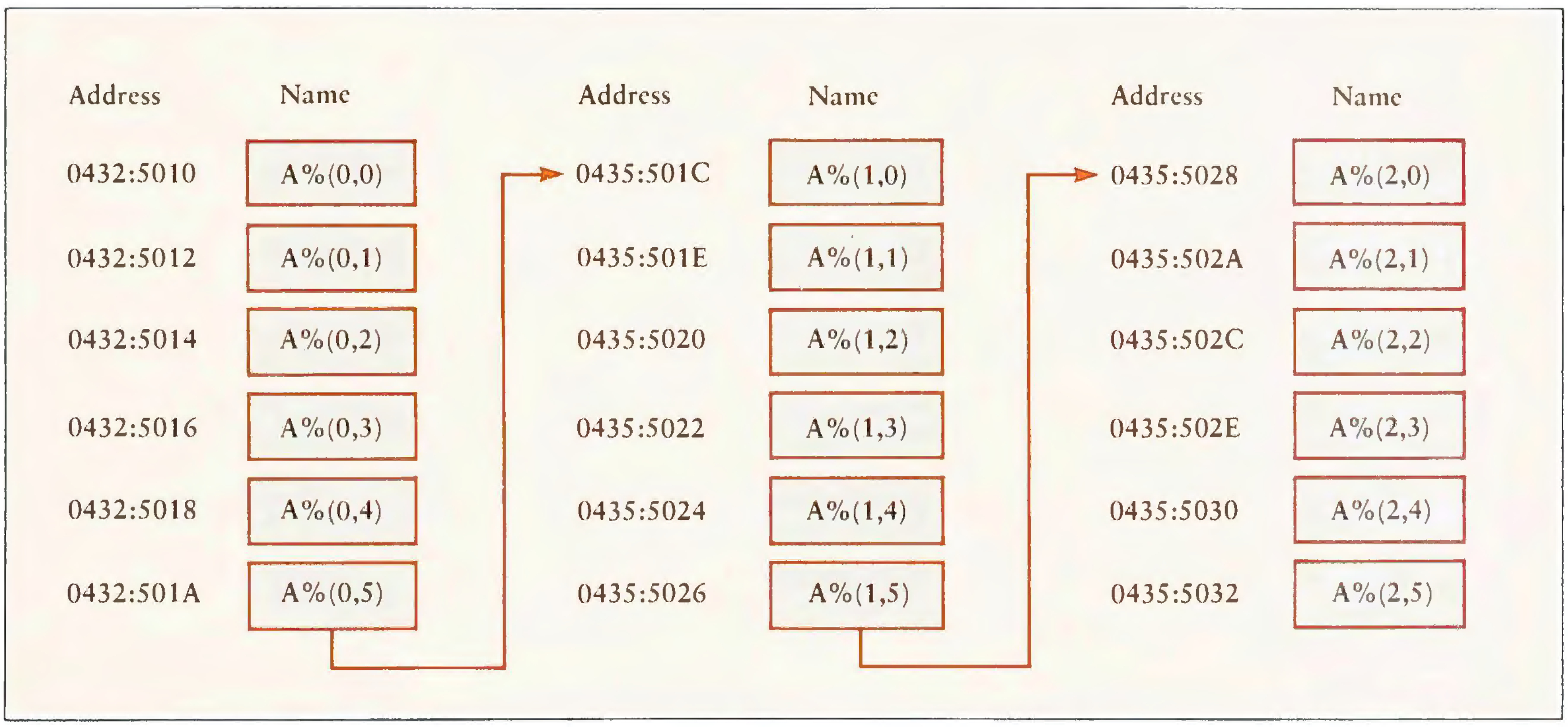

Figure 1: Conceptual Diagram of Array Storage in Memory

The BASIC Difference

Many BASIC programs can be saved in ASCII and compiled without change, but usually the file must be edited to conform to the restrictions described in the compiler manual. Notably, arrays must be explicitly dimensioned; nesting of FOR...NEXT and WHILE...WEND loops must be physical as well as logical; DEF FN and DEF type declarations must occur physically early in the source code, and the DRAW and PLAY statements must use VARPTR$ to locate any variable parts of their control strings. Also, the USR and CALL statements work differently in Compiled BASIC.

Certain BASIC commands are meaningless to the compiler. RENUM, LIST, SAVE, and NEW are examples. Some statements will only work when special compiler parameters are specified at compile time. For example, ON KEY(n) and STRIG(n) are only acceptable when the /V or /W parameters have been included in the BASCOM command line. ON ERROR GOTO will only work when a /E or /X parameter has been specified. The action of the CHAIN statement varies according to whether the /O parameter is used.

A careful eye is needed to convert the more subtle differences. One such difference is in the way Compiled BASIC handles numeric-precision conversions. Interpretive BASIC can make variable precision decisions on the fly, but the compiler must decide in advance which type of precision to use (see "Compiler Conversions Considered"). This makes overflow errors possible. For example

```
J% = -10000:K%=20000:L%=20000
A% = J% + K% + L%
```

will return an erroneous result. K% is added to L%, resulting in an overflow (an integer variable cannot exceed 32,767). Parentheses should be used whenever you expect that such an overflow might happen:

```
A% = (J% + K%) + L%
```

The compiler's line editor (used in INPUT and LINE INPUT statements) will only operate on one screen line at a time. Thus most of the cursor control keys don't work as expected. When an unacceptable key is pressed, the compiler makes an irritating beeping sound and ignores the key. Of course all the keys included in the extended ASCII character set may be read via the INKEY$ command and processed as desired. Ctrl-Break, for example, returns a key code of 03 and can be ignored to prevent the program from being stopped.

The PRINT function also works slightly differently. Compiled BASIC will ignore cursor control characters in a string. For example, Interpretive BASIC allows the printing of a multiline box:

```
CD$=CHR$(31) :CL$=STRING$(4,29)      'cursor down, left by 4
PRINT"—-";CD$;CL$;"I I";CD$;CL$;"—-";
```

Compiled BASIC does not support this technique.

Some of the PEEKs and POKEs mentioned in the BASIC manual will not work with the compiler. For example

```
DEF SEG :POKE &H4E,C
```

won't change the color of your medium-resolution character set and

```
DEF SEG :POKE &H6A, 0
```

won't flush the keyboard input buffer.

The compiler allows strings to be as long as 32,767 characters; this won't cause any problems in converting straight BASIC code, but it does affect the way a CALLed routine must handle string parameters. Also, string space is controlled differently with the compiler, making garbage collection much faster. This also means that any program that POKEs into string memory will likely confuse the system and cause a String Space Corrupt error.

> The most obvious way to speed up a program is to use integer variables whenever possible.

A couple of major differences are not mentioned in the compiler manual. First, the storage area for J% is the same 2 bytes as the storage area for J%(0). Generally, any variable is the same as the 0th element of the array with the same name. I spent hours debugging because of this problem.

The compiler apparently recognizes GO and SUB separately. The graphics program I was writing included an array for storing the location and various attributes of a submarine. I tried to name the array SUB%(), but that resulted in a syntax error.

Writing Faster Code

The following discussion gives samples of techniques that force the compiler to generate more efficient and faster-running code. When I explain why one method is faster than another, I'll be using terms that are familiar only to experienced 8088 assembly language programmers, but you can use these techniques even if you have only a little knowledge of BASIC.

Some of the following examples are accompanied by proof of the speedup—either a timed benchmark or a listing that counts the clock cycles required to perform a function. You can prove the validity of any of these techniques by using the following batch file:

```
REM —— TEST.BAT ——
BASCOM CON:,NUL,CON: /N/O/A;
```

This invokes the compiler specifying the keyboard as the input file. After you have entered some BASIC program lines, press F6 or Ctrl-Z to signal the end of the file. The compiler will immediately begin processing and then display the 8088 mnemonics of the opcodes that it generates. Be ready to press Ctrl-NumLock to halt the listing for inspection. You might also want to press Ctrl-PrtSc to obtain a printed copy of the display.

The most obvious way to speed up a program is to use integer variables whenever possible, because integer arithmetic operations are done rapidly within the 8088 registers. The following techniques are based on the arithmetic optimizations that the compiler performs only with integer variables. A simple example will make the point. The BASIC line

```
X! = Y! + Z!
```

compiles to

```
MOV   DI,OFFSET Z!   ;point to the operands
MOV   SI,OFFSET Y!
CALL  $FADA          ;invoke floating-point addition
                     routine
MOV   DI,OFFSET X!   ;point to the destination
CALL  $FASC          ;move the result to the destination
```

The same operation performed using integer variables,

```
X% = Y% + Z%
```

produces these lines when compiled:

```
MOV   AX,Z%          ;get the 16-bit Z% value into the
                     accumulator
ADD   AX,Y%          ;add the 16-bit Y% value
MOV   X%,AX          ;place the sum into X% storage area
```

Compiler Conversions Considered

Chris Gill

The Microsoft BASIC Compiler attempts to mimic the BASIC interpreter as closely as possible. There are, however, some variations due to the inherent differences between compilers and interpreters. A major portion of the *BASIC Compiler User's Guide* is dedicated to explaining these differences. One area where the differences are particularly subtle is discussed in the manual under the title "Expression Evaluation."

Because the interpreter is executing the user's program as it translates the program, the interpreter can be quite cagey in handling numeric overflow. Consider, for instance, the statement A=4*I%. If I% is equal to 10, the interpreter will perform an integer multiplication, convert the result to single-precision (since A is single-precision), and return the correct result of 40. If I% is equal to 10,000, the interpreter will attempt an integer multiplication, note an overflow condition (since 40,000 is too large to be expressed as a 16-bit integer), perform a floating point multiplication, and return the correct result of 40,000.

The compiler, however, faces an interesting dilemma here. Because translation is performed entirely before program execution is initiated, the compiler has no way of knowing how large I% will be. The compiler must therefore generate code to perform the necessary type conversions during compilation. In this case, the compiler can choose to always convert I% to a floating point number and perform a floating point multiplication (thereby penalizing all those programs in which I% is always a small number with very slow execution), or choose to always use an integer multiplication (thereby producing incorrect results when I% is larger than 8K).

Microsoft decided to support both requirements—efficiency and safety—but to allow the user to select which is more important for a given compilation. The compiler produces efficient code (using integer operations in this case), but it can also provide a check for incorrect results with the /D (debug) compiler option. Thus, for the above example without a /D the compiler would generate:

```
MOV    BX,I%    ;get I% into the BX register
SAL    BX,1
SAL    BX,1     ;multiply (BX) by 4 as efficiently
                 as possible
CALL   $CISA    ;convert the result to floating
                 point (for A)
```

This code is efficient, but possibly unsafe, since there is no overflow check. Using the /D option causes the compiler to generate extra code after each integer arithmetic operation to check for any overflow or underflow conditions. This additional code is expensive in terms of execution speed and memory requirements, but guarantees that these errors will be detected. We always advise liberal use of the /D option when first compiling and testing programs; the checks performed for arithmetic overflow, array bounds, and RETURNs without GOSUBs can considerably reduce debugging time later on.

Thus, we have two major recommendations for using the BASIC Compiler. First, be careful when using mixed mode arithmetic; second, thoroughly test programs with the /D option set before using them without the option.

Chris Gill is the manager of the BASIC Compiler for Microsoft Corporation.

The first example, using single-precision (floating-point) addition, takes over three times longer to execute than the second, which uses integer addition. Because of this, most of the following examples assume that a DEFINT A-Z declaration has defined all variables as integers.

Similar time improvements are obtained when an integer constant is added to an integer variable. In certain cases the performance for integers is even better. For example, when 1, 2, 3, or 4 is added to an integer, the compiler uses the efficient INC opcode to perform the math. (Likewise, DEC is used for subtractions and additions of small, negative values.) On the other hand, adding *any* value to a single- or double-precision number requires time-consuming calls to the floating-point arithmetic routines.

Comparing two values in a program is much faster if they are integer numbers. Many programs that use the keyboard to control an object use the INKEY$ function for keyboard input of one character. The following lines are typically used in this respect:

```
K$ = INKEY$ :IF K$ = " " THEN RETURN
IF K$ = "U" THEN Y = Y - 1
IF K$ = "D" THEN Y = Y+1
'..., etc.
```

This, however, forces multiple calls to $SCMA, the string compare routine. The following code is much more efficient:

```
K$ = INKEY$ :IF K$ = " " THEN RETURN
K = ASC(K$)
IF K = 85 THEN Y = Y - 1     'test ASCII value of "U"
IF K = 68 THEN Y = Y+1       'test ASCII value of "D"
'..., etc.
```

Doing some preprocessing in the CPU above your shoulders will save a great deal of processing at run time.

Constantly Slow

When writing in Interpretive BASIC, I like to avoid constants. Early in the program I define:

```
FALSE = 0 :TRUE = NOT FALSE
```

Then I can easily set or flip-flop the state of a flag variable while keeping the code from becoming too cryptic. Unfortunately, this technique slows down the operation when compiled. For example

```
MATCH.FOUND = TRUE
```

generates the 28-clock-cycle sequence

```
MOV    AX,TRUE%
MOV    MATCH.FOUND%,AX
```

The more efficient alternative method,

```
MATCH.FOUND = -1     'set it to true
```

generates the 20-clock-cycle opcode

```
MOV    MATCH.FOUND%,0FFFFH
```

Generally, you write more efficient (but possibly less readable) code when you use immediate, or constant, values wherever possible.

Faster Arithmetic

The 8088 microprocessor is blessed with hardware multiply and divide. Of course, the compiler uses this fact, and it shows up in speedy execution of all such arithmetic operations. Even so, an integer multiplication takes a minimum of 128 CPU clock cycles because the compiler always does 32-bit multiplication (two 16-bit operands). As experienced assembly language programmers know, certain multiplications and divisions can be accomplished in a fraction of that time. The speedy SHL and SAR instructions will respectively multiply and divide a number by a factor of 2 in only 2 clock cycles—a 600 percent increase in speed.

The programmers at Microsoft did not miss this point. The compiler takes advantage of shift instructions whenever possible. When it sees

```
X = Y*4
```

it generates the opcodes:

```
MOV   AX,Y%      ;retrieve the first factor
SHL   AX,1       ;multiply it times 2
SHL   AX,1       ;times 4
MOV   X%,AX      ;save the product
```

This optimization can only take place when one of the factors is a power of 2, and that factor must be a constant in the program. For example, both Z = 2 :X = Y*Z and X = Y*5 will use the slower IMUL opcode to perform the multiplication.

You can take advantage of this optimization in your own coding. Multiplication by 5 in the latter example can be replaced with

```
TEMP = Y*4 :X = TEMP+Y
```

Even with the extra variable manipulation and the extra addition operation, this multiplication is almost twice as fast as one that uses the 8088 IMUL instruction.

Speeding Array Operations

Programs that use multidimension arrays can be dramatically speeded up using this next tip. All variables stored in any type of array can be considered as a single list of values. BASIC string arrays are lists of pointers to string-descriptor blocks. Integer arrays are lists of 2-byte words containing the values of each of the array variables. A two-dimensional array is just two one-dimensional arrays stored one right after the other.

First we'll look at how the compiler works with a one-dimensional array. You can think of this type of array as a list of values, each of which is held in a 2-byte word of memory. The 8088 has powerful tools for manipulating arrays, namely its index registers. To access the *Xth* element of a one-dimensional array, you calculate the offset from the start of the array by multiplying X by 2 (the number of bytes in an integer array element) and place this value in an index register. The 8088 can automatically "look up" the address by adding the index register to the address of the start of the array. The address thus formed can then be used as a memory operand and manipulated as if it were a register.

The statements

```
DIM A%(20)
A%(X%) = Q%
```

generate these instructions when compiled:

```
MOV   DI,X%        ;index register becomes element to
                   access
SAL   DI,1         ;multiply by 2 to point to address of
                   A(X)
MOV   BX,Q%        ;set up register with new value
MOV   A%[DI],BX    ;transfer the data into the array
                   memory
```

This sequence will take exactly 60 clock cycles.

Figure 1 illustrates the way that BASIC stores a two-dimensional array of integers. The A%() array has been allocated with the statement DIM A%(2,5).

Therefore the computer has initialized a list of 18 locations to hold the array data (this includes the 0th elements of each dimension). Notice that the memory location for A%(1,0) is sequentially adjacent to the address of A%(0,5). Now consider the actions taken when you assign a value to an array element:

```
A(X,Y) = Q
```

1) Retrieve the value of Y
2) Multiply that by the number of rows of the array
3) Add the value of X
4) Use the sum as the index into the array
5) Move the value of Q into the address formed by adding the index pointer to the address of A(0,0)

In other words, move your pencil down the list to the start of the row indicated by Y, adjust it X more to point to element (X,Y), and then write a new value in that address.

If you enter these lines into the compiler using TEST.BAT,

```
DEFINT A-Z :DIM A(2,5)
A(X,Y) = Q
^Z
```

these opcode mnemonics will be generated by the compiler:

```
MOV   AX,0003H     ;get the number of rows
IMUL  Y%           ;calculate the start of this row
XCHG  AX,DI        ;set up index register
ADD   DI,X%        ;point to the element on this row
SAL   DI,1         ;multiply by 2 (bytes per element)
MOV   BX,Q%        ;get ready to store the new value
MOV   A%[DI],BX    ;store the new value in the array
```

The above operation requires a minimum of 212 and a maximum of 238 clock cycles. The IMUL calculation is by far the slowest component of the calculations needed to form the address. It also accounts for the possible variation in times—IMUL timing varies according to the bit patterns of the operands.

The calculation to form the offset address of any element of a multidimensional array must be performed, but it needn't be done by the time-consuming IMUL opcode. Consider what happens when the array has been dimensioned thus:

```
DEFINT A-Z :DIM A(3,5)
A(X,Y) = Q
```

The compiler generates:

```
MOV   DI,Y%        ;get the number of rows
SAL   DI,1
SAL   DI,1         ;calculate the start of this row
ADD   DI,X%        ;point to the element in this row
SAL   DI,1         ;multiply by 2 for bytes per element
MOV   BX,Q%        ;register must temporarily hold value
MOV   A%[DI],BX    ;store the new value
```

This sequence takes exactly 83 clock cycles. That is at least twice and possibly three times as fast! The difference is that IMUL has been avoided because the compiler knows that one of the offset factors will always be a power of 2. Therefore, even if your program uses only the first 3 columns of an array, i.e., (0,n), (1,n), and (2,n), it is wise to dimension the array with 4 columns, as in the latter example.

Generally, you should dimension arrays (string, integer, or floating point) so that the number of subscripts is a multiple of 2. Unless you use the OPTION BASE 1 statement, this means that the first subscript should be 1 less than a power of 2, i.e. 2^n-1. For three-dimensional arrays, declare the first two values using multiples of 2. For example, accessing elements of an array dimensioned DIM A!(3,7,20) is more than four times faster than if the array is declared DIM A!(2,5,20). As you might expect, there is a trade-off for this gain in speed. The unused array elements will take up storage area. In this example, you would be wasting a total of 1360 bytes (340 unused elements times 4 bytes per single-precision value.)

> The compiler takes advantage of shift instructions whenever possible.

Maximizing Compiler Optimization

IBM Pascal is an example of a two-pass compiler. After it has generated code, it checks back through the listing to find if it can generate more efficient code. BASCOM is a faster and smaller program, mainly because the folks at Microsoft chose to have it do everything in one pass. It therefore tends to create less efficient code.

BASCOM optimizes code, but only to a lesser degree. After it has generated the opcodes for a single source line, it checks back through that line to remove superfluous calculations. Among other things, it also tries to hold temporary values in registers, so as to avoid the more time-consuming storage and retrieval to RAM.

To get the most optimization, you should pack a lot of statements on one line.

```
100  Q = A(X,Y) :R = A(X,Y) + 1
```

will generate more efficient code than

```
100  Q = A(X,Y)
110  R = A(X,Y) + 1
```

simply because the address of A(X,Y) will be computed twice in the second example.

If you are willing to give up the advantage of debugging with the interpreter, you can write code that is highly optimized by using the /N compiler directive and placing line numbers only where they are needed as labels. This technique allows large blocks of code to be optimized by the compiler.

This gives you the added advantage of producing very readable source code. In my programming I have developed a line numbering convention that has proven very useful. Listing 1, which I'll explain in a moment, uses this convention. Notice that each line number label is on a line by itself followed immediately by a colon. This allows me to find that line number easily by using my text editor's global search capability (the search for 1000: will never stop at GOTO 1000).

Use PUT Not PRINT

One of the slowest operations of the PC is the PRINT command. When your BASIC program does a lot of printing to the screen, it is likely that compilation will not speed it up much. Word processing programs written in BASIC will be far too slow to be useful unless the author has coded a more efficient print routine in assembly language, but it is possible to print a string of characters in text mode at ten times the speed of even Compiled BASIC.

```
     '** compiled BASIC routine to time PRINT vs. PUT
     '** for 5-digit numbers
     '** Dan Rollins  3/12/83

defint a-z
dim c0(8),c1(8),c2(8),c3(8),c4(8),c5(8),c6(8),c7(8),c8(8),c9(8)

screen 1,0   'mid resolution graphics

     '** time an empty loop
10:
     print :print "timing the empty loop"
     t$=time$ :t1 = 60*val(mid$(t$,4,2))+val(right$(t$,2))
     '------
     for j=0 to 10000 :next
     '------
     t$=time$ :t2 = 60*val(mid$(t$,4,2))+val(right$(t$,2))
     empty.loop = t2-t1

     '** time the PRINT display
20:
     print :print "timing the PRINT function"
     t$=time$ :t1 = 60*val(mid$(t$,4,2))+val(right$(t$,2))
     '------
     for j=0 to 10000
          locate 1,1
          a$=str$(j) :a$=right$(a$,len(a$)-1)
          print right$("0000"+a$,5)          'add the leading zeros
     next
     '------
     t$=time$ :t2 = 60*val(mid$(t$,4,2))+val(right$(t$,2))
     prtime=t2-t1-empty.loop
     locate 5,1: print "using PRINT: ";prtime

     '** test the PUT display
30:
     print :print "timing the PUT function"
     gosub 1000    'define the digits
     t$=time$ :t1 = 60*val(mid$(t$,4,2))+val(right$(t$,2))
     '------
     for j=0 to 10000
          cx=0 :cy=0 :num=j
          gosub 2000          'display the number
     next
     '------
```

Graphics mode character printing is even slower than text mode printing, but coding a graphics print routine is more difficult and results in less time savings. In my graphics game I was updating the player's score (and the high score) at the end of every game cycle. This was slowing the game down to a crawl.

The first thing I did was skip the print when there had been no change in the score between cycles (an obvious step in retrospect). Later, I discovered a method of displaying the score without using PRINT at all. Listing 1 illustrates the method.

ASCII characters printed while in graphics mode are simply a collection of graphical dots arranged in specific shapes. Another way to display these shapes is to define a table of shape strings and use the DRAW command. A faster method is to use the graphics PUT command. The program in Listing 1 does a timing test of the normal printing of a 5-digit score compared against using a subroutine to display the same 5 digits by using the PUT command. Note that the program requires a color/graphics adapter and a suitable monitor.

The statements in Line 10 time an empty loop. The execution speed of the empty loop is saved and subtracted from the results of the following tests so that a valid percentage can be determined. Line 20 prints all five digits of scores ranging from 00000 to 10000 and displays the time it took.

Line 30 defines each of the 10 digits and GETS them each into an array. Then line 40 calls the subroutine to

```
      t$=time$ :t2 = 60*val(mid$(t$,4,2))+val(right$(t$,2))
      putime=t2-t1-empty.loop
      locate 9,1 :print "using PUT:   ";putime

      print :print"PUT is";100-int((100*putime)/prtime);"% faster"

 while inkey$="" :wend    '** examine the results
 end

       '$page
       '** subroutine saves the digits in PUT arrays
       '**
  1000:
       locate 1,1 :print"0" :get (0,0)-(6,6),c0
       locate 1,1 :print"1" :get (0,0)-(6,6),c1
       locate 1,1 :print"2" :get (0,0)-(6,6),c2
       locate 1,1 :print"3" :get (0,0)-(6,6),c3
       locate 1,1 :print"4" :get (0,0)-(6,6),c4
       locate 1,1 :print"5" :get (0,0)-(6,6),c5
       locate 1,1 :print"6" :get (0,0)-(6,6),c6
       locate 1,1 :print"7" :get (0,0)-(6,6),c7
       locate 1,1 :print"8" :get (0,0)-(6,6),c8
       locate 1,1 :print"9" :get (0,0)-(6,6),c9
  return

       '** subroutine displays a 5-digit number NUM, at CX, CY

  2000:
       n=num\10000            :gosub 3000 :tn=num-n*10000
       n=tn\1000   :cx=cx+8   :gosub 3000 :tn=tn-n*1000
       n=tn\100    :cx=cx+8   :gosub 3000 :tn=tn-n*100
       n=tn\10     :cx=cx+8   :gosub 3000 :tn=tn-n*10
       n=tn        :cx=cx+8

  3000:
       if n=0 then put (cx,cy), c0, pset :return
       if n=1 then put (cx,cy), c1, pset :return
       if n=2 then put (cx,cy), c2, pset :return
       if n=3 then put (cx,cy), c3, pset :return
       if n=4 then put (cx,cy), c4, pset :return
       if n=5 then put (cx,cy), c5, pset :return
       if n=6 then put (cx,cy), c6, pset :return
       if n=7 then put (cx,cy), c7, pset :return
       if n=8 then put (cx,cy), c8, pset :return
       put (cx,cy), c9, pset :return
```

Listing 1

display each of the 10,001 values and displays the required time.

The subroutine at 2000: displays all five digits of any number less than 32,767 starting at the pixel coordinate specified by *CX* and *CY*.

The timed results prove that using PUT to display these digits in medium-resolution graphics is 37 percent faster than PRINTing the same characters. Another advantage is that the digits can be displayed at any part of the screen, while printing is limited to 998 locations (you can't PRINT to location 24,40 or 25,40 without causing the screen to scroll). Incidentally, the series of IF...THEN commands in Line 3000: turned out to be slightly faster than a corresponding ON...GOTO sequence.

Optimizing Program Size

So far, my suggestions have been centered around optimizing the speed of a Compiled BASIC program. There may come a time when your code will become too large to fit in a 64K machine. This problem can be very difficult to solve. If you are compiling with the /O directive, there is a minimum code overhead of about 18K, and there is nothing you can do about it until IBM changes its licensing policy. Therefore, you must look to your program to find ways to get the job done in fewer bytes.

Use subroutines as much as possible for any code that is repeated. This may mean that you will need to generalize some procedures to use variables instead of constants so that they don't rely on specific values.

If your program contains a lot of DATA lines defining numeric values, you are using a lot of extra space. Because the compiler cannot be sure where the values will eventually be stored (or even assume that the values are numeric), it must store the entire DATA line as written in the source code. The lines

```
READ X%
DATA -12345
```

will require 6 bytes of static storage and 2 bytes for the variable X%. When you are reading an entire array of integers from DATA lines, you waste as much as 6 bytes per element.

One alternative is to read the array from a sequential disk file. A faster method is to write a short program to read in the array, and then BSAVE the values, starting at element 0 with a length of 2 bytes per element:

```
10   DIM A%(999)
20   FOR J = 0 TO 999 :READ A%(J) :NEXT
30   BSAVE "array.dat", VARPTR(A%(0)), 2000
```

The VARPTR function returns the starting address of the array. There are 1000 2-byte elements, so the length of the array is 2000 bytes. The applications program that uses the array can now avoid the lengthy READ and store process by directly BLOADing the values starting at the address of the 0th element:

```
DEFINT A-Z :DIM MY.ARRAY(999)
BLOAD "array.dat", VARPTR(MY.ARRAY(0))
```

If possible, avoid using the more exotic BASIC commands. Using DRAW, for example, will add almost 900 bytes to your program. The RND function will superficially cost about 300 bytes. By coding my own assembly routine to return a random number between two values, I was able to save 200 bytes, plus all the time required for the floating-point multiplications needed with BASIC's RND function.

This illustrates perhaps your biggest resource in code compression—writing custom routines with the assembler to avoid the bulky, generalized BASIC commands. If your BASIC program is written in clear-cut modules, you should be able to rewrite entire subroutines in assembly language.

The CALL command allows you to pass as many as 60 variables to a machine language subroutine. For example,

```
MIN = 0 :MAX = 20
CALL MY_RND(RND.NUM, MAX, MIN)
```

will pass three addresses to the random number generator I wrote. It does this by PUSHing the addresses of the variables onto the stack one at a time. You can shorten this process by placing the values in an array and passing only one address—that of the array's 0th element:

```
RND.NUM(1)=0 :RND.NUM(2)=20
CALL MY_RND(RND.NUM(0))      'or CALL MY_RND(RND.NUM)
```

The assembly language routine must assume that the address it receives points to 6 bytes of data and that the first 2 are for the return value, the next 2 are the minimum, and the last 2 are the maximum value. This saves time and code in both the compiled program and your own routine.

The IBM BASIC Compiler has limitations, but it is a logical choice over writing applications in assembly language. By studying the code that the compiler generates and taking advantage of its optimization techniques, it is possible to make faster running, more efficient programs. By doing some mental and programmatic preprocessing and using some ingenuity, you can squeeze the most value from this programming tool.

Dan Rollins is a freelance writer and programmer who has published articles in numerous magazines. He has extensive experience with the BASIC Compiler and is currently working for Adventure International.

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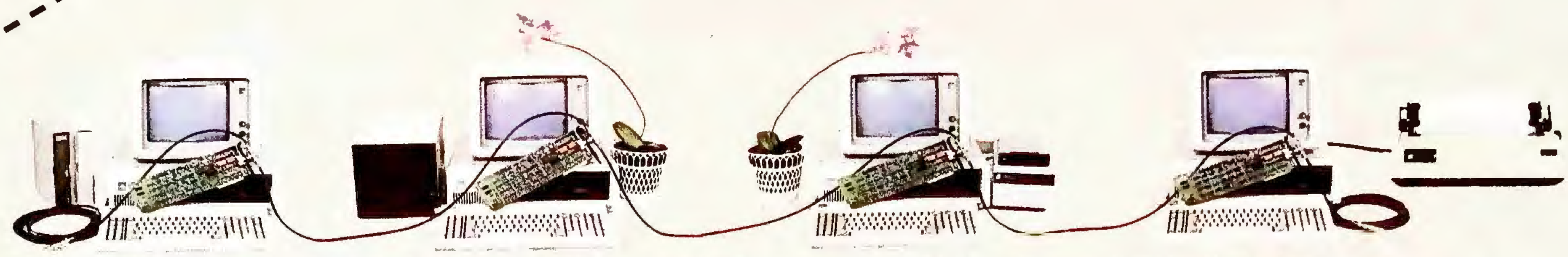

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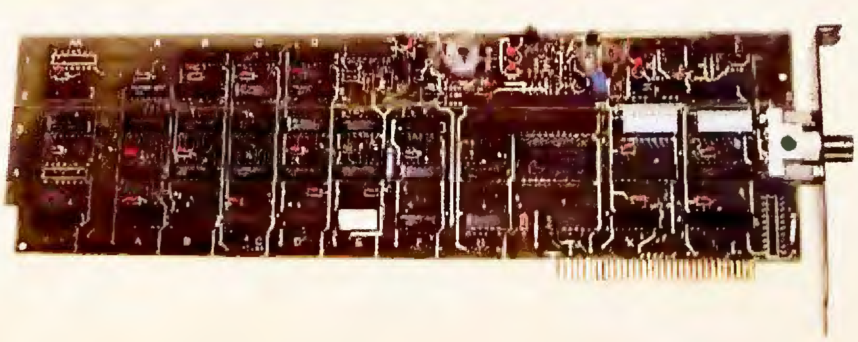

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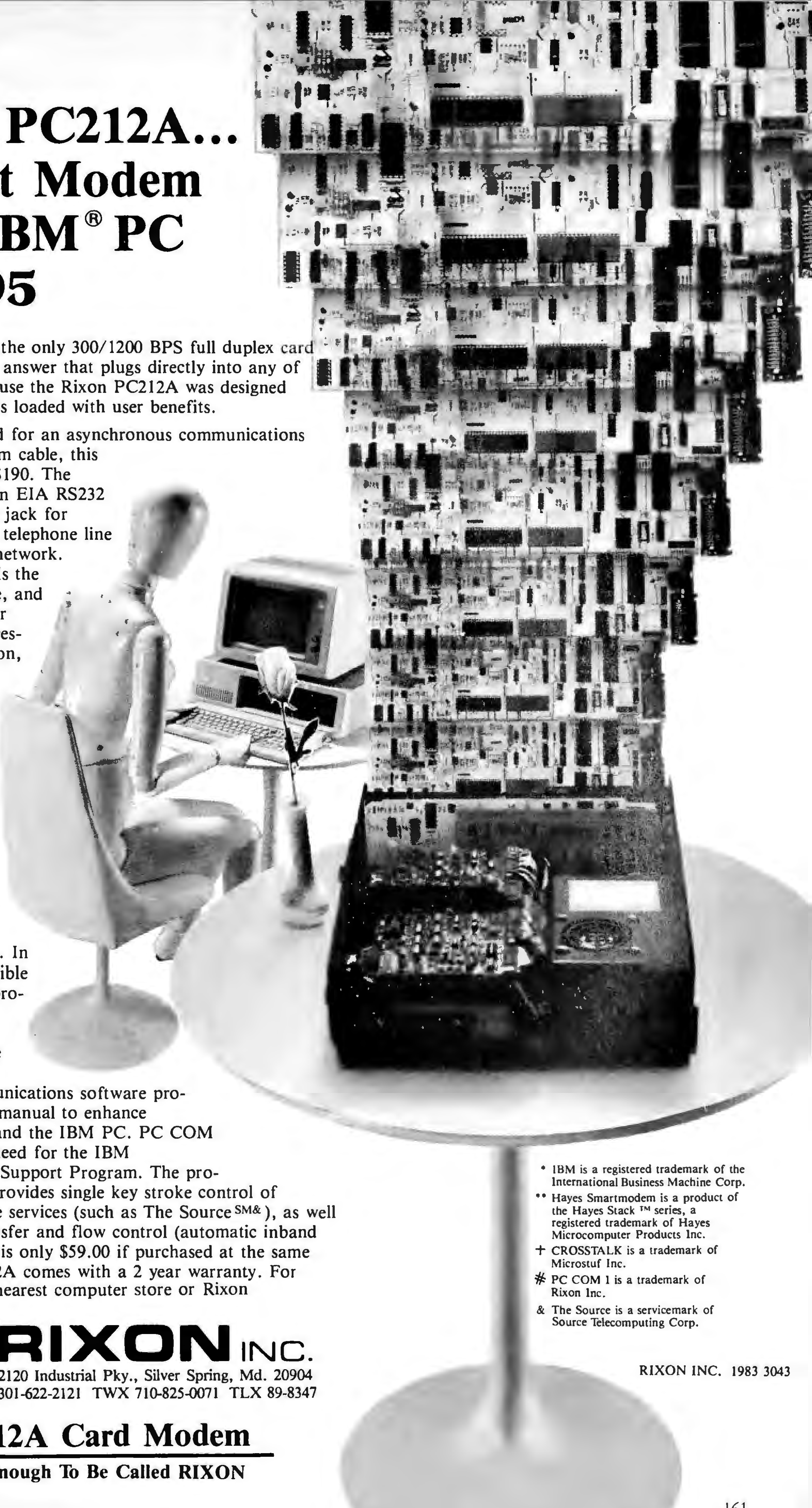

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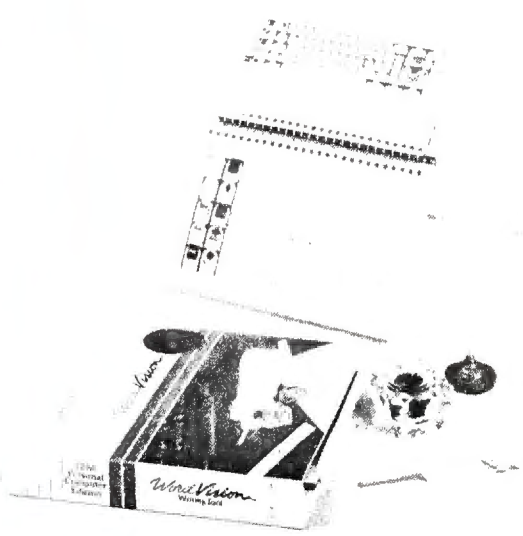

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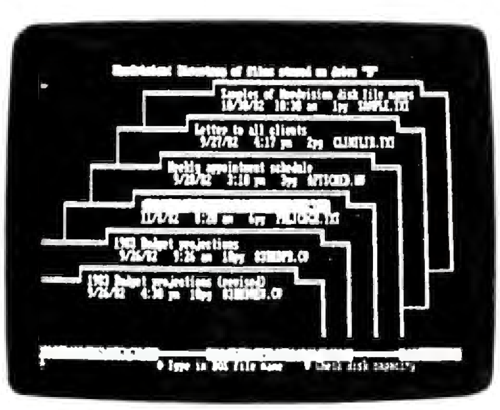

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Lawrence J. Magid

I remember a 1950s TV show called "The Millionaire." Each week an anonymous donor would bestow $1 million on an ordinary citizen. For the next 30 minutes viewers from coast to coast would watch that person learn to cope with the sudden windfall. The typical recipient's first response was to think that everything would be wonderful. By the first station break, however, each one discovered that wealth creates almost as many problems as it solves.

That's similar to how I felt when my 27-megabyte MicroDisk hard disk arrived. I was a millionaire 27 times over. I loved the convenience, speed, and reliability of the hard disk but soon realized that I had to change my operating procedures to accommodate my newfound profusion of megabytes.

A hard disk has many advantages. Unlike floppies, hard disks come with no warnings about exposing them to fingers, magnets, or dog bites. Neatly tucked away in a sealed cabinet, a hard disk is immune to most hazards. Not only are you spared the "floppy shuffle" every time you want to find a program or data file, but most hard disks read and write at several times the speed of their floppy counterparts. I would no sooner give up my hard disk than a millionaire would part with his or her riches. Once you've experienced the convenience of a hard disk, you'll never want to go back to floppies.

Divide and Conquer

Before I could begin to use those millions of bytes of storage, I had to format the hard disk's surface. Because PC-DOS 1.10 does not include a way to utilize a hard disk, I had to use special software supplied with the hard disk.

PC-DOS 2.00 does support hard disks. As this article goes to press, all the major hard disk manufacturers are busily writing device driver software so that their products can be used with DOS 2.00. They are all promising that the software will be available before the end of 1983. Except where noted, the procedures and helpful hints offered in this article are to be used with DOS 1.10. If your disk manufacturer is slow in delivering the software, these procedures will surely save you time and energy in the interim.

Software supplied with a hard disk should provide several formatting options and utility programs for integrating the hard disk into your computer system. Most hard disks can be divided into several volumes, which are sections of the disk treated by DOS 1.10 as if they were separate—though much larger—floppy disks. Although I use 4 volumes only, my hard disk can be divided into up to 33 volumes that are labeled and addressed just like floppies.

I divided my disk into volumes C, D, E, and F. My word processing programs and files are stored on drive D, and my spreadsheet, data base, and communications programs are on drive E. Drive F is used for some data files, and I use Drive C to back up important data and program files. I did not use A and B as volumes of the hard disk; instead, I retained drive A for my one floppy drive and reserved drive B for an electronic simulated drive (also called a RAM disk).

The way you organize volumes is arbitrary. The organization should be functional, meaning you should know what programs and data reside on what volumes. The important idea is to establish procedures and stick to them.

With DOS 2.00, you don't have to divide the hard disk into separate volumes or logical drives when you format it. DOS 2.00 allows a single drive to be divided into many directory areas. Each new directory area contains files that are logically related to one another. ("The Path to UNIX" in *PC World*, Vol. 1, No. 3, includes a discussion of DOS 2.00's directory and hard disk facilities.)

Backup

By having all data on one piece of media—spinning at 3600 rpm—you run an obvious risk. If one of your floppies quits, damage is confined to that particular disk. If your one and only hard disk fails, or if you erase some vital data accidentally, you may be in serious trouble. If you need proof, type 'ERASE *.*' and see how quickly the equivalent of 16,000 typed pages of information can be destroyed.

> Most hard disks read and write at several times the speed of their floppy counterparts.

Of course, erasing the disk's entire contents is not recommended, even as an experiment, but that rather absurd suggestion does serve to emphasize one essential principle of computer use: No matter what storage media you use, make backups. Even the most reliable hard disks are subject to potential damage or theft. Failing to have a backup copy of important data and programs is about as smart as driving without auto insurance.

There are elaborate and simple ways to back up files. Some hard disk systems use videotape machines (often called mirrors) as a means of backing up the hard disk. Others use exotic copy programs that allow you to transfer files periodically from the hard disk to floppy disks, based on the time and date of file creation.

The method I use is simple. Every time I create or update a file, I copy it to the floppy disk in drive A. When that floppy is full, I replace it with another. This system is not fancy but it works.

As an additional precaution, I back up important data files on another volume of the hard disk. This doesn't protect the data against total disk failure, but it does guard against human error such as accidental erasure.

I also periodically back up the entire disk to floppies using *JET*, a program from Tall Trees Systems that transfers large blocks of data at a high rate of speed. Before using *JET* I had a primitive but effective method—I copied files alphabetically. I would place a formatted floppy in drive A and type 'COPY A*.*', which would transfer all files beginning with A to that floppy. I would then run CHKDSK (a utility on the PC-DOS disk) to see how much room was left; if enough space was available, I'd type 'COPY B*.*'. This method was slow and cumbersome, but after about 30 minutes, I had an alphabetical backup of 500 files. Storing the files alphabetically on floppies also makes locating individual backup copies easy.

Again, DOS 2.00 makes using a hard disk easier. The new version of DOS includes a backup program that allows you to selectively copy only those files that have been altered since the last backup or to copy all files created since a certain date.

The Name Game

After the need for backing up, the next major concern for hard disk users is figuring out what to call a particular file. With a floppy the directory (DIR) can always be displayed, giving a complete catalog of all files on the disk. The list is usually short enough so that files can be located easily. The directory of a hard disk can be displayed as well, but the list could be almost as long as a small town's phone book.

You may think that you'll remember the name of a precious file, but several months from now it may be a blur in your memory—and one of hundreds of names on your hard disk. And the file names are your only clues—there's no way to affix labels to the volumes of a sealed hard disk. That's why you should develop procedures to name, sort, and categorize files.

One simple and useful procedure is to make sure files are named in a logical, consistent manner. One method of naming files is to divide them into several categories, assign an extension to each type of file, and label them accordingly. I write a great deal and create enough word processing files to confuse an FBI cryptographer. My organizational scheme may or may not work for you, but it saves me from an eternal search.

I have divided my writings into several categories and labeled them as follows: proposed projects are labeled '.PRO', works in progress are coded '.DRA' (for draft), articles submitted for publication, '.PUB', and contracts and agreements '.CON'. When I need to locate a particular published article, '*.PUB', calls up a manageable list.

Some programs automatically produce extensions to file names. *SuperCalc* adds '.CAL' to all its files, and *dBASE II* adds '.DBF' to its data files and '.PRG' to its program files. Some word processing programs add '.TXT' to the end of file names. These automatically imposed extensions are a useful feature. I can obtain a quick review of my *SuperCalc* files, for example, by typing '*.CAL'.

If you have many such files, you may wind up with an unwieldy directory. In that case you should categorize by prefix. Data files that apply to your business, for example, can start with 'BUS'. Your business budget for 1983 could be labeled 'BUSBUD83.CAL' to distinguish it from your home budget ('HOMBUD83.CAL'). If you want a complete list of your business data files, you can get them by typing 'DIR BUS*.*'. Whatever scheme you choose, you can create logical file names based on your own particular needs.

Reaching the Limit

I may seem like a millionaire feigning poverty, but I do worry about running out of disk space. Depending on the capacity of a hard disk, the problem could be either lack of storage space or too many file names for the directory space of a volume on the disk. Each hard disk operating system sets a limit on the number of files that can be stored on a volume. One system I evaluated could handle 512 files on a single volume, while another had a limit of 208 files. Even with 512 files I had to develop a strategy to avoid reaching the limit.

> Once you've experienced the convenience of a hard disk, you'll never want to go back to floppies.

Before I developed this system of file organization, my hard disk was as cluttered as the trunk of my car, but a spring cleaning saved the day. I deleted unneeded files and rearranged needed ones among the disk's several volumes. I eliminated scores of files by combining all my correspondence files into one large archive file.

Like most business people, I write many letters. When I was using floppies, I had a separate file for each letter. If I wrote a letter to Mr. Collins, I'd call the file 'COLLINS', and if I wrote a second letter to the same person, I'd call it 'COLLINS2'. These files would be stored on a disk labeled Correspondence. When that disk was full I'd start another labeled Correspondence 2.

That system was fine for floppies but not for a hard disk. I developed two methods for filing correspondence on the hard disk; they are mutually exclusive, but both work.

At first I created an extension for each file, '.COR'. Looking for a correspondence file, all I had to do was type 'DIR *.COR', and my directory, though still long, was reduced to correspondence files only. An even better method is combining all your letters into one big file.

Concatenating Files

Concatenation is a seldom-used DOS command that allows you to combine files. Instead of having hundreds of small '.COR' files, I have one large file, 'LETTER.ARC' (the '.ARC' extension stands for archives).

For example, every time I write a letter, I name the file 'LETTER'. After printing it, I insert the letter file at the top of the 'LETTER.ARC' file. If the commands were typed in one at a time, the procedure would be tricky, but it is done with a batch file, 'ARCH.BAT', that is invoked by typing 'ARCH'. Once the batch file is created, it's a cinch to add a letter file to 'LETTER.ARC'.

On my system 'LETTER' is always on disk volume B (my electronic disk) and 'LETTER.ARC' on volume D. You can set yours up any way you want, as long as the batch file accurately reflects your arrangement.

My 'ARCH.BAT' file contains the following commands. The numbers in brackets are not part of the file but are for your reference as you read the explanation.

```
[1] COPY LETTER.ARC,LETTER.TEM <ENTER>
[2] COPY LETTER+LETTER.TEM,LETTER.ARC
    <ENTER>
[3] DIR LETTER *.* <ENTER>
[4] PAUSE CTRL 2 to ABORT ANY KEY TO
    CONTINUE <ENTER>
[5] ERASE LETTER
```

The file is invoked by typing 'ARCH'. When this is done, the following takes place:

[1] The file 'LETTER.ARC' is copied to 'LETTER.TEM' (if 'LETTER.ARC' doesn't exist yet, this step will not get in the way).

[2] This step appends the information in 'LETTER.TEM' to the end of the information in 'LETTER', and then overwrites the old 'LETTER.ARC' with the newly combined file.

[3] You are given a directory of all files beginning with 'LETTER'.

[4] The PAUSE command allows you to look at your files to be certain that's what you want to do. You can abort the batch file by typing Ctrl-2. Pressing any other key will take you to step 5.

[5] The file 'LETTER' is erased since its contents have been appended to the new 'LETTER.ARC' file.

The file 'LETTER.TEM' has not been erased and provides a backup of all correspondence except the most recent letter.

To check your handiwork, use your word processing program to examine 'LETTER.ARC.' If this is the first time you've used this system, 'LETTER.ARC' should contain only the file called 'LETTER'. If you've used this scheme before, your most recent letter should be at the top of the file above all previous letters.

Once this giant letter archive has been created, finding a piece of correspondence is easy. You can use your word processing program's Search or Find feature to locate a particular name, date, or key word. When I want to find that letter to Mr. Collins, I just search for the word *Collins* and within seconds it appears—that's using the computer.

Finding Filenames

If you've divided your disk into several volumes, you're likely to search for a file without knowing what volume it is on. The slow way to find it is to go to each volume and display the directory. For example, 'DIR

And the Winner Is...

The reader response cards from the second issue have been tallied and the results of the random drawing are in. One box of ten Maxell disks goes to each of the following winners:

M. Garner, Bala Cynwyd, PA; B. Wiegan, Stroughton, WI; T. Masengarb, Grapevine, TX; L. Askeland, Loveland, CO; R. Holts, Ventura, CA; P. Rice, Athens, GA; R. Perreault, Warwick, RI; B. Komanetsky, St. Louis, MO; J. Ovear, San Francisco, CA; D. Albanese, Cuyahoga Falls, OH.

A new drawing is held each month, but you must submit a new entry for each drawing. We appreciate your comments, even if you write them in the margins. Next month's questionnaire will have new questions and room for you to write. One last note: please do not staple the form! A small piece of tape over the long edge of the card is best; other sealing methods just frustrate the staff. Thank you and good luck!

E:FLOPPY.PUB' checks to see if the file named 'FLOPPY.PUB' is on drive E. If it isn't, you have to type 'DIR F:FLOPPY.PUB' and so on until you find the file.

A more effective way to locate files is to create a batch file that searches the directory automatically for a requested file on each volume of the hard disk. I call this batch file 'DIRALL':

```
DIR B:%1
DIR C:%1
DIR D:%1
DIR E:%1
DIR F:%1
```

This batch file is essentially a utility that checks each volume for '%1'; the percent sign is a variable used in a batch file, which is replaced by whatever is typed after the batch file's name ('DIRALL'). If 'DIRALL FLOPPY.PUB' has been typed, the file looks for 'FLOPPY.PUB' on all the volumes. Once that file is located, the file's name, location, size, and the time and date of its most recent revision are displayed. If the file is not located on a particular volume, DOS reports 'File not found'.

Develop procedures to name, sort, and categorize files.

This batch file can also be used with the '*.' and '*.*' parameters. Typing 'DIRALL *.PUB' locates all files with the '.PUB' extension on all volumes. Typing 'DIRALL BUS*.*' locates all files beginning with 'BUS' on all volumes.

Batch Files That Find Programs

Batch files can also be used to locate programs on various volumes. You may use volume D as the main drive, for instance, but you also need to store programs on other volumes.

Rather than having to remember the location of each program, you can create a series of batch files. Let's say that *SuperCalc* is located on drive E. You can have a batch file on drive D, 'SC.BAT', that you use to run *SuperCalc*. This utility not only saves you from having to remember where *SuperCalc* is located, but also from having to type 'E:' every time you want to run the program.

'SC.BAT' looks like this:

```
E:
SC
D:
```

When implemented with the command 'SC', the utility switches the logged drive from D to E and runs *SuperCalc*. When you finish using *SuperCalc*, the utility switches back to drive D.

You can write similar batch files for all your programs. This is especially helpful for BASIC programs. My copy of *PC-Talk* resides on volume F, but 'TALK.BAT' on volume D performs the following:

```
F:
BASIC PC-TALK
D:
```

Erasing Safely

Typing 'ERASE' directly from the keyboard increases the possibility that massive amounts of data will be lost. Typing 'ERASE *.*' will destroy an entire volume of data, and typing 'ERASE*.COM' will destroy all COM programs and the system won't even ask if you really want to do that (as some programs will). To protect my files, I created a batch file, 'ERA.BAT'. If I want to erase a file, 'STEVE', I type 'ERA STEVE', and the batch file does the rest.

The numbers in brackets to the left of the commands do not appear in the file.

```
[1] DIR %1
[2] PAUSE ANY KEY TO ERASE %1, CTRL 2 to
    ABORT CTRL G
[3] ERASE %1
```

[1] 'DIR %1' does a directory of the file(s) to be erased. (The '%1' is a variable that is replaced by whatever word is entered after 'ERA'. If 'ERA STEVE' had been typed, '%1' would be replaced by 'STEVE'.)

[2] The 'PAUSE' statement offers a chance to reconsider the procedure. Pressing Ctrl-2 (DOS will then ask if you are sure you want to abort) allows you to cancel the ERASE command. 'CTRL G' causes the PC speaker to beep as a gentle reminder that an important decision has to be made.

[3] If the ERASE command is not canceled, the file(s) is erased.

The whole process takes about 1 second longer than a regular ERASE command, and it is well worth the wait.

Copying Files

Copying files from one disk volume to another can become easier and less risky. Rather than typing 'COPY FILENAME A:', type 'B A:FILENAME'. This invokes a batch file, 'B.BAT'. Not only does it simplify copying, but it prevents accidental copying of a file over another file with the same name.

'B.BAT' is as follows:

```
[1] DIR %1:%2 REM DESTINATION DRIVE
[2] DIR %2 REM SOURCE VOLUME
[3] PAUSE CTRL 2 TO ABORT. ANY KEY TO
    CONTINUE CTRL G
[4] COPY %2 %1:
```

[1] This step searches the directory for the file on the destination drive, checks to see if the file currently exists, and if so, when it was last backed up. The variable '%1' is used for the drive name and '%2' for the file name.

[2] Searches the directory for the file on the source volume to see when it was last updated.

[3] Offers a chance to abort the backup, if necessary. The 'CTRL G' causes the PC speaker to beep.

[4] Copies the file from the source volume to the destination disk or volume.

Automatic '.BAK' Deletion

Several programs, including *WordStar,* create automatic backup files on the same volume as the main file. The files usually end in the extension '.BAK'. While such backup files can be useful, they can clutter up the

> Even with 512 files I had to develop a strategy to avoid reaching the limit.

disk, wasting space and possibly causing you to reach file limit.

To avoid this problem I use a batch file that erases all '.BAK' files. This procedure saves time and avoids the catastrophe-by-typo syndrome. Once, when I meant to type 'ERASE *.BAK', I accidentally typed 'ERASE *.BAT', which resulted in the destruction of about 30 valuable batch files. Fortunately, I had the files backed up, so the lesson was relatively painless.

Like other batch files that do erasures, this one first checks the directory and displays the file names, and then offers an opportunity to back out of the procedure. This batch file is as follows:

```
DIR *.BAK
PAUSE CTRL 2 TO ABORT, ANY KEY TO
  CONTINUE CTRL G
ERASE *.BAK
```

The Right Programs

The issue of copy-protected software has been argued from many points of view, and the controversy is likely to continue. Regardless of your opinion on this issue, you should be aware that most copy-protected programs cannot be copied to a hard disk.

When you shop for software, don't ask if it's copy protected (they'll think you're a pirate); ask if it can be copied to a hard disk. If the software is copy protected, it probably can't be transferred. Most copy-protected programs (like *VisiCalc*) allow you to write data files to the hard disk, but you still have to fish out the program disk every time you want to run the program.

Some programs automatically produce extensions to file names.

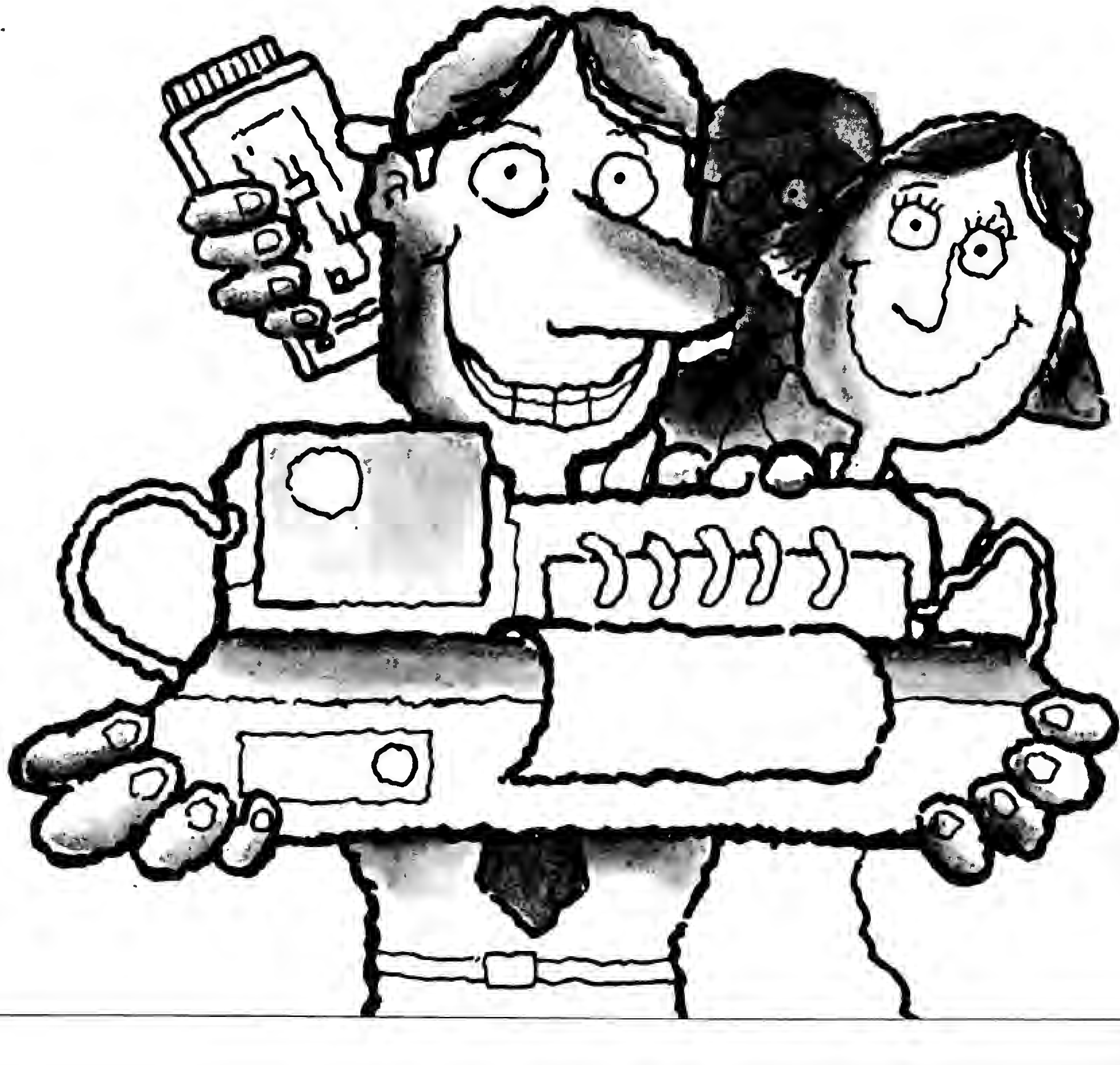
Though I haven't seen any examples, I'm told that some companies are developing antitheft techniques that allow the programs to be transferred to a hard disk without being copied in other forms. Until those programs are available, be sure to inquire about copy protection and the hard disk.

Relax

After all my precautionary procedures, you may wonder if installing a hard disk is worthwhile. It is. The benefits of a hard disk far outweigh the alternatives. Precautions are like door locks: although they don't always prevent catastrophes, they greatly minimize their likelihood. Take a few precautions and relax—you'll know that you've done all you can to protect valuable data. Like the lucky recipients on "The Millionaire," hard disks users must protect and learn to live with their newfound bounty.

MicroDisk
1422 Industrial Way
Gardnerville, NV 89410
702/782-8105

JET and JFORMAT
Tall Tree-Systems
1036 Los Altos Ave.
Los Altos, CA 94022
415/941-5500



Programming Sound in BASIC

You and your PC can make music together. This introduction takes you step-by-step from the creation of simple tones all the way to Bach minuets.

Lon Poole

The following excerpt is Chapter 14 of Using Your IBM Personal Computer *(Howard W. Sams & Co., Indianapolis), a comprehensive book that takes the user from turning on the power to advanced programming in BASIC. This guide to making music with the PC introduces the full range of sounds and tempos the computer can produce and provides listings for several melodies.*

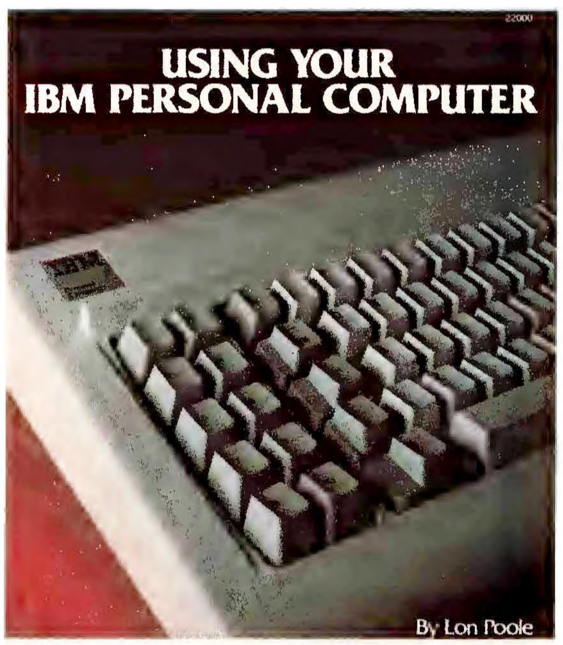
The PC can generate sounds and music through its built-in speaker using either of two BASIC statements, SOUND or PLAY. Both statements give you control over the frequency and duration of a tone, but neither statement can control loudness. Tones produced are always pure; there is no direct way to distort them for sound effects.

Generating Tones

The SOUND statement generates a tone of any frequency between 37 and 32767 hertz (cycles per second), lasting for any duration from a split second to a half hour. Here is an example:

```
SOUND 523.25, 18.2
```

The example above generates a tone that has a frequency of 523.25 hertz, which is the note middle C. Figure



14-1 illustrates the frequencies of the natural notes spanning two octaves below middle C and two octaves above it.

The second number in a SOUND statement determines the duration of the tone. Duration is measured in *clock ticks,* and there are 18.2 ticks per second. Table 14-1 compares selected clock tick values with typical music tempos and their equivalent number of beats per minute.

PC BASIC does not wait for a SOUND statement to finish before going on to the next statement. The following example demonstrates:

```
10  CLS:WIDTH 40
20  SOUND 440, 27.3
30  FOR K=1 TO 40
40  LOCATE RND(1)*23+1,RND(1)*39+1
50  PRINT CHR$(14);
60  NEXT K
70  LOCATE 24,1
```

After clearing the screen, the program above generates the note A below middle C for a second and a half. While it holds the note, PC BASIC executes the rest of the program, which displays musical note characters at random locations on the screen. In fact, the program finishes before the note stops.

PC BASIC will not overlap execution of two SOUND statements, however. If a second SOUND statement occurs before the end of a tone from a prior SOUND statment, the PC waits until the first tone finishes. For example, if the following line were added to the previous example, the note it generates (D above middle C) would not occur until after the earlier note lasted its 1½ seconds:

```
80  SOUND 587.33, 9.1
```

You can turn sound off at any time by executing a SOUND statement with a duration of zero, like this:

```
SOUND 1760,32767
Ok
SOUND 100,0
Ok
```

Tones above 25,000 hertz are inaudible; in fact most people cannot hear tones above 15,000 hertz. Therefore a SOUND statement that specifies a high frequency will generate periods of silence.

Sound Effects

You can use the SOUND statement to create some acceptable sound effects. Unfortunately, there are no rules or guidelines that apply; all you can do is experiment. Figure 14-2 lists some program lines that you can use as a starting point.

Music

While it is possible to play music using the SOUND statement, the requisite translation of notes to multi-digit numbers is awkward at best. In Advanced BASIC, you can use the PLAY statement instead. It has a special music language that makes it easy to program tunes. The music language consists of 19 subcommands, which are listed in Table 14-2. To play a tune, you make up a string value that contains the appropriate sequence of subcommands, as explained in the following paragraphs.

Naming Notes

There are two ways to specify notes in a PLAY statement subcommand string. You can name the note by letter, like this:

```
100  PLAY " C D E F G A B "
```

The example above plays a seven-note scale, starting with the C above middle C.

For sharp notes, suffix the name of the note with a # or + character. For flat notes, use the - character as a suffix. Sharps and flats that have no corresponding black key on a piano are not allowed, namely B-sharp, E-sharp, C-flat, and F-flat.

To change octaves, use the O subcommand. The PLAY command has seven octaves, three below middle C numbered 0 through 2, and four above it numbered 4 to 7. The following example plays all the notes, including half steps, in the octave starting with middle C:

```
110  PLAY " 03 C C# D D# E F F# G G# A
       A# B "
```

Altogether, there are 84 notes in the seven available octaves (Figure 14-3). Instead of designating them by octave and name, you can designate them by number, using the N subcommand. The following example generates the same scale as the last example:

```
PLAY " N37 N38 N39 N40 N41 N42 N43 N44
   N45 N46 N47 N48 "
```

Note Length

Notes in the examples so far have had the length of a quarter note. To change the length of the note, suffix it with a number, like this:

```
PLAY " 03 C1 C2 C4 C8 C16 C32 C64 "
```

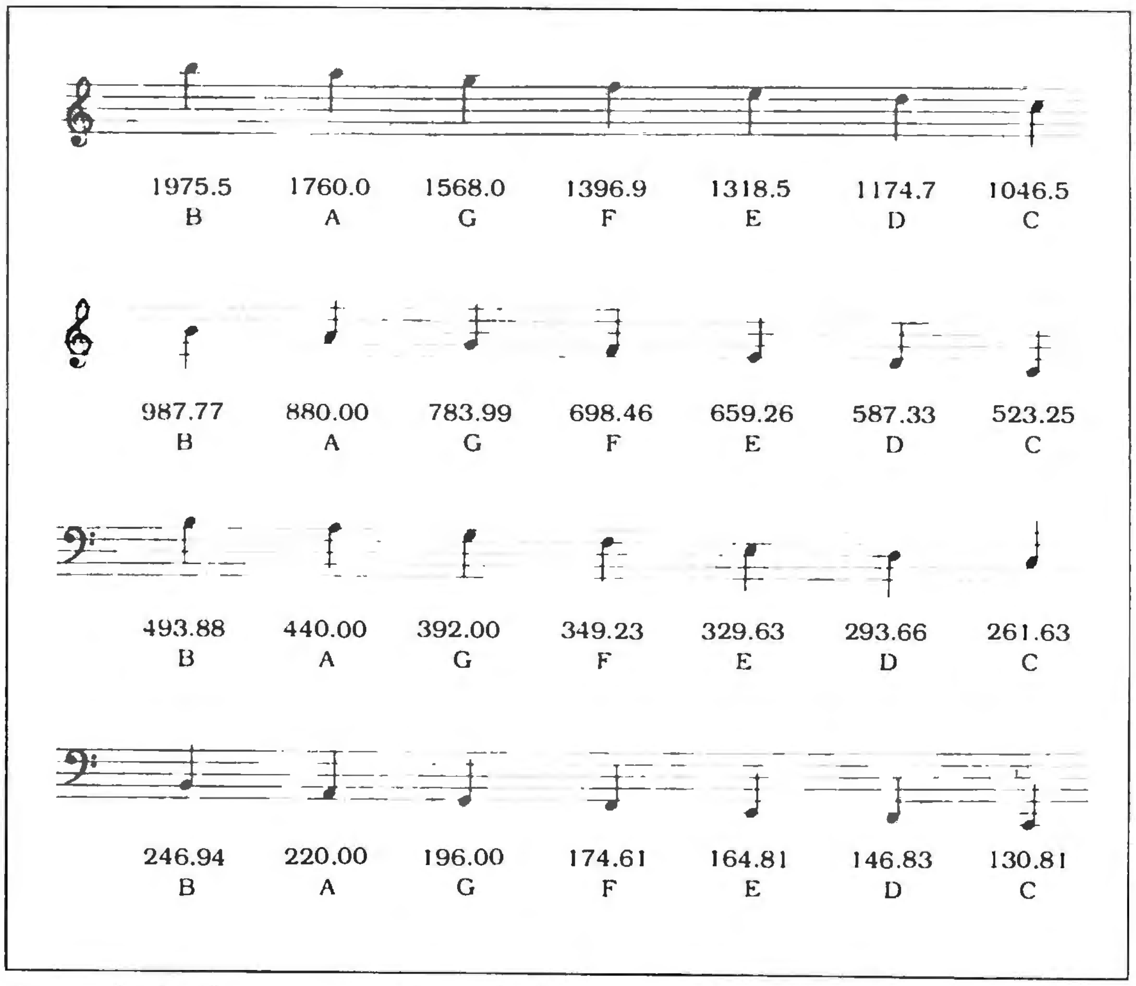


Figure 14-1: Frequencies of musical notes

Clock ticks	Tempo	Beats per minute
	Larghissimo	
27.30		40
	Largo	
18.20		60
	Larghetto Grave Lento	
16.55		66
	Adagio Adagietto	
14.37		76
	Andante Andantino	
10.11		108
	Moderato Allegretto	
9.10		120
	Allegro Vivace	
6.50		168
	Presto	
5.25		208
	Prestissimo	

Table 14-1: Musical Tempos

Hands On

The length of the note is equal to one divided by the number that follows the note. Thus a suffix of 1 designates a whole note, a 2 designates a half note, and so on. The example above plays seven middle C notes, the first one a whole note, the next a half note, then comes a quarter note, after that a sixteenth note, and the last two are thirty-second and sixty-fourth notes (Figure 14-4).

You can use the L subcommand to establish a note length that will be used by default. Just suffix it with a number as described in the preceding paragraph. The following example plays a descending scale of eighth notes:

PLAY " O2 L8 C B A G F E D "

To play a dotted note, suffix it with a period. You can use more than one period after a note; each period increases the note's length by 50 percent. Here is an example of a dotted half note and a dotted eighth note:

PLAY " C2. G8. "

Pauses (Rests)

The P subcommand establishes pauses (rests), with the length determined by a number the same as for the L subcommand (Figure 14-4). Here is an example:

PLAY " O3 C P1 C P2 C P4 C P8 C P16 C "

Tempo

The tempo of a musical composition (the rate of speed at which it is played) is indicated by notations like *allegro*, *andante*, and so forth, or by

```
10 REM '--Random noise----------------
20 SOUND RND(1)*300+440,RND(1)*RND(1)
30 GOTO 20

10 '--Bouncing-----------------------
20 FOR K=60 TO 1 STEP -2
30 SOUND 246.94-K/2,K/20
40 SOUND 32767,K/15
50 NEXT K

10 '--Falling------------------------
20 FOR K=2000 TO 550 STEP -10
30 SOUND K,K/4000
40 NEXT K

10 '--Siren--------------------------
20 FOR L=650 TO -650 STEP -4
30 SOUND 780-ABS(L),.3
40 L=L-2/650
50 NEXT L
60 GOTO 20

10 '--Hi-lo alarm--------------------
20 SOUND 987.7,5
30 SOUND 329.63,5
40 GOTO 20

10 '--Motor--------------------------
20 FOR L=50 TO 60 STEP 10
30 SOUND L,.002
40 NEXT L
50 GOTO 20
```

Table 14-2: PLAY statement subcommands

Subcommand	Interpretation
note	Play a named note (C, D, E, F, G, A, or B) in the current octave, either sharp (suffix + or #), flat (suffix -), or natural (letter alone)
O*oct*	Set octave number, 0 to 6 (middle C is octave 3)
N*nbr*	Play a note by number, 0 to 84 (0 means rest)
L*len*	Set the length of all later notes, from a whole note (*len* = 1) to a 64th note (*len* = 64); Optionally, *len* alone may suffix a single note to only affect that note
P*len*	Pause (rest): *len* as described for the L subcommand
dots	Each period that suffixes a note or pause subcommand holds the note or pause 1½ times normal
T*beat*	Set the tempo in beats per minute, 32 to 255
MF	Music foreground, program waits
MB	Music background, program continues
MN	Music normal, not legato or staccato
ML	Music legato
MS	Music staccato
X*s$*;	Execute subcommands from another string

Figure 14-2: Sample sound effects programs

metronome timing. The T subcommand sets the tempo using metronome timing. Table 14-1 compares tempo notations like *allegro* and *andante* with metronome timing.

Music Foreground or Background

Normally, Advanced BASIC will not proceed to the next note in a tune until the current note finishes playing. That is called *music foreground* mode. The MB subcommand tells Advanced BASIC to process up to 32 notes and store them in a memory buffer, and to play music from the buffer while it goes ahead with program execution. That is called *music background* mode. So for short tunes with 32 notes and rests or less, it is possible to have the computer do two things at once: play a tune and keep executing the remainder of the program.

Style: Staccato, Legato, Normal

The PLAY statement can play notes staccato, with distinct breaks between them; it can play notes legato, with no breaks between them; or it can play notes normally, with just enough pause between them to make them distinct. The MS subcommand produces a staccato performance by only holding each note for ¾ of its nominal length, and resting for the remaining ¼ beat. The ML subcommand creates a legato performance by holding each note for the full

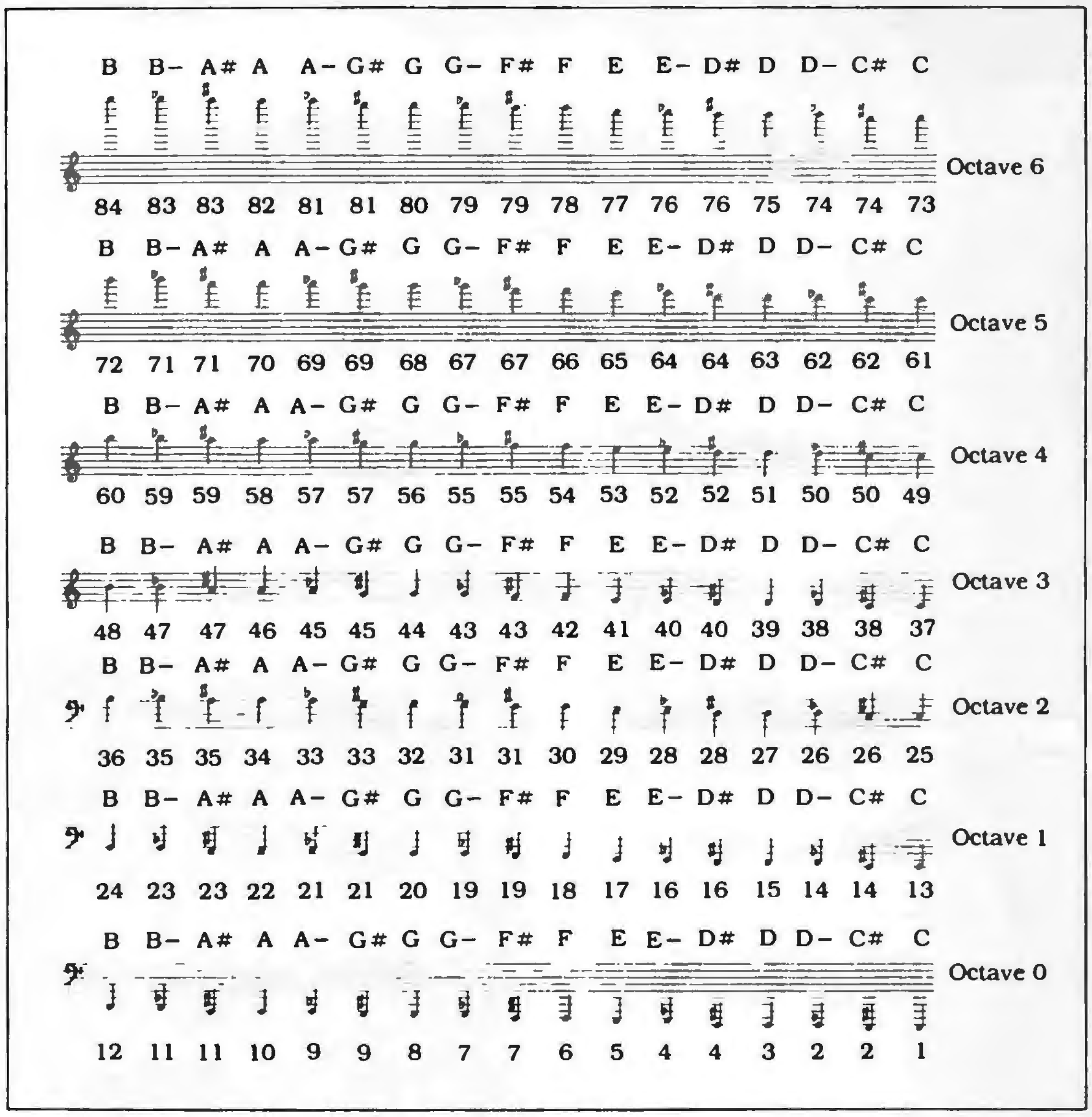


Figure 14-3: Notes available in the PLAY statement. (Numbers shown below notes are for the N subcommand.)

Figure 14-4: Note and rest lengths

length, so that succeeding notes seem to run together. Subcommand MN produces a normal performance by playing notes ⅞ of their nominal lengths, resting for the remaining ⅛ beat.

Playing Music

The PLAY statement does a credible job performing simple tunes, especially those written for keyboard instruments like the piano or organ. It is limited, however, to playing just one part. Two suitable compositions by Johann Sebastian Bach, the "Minuet" and the "Minuet in D Minor" from his *Anna Magdalena Notebook*, are shown in Figures 14-5 and 14-6. Programs that play them are listed in Figures 14-7 and 14-8. To make comparing the programs with the music easier, the name of each note is printed underneath it on the musical score. The following paragraphs briefly analyze how the programs work and how the musical scores were translated into subcommands.

Both programs work the same way. They store the PLAY statement subcommands in DATA statements starting at line 1010 and read the subcommand strings into string array TUNES one measure at a time.

Figure 14-5: "Minuet" from Anna Magdalena Notebook, by J.S. Bach

Hands On

Then, playing the tune stored in the array is simply a matter of using an X subcommand to incorporate each array element in turn.

The score for the "Minuet" specifies a tempo of *moderato* (Figure 14-5), which Table 14-1 says equals 108 to 120 beats per minute. The subcommand in the first measure (Figure 14-7, line 1010) sets the tempo at 110. It also establishes the default note length as an eighth note. The dot over the first note in the first measure means it is to be played staccato, so the MS subcommand designates that. The note itself is a D in octave 4 (the default octave), and it is a quarter note, so the subcommand D4 plays it. The next subcommand, MN, sets normal performance style, since the remainder of the notes in the measure are not marked staccato. The next note is in octave 3, and the O3 subcommand stipulates that. The G, A, and B subcommands play the appropriate eighth notes. The last

Figure 14-6: "Minuet in D minor" from Anna Magdalena Notebook, by J.S. Bach

note in the measure is C in octave 4, played by subcommands O4 and C. Each of the other 31 measures in the composition is similarly translated to a single DATA statement (lines 1020 to 1320).

The tempo in the second composition (Figure 14-6) is *andante*. The first subcommand (Figure 14-8, line 1010) sets the tempo at 90 beats per minute, which is within the range indicated by Table 14-1. The ML sub-

```
10 DIM TUNE$(4)
20 CLS:WIDTH 40:KEY OFF
30 LOCATE 11,17:PRINT "Minuet"
40 LOCATE 12,15:PRINT "J.S. Bach"
90 REM '--Read music from data----------------------------------
100 FOR MEASURE=1 TO 32
110 READ NOTES$
120 TUNE$(MEASURE\8)=TUNE$(MEASURE\8)+NOTES$
130 NEXT MEASURE
190 '--Play the tune----------------------------------------------
200 PLAY "xTUNE$(0); xTUNE$(1); xTUNE$(2); xTUNE$(3); xTUNE$(4);"
1000 '--Music, measure by measure---------------------------------
1010 DATA T110 L8 MS D4 MN O3 G A B O4 C
1020 DATA D4 O3 MS G4 MN G4
1030 DATA O4 MS E4 MN C D E F#
1040 DATA G4 O3 MS G4 MN G4
1050 DATA MS O4 C4 MN D C O3 B A
1060 DATA MS B4 MN O4 C O3 B A G
1070 DATA MS F#4 MN G A B G
1080 DATA B4 A2
1090 DATA O4 MS D4 MN O3 G A B O4 C
1100 DATA D4 O3 MS G4 G4
1110 DATA O4 E4 MN C D E F#
1120 DATA G4 O3 MS G4 G4
1130 DATA O4 C4 MN D C O3 B A
1140 DATA B4 O4 C O3 B A G
1150 DATA A4 B A G F#
1160 DATA G2.
1170 DATA O4 B4 G A B G
1180 DATA A4 D E F# D
1190 DATA G4 E F# G D
1200 DATA C#4 O3 B O4 C# O3 A4
1210 DATA A B O4 C# D E F#
1220 DATA MS G4 MN F#4 E4
1230 DATA MS F#4 O3 A4 O4 C#4
1240 DATA MN D2.
1250 DATA D4 O3 G F# G4
1260 DATA O4 E4 O3 G F# G4
1270 DATA O4 D4 C4 O3 B4
1280 DATA A G F# G A4
1290 DATA D E F# G A B
1300 DATA O4 C4 O3 B4 A4
1310 DATA B O4 D O3 G4 F#4
1320 DATA G2.
```

Figure 14-7: Program to play Bach Minuet (see Figure 14-5)

```
 0 DIM TUNE$(4)
20 CLS:WIDTH 40:KEY OFF
30 LOCATE 11,12:PRINT "Minuet in D minor"
40 LOCATE 12,17:PRINT "J.S. Bach"
90 REM '--Read music from data-------------------------------------
100 FOR MEASURE=1 TO 32
110 READ NOTES$
120 TUNE$(MEASURE\8)=TUNE$(MEASURE\8)+NOTES$
130 NEXT MEASURE
190 '--Play the tune---------------------------------------------
200 PLAY "xTUNE$(0); xTUNE$(1); xTUNE$(2); xTUNE$(3); xTUNE$(4);"
1000 '--Music, measure by measure--------------------------------
1010 DATA T90 ML L8 O3 A4 O4 F E D C#
1020 DATA D4 O3 A4 B-4
1030 DATA O3 C# E G B- A G
1040 DATA F4 E F D4
1050 DATA F4 B- A O4 D C
1060 DATA F4 E D C O3 B-
1070 DATA A B-16 O4 C16 O3 F4 E4
1080 DATA F2.
1090 DATA A4 O4 F E D C#
1100 DATA D4 O3 A4 B-4
1110 DATA C# E G B- A G
1120 DATA F4 E F D4
1130 DATA F4 B- A O4 D C
1140 DATA F4 E D C O3 B-
1150 DATA A B-16 O4 C16 O3 F4 E4
1160 DATA F2.
1170 DATA MS O4 A4 O3 F ML O4 A G F
1180 DATA E16 F16 G C2
1190 DATA MS F4 O3 D ML O4 F E D
1200 DATA C#16 D16 E O3 A2
1210 DATA A B O4 C# D E F
1220 DATA G E C# B- A G
1230 DATA F16 E16 D E4 C#4
1240 DATA D2.
1250 DATA MS A4 O3 F ML O4 A G F
1260 DATA E16 F16 G C2
1270 DATA MS F4 O3 D ML O4 F E D
1280 DATA C#16 D16 E O3 A2
1290 DATA A B O4 C# D E F
1300 DATA G E C# B- A G
1310 DATA F16 E16 D E4 C#4
1320 DATA D2.
```

Figure 14-8: Program to play Bach Minuet in D minor (see Figure 14-6)

command then establishes a legato performance, as directed by the musical score. The rest of the DATA statements translate the composition into subcommands in a straightforward way.

Lon Poole lives in Oakland, California, and has been writing about personal computers since 1976. He is the author of such books as Some Common BASIC Problems, Apple II Users Guide, *and* Your Atari Computer.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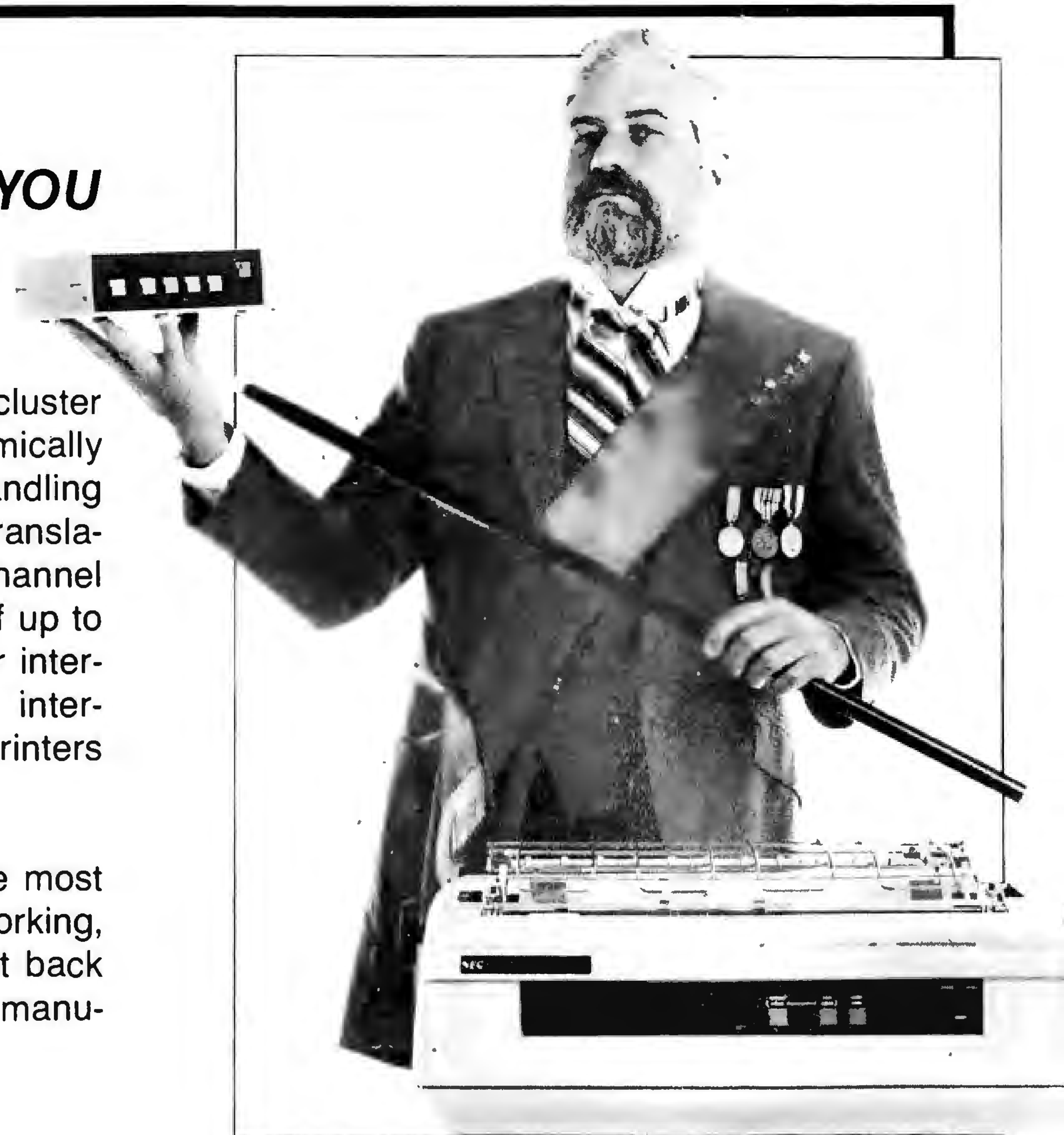

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Inside the PC Keyboard

The IBM Personal Computer keyboard appears to be a sophisticated electronic typewriter but is actually a small computer in itself.

Peter Norton

The keyboard is at the heart of the connection between human and computer. The 83 keys of the IBM PC keyboard hold the codes that allow you to communicate with the computer. Inside the keyboard is a microprocessor, the Intel 8048, that handles the task of supervising the keys and reporting their activity. The 8048's tasks include carrying out diagnostic error checking (performed when the computer is powered on), checking for stuck keys, and debouncing (preventing one keystroke from being seen as two).

The 8048 also has the ability to buffer up to 20 key actions in case the PC system unit can't accept them. Normally this buffer is empty, for the PC system unit is rarely unresponsive to the keyboard's request for attention.

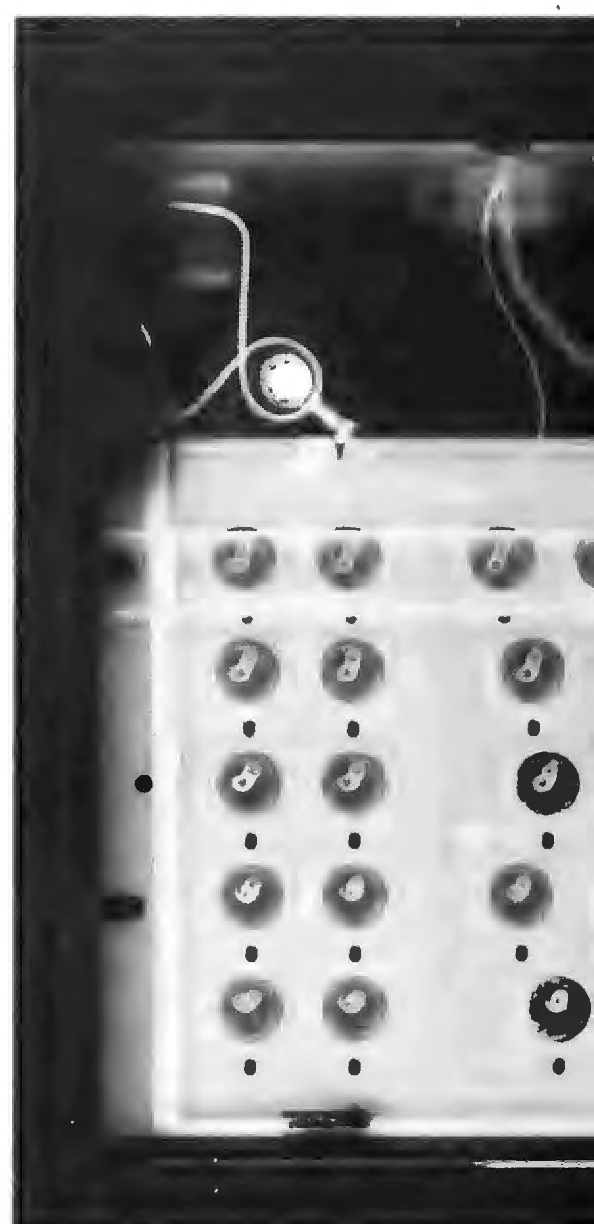
You have probably heard the PC beep when your keystrokes move ahead of a program's ability to accept them. This beep isn't caused by a full buffer in the keyboard unit; it sounds because the buffer maintained by the ROM BIOS routines that support the keyboard is full. While the buffer inside the keyboard unit holds 20 characters, the ROM BIOS buffer holds only 15.

Scan Codes

The keyboard microprocessor does not interpret the keys according to their common meanings (e.g., the A key doesn't mean *A*). Instead, the keyboard unit recognizes each key by an identifying number called the scan code. The scan codes of the keys are numbered from 1 through 83 (see Figure 1). When a key is pressed the keyboard unit reports the scan code to the system unit. When the key is released the keyboard unit reports again, this time with a released key code, which is the regular scan code plus 128 (hex 80). (For an explanation of hexadecimal notation, see "How the PC Thinks," Vol. 1, No. 1.)

Keyboard actions are reported to the system unit via interrupts and ports. When a key action occurs—when a key is pressed, released, or automatically repeated—the keyboard unit records the action in its buffer. The keyboard unit then generates a keyboard action interrupt (using interrupt 9). In response to the interrupt, the ROM BIOS routines read the scan code from the keyboard port (port 96) and send instructions back to the keyboard port to clear the key action from the keyboard unit's buffer. If the system unit doesn't respond to keyboard interrupts (this rarely occurs), the keyboard unit's buffer accumulates the scan codes. Scan code 255 (hex FF) is used to report that the keyboard buffer is full.

Since keystroke information passes from the keyboard to the system unit through a port, in theory any program with access to the ports can communicate directly with the keyboard. In practice this isn't the case because the keyboard unit generates interrupts processed by the ROM BIOS. However, a short BASIC program can be written to read the key-



board port and report when it encounters activity (see Listing 1).

The keyboard on the PC has repeat-key action, which IBM calls typematic. The keyboard unit is responsible for keeping track of the length of time a key is held down and for generating the repeat-key signals.

If a key is held down for a certain length of time, the keyboard unit automatically starts sending the key-depressed signal at regular intervals. You can't change the rate at which keys repeat because repeating is carried out at the hardware level inside the keyboard, and there is no practical way to change it with programming.

The ROM BIOS routines in the system unit tell the difference between a regular keystroke and a repeat key by keeping track of the scan codes for keys being released. If two key-pressed signals are received for the same key without a key-released signal in between, the key must be repeated. This scheme is used by the ROM BIOS to suppress repeat action for keys such as the Shift keys that don't use that action.

Most people are unaware that the PC keyboard actually signals when keys are released. You can see the signal in action by running the keyboard test in the PC diagnostic programs. If you pay close attention, you will see that the screen display changes when you press a key, release a key, or hold a key down long enough for the repeat action to work.

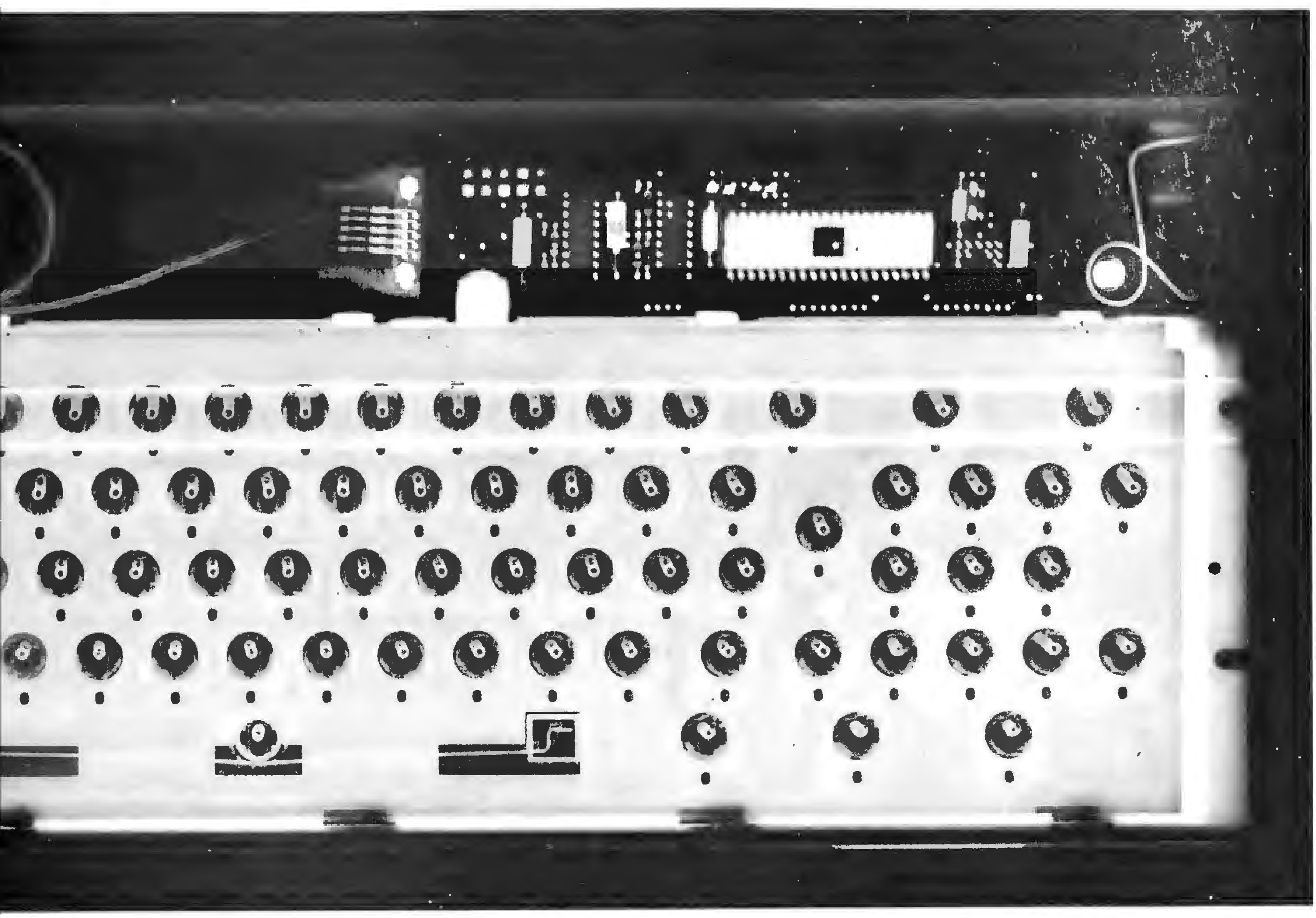
Shift Keys

The ROM BIOS service routine for the keyboard action interrupt (interrupt 9) is responsible for making sense of the key actions. This task includes keeping track of shift operations and translating keystrokes into the correct meaning, whether for a letter of the alphabet or a function key signal.

Part of the ROM BIOS's task in supervising the keyboard is to keep track of all the possible shift states. The PC keyboard and other keyboards have three kinds of shift operations: the normal action of the keys without shifting (e.g., to produce lowercase letters), the conventional shift (corresponding to a typewriter shift) that produces uppercase letters and usually anything written on the top half of a key top, and the two special shift keys, alternate shift (Alt) and control shift (Ctrl). These shifts work much like the regular shift key, but just as a lowercase *a* is different from an uppercase *A*, Ctrl-A and Alt-A also have different identities.

Not all the possible combinations of a shift key and an ordinary key represent legal PC keyboard functions. If you enter an incorrect combination, the ROM BIOS routine ignores it as if nothing had happened. Table 1 shows the legal combinations of shifted keys.

The PC keyboard has four special toggle keys that act like on-off switches for their particular func-

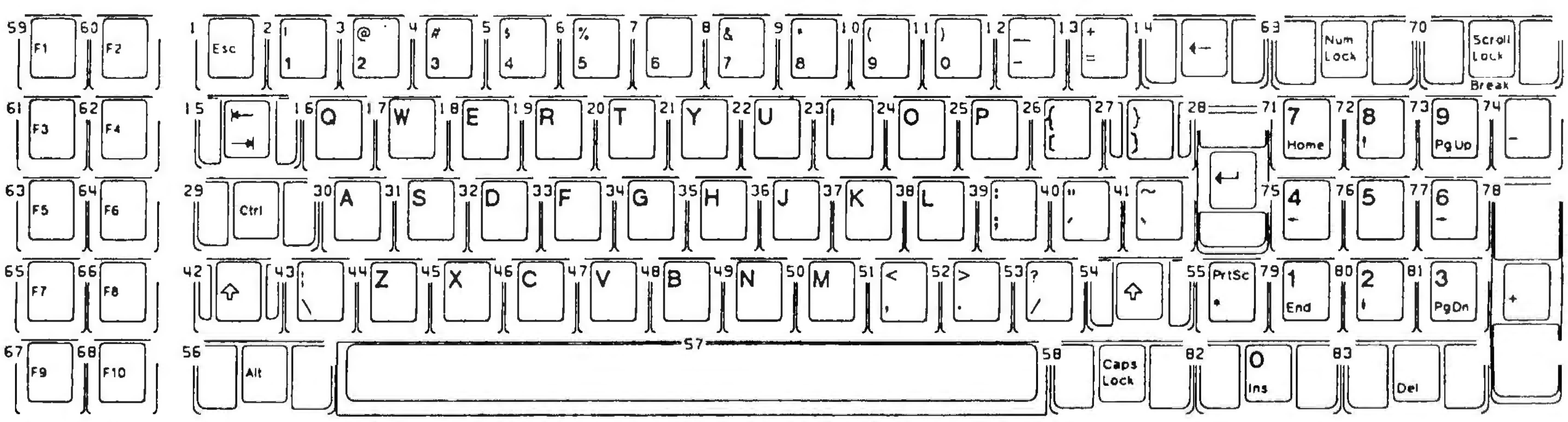


tions. These four keys are Ins (insert), CapsLock, NumLock, and the neglected ScrollLock. Two of these toggle keys, CapsLock and NumLock, are part of the keyboard shift mechanism, while the other two control their own special information.

For the three ordinary shift keys, which must be held down to be active, the ROM BIOS routine keeps track of whether they are pressed or released and makes appropriate changes in the interpretation of the keys. The ROM BIOS pays attention to the scan code sent only when a shift key is released.

lists the control bits for the keyboard, which you can see in action in Listing 2.

Several interesting features are revealed in Table 1. Note the parallelism in the first 4 bits of the 2 bytes for the four toggle keys. In the first byte, the current state is indicated,



Nomenclature is on both top and front face of keybutton as shown. The number to the upper left designates the button position.

Figure 1: Keyboard Diagram

```
100 REM              A BASIC routine to read the keyboard scan codes
110 X = INP (96)               ' read the keyboard port
120 THROW.AWAY$ = INKEY$       ' discard any keystrokes the ROM-BIOS read
130 IF X = 0 THEN GOTO 110  ' if no data, keep looking
140 PRINT
150 PRINT "Keyboard scan code ";X MOD 128;   ' report scan code
160 IF X > 128 THEN PRINT " key released";   ' report if key-released code
170 IF X < 129 THEN PRINT " key pressed ";   ' report if key-pressed  code
180 GOTO 110
```

Listing 1

The ROM BIOS keeps information on the state of the four toggle keys and whether the shift keys are held down in a dedicated location in low memory. Two bytes, located at memory addresses 1047 (hex 417) and 1048 (hex 418), are used during the operation of the PC to keep track of these shift- and toggle-key states no matter what programs are run.

The BASIC program shown in Listing 2 displays the two keyboard control bytes and demonstrates the action of the shift and toggle keys.

When the ROM BIOS receives a scan code for an ordinary key (other than a shift key), it checks the state of the various shift possibilities and translates the key into the appropriate meaning, which could be an ASCII code or a special key code.

Toggle Keys

The ROM BIOS routine keeps track of more keyboard functions than just the shift states. The status of the keyboard is kept track of in the first 13 of the 16 bits in the two keyboard status bytes at location 1047. Table 1

while in the second byte the 4 bits indicate whether the corresponding key is depressed. In the bits that indicate that the four ordinary shift keys (Alt, Ctrl, Shift left, Shift right) are depressed, the Shift keys on the left and right sides of the keyboard are treated separately.

Also, note that the ROM BIOS keeps track of the insert status as an on-off toggle function. This feature is generally ignored by programs such as word processors that make use of

```
1000 REM  Listing 2 -- A program to display keyboard status bits
1010 REM                 (C) Copyright 1983, Peter Norton
1020 REM
1030 GOSUB 2000                    '  TITLE
1040 GOSUB 3000                    '  MISCELLANEOUS INFORMATION
1050 GOSUB 4000                    '  DISPLAY KEYBOARD BITS
1060 GOSUB 5000                    '  CHECK FOR KEYBOARD INPUT TO END
1070 GOTO  1050                    '  CONTINUE DISPLAYING

2000 REM  Title subroutine
2010 KEY OFF : CLS : WIDTH 80 : LOCATE ,,0
2020 REM
2030 LOCATE 5,1
2040 PRINT "                Programs for INSIDE THE IBM PERSONAL COMPUTER"
2050 PRINT "                      (C) Copyright 1983 Peter Norton"
2060 PRINT
2070 PRINT "               Program 10-1: Display the Keyboard Status Bits"
2999 RETURN

3000 REM  Subroutine to display miscellaneous information
3010 LOCATE  11,28
3020 PRINT " Byte 1   Byte 2";
3030 LOCATE  12,28
3040 PRINT "12345678 12345678";
3050 LOCATE 17,10
3060 PRINT "To see the status bits change, press (and hold) any of";
3070 LOCATE 18,15
3080 PRINT "-- left and right shift keys";
3090 LOCATE 19,15
3100 PRINT "-- Ctrl, Alt, NumLock, ScrollLock, CapsLock, Ins";
3110 LOCATE 21,10
3120 PRINT "(beware the effect of the Shift and NumLock on the Ins key)";
3130 LOCATE 24,10
3140 PRINT "To return to DOS, press any normal input key...";
3999 RETURN

4000 REM     Subroutine to display keyboard control bits
4010 DEF SEG = &H40
4020 CONTROL% = PEEK (&H17)
4030 CHECK% = 128
4040 FOR I% = 1 TO 8
4050   LOCATE 14,27+I%
4060   IF CONTROL% >= CHECK% THEN COLOR 30,0 ELSE COLOR 7,0
4070   IF CONTROL% >= CHECK% THEN PRINT "1"; ELSE PRINT "0";
4080   IF CONTROL% >= CHECK% THEN CONTROL% = CONTROL% - CHECK%
4090   CHECK% = CHECK% / 2
4100 NEXT I%
4110 CONTROL% = PEEK (&H18)
4120 CHECK% = 128
4130 FOR I% = 1 TO 8
4140   LOCATE 14,36+I%
4150   IF CONTROL% >= CHECK% THEN COLOR 30,0 ELSE COLOR 7,0
4160   IF CONTROL% >= CHECK% THEN PRINT "1"; ELSE PRINT "0";
4170   IF CONTROL% >= CHECK% THEN CONTROL% = CONTROL% - CHECK%
4180   CHECK% = CHECK% / 2
4190 NEXT I%
4999 RETURN

5000 REM   Subroutine to check for ending keystroke
5010 K$ = INKEY$
5020 IF  LEN(K$) = 0 THEN RETURN   ' LOOP UNTIL KEYBOARD INPUT
5030 IF (LEN(K$) = 2) AND (CHR$(82) = MID$(K$,2,1)) THEN RETURN ' "Ins" key
5040 CLS : LOCATE ,,1
5999 SYSTEM

9999 REM   End of program Listing 2
```

Listing 2

the Ins key. Usually any program that uses the Ins key keeps its own record of the insert state, which might easily be the opposite of the insert state kept by the ROM BIOS. This situation means that when a program such as a word processor starts operating, it designates the insert state as off, even if the PC's own record of the insert toggle indicates that it should be on. Again, if you stop using a word processor with the insert state on and return control of the computer to PC-DOS, DOS interprets the insert toggle as reset to off, even though according to the record kept by the ROM BIOS the insert toggle is still on.

Finally, notice the hold-state bit, which is set when the ROM BIOS keyboard routine detects the Ctrl-NumLock combination. When the hold state is on, the keyboard ROM BIOS runs in a tight loop, waiting for a key to be pressed to break out of the hold state. The hold-state bit is used to keep track of whether the computer has been asked to pause, and during the loop any interrupts that occur are serviced. If the interrupt is a keyboard interrupt for an ordinary key, the hold state is ended, the keystroke is thrown away, and the ROM BIOS returns control to the program that was executing before the hold state was set. If an interrupt occurs from another device such as a disk drive, that interrupt is serviced and the hold-state loop continues, waiting for a key to be struck.

While the ROM BIOS keyboard service routine is processing key actions received from the keyboard unit, it constantly checks for four special cases, Ctrl-NumLock, PrtSc, Ctrl-Alt-Del, and Ctrl-Break, which are treated as commands rather than ordinary keyboard input.

Ctrl-NumLock is used to suspend the operation of the computer until the suspension is broken with a keystroke. PrtSc (print screen) is the command to send a copy of the screen contents to the printer. Since this operation is carried out at the most primitive BIOS level, it isn't af-

Byte	Bit	Subject Matter	Meaning when bit is 1
1	1	Ins	state active
1	2	CapsLock	state active
1	3	NumLock	state active
1	4	ScrollLock	state active
1	5	Alt	key depressed
1	6	Ctrl	key depressed
1	7	Shift (left)	key depressed
1	8	Shift (right)	key depressed
2	1	Ins	key depressed
2	2	CapsLock	key depressed
2	3	NumLock	key depressed
2	4	ScrollLock	key depressed
2	5	hold state	state active (from Ctrl-NumLock)
2	6	(not used)	
2	7	(not used)	
2	8	(not used)	

Table 1: Control Bits for the Keyboard

Special code value	Keys to generate it
3	Ctrl-2 (this is supposed to be taken as CHR$(0), the ASCII NULL)
15	Back-tab (shift tab)
16–25	Alt-Q through Alt-P (top row of letters)
30–38	Alt-A through Alt-L (middle row of letters)
44–50	Alt-Z through Alt-M (bottom row of letters)
59–68	F1 through F10 (function keys, no shift)
71	Home
72	CursorUp
73	PgUp
75	CursorLeft
77	CursorRight
79	End
80	CursorDown
81	PgDn
82	Ins
83	Del
84–93	Shift-F1 through Shift-F10 (regular shift function keys)
94–103	Ctrl-F1 through Ctrl-F10 (control shift function keys)
104–113	Alt-F1 through Alt-F10 (alternate shift function keys)
114	Ctrl-PrtSc
115	Ctrl-CursorLeft
116	Ctrl-CursorRight
117	Ctrl-End
118	Ctrl-PgDn
119	Ctrl-Home
120–131	Alt-1 through Alt-= (top row of the keyboard)
132	Ctrl-PgUp

Table 2: Legal Combinations of Shifted Keys

fected by DOS enhancements, such as those that redirect printer output to a communications line. The print-screen service is available to programs on an interrupt level if you provide access to assembly level interfaces with the ROM BIOS.

The Ctrl-Alt-Del key combination is used to request a restart of the computer system. When the keyboard service routine detects this key combination, it passes control to the same program used to test the computer and start up the operating system. Supposedly you can press Ctrl-Alt-Del at any time to restart the PC.

You may have already discovered, however, that this operation doesn't always work. Sometimes you have to turn the PC off and then on again to get it restarted. The most common cause of this problem is the disabling of interrupts. Ctrl-Alt-Del works only if the keyboard interrupt service is working. The clear interrupts instruction (CLI) suspends interrupts until a start interrupts instruction (STI) reactivates them. Normally a CLI is quickly followed by an STI, but if a program accidentally leaves interrupts disabled, keystrokes, including Ctrl-Alt-Del, go undetected by the microprocessor. (See "How the PC Thinks," Vol. 1, No. 2, for a more in-depth discussion of interrupts.)

The other situation that can disrupt a Ctrl-Alt-Del reset is a change in the keyboard interrupt vector. If memory locations 36 through 39 (where the keyboard interrupt vector resides) are changed, none of the keys will work, including Ctrl-Alt-Del.

Ctrl-Break is a command that is intended to stop the current operation. Unlike the other three special-status commands, Ctrl-Break can be controlled by program software. Interrupt 27 (hex 1B) is reserved for a routine that activates when Ctrl-Break is keyed. When a program makes use of this capability, it inserts the address of its interrupt service routine into the vector location for interrupt 27 (at storage location 108, or hex 6C).

You can experience this facility by using Ctrl-Break with either BASIC or the EDLIN editor that comes with PC-DOS. If a program does not insert the address of an interrupt handler into location 108, then the BIOS and DOS cooperate to break out of the current program or batch processing file.

Since the keyboard unit reports each key action separately and the ROM BIOS routines interpret the meaning of the key actions, programs are able to keep track of the exact action going on at the keyboard. Because programs rarely require more information than that reported by the ROM BIOS service routines, no special provision is made for a program to receive the exact key actions.

If you want more complete information about keyboard activity, your programs can replace the interrupt vector for the keyboard action interrupt located at memory address 36 (hex 24). When you provide your own keyboard interrupt program or use one of the popular keyboard enhancers such as *Keynote* or *ProKey* (see "The PC in a New Key" and "ProKey Chimes In" in Vol. 1, No. 1), the programs can either take complete charge of the keyboard or act as a front end to the regular ROM BIOS routine. A front-end routine can extract any information you need and pass control on to the regular ROM BIOS routine, thereby completing the regular keyboard processing.

ASCII and Special Characters

After the ROM BIOS processes the keystrokes, they are made accessible to programs in translated form. Two sets of characters are available. The first is the ordinary extended ASCII character set, the conventional characters described in the IBM PC manuals. This set consists of the 256 possible byte codes, except for one (the zero-value byte). The codes can be generated from the keyboard either by using the regular keystrokes (the A key for *A*, and so forth) or by using the Alt-numeric keys.

To generate ASCII codes by the Alt-numeric method, hold down the Alt key and key in the numeric value of the ASCII code. The value must be in decimal (from 1 to 255), and you must use the numeric keys on the right of the keyboard (not the numbers on the top row of the keyboard). The Alt-numeric method is handled specially by the ROM BIOS routines, since several keystrokes are interpreted as one keyboard input character.

Not all the possible combinations of a shift key and an ordinary key represent legal PC keyboard functions.

As long as the Alt key is held down, you can key indefinitely on the numeric keys. When you release the Alt key, an ASCII character is generated, corresponding to the numeric value you entered. If you have keyed in too large a number, the modulo-256 value is used. If you key in Alt-1000, for example, the character CHR$(232) is generated. Dividing 1000 by 256 leaves a remainder of 232, so CHR$(232) is the character code that is generated.

The one ASCII value that cannot be entered from the keyboard is the zero (or value CHR$(0)). There are some lame reasons for this situation (code 0 is defined in ASCII as the null character, which is supposed to be ignored), but the real reason is that zero is used by the ROM BIOS to indicate the presence of the second set of characters, the special characters.

Although IBM PC manuals indicate that the zero character can be generated by either Ctrl-2 or the Alt-numeric method, this is incorrect. If you hold the Ctrl key and press 2, one of the special characters is generated. The character is supposed to be interpreted as if it were CHR$(0) in the ASCII character set, but that isn't really the same thing as generating a true ASCII CHR$(0). And the Alt-numeric method doesn't work either, whether you key in Alt-0 or try to fool the ROM BIOS by keying in a modulo-256 equivalent, such as Alt-256 or Alt-512.

In addition to the regular ASCII characters are the special characters used to indicate special keys such as Home, End, and the 10 function keys (actually there are 40 function keys). These special character codes make available the use of the special keys without using up any of the 256 extended ASCII codes.

The coding mechanism used by the ROM BIOS to indicate the character keyed in (and whether the character is conventional extended ASCII or a special character), provides 2 bytes whenever a keyboard character is requested. If the main byte of the two is not zero, the input is extended ASCII and the character is stored in the main byte. If the main byte is zero, however, the keyboard character is a special character and the character is stored in an auxiliary byte. Common sense suggests that it would have been better to use 1 bit of the auxiliary byte to indicate the difference between conventional and special key characters. This method would have been simpler and would have allowed the zero character to be keyed in. But that isn't the way IBM designed the system.

While there are 256 extended ASCII codes (255 of which can be keyed in), only as many special codes exist as are needed for the intended purposes of the PC keyboard. For example, 40 codes exist for the function keys (10 regular codes, and another 30 for the three possible shift states, normal Shift, Alt-Shift, and Ctrl-Shift). Table 2 shows the special codes and the key combinations that create them. This is a hodgepodge of codes without a great deal of consistency. Some Alt-key combinations are allowed and others are not; the same is true for the Ctrl-key combinations. With all these special key codes available, programs have no shortage of codes to access for special purposes. All any program needs are the function keys and a few special-purpose keys such as Home and the cursor keys. If more special key codes are needed, you will find them in Table 2.

Ordinary keyboard input to programs is available in every language used on the PC, but using keyboard input always involves suspending the program to wait for keyboard action. For many purposes this procedure is adequate, but often programs have to keep track of keyboard input without being suspended.

Both BASIC and Pascal use keyboard input services that allow testing for input characters without suspending program execution. BASIC carries out the operations through the INKEY$ function, and Pascal does it by accessing the input buffer via a file pointer (for details on this, see the IBM Pascal manual, particularly page 12-7 in the first edition).

BASIC also provides access to the special input codes through the INKEY$ function. When LEN (IN-

KEY$) is 2, a special key is pressed, and INKEY$ has CHR$(0) for its first character and the special code value for its second character.

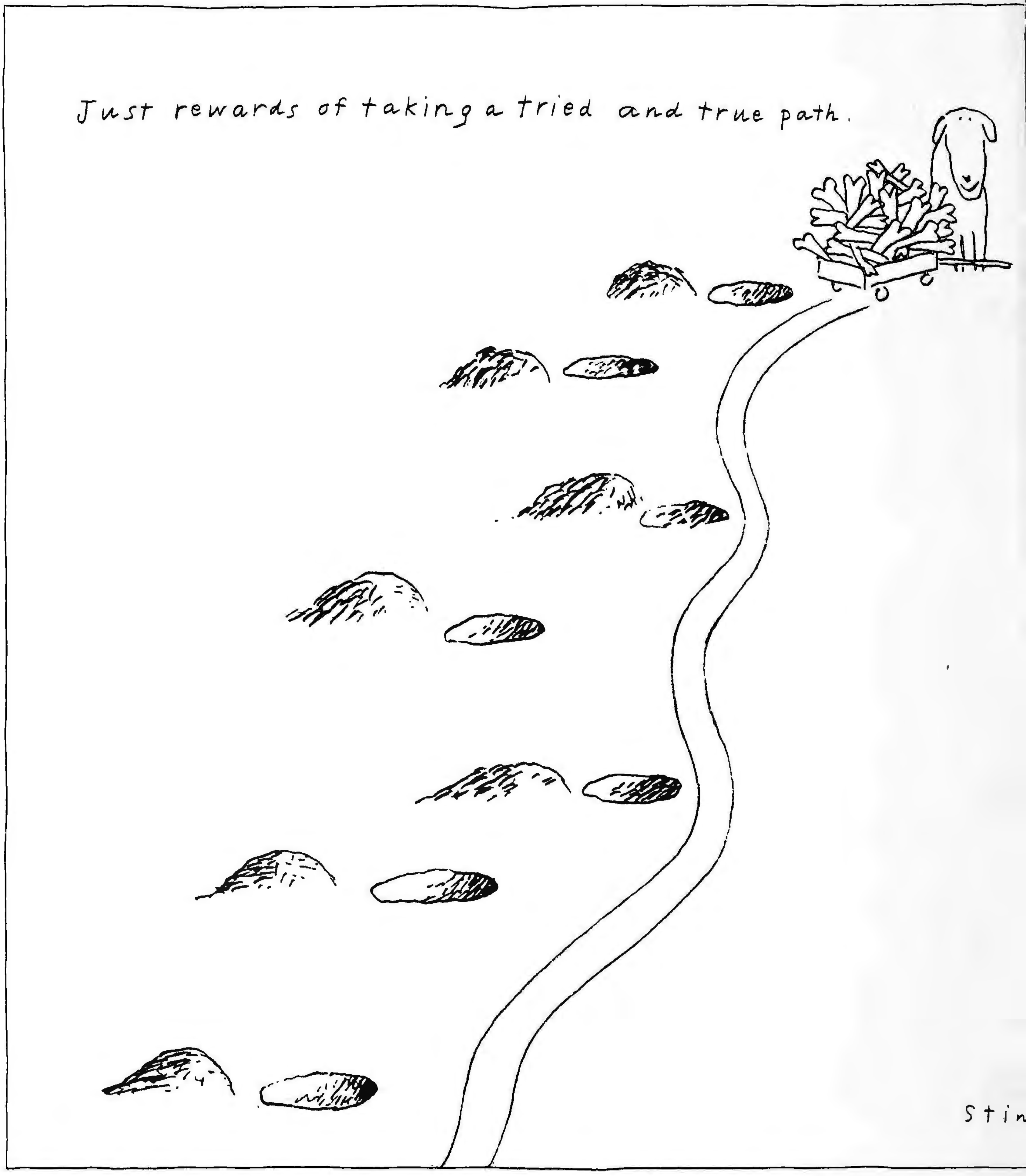
Pascal, however, does not provide full access to the special key codes. When the special key combinations are pressed, Pascal recognizes the keystroke but gives no indication whether the character is a special code or an ordinary ASCII character.

Both BASIC and Pascal use keyboard input services that allow testing for input characters without suspending program execution.

For Pascal programs to properly recognize the special codes, you need assembly language interface routines. (A full set of these routines is included in the disk program package that accompanies the book *Inside the IBM Personal Computer,* from which this article is taken.)

Access to the keyboard shift status bits is very important. The shift states can be accessed either through the ROM BIOS service code 2 or by direct memory access, as illustrated in Listing 2. From the keyboard microprocessor to the keyboard buffer and the ROM BIOS control routines, the IBM PC keyboard design is simple and elegant. Knowledge of this link between human and computer is essential for sophisticated programming in any language.

Peter Norton has worked in computing as a programmer, designer, and author. He wrote and produced The Norton Utilities. *This article will be included in his forthcoming book,* Inside the IBM Personal Computer: Access to Advanced Programming. *It is used with permission of the Robert J. Brady Co., copyright 1983, Peter Norton.*



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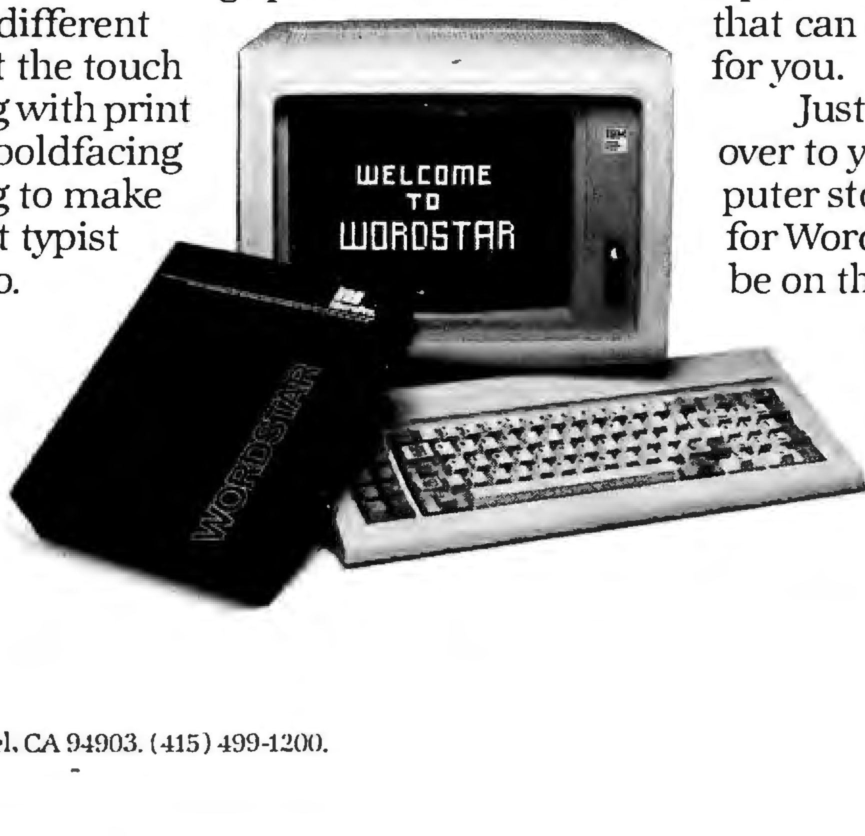

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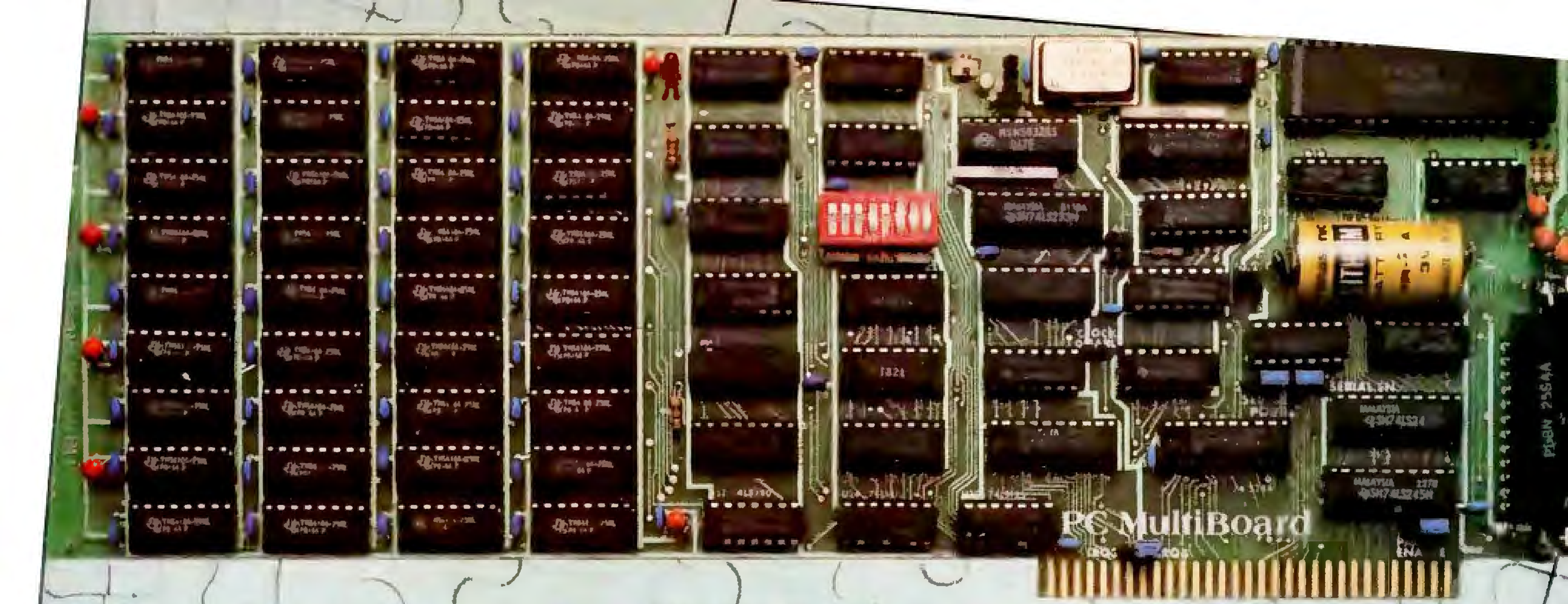

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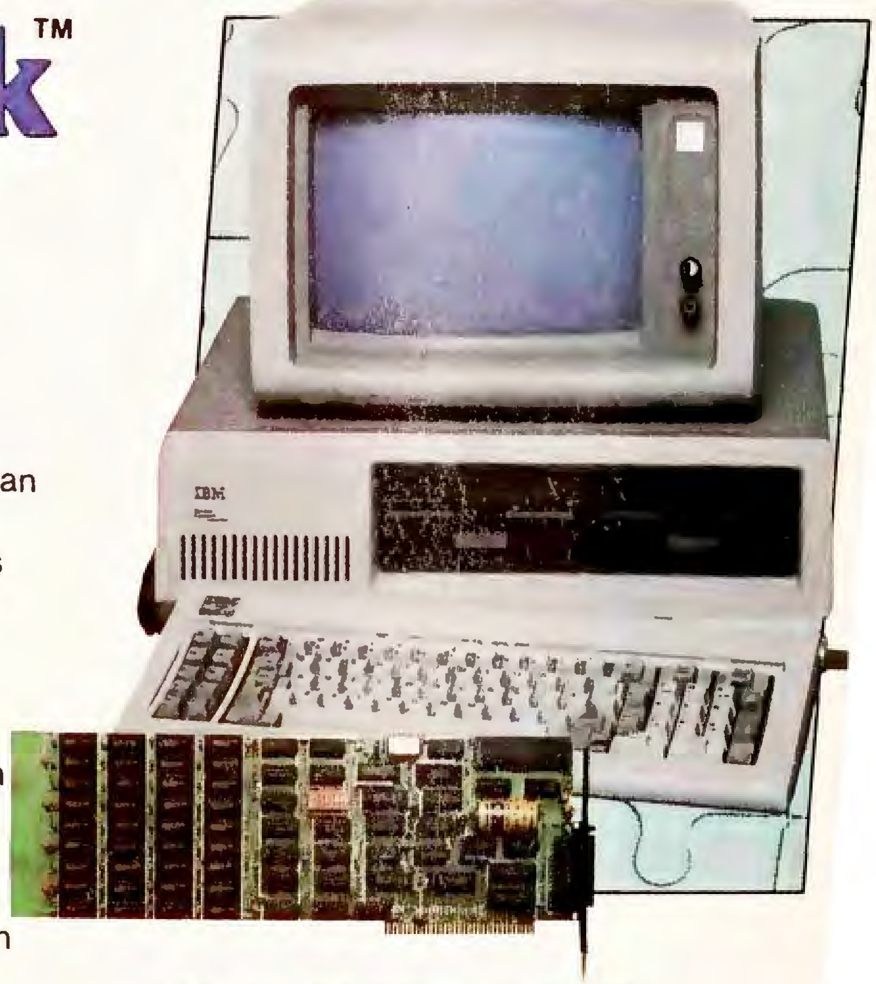

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Tracking Bulls and Bears

The stock market went up 10 points today. Do you know where your stocks are?

Andrew T. Williams

Owning common stocks means watching their movements like a hawk. Casting a sharp eye on each morning's financial page, you find out your stocks' current prices as well as how much the prices have changed since the previous day.

But the newspaper can't tell you how much you've made or lost since you bought the stocks. Nor can it tell you how much commission to subtract from the gross sale price if you want to sell a holding. You might also want to calculate the percentage change on an annualized basis so you can see how stocks you've owned for different periods of time are doing. And by the way, how long have you owned that stock? Does it qualify for treatment as a long-term capital gain?

> With a minimum of effort you can know just how well your stock portfolio is doing each day.

If you own a portfolio of common stocks, these important analyses should be made every day. With a calculator, portfolio tracking is tedious and time consuming. But with a PC and an electronic spreadsheet package, you can transform this task into a matter of few minutes of data entry and a push of the recalculation key.

By recreating the worksheets in this article you can easily monitor the performance of your stock portfolio. These worksheets are arranged on a single *SuperCalc* spreadsheet in three descending steps (see Figure 1). Table 1, which is dependent on Tables 2 and 3, is the main worksheet on which your portfolio is tracked. Table 2 is a work space where many calculations are performed and summarized. Table 3 contains five lookup tables: the top two are used when calculating the commission, and the bottom three are used when calculating the number of days between dates.

By constructing these worksheets separately, you can insert or delete rows and expand or contract column widths in any table without affecting entries in the other two tables. This layout demonstrates a cardinal rule of electronic worksheet construction: use the entire worksheet; don't be constrained by the small portion displayed on the screen.

The Electronic Worksheet

You can see how much you've invested in each of your stocks and how much they're worth each day with the help of the electronic worksheet in Table 1. The worksheet shows how much the value of each stock has changed since it was purchased and how much the stock's value has changed since you last evaluated your portfolio. The value of your holdings is summarized at the bottom of the worksheet, and the portfolio's performance is compared with the change in the Dow Jones Industrial Average (DJIA) over the same period. With this worksheet you can track changes in your portfolio value quickly and easily, enabling you to act fast when required.

The worksheet shown in Table 1 uses several special features of *SuperCalc*, although you could duplicate the worksheet with other spreadsheet programs designed to run on the IBM PC. This worksheet uses *SuperCalc*'s ability to copy values from one part of the worksheet to another without copying the underlying formulas. It also uses *SuperCalc*'s variable column widths, which enable you to place as much material as possible on a single page.

Formulas

Before entering formulas into the worksheet, turn off *SuperCalc*'s automatic recalculation feature by typing /GM. With recalculation off, the computer won't calculate the formulas on the worksheet after each entry; type an exclamation mark when you want to recalculate the worksheet.

To create Table 1, position the cursor at cell AA45. Set column widths as indicated in row 45, and copy the title material and column headings in the lower rows. Set the dollars and cents format to the global format with the command /FG$. Set the columns AB and AE and the date cells (AA56 to AC56) to the integer format.

The formulas entered into each cell of row 62 of the worksheet and the formulas from cells AO55 and AO56 are listed in the lower left of the worksheet. Most of the formulas are straightforward. Those in AD62 and AJ62 calculate the value of each holding, while those in AK62 and AN62 calculate the difference between yesterday's value and the purchase price. The formulas in row 73 total the overall value of the portfolio.

Enter the formulas for columns AE and AF, even though these formulas are dependent on information from Table 2. Once we construct Table 2, the information in columns AE and AF will be calculated.

The four IF functions in cells AL62, AO62, AQ62, and AO55 prevent error messages from appearing on the worksheet when division by zero is attempted. These IF functions, like all other IF functions, consist of a comparison and two alternatives. If the comparison is true, the IF function calculates the first alternative; if the comparison is false, the IF function calculates the second alternative.

In cell AL62 the comparison "Is AH62 equal to zero?" is true if AH62 equals zero. In this case, 'Error' would be displayed if division by zero were attempted. To prevent this from happening, when the comparison is true the IF function calculates the first alternative, placing a zero instead of an error message in the cell. If the comparison is false, the second alternative performs the division.

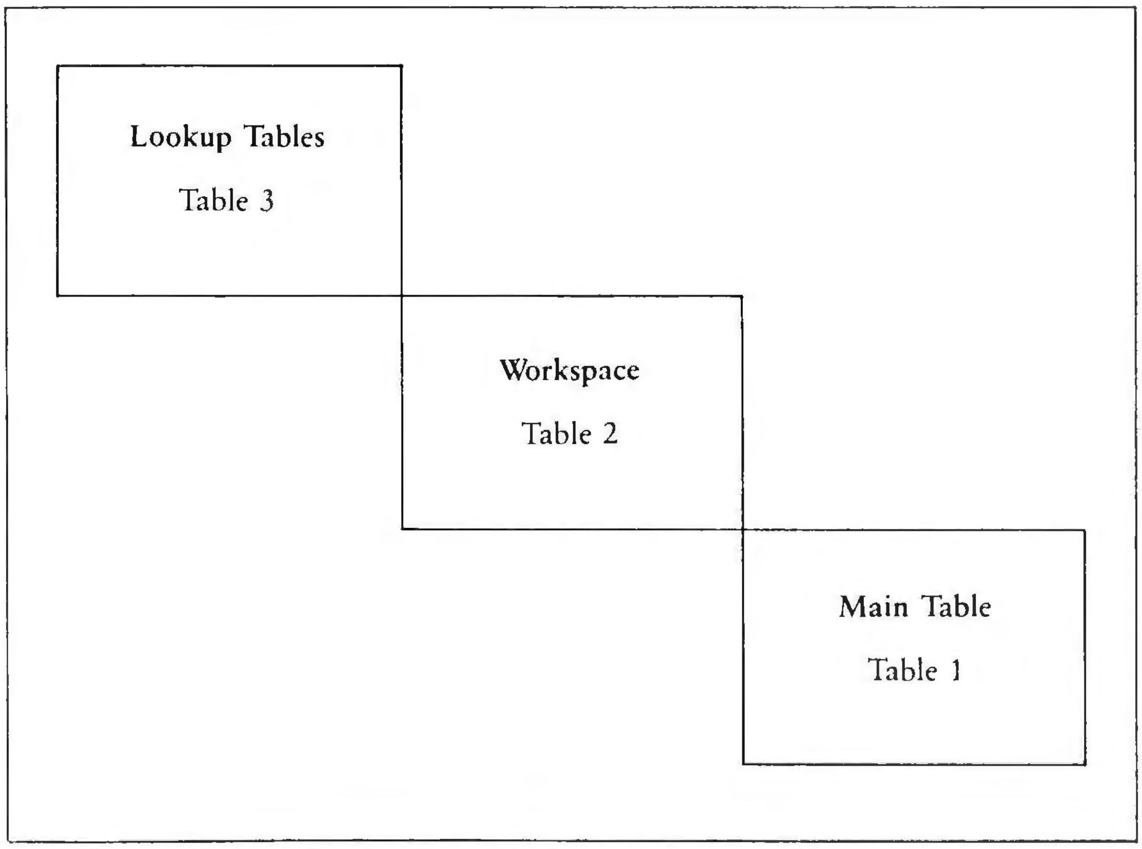

Figure 1: Arrange Tables 1, 2, and 3 in this stepwise manner.

Completing the Table

Complete the worksheet by replicating the formulas in the first row of Table 1 down their respective columns. Before you do the replication, however, enter dots (....) into those columns where you'll be entering information, move the cursor to AF62, and set the graph format by typing /F*. Enter percent signs into columns AM, AP, and AR. The dots remind you where you need to make entries when filling out the worksheet, and the percent signs signify the values that are percentages rather than dollars and cents. The columns containing the percent signs are so narrow that their column letters don't appear at the top of the *SuperCalc* screen, but the columns can be viewed by moving the worksheet cursor across row 62.

Replicate row 62 down the worksheet, allowing all the formula references to adjust, except the one in column AE that refers to cell X31. Today's Date is the same for each stock, so the reference in column AE to cell X31 is not relative. (Remember that until we construct Table 2, which contains the information for cell X31, column AE will contain zeros and AF will be blank.) Table 1 has ten rows for ten stocks, but you should make the table large enough to hold your portfolio, plus some room to grow.

The formulas in the Total line (row 73) are listed in the lower right of Table 1. These are simple summation functions and formulas to calculate percentage changes. Notice that the range of the summation functions includes the row of dashes at the top and the row of double dashes at the bottom. These are evaluated as zeros; using them means that you can insert or delete any row in the table—including the first or the last—and not have to worry about upsetting the range of a summation function.

Using the Worksheet

Constructing this electronic worksheet is an exacting task, but the result is worthwhile. You can update the table quickly and add new purchases and remove sales easily.

By the way, if you haven't saved a copy of the worksheet on disk, do so now.

```
    : AA :: AB::   AC  ::   AD  :: AE ::     AF    ::   AG  ::   AH  ::   AI  ::   AJ  ::  AK  ::  AL : :   AN   ::   AO  : :  AQ :
42:
43:                                                   COLUMN WIDTH SETTINGS
44:=================================================================================================================================
45:   6    5      9       9     6       11        9        9        9        9       8       7  1     10        9   1   7   1
46:=================================================================================================================================
47:
48:PRINT:AA50:AQ75   [CTRL]-[O]
49:WorkSpace IS LOCATED AT: J33
50:
51:                                         KEEPING TRACK OF YOUR STOCKS
52:
53:                                                                                 TODAY'S DJIA:                 1088.91
54:     TODAY'S DATE                                                                YESTERDAY'S DJIA:             1087.43
55:     MO  DAY YEAR                                                                % CHANGE  IN DJIA:                .14%
56:      2   17 1983                                                                % CHANGE  IN PORTFOLIO:           .97%
57:
58:                                                                                   CHANGE FROM     OVERALL  OVERALL  ANNUAL
59: STOCK # OF       PURCHASE       DAYS  LONG TERM     YESTERDAY'S           TODAY'S         YESTERDAY    $ GAIN OR       %        %
60:SYMBOL SHS.  PRICE      VALUE OWNED    ??????? PRICE      VALUE     PRICE     VALUE        $        %  LOSS (-)   CHANGE  CHANGE
61:---------------------------------------------------------------------------------------------------------------------------------
62:IBM     100    88.25  8870.00   41                98.875  9804.03  98.875  9804.03      .00     .00%     934.03    10.53%  93.74%
63:CSC     400   20.625   331.75  845  *******         21.5  8517.20     21.5  8517.20     .00      .00%    185.45     2.23%    .96%
64:UAL     125   29.875  3790.63  618 *******        31.75  3912.50       33  4068.75  156.25    3.99%     278.13     7.34%   4.33%
65:DEC     200  104.375 20965.00  104               123.75 24660.00   126.25 25160.00  500.00    2.03%    4195.00    20.01%  70.23%
66:BUD      75     51.5  3896.25  407 *******       64.875  4800.43   65.375  4843.95   43.52     .91%     947.70    24.32%  21.81%
67:AAPL    250    19.75  5003.13  105               44.375 11003.47       44 10910.00  -93.47    -.85%    5906.88   118.06% 410.41%
68:...     ...    .....      .00    0                  ...    .....      ...      .00     .00     .00%        .00      .00%    .00%
69:...     ...    .....      .00    0                  ...    .....      ...      .00     .00     .00%        .00      .00%    .00%
70:...     ...    .....      .00    0                  ...    .....      ...      .00     .00     .00%        .00      .00%    .00%
71:...     ...    .....      .00    0                  ...    .....      ...      .00     .00     .00%        .00      .00%    .00%
72:=================================================================================================================================
73:TOTAL                  50856.75                           62697.63          63303.93  606.30     .97%   12447.18    24.47%
74:


75:
76:CONTENTS OF                                          CONTENTS OF
77:CELLS  IN ROW 62                                     CELLS  IN ROW 73
78:
79:AD62   (AB62*AC62)+R38                               AD73      SUM(AD61:AD72)
80:
81:AE62   IF(AB62=0,0,X31-X38)                          AH73      SUM(AH61:AH72)
82:
83:AF62   IF(AE62>=365,7,0)                             AJ73      SUM(AJ61:AJ72)
84:
85:AJ62   (AI62*AB62)-W38                               AK73      SUM(AK61:AK72)
86:
87:AK62   AJ62-AH62                                     AL73      IF(AH73=0,0,(AK73/AH73)*100)
88:
89:AL62   IF(AH62=0,0,((AJ62-AH62)/AH62)*100)           AN73      SUM(AN61:AN72)
90:
91:AN62   AJ62-AD62                                     AO73      IF(AD73=0,0,((AJ73/AD73)-1)*100)
92:
93:AO62   IF(AD62=0,0,(AN62/AD62)*100)
94:
95:AQ62   IF(AE62=0,0,(AO62/AE62)*365)
96:
97:
98:CONTENTS OF
99:CELLS AO55 AND AO56
100:
101:AO55   IF(AO54=0,0,(((AO53-AO54)/AO54)*100))
102:
103:AO56   AL73
104:
```

Table 1: The Stock Tracking Worksheet

To use the worksheet the first time, enter the symbol, the number of shares, and the purchase price per share for each of your stocks into the first three columns of the table. Enter the day's date into cells AA56, AB56, and AC56. Enter today's DJIA into cell AO53, and the day before's DJIA into cell AO54. Enter yesterday's stock prices into the column labeled Today's Price, and press the exclamation mark to calculate the values on the worksheet. After the values have been calculated, move the entries in columns AI and AJ (Today's Price and Today's Value) to columns AG and AH (Yesterday's Price and Yesterday's Value). Do this by using the *SuperCalc* copy command (/C). When you are asked for the range of the cells you wish to copy, type

AI62:AJ71

When you press ENTER after the last cell address of the source range, *SuperCalc* asks for the cell address of the upper-left corner of the target range. Type AG62 , the first cell in the Yesterday's Price column, but don't press ENTER yet. Pressing ENTER transfers all the formulas in the source range, but you want to transfer only the values, so type a comma. *SuperCalc* asks if you want N (no adjust), A (ask for adjust), or V (values). To copy values only, type a V.

Now you're ready to enter today's prices into column AI and press the exclamation mark to evaluate your portfolio. Each day, when you update the table, all you have to do is enter the date, move the entries in Today's DJIA down to Yesterday's DJIA, enter the current day's DJIA, move the figures for Today's Price and Value into Yesterday's Price and Value, enter the current day's prices into the the appropriate cells, and press the exclamation mark to recalculate the worksheet. The updating procedure takes only a few moments.

The worksheet in Table 1 is changeable, so adapt it to your needs. You may want to calculate percentage distributions or compare a stock's value to certain predetermined values. Some experts, for example, recommend selling if a stock drops 10 percent. If you wish, dividends can be included and total returns (capital gains plus dividends) calculated for each stock.

Laying Out the Work Space

The work space in Table 2 is where commissions are calculated and numbers are assigned to the purchase date and to the current day's date so that the number of days between dates can be calculated.

Before laying out the work space, adjust the column widths as indicated at the top of Table 2. Copy the titles and row headings and the formulas listed at the bottom of Table 2 into the appropriate cells. Use /C to copy the list of stock symbols in column AA into column J, beginning with cell J38. Enter the purchase date for each stock into columns K, L, and M.

Days Owned

When the information in Table 2 is filled in, columns AE and AF in Table 1 will also be complete. Let's return briefly to that table to review the two simple formulas for these columns.

Column AE displays the number of days you've owned each stock. Look at the formula in cell AE62.

IF(AB62=0,0,X31-X38)

The last part, X31-X38, subtracts the purchase date number (cell X38) from the number assigned to Today's Day (X31). The IF function prevents the number for Today's Day from appearing whenever an entry is not made in a row. Instead, the IF function assigns a zero to the cell.

> Knowing the number of days since you purchased a stock can be helpful with your taxes.

With the help of an IF function and the graph format we set when we constructed Table 1, column AF sets a flag (a row of seven asterisks) if the Days Owned column value is 365 or greater. The formula that sets the asterisks in cell AF62 is

IF(AE62>=365,7,0)

This IF function asks, "Is the value in AE62 (the number of days you've owned a stock) greater than or equal to 365?" If the value is greater than or equal to 365, then the comparison is true and the first alternative of the IF function is executed. This alternative places a 7 into the cell, and the graph format converts the 7 into asterisks. If the comparison is false, the second alternative is executed and a zero is entered into the cell.

Calculating the Commission

For a better understanding of how to use the work space, look at how the commission rates are calculated. Stock commissions are made up of a combination of a flat fee and a percentage fee based on the value of the transaction. Each stock sale is subject to a minimum and maximum commission based on the number of shares traded. The commission schedule in Table 4 is for Charles Schwab and Co., Inc., the largest discount brokerage firm in the United States. Schwab's commission schedule is typical of what you would find at other brokerage houses. At Schwab the minimum commission is 8 cents per share on trades of up to 600 shares and 4 cents per share thereafter. The maximum commission, on trades of 100 shares or more, is 45 cents per share.

The easiest way to find a commission rate is to use the LOOKUP functions in this worksheet. Every LOOKUP function consists of a search argument and a range of cells that gives the location of the lookup table. The LOOKUP function in cell N38, for example, looks up the commission rate based on the value of the transaction.

LOOKUP (AB62*AC62,B10:B14)

In this formula, AB62*AC62 is the search argument and BIO:B14 is the location of the lookup table. The search argument is the value of the transaction. Check cells B10 to B14 in the lookup table in Table 3 for the search argument.

A LOOKUP function looks through a table to find the largest value that is less than or equal to the value of the search argument. After the largest value is found, the function returns the corresponding percentage value and puts it in the cell containing the LOOKUP function. In this case, the search argument is $8825 and the largest value in the lookup table less than or equal to this value is $7001. Thus, the LOOKUP function returns .003 and puts it in the appropriate cell in the Com. Rate column in Table 2. This means that for a transaction of $8825 there is a commission rate of 3 percent.

Once you've found the commission rate, you can calculate the total commission based on the value of the

```
  :   J   ::K:: L :: M ::  N ::   O   ::   P   ::   Q   ::   R   :: S ::   T   ::   U   ::   V   ::   W   ::   X   ::
21:
22:                                              COLUMN WIDTH SETTINGS
23:=====================================================================================================================
24:    9     3   5    5     6       9        9        9        9      6       9        9        9        9        9
25:=====================================================================================================================
26:          PRINT J28:X49   [CTRL]-[O]
27:          MAIN TABLE IS LOCATED AT:AA50
28:
29:                                                      WORKSPACE
30:
31:                                                                                # OF TODAY'S DAY:  2971
32:
33:                                    PURCHASE VALUES                          TODAY'S VALUES
34:                          ------------------------------------------  ----------------------------------------  # OF
35:STOCK     PURCHASE DATE  COM.    VALUE     MIN.     MAX.   CORRECT  COM.    VALUE     MIN.     MAX.   CORRECT PURCHASE
36:SYMBOL     MO  DAY YEAR  RATE    COM.      COM.     COM.     COM.   RATE    COM.      COM.     COM.     COM.      DAY
37:---------------------------------------------------------------------------------------------------------------------
38:IBM         1    4 1983  .003    83.48     8.00    45.00    45.00  .003    86.66     8.00    83.48    83.48     2930
39:CSC        10   23 1980  .003    81.75    32.00   180.00    81.75  .003    82.80    32.00   180.00    82.80     2126
40:UAL         6    7 1981  .006    58.41    10.00    56.25    56.25  .006    60.75    10.00    56.25    56.25     2353
41:DEC        12    3 1982  .003   119.63    16.00    90.00    90.00  .003   132.75    16.00    90.00    90.00     2867
42:BUD         1    3 1982  .006    59.18     6.00    33.75    33.75  .006    65.42     6.00    59.18    59.18     2564
43:AAPL       29    2 1982  .006    65.63    20.00   112.50    65.63  .003    90.00    20.00   112.50    90.00     2866
44: ...      .. ... ....     0        .00      .00      .00      .00    0        .00      .00      .00      .00        0
45: ...      .. ... ....     0        .00      .00      .00      .00    0        .00      .00      .00      .00        0
46: ...      .. ... ....     0        .00      .00      .00      .00    0        .00      .00      .00      .00        0
47: ...      .. ... ....     0        .00      .00      .00      .00    0        .00      .00      .00      .00        0
48:=====================================================================================================================
49:
50:          CONTENTS OF
51:          CELL...
52:
53:          N38     LOOKUP(AB62*AC62,B10:B14)
54:
55:          O38     LOOKUP(N38,E10:E13)+AB62*AC62*N38
56:
57:          P38     IF(AB62<600,AB62*.08,((AB62-600)*.04)+42)

59:          Q38     IF(AB62>0,AB62*.45,O38)
60:
61:          R38     IF(P38>O38,P38,IF(Q38<O38,Q38,O38))
62:
63:          S38     LOOKUP(AB62*AI62,B10:B14)
64:
65:          T38     LOOKUP(S38,E10:E13)+AB62*AI62*S38
66:
67:          U38     IF(AB62<600,AB62*.08,((AB62-600)*.04)+42)
68:
69:          V38     IF(AB62>100,AB62*.45,O38)
70:
71:          W38     IF(U38>T38,U38,IF(V38<T38,V38,T38))
72:
73:          X38     L38+LOOKUP(K38,B21:B33)+LOOKUP(M38,E21:E32)+IF(K38>2,LOOKUP(M38,H21:H32),0)
74:
75:
76:          X31     AB56+LOOKUP(AA56,B21:B33)+LOOKUP(AC56,E21:E32)+IF(AA56>2,LOOKUP(AC56,H21:H32),0)
77:
78:
```

Table 2: Calculations and Formulas for Stock Commissions

trade. Remember that each commission is made up of a flat dollar amount and a percentage of the value of the trade. Using a LOOKUP function, you can find the appropriate amount for each transaction. In Table 2 the formulas entered into column O under the heading Value Com. calculate this amount for each stock in your portfolio.

Recall that the Schwab commission schedule also specifies a minimum and maximum commission based on the number of shares traded. These commissions are figured in columns P (Min. Com.) and Q (Max. Com.). The following formula is entered in cell P38 and calculates the minimum commission for the first entry in the workspace table.

```
IF(AB62<600,AB62*0.08,((AB62-600)*0.4)+42)
```

The comparison in the IF function asks, "Is the number of shares in AB62 less than 600?" If the number of shares is less than 600, the comparison is true and the first alternative, which calculates the commission at the rate of 8 cents per share, is calculated. If the number of shares is 600 or more, the second alternative is calculated. This alternative adds $42 (the commission on 600 shares at 8 cents per share) to 4 cents times the number of shares over 600.

The maximum commission, listed in column Q under the title Max. Com., is calculated by a similar formula.

The Correct Commission

There are three commissions that might apply to the sale of a stock: the commission based on value, the minimum commission, and the maximum commmission. Use an IF function to find the correct one. The IF function entered into cell R38 is

IF(P38>O38,P38,IF(Q38<O38,Q38,O38))

In this formula O38 is the commission based on value, P38 is the minimum commission, and Q38 is the maximum commission. The comparison asks, "Is the minimum commission larger than the commission based on value?" If so, the first alternative is executed and the minimum commission is the correct commission. If the comparison is false, the second alternative is executed, in which case another IF function asks, "Is the maximum commission less than the commission based on value?" If so, this function's first alternative is executed and the maximum commission is the correct commission. If this comparison is false, the second alternative of this IF function is executed and the commission based on the transaction value is the correct value.

The work space must also calculate the various commissions that apply to each stock's current value. The formulas to do this are entered into columns S through W.

To complete this part of the work space, replicate the formulas in the first row of the table, columns N to W, down to the bottom of the table. Include enough rows to accommodate your current portfolio and, in anticipation of a bullish market, your future portfolio.

When replicating the formulas, keep all references except the ones to the locations of various lookup tables relative to their current locations. Ask *SuperCalc* to specify each reference individually, or the program will automatically make all references relative.

Days Between Dates

For tax purposes, a stock held for more than 1 year is a long-term capital asset. Gains on long-term assets are taxed at substantially lower rates than ordinary income, while long-

:	A	B	C	D	E	F	G	H	I
1:									
2:									
3:									
4:			LOOKUP TABLES FOR STOCK TRANSACTIONS						
5:									
6:		COMMISSION RATE			DOLLAR COMMISSION				
7:									
8:			COM.		COM.	$			
9:		AMOUNT	RATE		RATE	AMT.			
10:		0	0		0	0			
11:		.001	.012		.003	57			
12:		3001	.006		.006	36			
13:		7001	.003		.012	18			
14:		56001	N/A						
15:									
16:				LOOKUP TABLES FOR DAYS BETWEEN DATES					
17:									
18:	MONTHS TABLE				YEARS TABLE			YEARS TABLE	
19:									
20:	MONTH	#	DAYS		YEAR	# OF DAYS		LEAP YEARS	
21:		0	0		0	0		0	0
22:	JAN	1	0		1975	0		1975	0
23:	FEB	1	31		1976	365		1976	1
24:	MR	2	59		1977	731		1977	0
25:	APRIL	3	90		1978	1096		1978	0
26:	MAY	4	120		1979	1434		1979	0
27:	JUNE	5	151		1980	1799		1980	1
28:	JULY	6	181		1981	2165		1981	0
29:	AUG	7	212		1982	2530		1982	0
30:	SEPT	8	243		1983	2895		1983	0
31:	OCT	9	273		1984	3260		1984	1
32:	NOV	10	304		1985	3626		2062	0
33:	DEC	11	334						
34:									
35:									
36:									
37:									
38:									
39:									
40:									

Table 3: Lookup Tables

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Dollar Range Per Transaction	Commission Rates
$ 0–3000	$18 + 1.2% of principal amount
$3001–7000	$36 + 0.6% of principal amount
$7001–56,000*	$57 + 0.3% of principal amount

*Over $56,000 principal amount the commission charge is 72% below fixed rates in effect prior to 5/1/75 but not less than $225.

The above rates are subject to minimums and maximums. Minimum charge is 8 cents per share for the first 600 shares and 4 cents per share thereafter. Maximum commission is 45 cents per share for orders of 100 or more shares.

Table 4: Charles Schwab and Co., Inc., Stock Transaction Commission Schedule

term losses result in substantially less tax savings than their short-term counterparts. Consequently, knowing the number of days since you purchased a stock can be helpful with your taxes.

Before examining the formula that assigns a number to a specific date, review the numbering system in the bottom half of Table 3. The Months Table shows the numbers assigned to each month (e.g., January, 1; February, 2). Beside the month numbers are the numbers of days that have elapsed since the first of the year up to the first day of each month (e.g., February, 31; March, 59).

The value of your holdings is summarized at the bottom of the worksheet, and the portfolio's performance is compared with the change in the DJIA over the same period.

The Years Table indicates the number of days that have elapsed each year. In the example, the numbering system begins with zero on January 1, 1975. Start this part of your lookup table with the year in which you purchased your oldest stock.

Finally, to make amends for leap years, there is a leap year lookup table. Next to each year listed is a zero or a one; zeros indicate normal years and ones indicate leap years.

Once you understand the numbering system, you can examine the formula in cell X31 of Table 2 that assigns the number to Today's Day.

```
AB56+LOOKUP(AA56,B21:B33)+LOOKUP
  (AC56,E21:E32)+IF(AA56>2,LOOKUP(A
  C56,H21:H32),0)
```

This formula is made up of a series of simple LOOKUP functions. The number assigned to Today's Day is the sum of the number of the day of the month, the number of days between the first day of the current year and the first day of the current month, the number of days elapsed since the beginning of the numbering system and the first day of the current year, and the leap year adjustment.

On Your Own

The worksheet in this article uses IF and LOOKUP functions extensively and can serve as an example of how to use these functions to make other electronic worksheets. Once the worksheet is constructed, it can perform a large number of calculations quickly and easily. With a minimum of effort you can know just how well your stock portfolio is doing each day.

Use this worksheet as a starting point for your own modifications. One of the great strengths of electronic worksheets is that they can be modified to suit the user's needs. Take advantage of this flexibility to build in the comparisons you need and to omit the ones you don't need.

Then, with the help of this worksheet, just keep on trackin'.

Adapted from the forthcoming book WHAT IF...A Guide to Using Electronic Spreadsheets on the IBM Personal Computer *by Andrew T. Williams, copyright 1983, to be published by John Wiley & Sons.*

If you want a copy of this worksheet but don't feel like constructing it yourself, send your address and a check for $10 to cover the cost of a disk, postage, and handling to Andrew T. Williams, Keeping Track of Your Stocks, P.O. Box 9563, Berkeley, CA 94707. Please specify whether you would like the model in SuperCalc *or* VisiCalc *form. To use the worksheet disk you'll need your own copy of the appropriate spreadsheet program.*

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

Buy the software first.

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

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

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

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

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.

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When you do go shopping, we recommend you take a look at the PFS® Family of Software.

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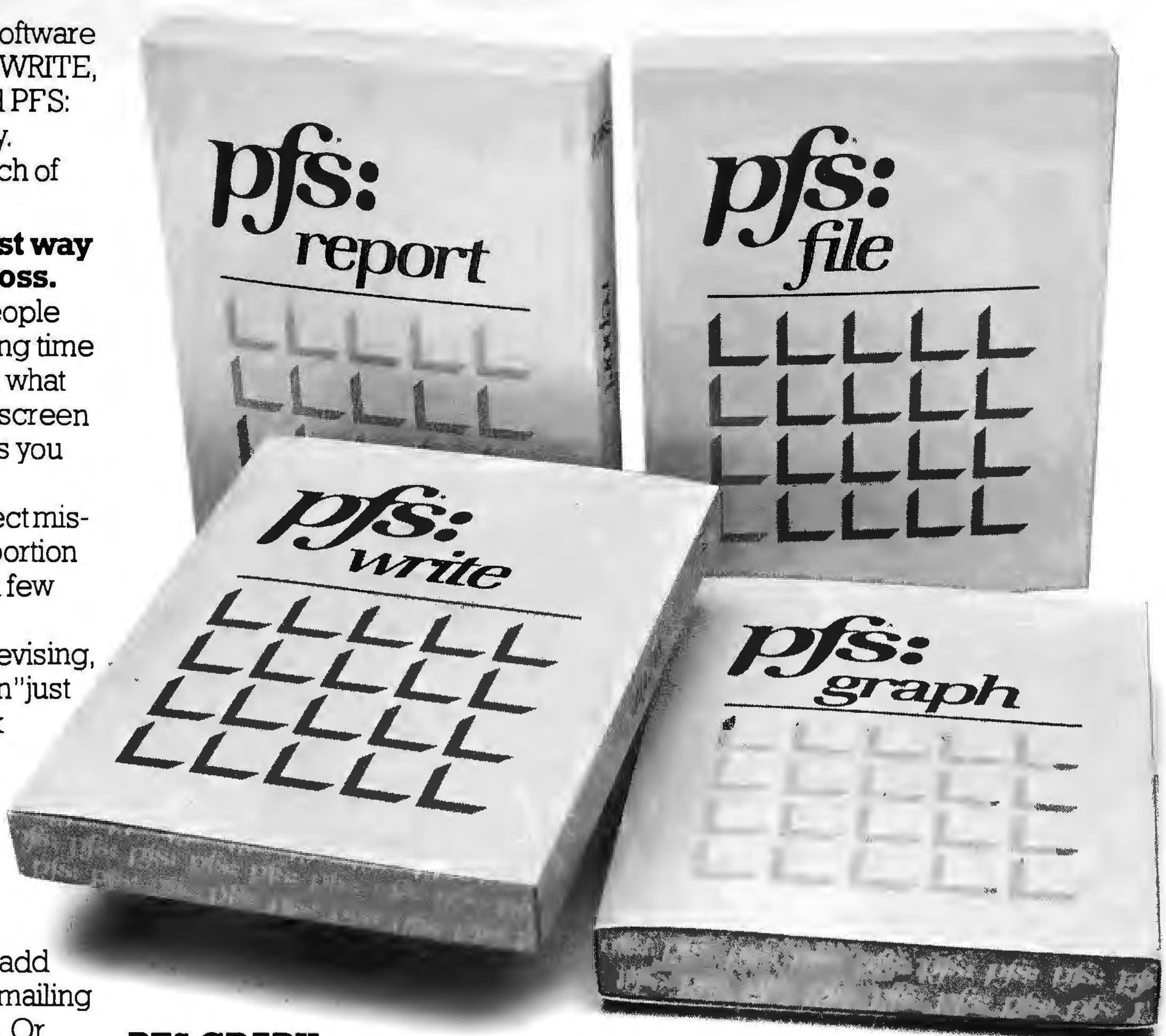

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FILE is basically a paper filing system without the paper. So you can record, file, retrieve and review information in a fraction of the time it takes with a conventional filing system.

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PFS:REPORT. The simplest way to sum it all up.

REPORT is a powerful analysis tool that works with FILE.

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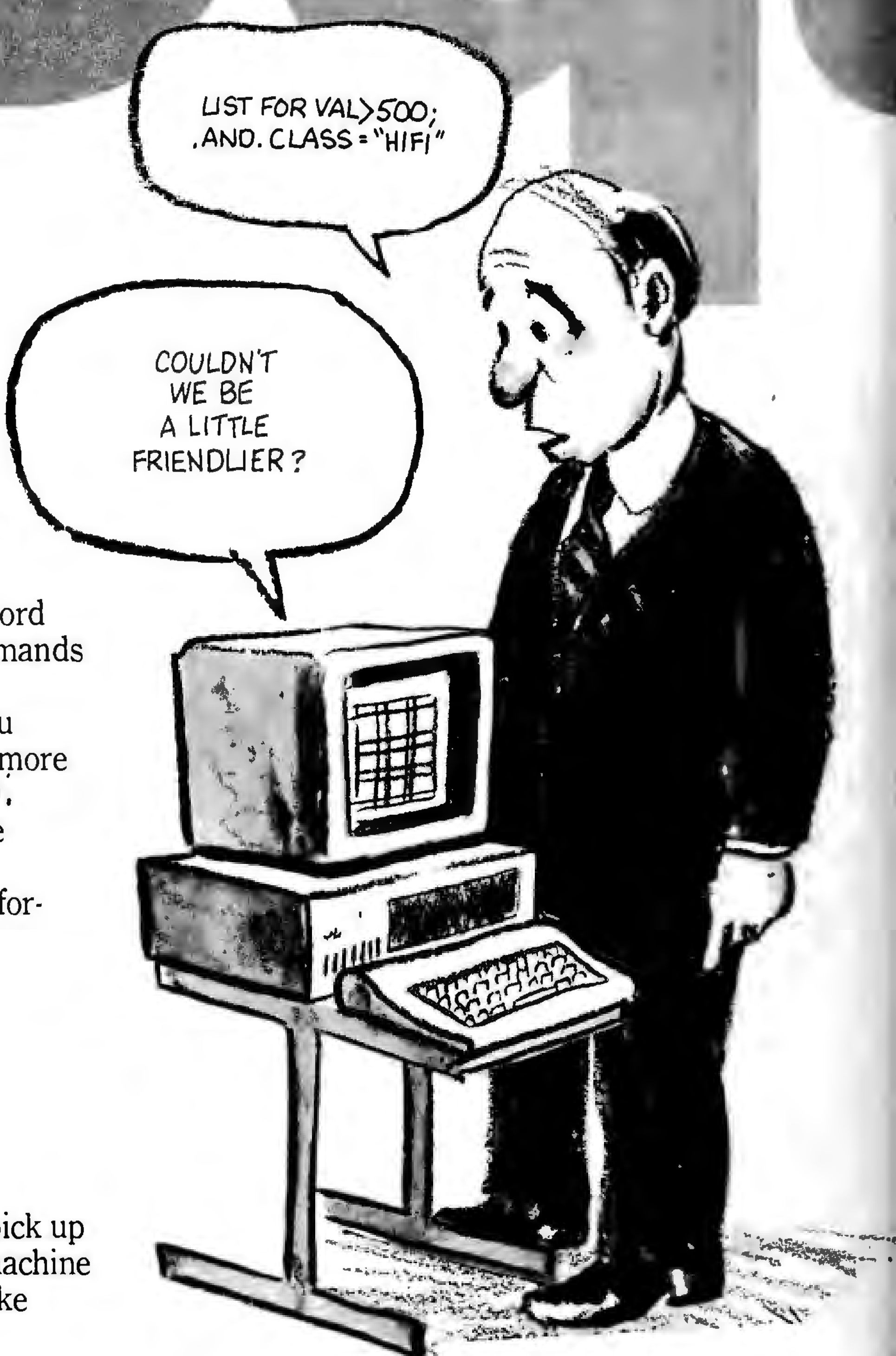

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Getting to First Base

A tutorial for beginners that explores the purposes and fundamental concepts of data base management systems

David Frankel and Michael Guttman

All organizations and most individuals have to keep track of information that must be systematically organized for easy retrieval. Most people keep track of appointments, correspondence, and personal budgets. Businesses need records of inventory, creditors, and customers.

Many software packages for the IBM Personal Computer are designed to make effective record keeping easier. These programs are called data base management systems (DBMSs) or data base managers. A data base is simply information collected on disk. A DBMS is a set of programs that organizes and provides easy access to a data base.

Before using a DBMS you need to understand basic record-keeping concepts common to both manual and computerized systems. A hypothetical example of a manual record-keeping system used in a typical small business will help illustrate these concepts.

Manual System

Imagine you are running the business office of a small retail auto parts store that does not have a computer. You maintain two sets of records: one set contains information on every parts supplier your company does business with, and the second set lists the items in your company's inventory. You keep each set of records in a separate file cabinet drawer.

The set of supplier records is made up of folders, each of which contains information on a different supplier. Each folder contains the supplier's name, street address, city, state, and zip code. You label the folders with the suppliers' names and arrange them alphabetically.

The set of inventory records has one folder for each inventory item. Each folder contains the stock number used to identify the item, a title or description of the item, the quantity in stock, the quantity on order, the cost, the list price, and the supplier's name. The folder label lists the stock number, so you arrange the folders in numerical order.

DBMS Terminology

The manual record-keeping system just described makes understanding standard data base terminology easier. In the office, each set of records is contained in one file drawer; in a data base, each set of records is called a *file*. In this case you have a supplier file and an inventory file.

Each folder in a file drawer is represented in the data base by one *record* in a file. For example, the folder labeled Amalgamated Auto Supplies might be one of many records in the supplier file. The information in this record pertains solely to this supplier. Similarly, each data base record in the inventory file represents a folder with information regarding a particular inventory item.

In a data base the categories of information in each record are called *fields*. The list of fields for a file defines the structure for every record in the file. In other words, each record in a data base file has the same fields and uses the same field names. For example, each record in the supplier file includes the fields for name, street address, city, state, and zip code. The fields for each record in the inventory file are stock number, title, quantity in stock, quantity on order, cost, list price, and supplier's name. Figure 1 illustrates the hierarchy of files, records, and fields.

One field in each file plays a special role. The purpose of this field, called the *unique key*, is to unambiguously identify each record. The unique key for the supplier file is the supplier's name, because each supplier will probably have a different name. The unique key for the inventory file is the stock number, because only this field precisely identifies each record.

Related Files

A DBMS avoids repeating the same information in two different files whenever possible. Instead, files are related so that you can refer to a secondary file when you require further information on a field in the first file. Although the simplest DBMS software does not allow you to define relationships among files, we will assume the use of a slightly more sophisticated package as we continue with the office example to explain how this feature works.

An inventory record contains the field for a supplier's name, but the rest of the information about that supplier is in a record in the supplier file. Because the unique key for the supplier file (supplier's name) is included as a field in the inventory file, the inventory file is said to be related to the supplier file.

> A DBMS is a set of programs that organizes and provides easy access to a data base.

Suppose you decide to keep a file of all inventory item purchases. You create a purchases file that contains a record for each purchase. Each record shows the purchase number, the stock number, the quantity purchased, and the date purchased. In this file the purchase number is the unique key.

The purchases record does not have to contain information about the purchased inventory item (price, supplier's name, etc.) as long as it does contain the stock number of the inventory item. Remember, the stock number is the unique key for the inventory file, so you can use the purchases file to call on the inventory file if you need more information about an item. Figure 2 illustrates how the supplier file, the inventory file, and the purchases file are related.

Unique keys are very important in a system that uses related files. If an inventory record contained only the supplier's zip code instead of the supplier's name, the system could not precisely identify the supplier when looking at that record because many suppliers may have the same zip code. Without precise identification of a particular supplier you could not refer to the supplier file for further information.

A DBMS that uses related files performs a number of other special functions. For example, in the parts store when you enter a stock number into a record in the purchases file, the DBMS instantly determines whether a record in the inventory file has that stock number as its unique key. If the number entered is not found in the inventory file, a screen message appears to that effect and you have to enter the correct number. If the DBMS finds the stock number in the inventory file, other information, such as the description of the item, can be displayed on the screen.

Types of Files

The purchases file differs in some important respects from the supplier and inventory files. The purchases file contains data relating to business transactions. The supplier and inventory files contain background information useful to the organization. New records are added to the purchases file whenever a purchase is made, which may be several times per day. In contrast, new records are added to the supplier file infrequently—only when the company does business with a new supplier. Similarly, you would create a new record for an inventory file only when the company stocked a new item.

Although new records are frequently added to the purchases file, existing records are rarely altered. The information about a purchase would change only if the original entry contained an error. On the other hand, records in the inventory and supplier files change all the time. You must alter inventory records when the cost, the list price, the quantity in stock, or the quantity on order changes for an item. Whenever a supplier has a change of address you alter the supplier record.

A *master file* is a type of file that contains background information and has new records added to it infrequently, but whose existing records need to be revised routinely. The supplier and inventory files are master files. A *transaction file* is a file like the purchases file, which contains information about business transactions and has new records added to it frequently, but which has records that rarely change. A transaction file is almost always related to at least one other file, whereas master files are often not related to any other files.

Using a DBMS

In using almost any DBMS, whether simple or sophisticated, the first step is to define the files. You then define the fields contained in the file records. The DBMS prompts you to supply these specifications. To define a file you enter a title for the file, the maximum number of records for the file, and the total number of fields.

To define each field, you enter a title, the type, and the maximum length. The title is an identifying name for the field, such as address or stock number. The most common types of fields are numeric, character, logical, and date. A numeric field contains only numeric data, such as quantity or price. A character field, also called an alphanumeric field, may hold any characters, whether they are numbers, letters, or other symbols. One example is an address field. A logical field may be used whenever a simple yes or no answer is sufficient. The field type is important because the DBMS stores each type of data differently.

Specifying the length of a field means choosing the number of digits (whether letters or numbers) the field can hold. To specify the maximum length of a field, decide what the largest piece of data will be for any record in the file. For example, if no address will ever exceed 40 characters for any supplier record, then the

One field in each file plays a special role.

maximum length of the address field should be 40. If you will never keep more than 200 of any inventory item in stock, then the maximum length for the quantity in the stock field should be 3. A maximum length of 3 allows for a quantity up to 999. A quantity larger than 999 requires a field length of 4 digits or more. Careful choice of field lengths will result in the most efficient use of disk space. You don't need to specify the maximum length for the date field because it is always the same.

To finish defining the files, indicate the unique key field for each file. Figure 3 shows typical prompts and responses for defining the attributes of a file.

Data Entry

Once you define the files and fields, you can enter information into the files. When you select the data entry function, the DBMS prompts you to enter the name of the file that will hold the data. After the video screen clears, a new screen will appear that lists the titles of all the fields in that file. Next to each field title is a space, marked by beginning and closing brackets, for entering data. Figure 4 shows a sample data entry screen for the supplier file.

As part of the data entry function you may choose to enter new records or to list (display), edit, or delete an existing record. If you are entering a new record, the cursor moves to the beginning of the space next to the name of the first field. After typing in the data for the first field, you press ENTER and the cursor moves to the beginning of the space next to the name of the second field. When you

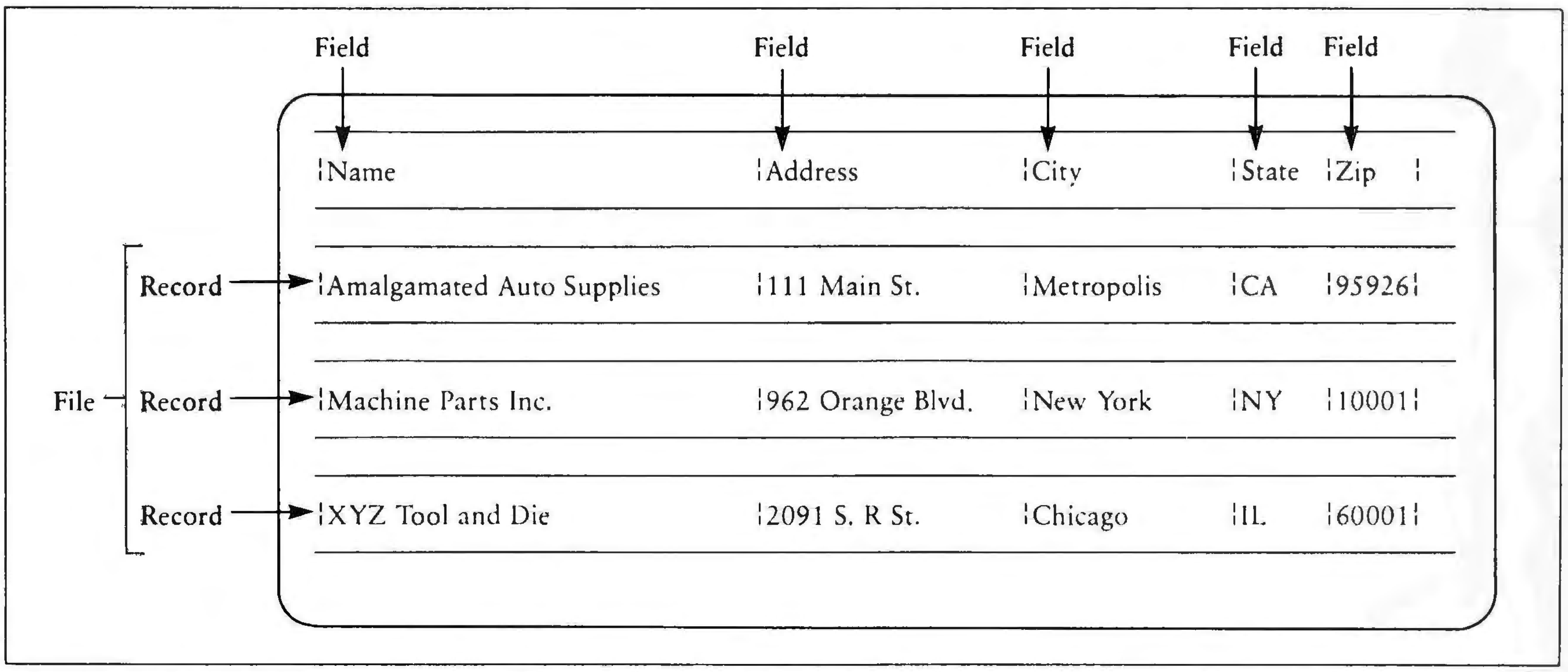

Figure 1: Fields, Records, and Files. The fields define the structure for each record in a file. A file consists of records that conform to the structure defined by the fields.

have entered information for each of the fields, one record for the file is complete. The spaces for entering data are then cleared and you repeat the process for the next record. Pressing a designated function key indicates that you will not enter any more records at that time.

For each field the DBMS checks that the data entered conforms to the field type. For example, if 'Amalgamated Auto Supplies' is entered for the zip code, a screen message tells you that the zip code is a numeric field. You then have the opportunity to reenter the zip code.

If you choose the list option for an existing record, the cursor moves to the unique key field. You enter the information that identifies the record you want to see. To display the supplier file, for example, you enter the name of a supplier. If the DBMS finds the record you've asked for, the information appears in the spaces next to the field names. A screen message informs you if the DBMS does not find the record.

If you choose to edit the record, a designated function key moves the cursor to the field you want to change. After entering the new information, you move the cursor to the next field you want to edit. Pressing a function key indicates the editing is complete.

If you select the delete option, a screen prompt asks you to confirm this request. The record is then removed from the file.

Think of the data entry screen as an electronic business form. When entering data you are essentially filling out a form on the screen. A well-designed DBMS should make data entry easy and efficient.

Reports

The DBMS functions described so far would be of little use unless you could easily get an overview of the information you've collected. A report is an overview of a selected portion of data.

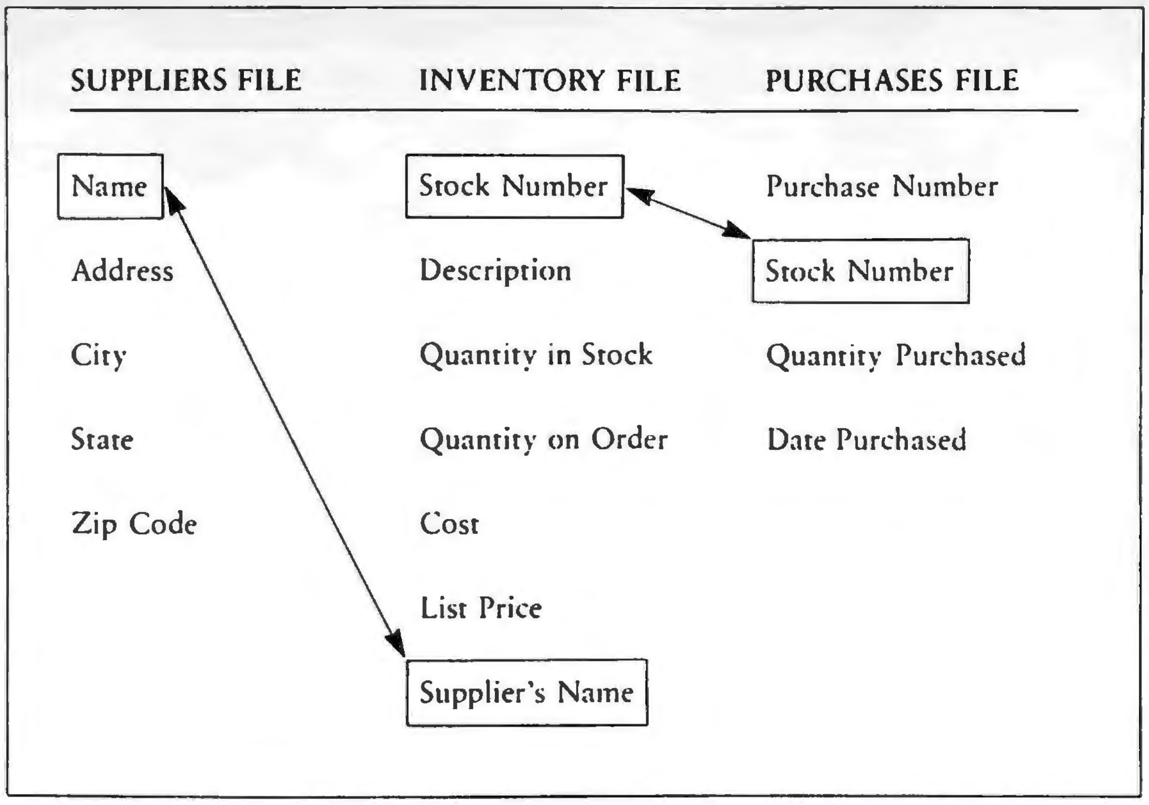

Figure 2: Related Files

```
ENTER FILE NAME          : SUPPLIER FILE
MAXIMUM NO. OF
  RECORDS                : 150
NO. OF FIELDS            : 5

FIELD #1
  TITLE                  : NAME
  TYPE                   : CHARACTER
  MAXIMUM LENGTH         : 25
FIELD #2
  TITLE                  : ADDRESS
  TYPE                   : CHARACTER
  MAXIMUM LENGTH         : 15
FIELD #3
  TITLE                  : CITY
  TYPE                   : CHARACTER
  MAXIMUM LENGTH         : 13
FIELD #4
  TITLE                  : STATE
  TYPE                   : CHARACTER
  MAXIMUM LENGTH         : 2
FIELD #5
  TITLE                  : ZIPCODE
  TYPE                   : NUMERIC
  MAXIMUM LENGTH         : 5

WHICH FIELD IS THE UNIQUE KEY? 1
```

Figure 3: Defining a File for the DBMS

Hands On

Reports can be either displayed on the screen or printed out. The DBMS allows you to specify the portion of the data you want for the report and the format in which you want it to appear. A screen prompt asks you to give the report a title and to supply the name of the file you wish to view.

You may specify the order in which the records appear on the report by designating a field as the *sort key*. For example, you may want a report from the supplier file that orders the records according to zip code. In this case the zip code would be the sort key. The sort key may be the unique key or another field. You may request that totals for numeric fields appear at the end of the report. Once you have defined the report format, the report can be recalled by name at any time to display or print out the current contents of the file.

> The most common types of fields are numeric, character, logical, and date.

A *master list* is a common type of report that shows the records contained in a master file. The master list is divided into columns, one column for each field. The names of the fields appear above the columns at the top of the page. Each horizontal line on the report represents one record. Figure 5 shows a sample master list of the supplier file that is in alphabetical order by supplier name (the sort key is the unique key in this case).

Another type of report is a transaction log. This report shows the records in a transaction file in much the same way that a master list shows the records in a master file. Figure 6 shows a sample transaction log for the purchases file. The records are ordered by date (sort key) and a total appears at the bottom of the quantity purchased column.

```
                    SUPPLIER FILE

NAME      : AMALGAMATED AUTO SUPPLIES
ADDRESS   : 111 MAIN ST.
CITY      : METROPOLIS
STATE     : CA
ZIPCODE   : 95926

1) ENTER NEW RECORDS
2) LIST RECORD
3) EDIT RECORD
4) DELETE RECORD

ENTER OPTION NUMBER: 1
```

Figure 4: Sample Data Entry Screen for Supplier File

Other Features

In addition to defining related files, sophisticated DBMSs include the following features.

Index file. A simple DBMS can produce a master list of an inventory file ordered by stock number, by description, or by any other field. To do this, however, the DBMS must perform a time-consuming sorting procedure.

Some DBMSs have an indexing feature that avoids this delay. An index file is an auxiliary file that specifies the order of the records in the main file. The *index key* is the field from the main file that you select to determine this order.

The index key doesn't have to be the unique key. For example, a transaction log of purchases could be ordered by date, which is not the unique key for purchases records. Every time a new record is added to the main file, the index file is immediately updated. When you request a report to display or print the records

SUPPLIERS MASTER LIST
JOHNSON'S AUTO SUPPLIES
3/1/83

NAME	ADDRESS	CITY	STATE	ZIP CODE
AMALGAMATED AUTO SUPPLIES	111 MAIN ST.	METROPOLIS	CA	95926
MACHINE PARTS INC.	962 ORANGE ST.	NEW YORK	NY	10001
PRECISION PARTS CO.	8976 BROADWAY	LOS ANGELES	CA	90001
SUPERIOR ELECTRIC MOTORS	1007 91ST ST.	SAN FRANCISCO	CA	94001
TECHNOLOGICAL MACHINE CO.	14 JASPER AVE.	BROOKLYN	NY	11001
XYZ TOOL AND DIE	2091 SO. R ST.	CHICAGO	IL	60001

Figure 5: Supplier File Master List

in a particular order, the index file produces the report without any sorting delay.

A DBMS may also allow more than one index file for a main file. Several fields can serve as index keys so that a file can be reported in a variety of orders, all without sorting.

Electronic form. An advanced DBMS allows great flexibility in designing an electronic form for data entry. You can create this form using a word processor. The field names, along with the spaces for entering the data, can be placed anywhere on the screen. You can include instructions and borders as well. Data may be entered into many files on the same screen. Figure 7 shows an example of a complex electronic form.

Report functions. In generating reports, a DBMS can do subtotals, show totals and subtotals without displaying individual records, select subsets of a file for reporting, produce counts of the number of records that fall into certain categories, and perform arithmetic on numeric fields, such as multiplying cost by quantity purchased to produce an extended price column on the report.

A DBMS can also locate information on related files via unique keys when producing reports. For example, a transaction log for the purchases file could display an item description from the inventory file for every purchase.

Updating files. Some DBMSs provide means other than direct data entry for updating the information in files. Returning to the office example, you might want a field in the supplier file called total purchased. This field records the total dollar value of all purchases made from each supplier. Upon entry of each record to the purchases file, an advanced DBMS can calculate the dollar value of the sale and add that amount to the total purchased field in the correct supplier record. To calculate the dollar value of the sale, the DBMS multiplies the

PURCHASES LOG
JOHNSON'S AUTO SUPPLIES

PURCHASE NO.	STOCK NO.	QUANTITY PURCHASED	DATE PURCHASED
1001	191	30	3/1/83
1002	2806	10	3/1/83
1003	1561	15	3/1/83
1004	2902	25	3/2/83
1005	1798	25	3/2/83
1006	909	20	3/3/83
1007	887	10	3/3/83
1008	1172	30	3/3/83
1009	2135	20	3/3/83
1010	1986	15	3/4/83
1011	540	20	3/4/83

TOTALS 220

Figure 6: Transaction Log for Purchases File

```
                    INVOICES ENTRY

                     **INVOICE**

INVOICE NO.       |      |
CUSTOMER NO.      |      |      NAME |                  |
DATE              |        |
TOTAL AMOUNT      |          |
---------------------------------------------------------
                    **LINE ITEM**

INVENTORY STOCK NO. |      |
  DESCRIPTION       |                |
  PRICE PER UNIT    |        |
QUANTITY SHIPPED    |     |  QUANTITY BACKORDERED |    |
EXTENDED PRICE      |        |
```

Figure 7: Complex Electronic Business Form

JOHNSON'S AUTO SUPPLIES
MAIN MENU

1) SUPPLIER FILE DATA ENTRY
2) INVENTORY FILE DATA ENTRY
3) PURCHASES FILE DATA ENTRY
4) SUPPLIER FILE MASTER LIST
5) INVENTORY FILE MASTER LIST
6) PURCHASES FILE LOG

ENTER SELECTION NUMBER: 3

Figure 8: Menu

quantity purchased data from the purchases record by the item cost contained in the inventory record.

Menus. Some DBMS systems allow you to construct menus of frequently used procedures. For each option on a menu you specify the wording and the function that is performed when that option is selected. Instead of having to enter several DBMS commands, you choose one menu option to perform the desired procedure.

> Think of the data entry screen as an electronic business form.

For example, a simple DBMS might require that you call the data entry program first and then specify the file that will contain the data. These two steps could be performed automatically with a menu. Figure 8 shows a sample menu. By choosing option 3 you can call the data entry program and the purchases file in one step. A menu allows anyone to operate a DBMS, even if they don't know the DBMS commands or how to define files and fields.

The Changeover

Before the advent of the personal computer, DBMS packages were tools available only to the software houses that developed them. Using a DBMS enabled programmers to produce custom software more efficiently for their clients. Often these DBMSs were not well integrated and lacked documentation.

Eventually, some software houses realized that general-purpose DBMS programs, carefully integrated and properly documented, were marketable products. These DBMS packages were sold mostly to other software houses or to corporate data processing departments. IBM developed a line of DBMS products for its mainframe computers.

After the personal computer appeared on the scene, DBMS products became available to everyone. Today these products range from simple, inexpensive packages to more sophisticated, costly models. The right one for you depends on your computer experience, your budget, and what you want a DBMS to accomplish (see "The DBMS Match Game"). With a general understanding of DBMS features and capabilities, you're better prepared to make the changeover from manual to computerized data management.

David Frankel and Michael Guttman are freelance software developers based in Chico, California, who also teach computer courses.

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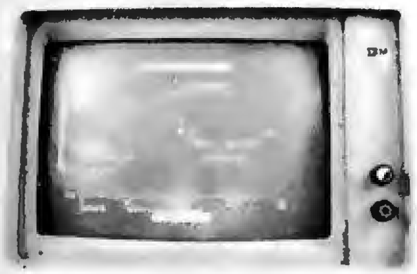
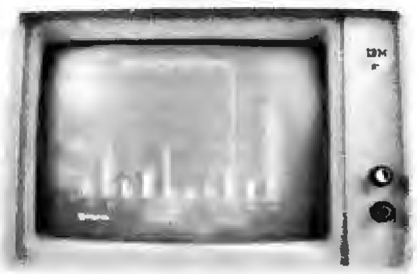
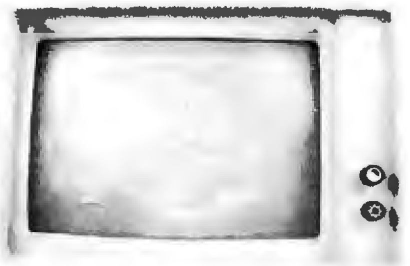


CURVE FITTING



BAR GRAPHS



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The DBMS Match Game

Some hints on matching your needs with the right data base management system

David Kruglinski

My phone rings for the twentieth time.

"Hi, I'm desperate. How do I get my Microsoft parallel parking simulator out of Van mode?"

"Are you one of our customers?"

"No, but I saw your ad in the yellow pages."

"Sorry, but you'll have to call the guy you copied the program from. Try turning off the power. Good luck."

The twenty-first call.

"Hi, I just bought a copy of your book *Data Base Management Systems, A Guide to Microcomputer Software*. I really like the book, but tell me, what is the best data base management system?"

"Give me your Visa number and I'll tell you."

As you would expect, the last caller's question is comparable to "What's the best microcomputer?" If you already own a data base management system (DBMS) or a microcomputer, the answer is "The one I bought," but otherwise, there is no easy answer. For both DBMSs and microcomputers, the best choice depends on three things: your skills and aptitude, what you need or want to do, and how much money you are willing to spend.

From conversations with first-time users, software developers, and everyone in between, I've been able to classify users as subjectively as I've been able to classify DBMSs. Undoubtedly you will be able to fit all your associates into one of these groups, but not yourself.

Anyway, here's a crash course in data base theory. If you need more, you know which book to buy. (Also see "Getting to First Base" in this issue for an introduction to basic data base concepts.)

A data base is a collection of data on disk, organized to provide easy access by people and by computer programs. A DBMS is a set of programs controlling access to the data base. These definitions are sufficiently broad to cover all packages that are called DBMSs, from simple file managers to sophisticated applications development tools.

The DBMS Family

The simplest DBMS is a file management system (FMS), one that stores data in individual disk files composed of records and fields. In contrast to ordinary disk BASIC data files, FMS files have extra information attached. This includes a description of each field (data dictionary) and one or more indexes that keep the file in order by key fields.

FMS programs allow effective use of the video terminal for data entry, sometimes permitting design of forms directly on the screen. All FMSs provide a report generator for organized printed output. The fancier FMSs provide multifile capability, allowing simultaneous access to data in more than one file.

The relational data base management system (RDBMS) goes one step beyond the FMS. It is based on mainframe DBMS theory, in which the file is replaced by a mathematical concept called a relation. A relation is really a table with horizontal rows corresponding to records and columns corresponding to fields. Operations are performed on these relations, or tables, according to mathematical rules, producing new relations useful in data base management.

The important point is that relationships between fields and files are not inherent in the data base, but are defined only when you use commands to access the data base. For example, assume that you have two relations, one with records representing your employees and another with records representing known computer criminals. If there is a common field for social security number, a simple Join operation will show which of your employees to keep an eye on. In general, single commands operate on entire relations at a time, rather than on individual records.

The network/hierarchical data base management system (NDBMS) is a breed apart, with parents in the mainframe world. It's probably the most powerful, the most difficult to use, the most expensive, and, consequently, the rarest DBMS. Only one NDBMS package worthy of the name is currently on the market for the IBM Personal Computer: *MDBS III* distributed by International Software Enterprises. More are on the way, however, notably from the mainframe software companies.

Ordinary data base features such as field length definition and alphanumeric type common to all DBMSs are discussed in "Getting to First Base." One feature, language interface, is not. Some DBMSs have no language at all (which makes them nonprogrammable), others have their own built-in language, and still others link to established languages such as BASIC, Pascal, or COBOL. Using a DBMS with a language interface is a distinct advantage; the DBMS will then perform functions such as formatting a report or a data entry screen in a unique and useful manner.

Home users need low-cost, easy-to-use DBMS packages.

Also consider whether you need a DBMS to be menu driven or command driven. Menu-driven systems are easier to learn, but later become tedious to use. Commands, on the other hand, are more concise and flexible but are more difficult to learn. Most command-driven systems, however, allow you to create menus to assist less experienced users.

The User Society

Identifying user needs is an essential part of evaluating the suitability of a DBMS. I've defined four user categories to facilitate this purpose.

Individuals with PCs at home. The personal computer was made for those who work at home. Because there are many more homes than offices, home users represent a mass market well served by software marketeers. Home users need low-cost, easy-to-use DBMS packages that are generally single-file, menu-driven, no-language FMSs. One package is available for $35, at one-twentieth the cost of the popular RDBMS, *dBASE II*.

Most low-cost DBMS packages have a data dictionary that defines a series of fixed-length fields. Screen layout, data entry, querying, sorting, reporting, and sometimes indexing functions are included. Some packages, such as *VisiDex* by VisiCorp, depart from this model by storing text with keyed access, which is similar to an index card system.

Home users usually don't have massive amounts of data to worry about, contenting themselves with Christmas lists, phonograph record catalogs, and the like. DBMSs often support hobbies such as coin collecting, animal breeding, and sports statistics— anything that requires the organization of more than about 50 similar items.

As for hardware, two 320K disk drives are the minimum needed for meaningful data base management. Even though you may calculate a low number for quantity of records times record size, that's not the whole story. Often you'll need disk space for work files, backups, indexes, and Murphy's Law.

As a home computer user you are not likely to hire a consultant if you have a problem, so be sure that either your dealer or the software publisher is available for questions. Better yet, make sure you can understand the DBMS user manual.

Small-business owners and volunteer committees. For this group of people the PC may be the only computer used. Strict budgets require that the PC pay for itself; the benefits of using a DBMS make the PC a more worthwhile investment. Because software is a tax-deductible business expense, more money is usually available for a costlier DBMS package than when buying one for home use. In considering a DBMS for business purposes remember that the data volume is higher than for home use, and relating data from multiple files is often necessary.

As an example of a typical user in this group, imagine a restaurant that serves about 1000 banquets per year. The management needs a record of each banquet, mostly to remind regular customers to return. In addition, statistics on room utilization, average number of guests served, and average check amount should be available. The old manual system kept banquet data on a form with entries for: customer name, customer address, banquet date, room number, number of guests, items on the menu, and total check.

The DBMS automates the restaurant's record-keeping by defining a field for each of the entries and allowing for retrieval, sorting, and reporting of data. A single-file system is adequate, but if there are sufficient repeat customers, a separate customer file is necessary.

An FMS can handle this simple application, but if the restaurant management wants to expand the system to handle accounts receivable, the DBMS should have language (programming) capabilities. Ashton-Tate's *dBASE II* would do well here, but would require either *Quickcode,* a program generator for *dBASE II,* or programming to format the data entry screens. *DataStar* by MicroPro would also work by providing direct multifile lookup so that special programming isn't necessary.

The restaurant system is a typical DBMS application; however, if you need an integrated accounting system, it's best just to buy one. A new alternative is to buy a DBMS that comes with a built-in accounting system. You can then modify the accounting system as required, add new modules such as payroll or inventory, and create new reports. *Sensible Solution* by O'Hanlon Computer Systems in Bellevue, Washington, is a welcome first attempt.

Concerning hardware for this group's needs, high data volume and the "time is money" effect often dictate the use of a hard disk and a printer that is faster than an Epson MX-80.

If you are a one-person company, then you have to be the DBMS programmer. If the organization is larger, the "Hal Effect" takes over. This effect is not named for the HAL in *2001: A Space Odyssey,* but for Hal Glatzer, the book author who discovered it. The Hal Effect says that in every organization there is at least one person with a remarkable aptitude for learning about computers. That person should be sought out to develop the DBMS.

Large-company management. In this situation the PC is not the only computer used. There is a mainframe or minicomputer that does the "real work" and a data processing (DP) department jealously guarding its turf. The PC is classified as an executive work station dedicated to electronic spreadsheet work or to some special application such as executive payroll. If a large volume of data requires processing, the DP department usually takes care of it.

The latest trend in PC software is the integration of the DBMS function (and graphics) into the spreadsheet. Context Management's *MBA* and Lotus Development's *1-2-3* are two examples of integrated programs. Unfortunately, the DBMS capabilities of these programs are less than those of stand-alone DBMSs, but I'm sure that situation will change. Meanwhile, using either a DBMS/spreadsheet program such as *1-2-3* or a non-programmable DBMS will solve almost any data management problem. If an executive takes on a language-driven DBMS, he or she may spend far more time programming than managing.

Software developers. Mainframe DBMSs were originally developed to aid programmers. Many mini/mainframe applications software systems have been built using NDBMS-style packages. With few exceptions, microcomputer DBMSs haven't been around long enough to spawn successful, proven applications packages.

One of those exceptions, *Solomon Series Software* from Computech, Inc. of Frazer, Pennsylvania, uses the NDBMS *MDBS III,* which has proven successful as an 8-bit package for over a year. It will shortly be released to run on the PC. *The Champion* from Data Base Research in Lakewood, Colorado, is a newly released accounting package written in *dBASE II.* The fact that this package took four person-years to produce illustrates that a DBMS doesn't necessarily make instant software. By using *The Champion* with *dBASE II,* you can produce additional modules tailored to your needs. The source code (original program code that can be modified) is scheduled to be released sometime next year.

The *Sensible Solution* DBMS with optional accounting system from O'Hanlon does offer source code, however. The authors claim that their source code is 1/12 the volume of the BASIC source in a predecessor system, making it that much easier to work with. A centralized data dictionary brings this system closer to the DBMS ideal of total shared data usage, in which all modules (accounts receivable, payroll, inventory, etc.) can automatically access the central data base.

Mainframe DBMSs are oriented to multiuser applications. The addition of multiuser hardware options to the PC should spur the development of applications packages for the PC that will use these DBMSs.

The twenty-second ring.

"My computer won't work."

"Switch the printer on line."

"Thanks."

David Kruglinski is president of a Seattle-based company that distributes data base management software for business applications.

Data Base Management Systems, A Guide to Microcomputer Software
David Kruglinski
(OSBORNE/McGraw-Hill, Berkeley, 1983)
260 pages; $16.95

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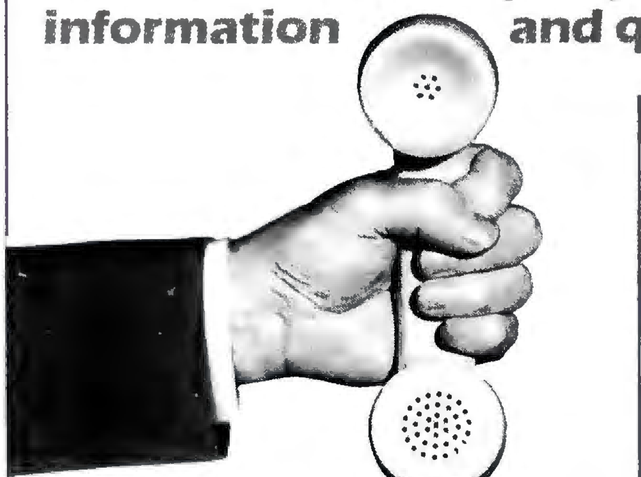

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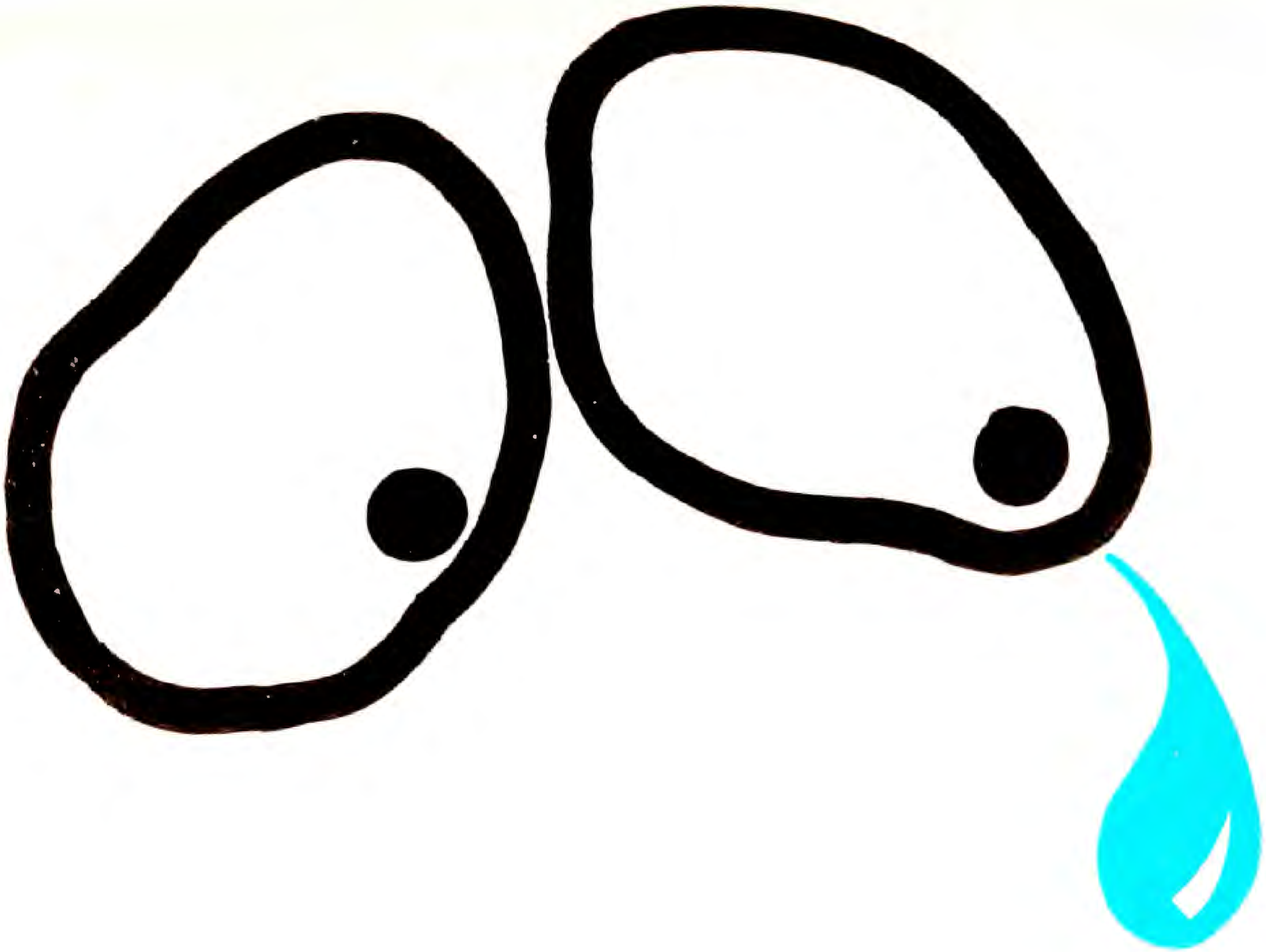

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Graphics in Motion

Learn the BASIC tools for animating simple figures.

Dan Illowsky and Michael Abrash

Drawing points, lines, and figures is easy to do on the IBM Personal Computer, as shown in our previous graphics articles (see issues 2 and 3). But like a hammer, nails, and wood, these drawings are only the tools needed to build something even more useful. With the IBM BASIC commands BSAVE and BLOAD you can save an entire screen to, and restore it from, a disk file, helping to create graphics slide presentations. With the PUT and GET commands, you can move the simple figures you've learned to draw around the screen quickly enough for use in video games.

Saving the Screen

Saving an image to disk requires having a figure on screen to save, so draw two concentric circles with CIRCLE (160,100), 50,2 and CIRCLE (160,100), 30, 1

Save the screen in medium- or high-resolution graphics mode with the BSAVE command

```
DEF SEG = &HB800:BSAVE "FILENAME.
  TYP",0,&H4000
```

where 'FILENAME.TYP' is any valid file name you want. If there's enough space on the disk, the screen is contained in a 16K file called 'FILENAME.TYP'. To save the screen in text mode, enter the command

DEF SEG = &HB800:BSAVE "FILENAME.TYP",0,*scrlen*

In this command *scrlen* is &H1000 in 80-by-25 text mode and creates a 4K file; in 40-by-25 text mode *scrlen* is &H0800 and creates a 2K file. To save the monochrome screen into a 4K file, issue the command

```
DEF SEG = &HB000:BSAVE
  "FILENAME.TYP",0,&H1000
```

Animation using the PSET command with the PSET option

Restoring the Screen

Once a file has been created with BSAVE, the screen may be restored within seconds using the BLOAD command

```
DEF SEG = &HB800:BLOAD "FILENAME.TYP"
```

where 'FILENAME.TYP' is the name of the file created with BSAVE. The screen must be in the same mode (text, medium resolution, or high resolution) it was in when the file was created, and, in medium-resolution mode, the palette selection must be the same as the original screen's. The screen takes several seconds to be completed with BLOAD because of the time needed to read 16K of memory from the relatively slow floppy disks.

To restore the monochrome screen, issue the command

```
DEF SEG = &HB000:BLOAD "FILENAME.TYP"
```

Run the program in Listing 1 to create a screen image, save that image to disk, clear the screen, and then load the saved file back onto the screen.

The IBM BASIC manual is a good resource if you have any questions about the BSAVE and BLOAD commands.

Animation from BASIC

The graphics commands discussed so far have speed limitations that make them impossible to use directly for the kind of rapid drawing needed for animation. What's needed is a command that stores an image in a BASIC memory variable and another command that puts the image back onto the screen. GET and PUT are just these commands.

The GET statement transfers a rectangular area of the screen into an array. The statement is in the form

GET (*x1,y1*)- (*x2,y2*),*arrayname*

where *x1*, *y1*, *x2*, and *y2* are the coordinates of opposite corners of the rectangular area and *arrayname* is the array into which the contents of that area of the screen are to be put. The coordinates may be absolute or relative, but all these parameters are required.

The array may be of any numeric data type, but it is easiest to use arrays of type INTEGER. For INTEGER arrays the formula is

INT((*x*/8) + 1)*y* + 2

where *x* = *x2*- + 1 and *y* = *y2*- + 1. This formula will roughly calculate the required size of the array in medium-resolution mode, while leaving a little extra space. In high-resolution mode, the formula

INT((*x*/16) + 1)*y* + 2

allows adequate space in the array for the image you are GETting.

For example, if we were to execute

GET (10,10)-(19,29),PIC1

in medium-resolution mode, the integer array PIC1 would have to be dimensioned to INT((10/8) + 1) 20 + 2 = 42 elements using the statement DIM PIC1(42) . The GET command section of the BASIC manual describes the method for calculating the exact minimum allowable size of the array, but unless you're running out of memory, it's best to make a rough estimate.

If the array is too small to hold the image, or if the GET command references a point off the screen, an 'Illegal Function Call' error results when the GET is performed.

PUT is the companion command to GET but is not strictly GET's re-

> The PRESET, OR, and AND options have few practical applications and often result in undesirable color effects.

verse. In fact, there are five ways in which the image may be PUT into the screen and each has a different application.

The PUT statement is

PUT (*x1,y1*),*arrayname,action*

Coordinates *x1* and *y1* define where the upper left corner of the image will be placed, *arrayname* is the array in which the image has been saved, and *action*, the only optional parameter, selects one of the five ways in which the image may be put onto the screen. Valid values for *action* are PSET, PRESET, XOR, OR, and AND, with XOR the default if no value for action is selected.

The last point referenced is (*x1,y1*), and the coordinates may be specified in either absolute or relative terms. Like GET, an 'Illegal Function Call' error results if PUT references a point off screen.

The Five PUT Options

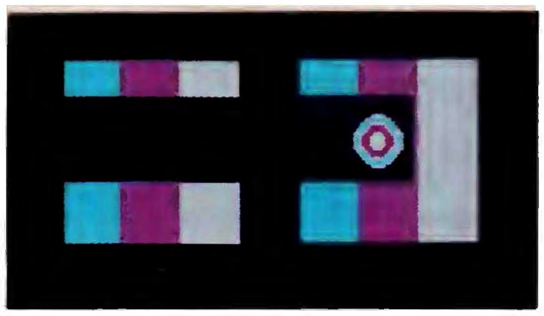
The most useful of the five PUT options are PSET and XOR. The PRESET, OR, and AND options have few practical applications and often result in undesirable color effects.

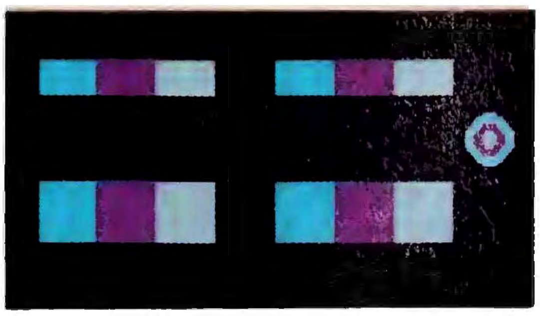
PUT with the PSET option is nothing more than the reverse of GET. The image stored in the array with the GET command is displayed on the screen with PUT/PSET, erasing what was there before. The PSET option is useful for copying an image drawn with the PSET, LINE, CIRCLE, and PAINT commands to a new screen location without laboriously redrawing the image.

The PRESET option is similar to the PSET option but puts a negative of the image onto the screen. In medium-resolution mode colors 0 and 3 are reversed, as are colors 1 and 2; in high-resolution mode colors 0 and 1 (white and black) are reversed. It's easier to describe the PRESET option than to imagine a use for it.

The XOR option is the default action for the PUT command. XOR causes the pixels in the image that are not the background color to be inverted. The effect of one PUT with the XOR option against the background color is to place the image on the screen; the effect of another PUT with the XOR option with the same image in the same location is to erase it. Therefore, the XOR option can be used to erase an image as well as to draw it.

The OR option to the PUT command superimposes an image over whatever image is already on the screen. Unlike the PSET and PRESET





options, the portions of the second image that are background color (color 0) do not erase the previous image. Basically, the second image is placed in front of the original.

The AND option, the least useful for our purposes, puts an image onto the screen only where there's already an image.

For a demonstration of the five PUT options, run the program in Listing 2. This program puts an image onto the screen against each of the four colors. Note the various color and background effects produced. For more details on the various options, refer to the tables under the PUT command in the BASIC manual.

```
100 REM demonstration of saving a screen image to a diskette
110 SCREEN 1,0:CLS:COLOR 0,1     'set to med-res pallete 1
120 REM draw squares inside squares of different colors
130 FOR I=0 TO  5
140   LINE(I*20,I*20)-(319-I*20,199-I*20),I MOD 4,BF
150 NEXT I
160 LOCATE 24,14:PRINT"Remember this"
170 REM save the screen image in a disk file
180 DEF SEG=&HB800:BSAVE "screen.scn",0,&H4000
190 REM clear the screen
200 CLS
210 REM restore the screen image from the disk
220 DEF SEG=&HB800:BLOAD "screen.scn"
230 REM wait for a key to be pressed before ending
240 IF INKEY$="" GOTO 240:END
```

Listing 1

Animation

Animation is the process of putting a rapid succession of images onto the screen to produce the illusion of motion, just as a movie consists of a series of frames, each differing slightly from the last. The image on screen must be moved only a short distance each time so that the motion seems continuous, and the previous image must be removed from the screen or the new image will have a trail in its wake.

The animation program in Listing 3 repeatedly PUTs an image on screen with the PSET option and then PSETs a blank area to erase the image before redrawing it in a new location. Lines 140 to 160 draw a colored ball using the CIRCLE command, and line 180 saves the image in memory. Line 200 GETs a blank area of the same size, while lines 230 to 260 create the impression of movement by drawing, erasing, moving, and redrawing the ball across the screen.

Animation is the basis for all video games. Arcade games and some computers use specialized hardware to perform animation, but the PC is a general-purpose computer, so animation must be done in software. In BASIC we use the PUT command to animate.

Animating with XOR

The XOR option, the simplest way to perform animation in a complex screen, is used in creating most games on home computers. The great virtue of XOR is that it draws and then erases an image but never changes the background, even if several images are moving past each other at the same time. Unlike the XOR option, PSET always destroys the background.

When erasing and redrawing an image to animate, the brief period when the image is not on the screen produces a distracting flicker. Using XOR to erase and the XOR to redraw as subsequent operations minimizes such flicker.

When a figure drawn with the XOR option is drawn over another figure, some odd color effects may occur where the two images overlap. This effect is normal and disappears when the overlap ceases. As mentioned, such color effects occur with all PUT options except PSET.

The program shown in Listing 4 demonstrates animation using PUT with the XOR option. Notice the color interaction, the flicker of the moving ball, and the preservation of the background.

Animating with PSET

When we created animation with the PSET option, we PSET the image initially, PSET a blank area of equal size over the image to erase it, and then redrew the image in a new location. This method is not as efficient as using the XOR option, but there is a good way to use PSET for animation.

First, GET an image with a border that's wider than the distance the image jumps each time it's moved, and then PUT the image onto the screen with the PSET option. These commands will erase the previous image and replace it with the new image all

```
100 REM demonstration of the five options to the PUT command
110 SCREEN 1,0:CLS:COLOR 0,1:KEY OFF  'set screen mode
120 REM draw circles inside circles of different colors
130 CIRCLE(25,25),25,3:PAINT STEP(0,0),3
140 CIRCLE(25,25),20,2:PAINT STEP(0,0),2
150 CIRCLE(25,25),15,1:PAINT STEP(0,0),1
160 CIRCLE(25,25),10,0:PAINT STEP(0,0),0
170 REM save the image of the circles just drawn
180 DIM IMAGE(364):GET(0,0)-(50,50),IMAGE
190 REM clear the screen
200 CLS
210 REM put in labels for the five options
220 LOCATE 14,1
230 PRINT "****PSET***PRESET**XOR*****AND*****OR***"
240 REM set up a background of different colors so that
250 REM   the various color effects can be observed
260 FOR I=0 TO 62
270   LINE(I*5,120)-(I*5+5,180),I MOD 4,BF
280 NEXT I
290 REM put the saved image on a black background and
300 REM   on the colored background using each of the
310 REM   options to the PUT command
320 PUT(20,125),IMAGE,PSET:PUT(20,50),IMAGE,PSET
330 PUT(80,125),IMAGE,PRESET:PUT(80,50),IMAGE,PRESET
340 PUT(140,125),IMAGE,XOR:PUT(140,50),IMAGE,XOR
350 PUT(200,125),IMAGE,AND:PUT(200,50),IMAGE,AND
360 PUT(260,125),IMAGE,OR:PUT(260,50),IMAGE,OR
370 REM wait for a key to be pressed before ending
380 IF INKEY$="" GOTO 380:END
```

Listing 2

```
100 REM demonstrate animation using the PUT command with
110 REM   the PSET option to repeatedly draw and erase
120 CLS:SCREEN 1,0:COLOR 0,1    'initialize the screen
130 REM draw a colored ball
140 CIRCLE(12,12),8,3:PAINT STEP(0,0),1,3
150 CIRCLE(12,12), 6,3:PAINT STEP(0,0),2,3
160 CIRCLE(12,12),2,3:PAINT STEP(0,0),3,3
170 REM save the ball
180 DIM BALL(144):GET(0,0)-(23,23),BALL
190 REM save a black area the size of the saved ball image
200 DIM BLANK(144):GET(50,50)-(73,73),BLANK
210 REM repeatedly erase and draw ball at slightly different
220 REM   positions to create the illusion of motion
230 FOR X=8 TO 288 STFP 2
240   PUT (X-2,60 ),BLANK,PSET:PUT(X,60),BALL,PSET
250   FOR I=1 TO 20:NEXT I  'wait to eliminate some flicker
260 NEXT X
```

Listing 3

The Graphics Programmer's Notebook

The BSAVE, BLOAD, PUT, and GET commands can be used without understanding how they actually work; one of the strengths of IBM BASIC is that the user can ignore the hardware of the machine and concentrate on programming. But many people enjoy understanding how the PC works and can happily spend their time exploring the screen, the basic input/output system (BIOS), DOS, and so on. Further, many arcade-style games are written in machine language, in which there are no conveniences such as the PUT command; programmers must design their own equivalent of the PUT command. To do this they must know their way around the PC.

Memory-Mapped Video

The IBM PC's memory-mapped screen is linked to an area of the computer's memory that is scanned constantly by the circuitry on the color/graphics adapter to generate the video signal that makes the image appear on the screen. The contents of this memory are the basis for whatever appears on the screen; each memory location corresponds to a screen location. In text mode, for example, a value of 65 in the first memory location of the graphics adapter's screen map would cause the character *A* to appear in the upper left corner of the screen.

There are separate memory map locations for the monochrome display and color/graphics adapter screens, and these addresses are given in hexadecimal (base 16) notation. The monochrome screen begins at address B000:0000; the graphics adapter screen begins at address B800:0000. In BASIC, hexadecimal numbers are preceded with '&H'. For example, the B800 cited above would be represented in BASIC with &HB800.

The two numbers separated by a colon in the addresses indicate the manner in which the 8088 microprocessor chip specifies a memory location. In order to address the PC's 1 megabyte of memory (that is, to specify a memory location from among the 1 million or more available in the PC), the 8088 uses two values. One is a base value, which defines a segment, and the other is an offset from that base value. The offset value can address a maximum of 64K (about 65,000 characters) of memory relative to the segment value (which can point anywhere in the 1-megabyte memory space). This is why BASIC can use only a 64K work space: a segment register is set when the program is started and is left unchanged, so only the 64K addressable via the offset value is available.

Accessing Memory from BASIC

With BASIC the user can set both the segment and offset values to get data into and out of any location in memory. The DEF SEG = command sets the segment pointer to the named value. `DEF SEG = &HB800`, for example, sets the working segment to the beginning of the graphics adapter screen memory map. This is the command we used when saving and restoring the screen.

The PEEK and POKE commands access a specific memory location relative to the defined segment. PEEK(*x*) returns the value of the memory location *x*, where *x* is an offset value relative to the defined segment. For example,

```
DEF SEG = &HB000:PRINT PEEK(9)
```

prints the value of the memory address B000:0009, or the ninth location in the monochrome memory map. `POKE` *i, j* puts the value *j* into the memory location *i*, where *i* is relative to the defined segment value and *j* is in the range 0 to 255. For example,

```
DEF SEG = &HB800:POKE 0,66
```

puts the value 66 into the first location in the graphics adapter memory map, which is the upper left corner of the screen. In text mode, this command produces the letter *B* on your screen.

For general purposes, however, just remember that `DEF SEG = &HB800` sets the segment pointer to the beginning of the graphics adapter memory map.

Incidentally, PEEKing around the PC with various segment values is a great way to learn the workings of the machine. For instance, the interrupt vectors (which control input, output, and disk functions) start at 0000:0000. The BIOS variables start at 0000:0040. They select which display text goes to, Caps-Lock state, disk parameters, and cursor location. The BIOS itself, with all input/output functions, starts at F000:E000. Check the

IBM Personal Computer Technical Reference manual for more details on the interior of the PC.

The memory location indicated by a segment:offset address is determined by multiplying the segment by 16 and then adding that product to the offset. This process is equivalent to putting an additional zero at the end of the segment value and adding it to the offset. For example, 0100:0050 points to 01000 + 0050 = address 1050 (all in hexadecimal), just as 0000:1050 and 0105:0000 address 1050 (hexadecimal). You can use many combinations of segment:offset to point to the same address.

Screen Memory Organization

Each memory location is 1 byte (8 bits) in size. What this byte causes to be displayed on the screen depends on the mode the screen is in. For example, in text mode each even-numbered byte in the screen memory map defines a specific character (see Appendix G in the BASIC manual or Appendix C in the *Technical Reference* manual for details). Each odd byte defines the color of the character and its background, and controls blinking. There are 2000 characters on the screen in 80-column mode, and because each character takes 2 bytes, 4000 bytes are needed for the screen memory in text mode.

In the graphics modes the necessary 16,000 bytes of screen memory can be provided on the color/graphics adapter. In text mode the 12K to 14K of extra screen memory can be used to create eight separate pages, or screens, any of which may be displayed or altered at any time.

In medium-resolution mode there are 64,000 (320 x 200) pixels, or dots, on the screen. Each pixel may be 0 for background or 1 through 3 for the colors in the selected palette. Two bits are required to represent values 0 through 3, which means that four pixels can be represented by a single byte. Therefore, the medium-resolution screen memory map requires 16,000 (64,000/4) bytes.

Similarly, high-resolution mode needs only one bit per pixel to represent its two colors. In high resolution, however, there are 128,000 (640 x 200) pixels on the screen, so that once again 16,000 (128,000/8) bytes are required for the screen memory map.

Samples of PEEK and POKE

PEEK and POKE are ideal tools for exploring the screen memory map. First enter medium-resolution graphics mode with `SCREEN 1,0` and then select palette 1 on a black background with `COLOR 0,1`. Next set the current segment to point at the beginning of the graphics screen with

```
DEF SEG = &HB800
```

Now whatever you POKE into memory in the address range B800:0000 to B800:3FFF immediately affects what is displayed on the screen. For example,

```
POKE &H1030,3
```

causes a white dot to appear toward the right of the screen.

```
POKE &H1032,255
```

causes all four pixels controlled by the byte at B800:1032 to be white. Entering

```
FOR I = &H1080 TO &H1180:POKE I,3:NEXT
```

will draw several dotted lines. Similarly,

```
POKE &H1800,255:PRINT PEEK(&H1800)
```

puts the number 255 into memory location 1800 (hexadecimal) and then reads that value back out on the screen.

You may have noticed that when several dotted lines are drawn they appear on every other line in the screen. Strange as it seems, all the even screen lines are stored in the first 8K of the screen memory map, and all the odd screen lines are stored in the next 8K. This occurs because the screen controller draws all the even lines first and all the odd lines second, a practice known as interlacing. If you plan to do graphics from a language with no graphics commands, such as FORTRAN or assembly language, you must account for interlacing when plotting points.

Experimenting with POKE will make this clearer. For example,

```
DEF SEG = &HB800:POKE 800,3:POKE
  800 + &H2000,3
```

plots two points, one directly above the other. The 8K difference between their locations is the offset between the even and odd sections of the screen memory map.

You'll probably never need PEEK and POKE to do graphics, since Advanced BASIC plots dots and checks pixel values with the PSET and POINT commands. But a fundamental understanding of the screen memory organization can be helpful in learning and applying the BASIC graphics commands.

```
100 REM demonstration of animation using XOR option
110 REM   to the PUT command
120 CLS:SCREEN 1,0:COLOR 0,1  'intialize screen
130 REM draw a colored ball
140 CIRCLE(12,12),8,3:PAINT STEP(0,0),1,3
150 CIRCLE(12,12), 6,3:PAINT STEP(0,0),2,3
160 CIRCLE(12,12),2,3:PAINT STEP(0,0),3,3
170 REM draw a series of colored stripes for ball
180 REM   to move over
190 FOR I=4 TO 12
200 LINE(I*20,50)-(I*20+19,100),I MOD 4,BF
210 NEXT I
220 REM save the image of the ball
230 DIM BALL(144):GET(0,0)-(23,23),BALL
240 REM put the image on the screen in its first
250 REM   position so that the next PUT will
260 REM   erase it
270 PUT(6,60),BALL,PSET
280 REM repeatedly erase and then draw the ball
290 REM   moving it 2 pixels right each time
300 FOR X=8 TO 288 STEP 2
310   PUT (X-2,60 ),BALL,XOR:PUT(X,60),BALL,XOR
320   REM wait to eliminate some flicker
330   FOR I=1 TO 20:NEXT I
340 NEXT X
```

Listing 4

```
100 REM demonstrate animation using the PSET command
110 REM   with the PSET option and a border around the
120 REM   image to erase the old image
130 CLS:SCREEN 1,0:COLOR 0,1  'initialize the screen
140 REM draw a ball
150 CIRCLE(12,12),8,3:PAINT STEP(0,0),1,3
160 CIRCLE(12,12), 6,3:PAINT STEP(0,0),2,3
170 CIRCLE(12,12),2,3:PAINT STEP(0,0),3,3
180 REM draw a series of colored bars for ball to
190 REM   moved through
200 FOR I=4 TO 12
210   LINE(I*20,50)-(I*20+19,100),I MOD 4,BF
220 NEXT I
230 REM save the image of the ball and some of the
240 REM   black border
250 DIM BALL(144):GET(0,0)-(23,23),BALL
260 REM repeatedly move the ball right by two pixel
270 REM   positions allowing the black border to
280 REM   wipe out the part of the old ball image
290 REM   not covered by the new image
300 FOR X=8 TO 288 STEP 2
310   PUT(X,60),BALL,PSET
320   FOR I=1 TO 20:NEXT I  'delay a bit
330 NEXT X
```

Listing 5

in one step. Since an image is always on the screen, the animation produced is smooth and flicker free. Also, because there is only one PUT performed, less time is used to create the animation.

The program in Listing 5 demonstrates animation with the PSET option. Note that the moving ball now flickers less than when it was animated with the XOR option.

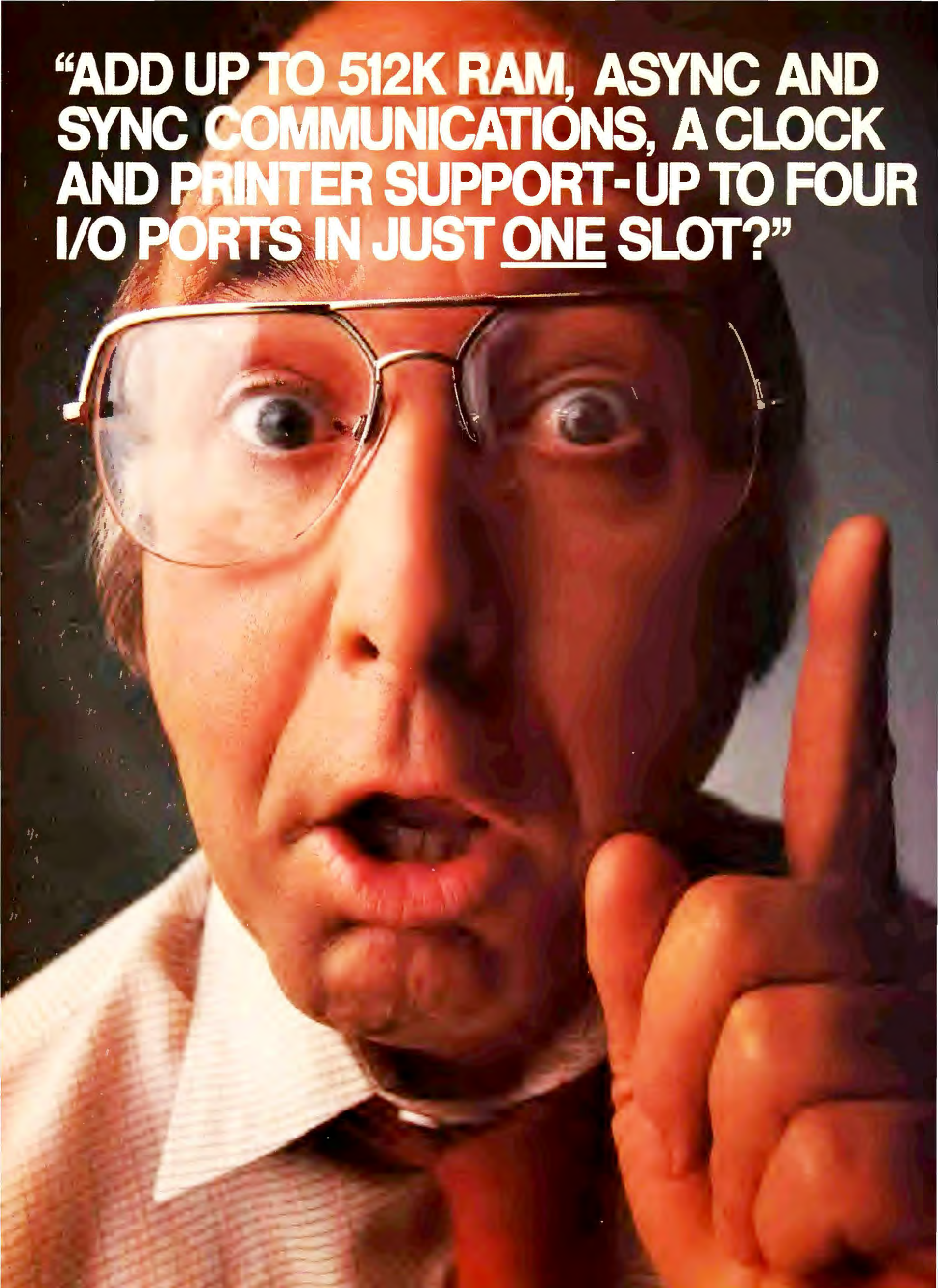
You'll also see that the PSET option does not preserve the images on the screen as it passes over them. The background can be restored with appropriate redrawing in the wake of the moving object, but this is difficult to do. The XOR option, on the other hand, does not require redrawing. If there is no background landscape, the PSET option works well; if there is a landscape, PSET can cause more problems than it solves. Care must also be taken that the blank border of the image does not go off the screen, as it will cause an error even though the figure appears to be fully on the screen.

Selecting between XOR and PSET depends on the complexity of the animation task; in general though, XOR is simpler and more widely used.

Until Next Month

Now that you have most of your drawing and animation tools in order, you're ready to do some designing, so next month we'll show you how to design and program an animated video game. Until then, work with the commands you've learned so far, particularly PUT and GET; next month we will put them to good use.

Dan Illowsky and Michael Abrash coauthored the Snack Attack II *video game for the IBM PC. Illowsky, author of the original* Snack Attack *for the Apple II, is president of Funtastic, Inc., in Drexel Hill, Pennsylvania. Abrash has written several video games and is an energy consultant with Delphi Energy Group in Philadelphia. The authors are planning to adapt the information in this article for a future book.*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With Time Spectrum, you can combine up to six powerful functions—plus two advanced software programs—on just one board. And get performance and features like nothing else.

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For example, Time Spectrum is the only multi-function board that lets you expand your IBM PC from 64K up to 512K RAM. Add a calendar clock. Add as many as two RS-232 asynchronous communications ports, or two synchronous and one asynchronous communications port. Plus print spooling and as much as 320K of RAM disk memory.

Up to four I/O ports—in just *one* slot.

How did we do it?

With the Cliffhanger.™ A unique, RFI-shielded connector system that solves the problem of tying two or more I/O ports to peripheral equipment like a printer or modem, without consuming two or more slots.

And only Persyst has it.

The Time Spectrum Cliffhanger.™
So ingenious, it's patented.

What's more, expansion functions can be plugged right onto the Time Spectrum board. Or added with Versapak™ piggyback modules. So you can add exactly the capability you need, when you need it.

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For the IBM XT, Time Spectrum not only delivers exceptional one-board expansion capability, but extra flexibility, too.

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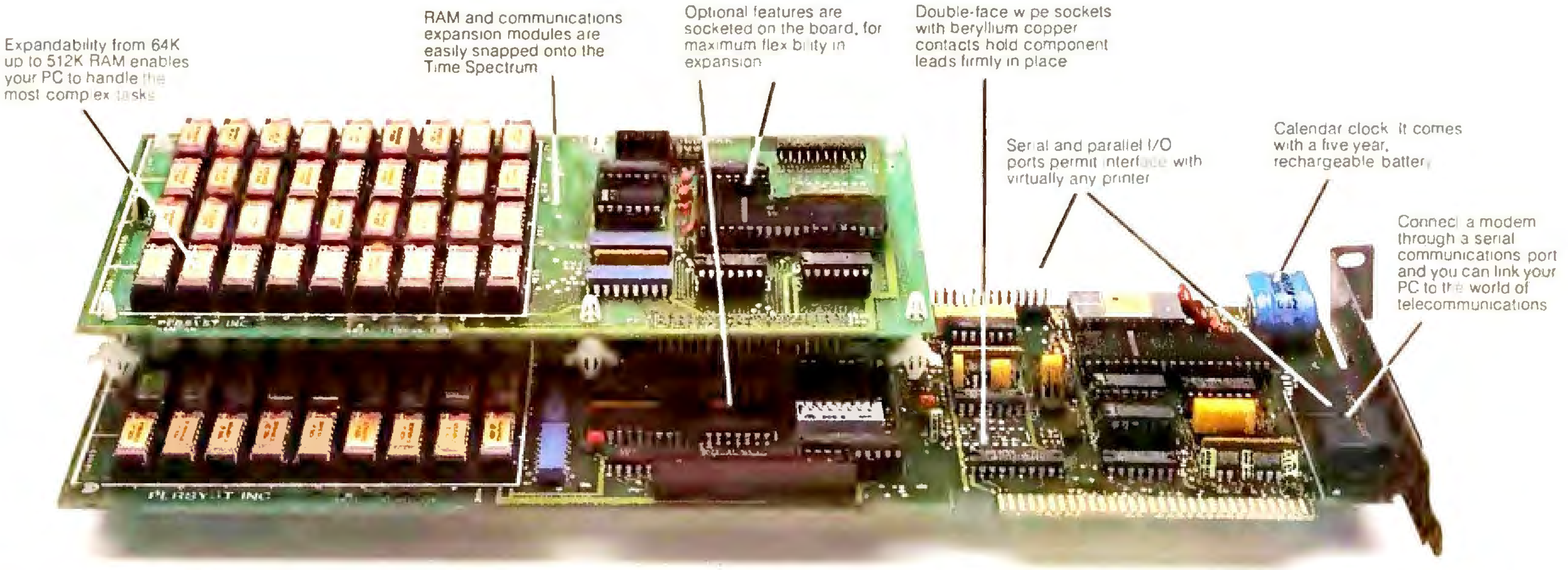
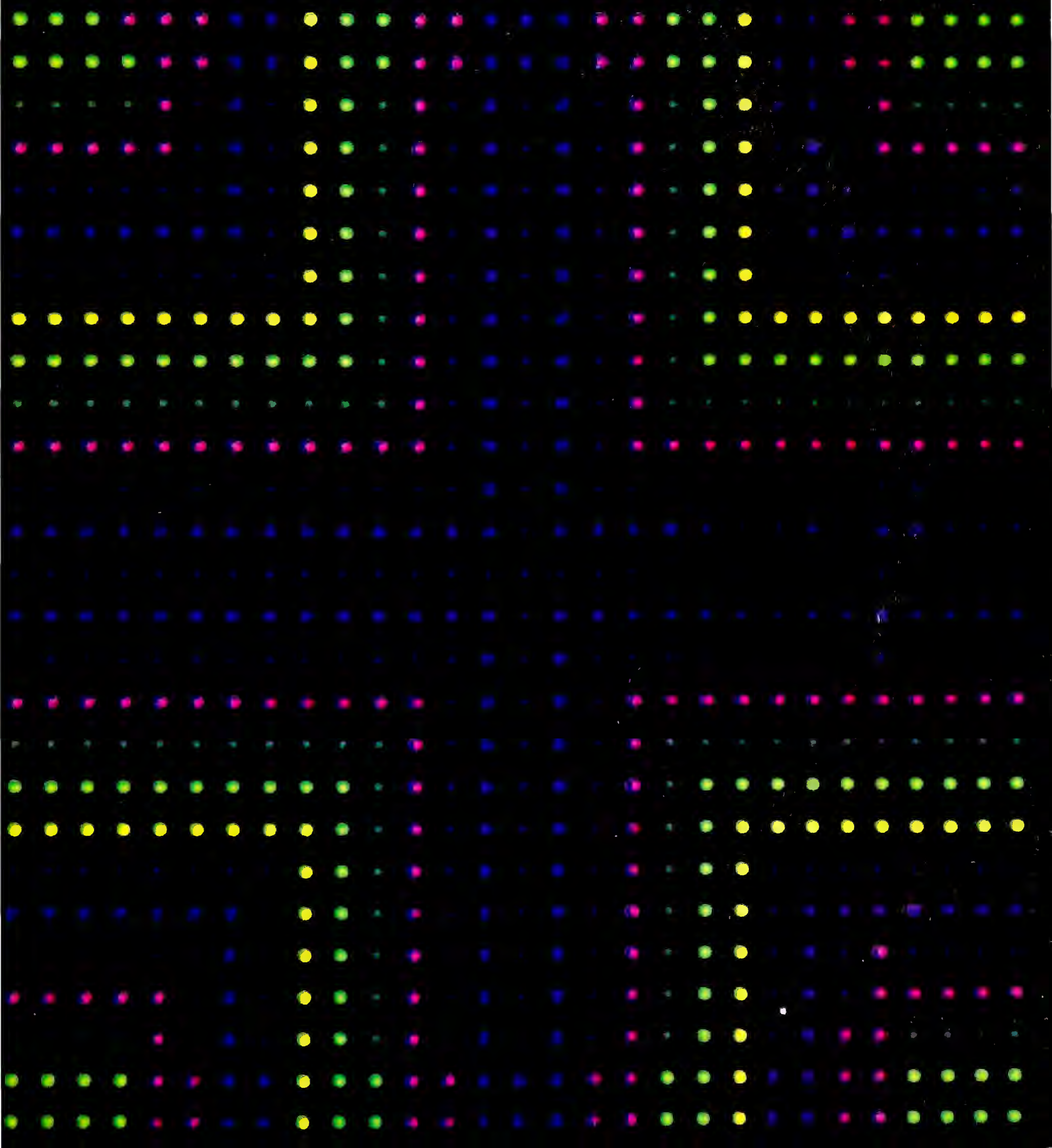


THE TIME SPECTRUM™ BY PERSYST.

Announcing The PC World Software Review written by the readers of PC World



You can be part of the most useful reference tool ever compiled for the IBM PC and compatible computers. In the process you may get your name in print and win up to $1500 worth of software.

With the assistance of our readers, *PC World* is compiling a guide to the most useful software products available for the IBM PC. The *PC World Software Review* will be published in fall 1983 and will be followed in the spring by the *PC World Hardware Review*.

The *Software Review* will list and evaluate all categories of software available for the IBM PC. From spreadsheets and communications programs to operating systems and games, the *Software Review* will be a user guide to the complex software marketplace. The *Software Review* will reflect the experience of the community of PC users, with selections and evaluations based on insights acquired through hands-on testing.

Contributors will be credited for each evaluation published in the *Software Review*, and published contributors will be eligible to win a grand prize of $1500 worth of software or five prizes worth $500 of software each. Contest winners will be selected in a drawing and their names will be announced in the *Software Review*.

Anyone who has used a product on the IBM PC or a compatible computer can write an evaluation of that product and submit it for inclusion in the *Software Review*. Manufacturers are invited to write about their own products, but they must credit the submission to an individual within the company. There is no limit to the number of evaluations that may be submitted. *PC World* must receive all materials by July 1, 1983.

Once received, submissions will be checked for accuracy, edited, and compared. If *PC World* receives more than one submission for a product, the most useful evaluation will be selected on the basis of completeness, clarity, and insight into the product's features. *PC World* reserves the right to edit reviews to conform to the magazine's format and style. A review form for the submission of evaluations is provided with this announcement.

If you have found a software product especially valuable, this is an opportunity to help your fellow users learn about it. We invite you to be a part of this exciting collaborative venture.

Form Instructions

Use the attached form for each evaluation you wish to contribute to the *Software Review*. The form may be photocopied to submit more than one evaluation.

• *Provide general product information.* Write the product's name with the spelling, capitalization, and punctuation used by the manufacturer. Check the box next to the category name that best describes the product. If you check the box for integrated applications, you must also check the applications that are integrated. Describe the minimum system requirements in terms of RAM (in K), number of disk drives, interface cards, and any other hardware or software needed by the user to effectively operate the program. Don't include the monochrome monitor, keyboard, DOS, or BASIC.

• *Describe and evaluate the product by its features.* Give a one-sentence summary of general features. Briefly explain two features that distinguish the product from its competitors. Describe two relevant limitations of the product (what the product doesn't do that users might ideally expect from a product in that category).

Describe the type of user for whom the product is intended. For example, is the product best suited for business, programming, personal use, or some other activity? The section for comments may be used for remarks that elude the review format but are essential to understanding the product.

• *Provide consumer information.* Include the product's list price and the price for the various available configurations and options. Give the manufacturer's complete name, address, and telephone number. A Source or Telex number can be included if available.

• *Tell us who you are!* List your name so we can publish it (unless you want your review to be anonymous). Include your address and telephone number in case you are a winner in the contest or we need to contact you for more information.

Check whether you are the product manufacturer. If you are, we encourage you to send us press information and a black and white, glossy photo for publication.

Please avoid advertising hyperbole, wordiness, and ambiguity. Identify concrete product features rather than making sweeping remarks. *PC World* reserves the right to edit submitted materials, all of which become the property of *PC World* magazine.

The PC World Software Review Form

I. Product Information

Product name ______________________________

Category (check one)

A. SYSTEMS SOFTWARE

1. ☐ Operating systems 2. ☐ Languages 3. ☐ Utilities

B. APPLICATIONS SOFTWARE

1. ☐ Spreadsheets
2. ☐ Word processing
3. ☐ Data management
4. ☐ Business graphics
5. ☐ Communications
6. ☐ Educational
7. ☐ Entertainment (games)
8. ☐ Financial and accounting
9. ☐ Business management
10. ☐ List management
11. ☐ Design graphics
12. ☐ Job and industry specific
13. ☐ Personal management
14. ☐ Integrated applications

System requirements ______________________________

II. Product Features

General features: ______________________________

____

Two distinguishing features: 1. ______________________________

____

2. ______________________________

Two limitations of the product: 1. ______________________________

2. ______________________________

Intended user: ______________________________

Comments: ______________________________

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III. Consumer Reference

List price: ______________________________

Manufacturer's name: ______________________________

Address: ______________________________

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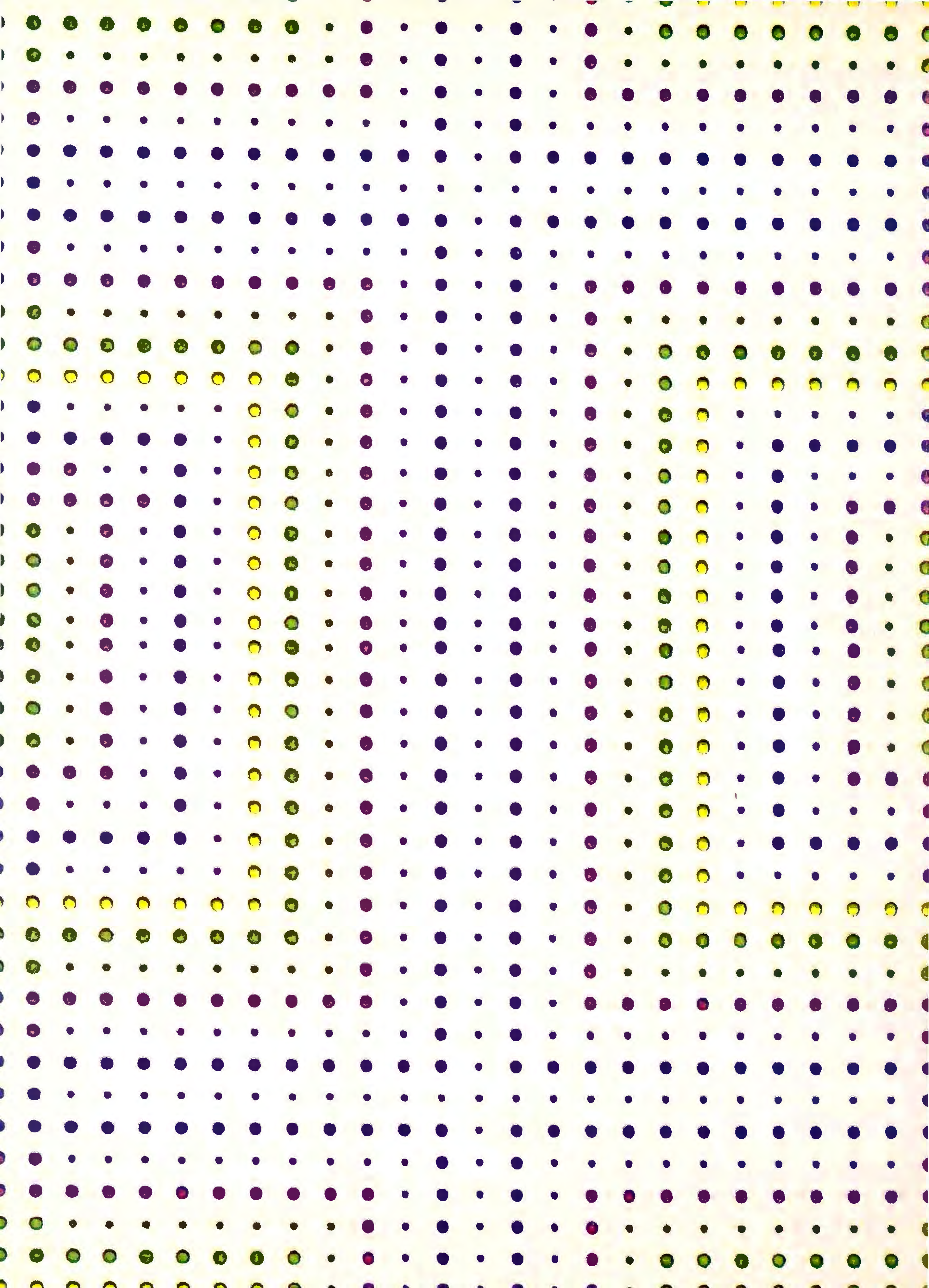

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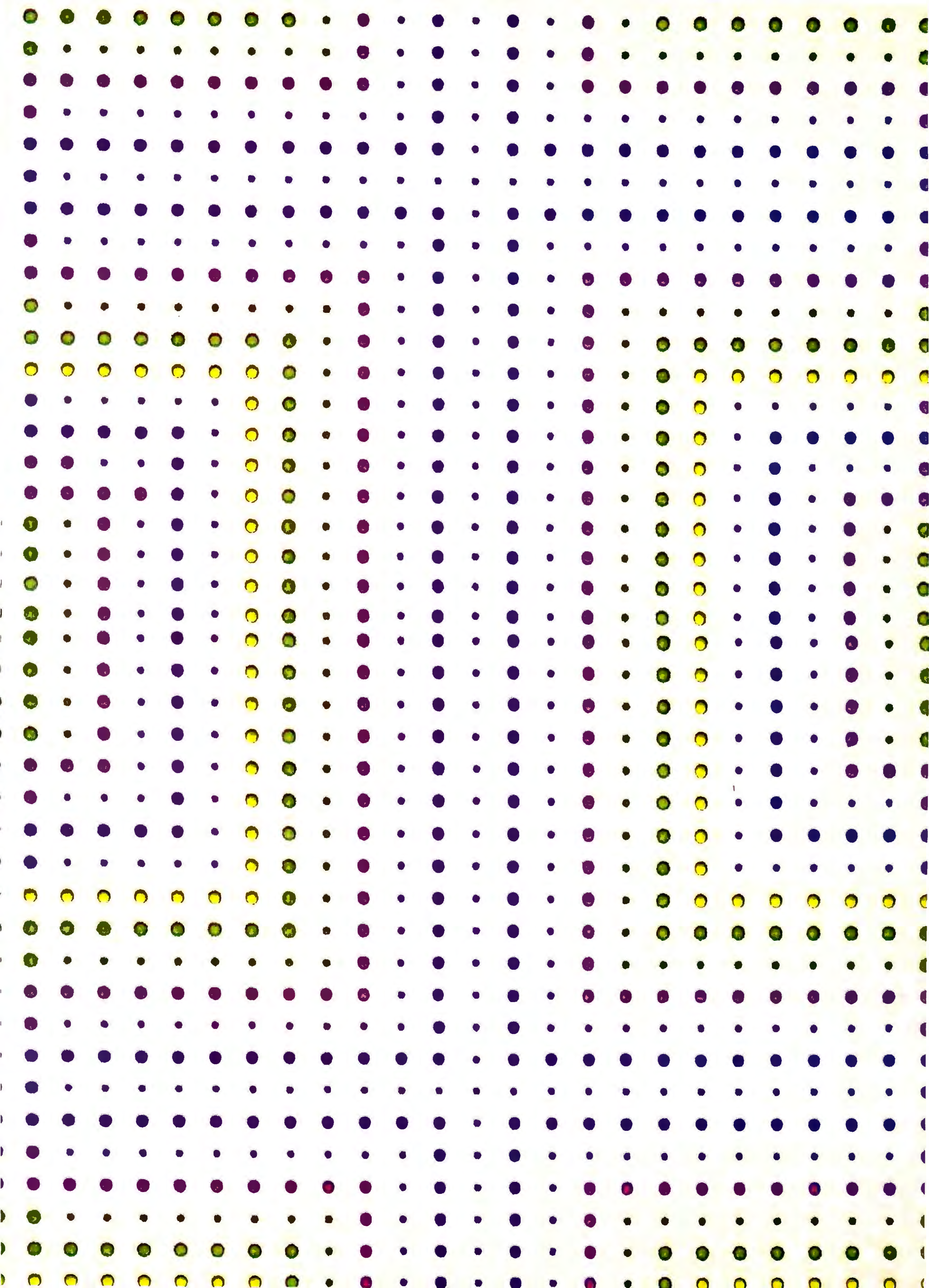

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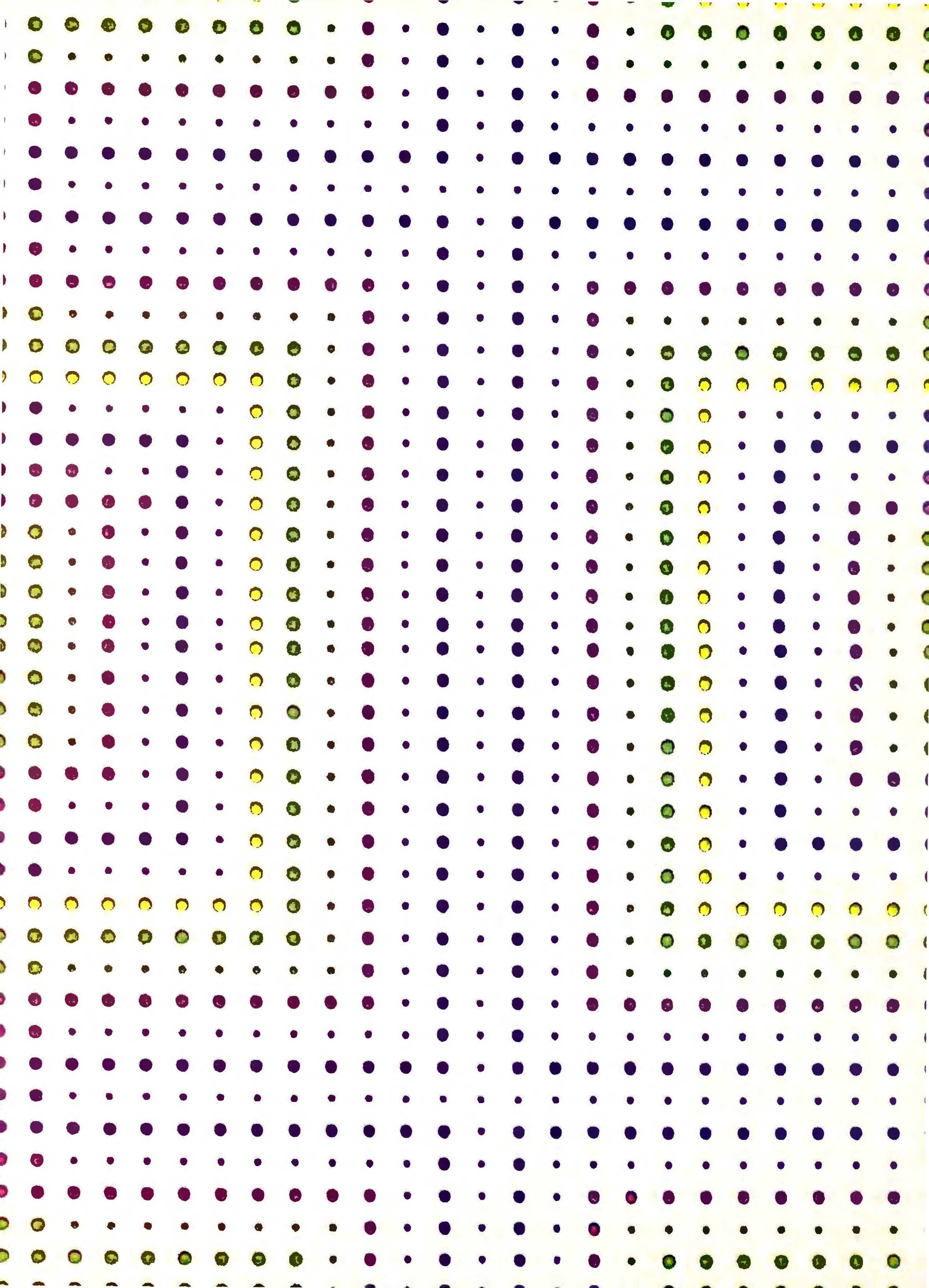

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A. SYSTEMS SOFTWARE

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B. APPLICATIONS SOFTWARE

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System requirements ______

II. Product Features

General features: ______

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2. ______

Two limitations of the product: 1. ______

2. ______

Intended user: ______

Comments: ______

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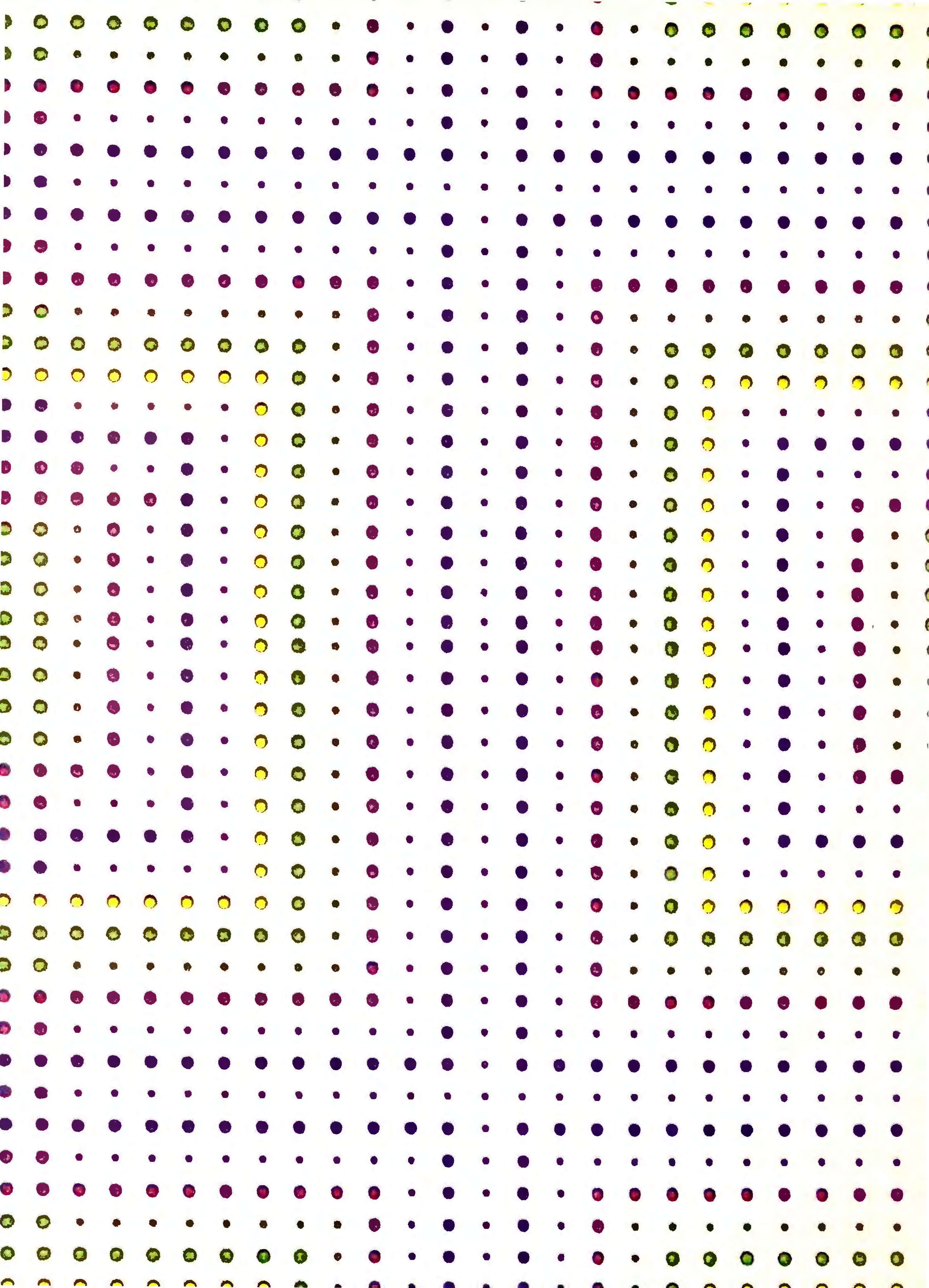

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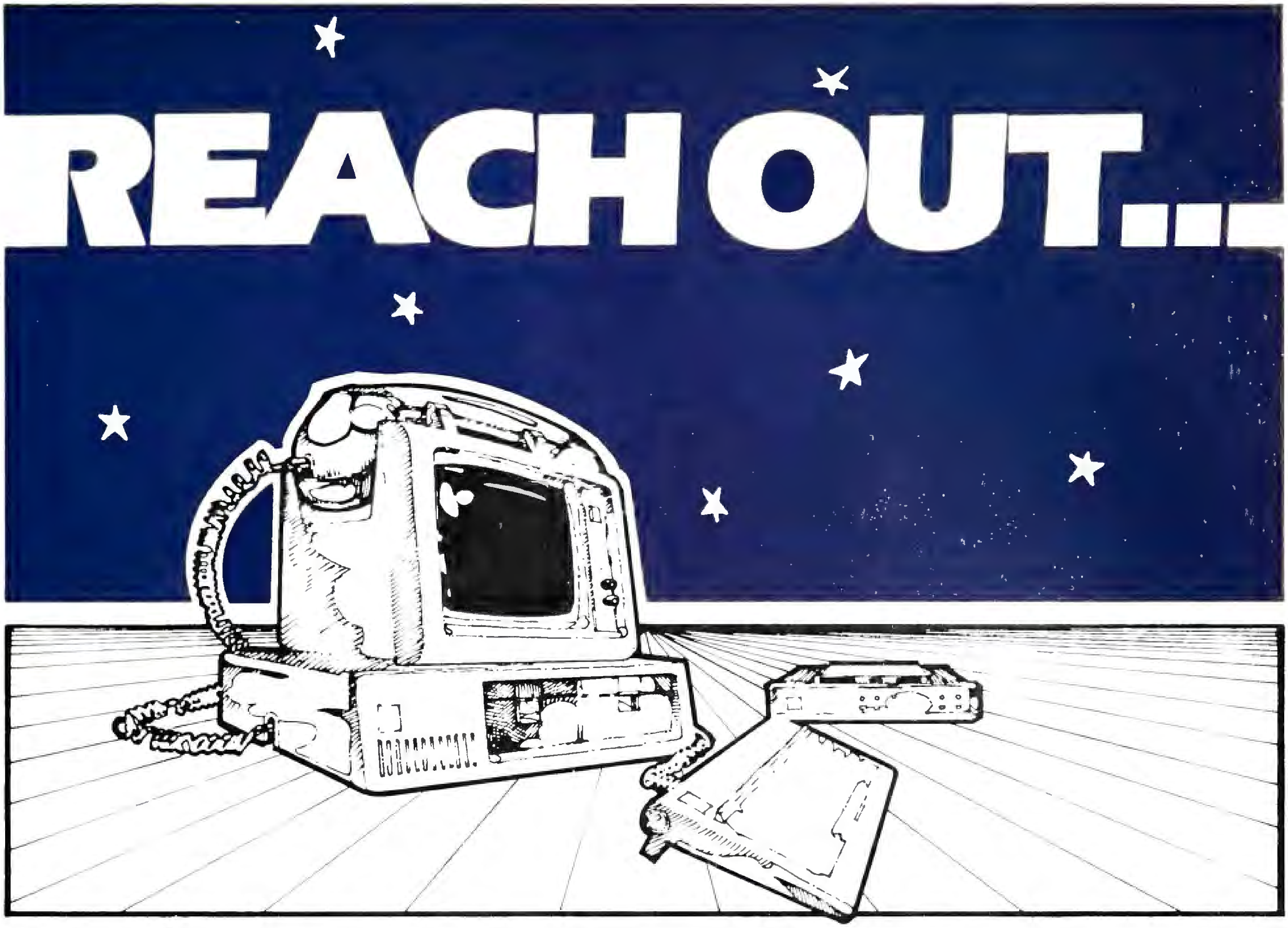

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- Collection agencies, etc.

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IBM Personal Computer with 128k, at least one diskette drive, 80 column monochrome or color monitor, and a Hayes Smartmodem or Novation Smart-Cat. Printer is recommended.

Arlington Software+Systems, 97 Bartlett Ave. Arlington, MA 02174 (617) 641-0290

- Have someone call me: I'm interested.
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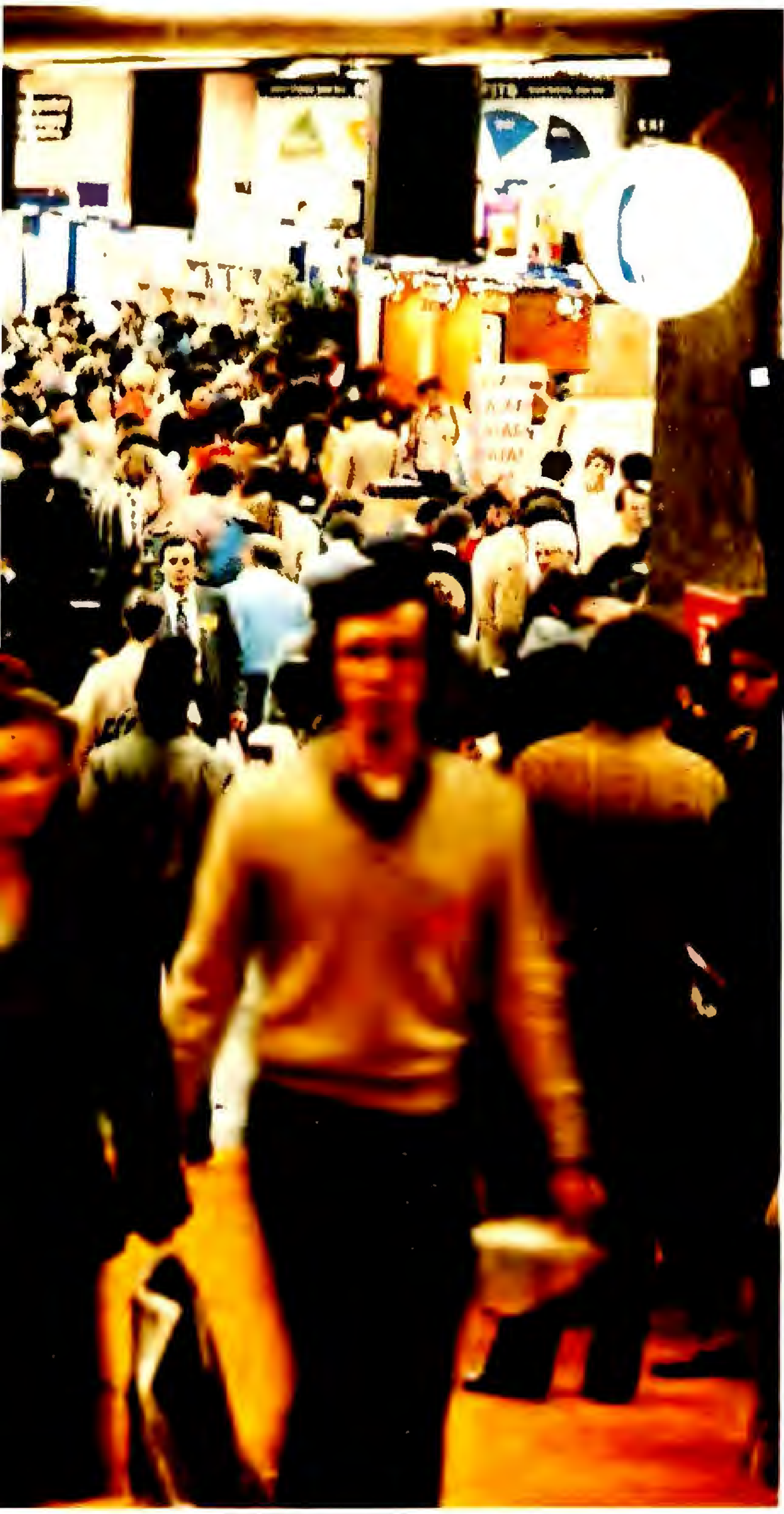
Let Me Take You to the Faire

David Bunnell



For anyone interested in the personal computing phenomenon there was no better place to be from March 18-20 than in San Francisco at the 8th West Coast Computer Faire. PC World *Publisher David Bunnell went on a whirlwind tour of the Faire, collecting a variety of audio and visual samples, some of which are reproduced in this article.*

"Is Jim Warren in the '80s like Bill Graham was in the '60s?"

"Yeah, I bet he could get 200,000 people easily."

Hearing in post-Faire chatter some bright fellow comparing rock concerts to computer shows struck me as absurd and fascinating. Bill Graham started Fillmore West and Jim Warren started the Computer Faire. Both events reflect the broad social changes of their times.

The comparison has a certain validity, yet there are some fundamental differences too. In the '60s the focus was on personal freedom and political consciousness; in the '80s its on productivity and computer literacy.

No matter what you compare it to, the West Coast Computer Faire has always been intensely rewarding for the thousands of Faire attendees. And it has played a sig-

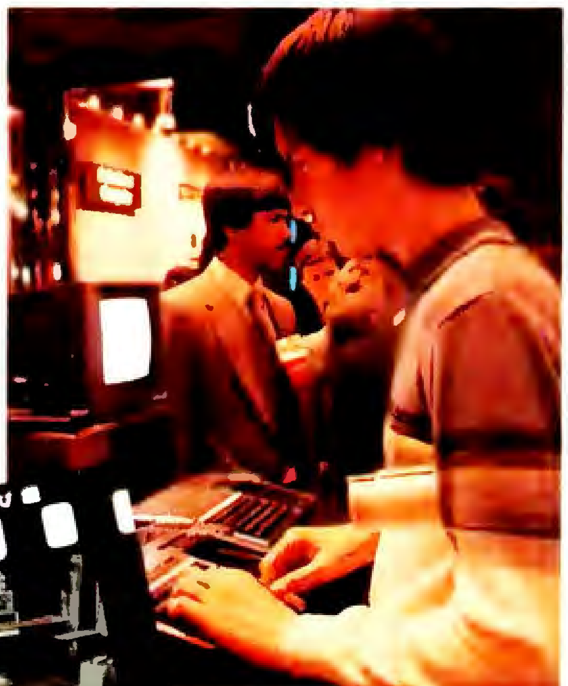
Starting from top left, row 1: Prelude to the Faire—crates containing the stuff of computer dreams; Thursday, March 17 was set-up day at the Civic Auditorium; on Friday the crowds moved in. Row 2: A look way behind the scenes; young project engineer Steve Innes with his portable synthesizer. Row 3: The Faire air was filled with computerese and video game sound effects; a budding young computer nerd.

Starting from top left, row 1: Video games and kids match wits; two Faire attendees meditate on a PCB as the row of printers scrutinizes other Faire goers. Row 2: A fighter pilot of the future battles the enemy in deep space. Row 3: You could fill a suitcase with the brochures, advertisements, magazines, and other printed matter available at the Faire.

Starting from top left, row 1: Famed BYTE cover artist Robert Tinney; Perfect Software's laser display. Row 2: After the Faire participants depart and begin preparing for next year's extravaganza; Mary Carol Smith, president of Avant Garde Creations, came dressed in her fighter-pilot suit. Row 3: Jason Matthews of Apparat explains their new hardware, including an unusual portable (see the tiny screen?).

Starting from top left, row 1: PC World Publisher David Bunnell interviews RB robot as RB's master, Sharon Smith, stands by; Ray Young and Rick Alber of the San Francisco IBM PC Users Group. Row 2: A representative from Corona Data Systems talks about Corona's PC-compatibles. Row 3: People standing several rows deep for a demonstration of Apple's mouse-based Lisa. From the expression on their faces, she was a big hit; the halls in the exhibit areas were filled for three days with a motley crowd of hobbyists and professionals.

Starting from top left, row 1: Jack Kroll explains the purpose of Computer Professionals for Social Responsibility; at $29.95 Spell-it from Berzurk Systems seems berzurk indeed. Row 2: A young computer whiz at the keyboard; a common sight at the Faire—serious perusal of a myriad of publications and products. Row 3: Sunday evening after the Faire; the PC World booth with Harry Miller in the foreground. Next in line are Brooke Hazard, Janet McGinnis, and Jacqueline Poitier.



nificant role in the personal computing story. The Apple II, the Commodore Pet, and *VisiCalc* are examples of products first introduced at the Faire.

The Faire is doubly blessed. It is the oldest and most recognized personal computer show, and the charming city it is located in happens to be less than an hour's drive from Silicon Valley. San Francisco, with Apple, Intel, Hewlett-Packard, and Stanford to the immediate south; Osborne Computers, Perfect Software, and Sybex to the immediate east; MicroPro, Information Unlimited, and dozens more to the north; and Japan looming over the western horizon, is the de facto capital of personal computing. In the words of Assistant to the Publisher Noreen Giannini, "There are more computer nerds per square inch here than anywhere else."

King of the Mountain

A major reason for the success of the Faire is Jim Warren himself. A lumbering, good-natured man whose heart is as big as the mountain top he lives on, Jim has a close kinship with both the user community and industry bigwigs.

Though I've heard Warren confess to hedonist tendencies (while sitting with him in his outdoor hot tub gazing at the sunset), I sincerely believe his highest priority is contributing to the future development of personal computers. His academic background is in computer science and education, and he has invested much of his Computer Faire profits in experimental projects such as electronic datacast. Although a commercial failure, the project proved that the subcarrier of the FM radio wave can be used to transmit large quantities of computer data to millions of personal computer users.

Warren is the founder of several publications including the *Intelligent Machine Journal*, which was sold to International Data Group and renamed *InfoWorld*. He also founded the first irregular newspaper focusing on microcomputers, *The Silicon Gulch Gazette*, of which he is still the editor and publisher, and he created a television show on personal computing that proved, like the electronic datacast project, to be somewhat ahead of its time. In addition, Warren has been known to make contributions in the form of cash, resources, and time to computer groups and educational organizations.

To really appreciate this man's talents, you have to visit his mountain-top house, which he designed and built himself. The house is an octagonal structure with features that include a swimming pool, three decks, solar heating, and a living room with a panoramic view of surrounding mountains and the Pacific Coast line all the way from Monterey, about 50 miles south of San Jose, to Point Reyes, about 50 miles north of San Francisco.

It is in this environment that the Faire is organized and managed. Jim's house and a couple surrounding buildings serve as headquarters of the Faire—the employees come to the mountain top.

Good Vibrations

To be sure, there are other big computer shows. The NCC (National Computer Conference) and COMDEX (Computer Dealer Exposition) are nearly as large as the Faire, but the Faire has the ultimate advantage of being a consumer-oriented event. Obviously, the Faire has a much larger potential draw than a show limited to people in the computer industry.

For that reason the Faire is the most electrifying of all personal computing shows. With street vendors standing outside its doors, robots running through its aisles, festive music spewing forth from computer synthesizers, people madly rushing about, balloons floating overhead, and literature tables piled high to the ceiling, the Faire has a definite carnival atmosphere. Several of my friends in the personal computer industry mentioned that they felt a sense of excitement in the air that was missing at other computer shows. A few complained that the Faire lacked dignity, saying that they prefer the more formal atmosphere of COMDEX or NCC.

Among the rows and rows of exhibits are not only major computer companies like IBM and Apple, but also start-up companies, computer clubs, video arcades, social action groups, computer bookstores, software companies, and numerous hands-on demonstrations. The Faire is both serious and fun.

To give our readers who were unable to attend the Faire a sense of what it was like, I went on a 2-hour tour of Brooks Hall and the Convention Center exhibit areas followed by photographer Phil Schermeister. During the tour, which took place Friday afternoon, the first day of the Faire, I visited the manufacturer of an IBM PC-compatible computer, chatted with members of a San Francisco-based IBM PC user group, got chased away from the IBM booth (their sales reps didn't like my tape recorder or my photographer), learned all about the Computer Professionals for Social Responsibility, discovered a $29.95 spelling checker for the IBM PC, bumped into a teenage project engineer standing in the aisle who was demonstrating an amazing sound synthesizer about the size of a cassette recorder, saw an unmarketed (and perhaps unmarketable) portable PC, talked to the cutest president of a software company you'd ever want to meet, who happened to be dressed in a space suit, and came across an ornery little robot named RB.

News From Compatibility Land

With photographer in tow, I pushed through the crowded isle in front of the Corona Data Systems booth. Corona recently announced two compatible PCs, a desktop unit and a portable. The desktop unit, which I am using to write this report, will be reviewed in the next issue of *PC World.* We haven't gotten their portable model yet. Corona, founded less than 2 years ago by Dr. Robert Harp and located in Westlake Village, California, also manufactures Winchester drives for the PC.

Buttonholing a Corona representative was easy enough, and on behalf of anyone interested in what appears to be well-engineered and highly compatible PC that sells at a significant discount from the IBM model, I asked Vice-president of Sales and Marketing George McMurtry the following questions.

DB: What do you want to tell our readers about the Corona PC compatibles that you're showing?

GM: We are shipping the desktop unit now, and we'll be shipping the portable unit soon. The Corona PC comes with 128K of memory, expandable to 512K without using any of the four expansion slots, and a half-size 320K disk drive. As far as compatability is concerned, we cannot be 100 percent compatible, nor can anyone, or IBM would sue. We are as compatible as we can be. We haven't found any programs that don't work yet, but I imagine there are a few that won't run on our machine. All the standard software, everything on the top-30 list, such as Lotus Development's *1-2-3* and Microsoft's *Flight Simulator,* have been tested. They all worked without problems.

The Faire has the ultimate advantage of being a consumer-oriented event.

DB: How would you compare your level of compatibility with the COMPAQ PC?

GM: I'd say it's about the same.

DB: What do you think of the IBM Personal Computer XT?

GM: We had that one pegged. We felt we knew exactly what they were doing with that product, and we hit it almost right on the nose as to what they were going to price it at. All they've done is come out with a hard disk version of the IBM PC. Our hard disk machine [Corona PC HD] has the same amount of memory as the XT—10 megabytes—and uses the same drive.

DB: Where do you see your main market, as far as the typical buyer is concerned?

GM: IBM has gone out to Sears and ComputerLand and a few selected dealers, and has less than 1000 authorized retail locations. We're not selling directly to the dealers; we're going to the regional, full-service distributors who offer sales support, training capabilities, and networks of authorized, independent dealers. Those dealers will be the outlets for our product and the front line of support. That's about 5000 locations, so we'll get our fair share.

DB: Do you have in mind capturing some percentage of the overall personal computer market?

GM: Yes, approximately 8 percent, but I can't produce enough units to grab 8 percent this year. I probably can next year and the year after that. The year after that, however, the product won't exist because something else will take its place.

Speculation and Words of Wisdom from IBM Users

The Corona booth was located in one of the wings of the Convention Center. Just outside the hall in the walkway was a row of miniature booths. One of them was occupied by the San Francisco IBM PC Users Group. I spoke with Rick Alber, editor of the group's newsletter, and Ray Young, newly elected president of the group.

DB: Can you tell us about the San Francisco IBM PC Users Group?

RA: We're the largest PC user group in San Francisco. We put out the best newsletter in the Bay Area, perhaps in the western half of the United States.

DB: You're referring to Blue Notes. *How many members do you have?*

RA: Climbing by the hour. Maybe around 110? We're expecting to double the amount this weekend.

DB: I wouldn't be surprised if you tripled it.

RY: Have you seen the Perfect Software exhibit?

DB: Yes, I thought it was an indoor US festival.

RY: I haven't walked in there yet. It looks rather ominous with all those glowing screens. It's like walking into space mountain, with the lasers and sounds.... Anyway, we've got ten user group library diskettes now, and various public domain software that seems to be circulating around the country.

DB: How often do you meet?

RY: We meet every third Monday. We have three speakers from IBM coming this Monday to talk about the XT and DOS 2.00. Maybe they'll be able to shed a little light on what's going on. I just came back from a couple of weeks of briefing in Boca Raton, so I thought it was nice to have them lined up for the first meeting after the Faire. They've got to be responsive to users and people who have fewer than 20 PCs.

DB: There's so much to know and learn, and it's very complicated.

RY: That's where user groups come in, filling in the gaps by collecting the information from IBM or finding out if they're unwilling to give out the information. Especially in the Bay Area, people who come to our user group meetings are in the field, involved in writing the software, putting together the hardware, and that sort of activity. We have a great information base to draw from in San Francisco. We've got a lot of new users who have never even touched a computer, and we've got people who've been programming in Pascal since it came out—so we've got quite a wide range.

DB: What do you think of the IBM announcement about the XT and DOS 2.00?

RY: What we really like about the XT is that it's not going to cut off people who already have a PC. The PC is going to be fully expandable up to the same capabilities as the XT. IBM could have gone with a completely different operating system or a different processor and left us out in the cold. At least they're thinking along those lines. We haven't heard enough about 2.00 to judge it. With 2.00 I imagine we'll all forget 1.10 before long. I suppose any of the software that runs on 1.10 will run on 2.00.

DB: You need more than 64K to run WordStar *on DOS 2.00, so it seems like people will be buying more memory.*

RY: In our user group we had a group buy on memory; we got 64K for $40, so there's no reason why anyone should have less than a 256K machine anyway.

RA: MS-DOS 2.00 for $60 is too much. There should be some kind of a deal for people to upgrade.

RY: Version 1.10 cost $40; $60 seems cheap, but after you do it three or four times a year, that's getting expensive.

DB: Do you think concurrency will put CP/M back in the picture as far as the IBM PC is concerned?

RY: Concurrent CP/M is really nice, but if all your applications run under MS-DOS, what choice do you have?

Computer Professionals for Social Responsibility

It turns out that Jim Warren gives small organizations like the San Francisco IBM PC User Group free exhibit space. This adds another dimension to the Faire and helps make it more than a commercial event.

Near the user group space was another organization that caught my attention. I spoke with Jack Kroll and Robert Henry of the Computer Professionals for Social Responsibility.

DB: Can you tell me about your organization?

JK: We are modeled after the Boston organization, Physicians for Social Responsibility. Like them, we are concerned about the threat of nuclear war and the buildup of nuclear weapons. As computer professionals we have a special responsibility to talk to computer colleagues and to help educate the general public about our concerns.

The computer plays a major role in our military and defense systems. Our military relies heavily on computers to warn us when there is a missile attack. New weapons systems that we're proposing in this country cut the lead time from about 30 minutes to 15 minutes or less. There have been instances when our computers indicated that we had an alert, missiles coming in, and it's been only human intervention that determined that it really wasn't the case and stopped our missles from being fired. As that time gap narrows we rely more and more on computers to make that decision for us, and that's our concern.

'We're working on ways to educate people, letting them know that there are people in the computer world who are indeed concerned.'

DB: I can appreciate that concern. What about computer professionals who work for the defense department and create computer systems. Do you encourage people to avoid that kind of work?

JK: No. We're educating mainly other professionals about our point of view.

RH: However, we've talked to people who work for the military contractors. They're generally receptive to what we have to say, but their bottom line is they have to have a job. There is an organization in Boston that encourages people coming out of colleges to interview with companies that are not involved in the military contract process. They operate an alternative employment agency in Boston, and they've had success. I think they've placed about 50 people so far.

We have not addressed that problem yet. Our interest is understanding the problem for ourselves and trying to find ways in which we can express to the general public our technical knowledge of what we feel is the unreliability of computers. We're working on ways to educate people, letting them know that there are people in the computer world who are indeed concerned. We are not nerds who do nothing more than program video games.

The Intersection of Art and Personal Computing

Although the Computer Faire is spread out over several halls and minihalls, conference rooms, loading docks, and hallways, it is ingeniously mapped out so that the aisles and passageways are broad enough to allow the heavy traffic to flow without bottlenecks.

My next stop was the main exhibit hall of the Civic Auditorium at the *BYTE* magazine booth where the major attraction was famed cover artist Robert Tinney, who was selling autographed reprints of his BYTE covers. Tinney's imaginative covers, done as paintings, are legendary in the personal computing business.

DB: How many covers have you done for BYTE?

RT: I haven't kept count. I imagine from 30 to 45.

DB: For a long time I've heard people talk about the BYTE *covers and how much they admire your work. Do you come up with these concepts?*

RT: Some of them I come up with, and sometimes it's between the *BYTE* editors and me. We throw the ball back and forth, and they'll come up with a suggestion. I do a series of sketches for them and we work it out.

DB: I'm always amazed at the quality and execution of the images and also at the cleverness of them.

> Each year at least one unique product comes out of this gigantic hornet's nest of technical hucksterism.

RT: I think one of the big advantages that I've had is that I'm not a computer person. I'm a commercial artist. I met Carl Helmers in Houston before he became the founding editor of *BYTE*. I got to be friendly with him, and he bought some of my original artwork. In 1976 Carl started *BYTE* in Peterborough, New Hampshire. Fortunately for me, he called me up and I've been with *BYTE* ever since. My perspective is a lay perspective. The result is that the covers are more conceptual than technical, and I think that makes it more interesting.

DB: The cover you did of the computer wristwatch with tiny floppy disks is the one I hear about most.

RT: That particular idea belongs to Chris Morgan, who was the editor-in-chief of *BYTE* and is now working at Lotus.

DB: That's wonderful. I think you've made a great contribution to BYTE.

RT: Probably not as much of a contribution as *BYTE* has made to me.

Welcome to the $29.95 Twilight Zone

After feasting on Tinney's classy images what should catch my eye but a crudely designed blue and white sign pronouncing the imminent availability of a $29.95 spelling checker for the IBM PC from a new Berkeley-based company called Berzurk Systems.

This could not go uninvestigated. I conversed with Ian Kettleborough about the program.

DB: Can you tell us about Spell-it.

IK: *Spell-it* is a new spelling checker, specifically for the IBM PC. It will be available on all MS-DOS machines in the future.

DB: How many words does it contain?

IK: It's got a 41,000-word literal dictionary, and you can specify up to 10 auxiliary dictionaries. You can also make unique dictionaries for your own applications.

DB: What about the $29.95 price—that seems extraordinary.

IK: That I think is the way a lot of software is going. It's the wave of things to come.

DB: Is this available by mail or through computer stores?

IK: Right now it's by mail order only. We're looking for distributors and dealers.

DB: Do you think that Spell-it *could be sold in bookstores?*

IK: Yes, especially if the price is kept down.

DB: I'll be looking for it next to Webster's Unabridged.

Hitting the Jackpot at the Faire

Each year, seemingly by divine deliverance, at least one unique product comes out of this gigantic hornet's nest of technical hucksterism. One new computer, piece of software, or marketing idea is such an instant hit that you know it's bound to become the stuff upon which Silicon empires are built.

As a perennial Faire observer I look for the one new product or marketing ploy that will rock the very foundations of our turbulent industry. On occasion, I have even found it.

At the 1977 Faire, for example, I was standing in one of the booths pushing *Personal Computing* magazine when editor Nels Winkless came running up excitedly saying, "David, you've got to see this."

PC World Day

Susan R. Keller

It was a Saturday just like any other, but there was a special excitement at the 8th annual West Coast Computer Faire. Twenty-six distinguished personal computer industry experts gathered to bat around their latest ideas with fellow members of the PC World Day seminars and to field questions from the audience that filled the auditorium.

The symposium sponsored by *PC World* featured five panel discussions open to Faire participants. Starting the day was "Systems Software for the PC" featuring Gary Kildall, President of Digital Research; Chris Larson, Director of Marketing for Microsoft; Gordon Bell, President of Quantum Software Systems, Ltd.; C. A. Irvine, Vice-president of Engineering for SofTech Microsystems; David Hughes of VRI Associates; and Kearney Rietmann, Associate Editor for *PC World.*

In discussing Digital Research's LOGO, Gary Kildall explained that the language was extended to be a complete programming environment that makes developing large programs, notation commenting, and workspace management facilities much easier. "We were able to do this with LOGO because we have a lot more space with the PC than with the smaller, 8-bit machines," Kildall explained.

With only a brief intermission after the first seminar, *PC World* President and Publisher David Bunnell headed another panel with the help of *PC World* Associate Publisher Cheryl Woodard. Also discussing "The PC Phenomenon" were Egil Juliussen, Chairman of Future Computing; Ronald Posner, Chairman of National Training Systems; and Martin Alpert, President of Tecmar. According to Alpert, the initial success of products such as Lisa and *VisiON* will be in their ability to emulate the office environment and work structure. In the long run, however, Alpert believes that the most important contribution these products will make will be in establishing personal computing as an integral part of the office environment.

With the help of Mitchell Kapor, President of Lotus Development Corporation and Gilbert Hoxie, President of Context Management Systems, *PC World* Associate Editor Harry Miller directed a panel discussion on "Second-Generation Software." Other panelists included Roy Folk, Division Marketing Manager for VisiCorp; Dr. Edward Currie, President of Lifeboat Associates; and Jeffrey Harbers, Associate Manager of the End-User Division for Microsoft. The panelists presented their projections on where the software market is headed in the future. "Second-generation software has a tremendous focus on ease of use and learning," explained Roy Folk, "but third-generation software will use mouse systems and third-party products."

The following panel focused on "PC Multiprocessing, Networking, and Communications." Participants included Harry Saal, President of Nestar; Bruce Eisenhard, Omni Project Manager for Corvus; Steven Pomeroy, Product Marketing Manager for 3Com Corporation; Knut Ojermark, EDP Audit Manager for Wells Fargo Bank; Drew Major, Software Systems Manager for Novell Data Systems; and *PC World* Technical Editor Steven Cook. Harry Saal summed up the panel's feelings with three reasons for having a personal computer network: to share peripherals, to share information between individuals, and to route information.

The final seminar, "PC Add-Ons," included a discussion on compatibility. Headed by *PC World* Editor Andrew Fluegelman, the panel also included William Murto, Vice-president of COMPAQ Computer Corporation; Robert Harp, Chairman of the Board of Corona Data Systems; Martin Alpert, President of Tecmar; and Karl Koessel, a Contributing Editor for *PC World.* To one manufacturer, the biggest problem in designing a PC-compatible computer was deciding on a definition of compatibility and then adhering to that definition while designing that PC-compatible machine. "We knew we had to take full advantage of as many of the standards set by the IBM PC as possible," said COMPAQ's William Murto, "including software, hardware add-ons and add-ins, documentation, quality, and human interface."

After 7 hours of far-reaching discussion, industry experts clearly emphasized product improvement for ease of use and learning as a primary concern.

If you missed the PC World Day symposium and would like to hear the panel discussions, cassette tapes are available. Send a check or money order to Cassette Services Co., 19745 Oakmont Dr., Dept. PCW, Los Gatos, CA 95030. Send $7.95 for each session or $34.95 for all five. Please include 75 cents per cassette (up to $5) for shipping and handling.

I dropped everything, leaving the booth unattended, and followed Nels. He took me to a computer store booth where we had to elbow our way through a small mob of people to see a new computer that has since changed the face of the planet. "Ain't that neat," Nels said. He was referring, of course, to the world's first Apple II.

On another occasion I was introduced to Dan Fylstra, who said he was a software publisher. Fylstra directed me to a a small room on the fourth floor of the Civic Center to show me something interesting that he called *VisiCalc*.

"What do you think of this," I remember him saying as I stood there thinking that I must be dreaming. It was such a wonderful idea; you just knew it had to be going places.

With this historical perspective always present I was on the lookout for that revolutionary new product that would make a name for itself. In fact, it was just as I was thinking of this when I ran into a scruffy blond kid standing in the middle of the aisle playing an amazing variety of zippy, eerie sounds through a miniature sound synthesizer strapped over his shoulder. There was a sizable crowd of curious people gathered about as a I recorded this interview with the "kid," composer/project engineer Steve Innes.

DB: What is this thing?

SI: Sci Fi 2. It does all sorts of different sound effects. It can do frequency sweeps, phase-shifter sounds, exponential sweeps, dualtones, and multitones. It can do all sorts of telephoning formats, morse code to ASCII, and it can translate talk to people in the deaf teletype network.

You can talk to computers directly at different baud rates, originate ads, plug it directly into your computer, download and upload, plug it into a TRS-80, download and upload, convert between TRS-80 at different formats and, of course, Morse code translation. You can send at any speed, from hundreds of words per minute to very slowly.

DB: What exactly is this product you're showing?

SI: It's a lunar crooner.

DB: Is this something that you made?

SI: Yes, it's a portable computer music synthesizer.

DB: That's fabulous. Are you selling them?

SI: I think I'd better.

DB: I think so too.

Life after Kid Innes

Trying to talk with the kid genius took my breath away. If he's for real, he may be going places.

I needed to speak to someone from the straight business community, like a solid IBM-compatible product company, just to keep in touch with the planet. Apparat, of course, I thought. I spoke with Jason Matthews, who showed me two intriguing new products: a half-sized 5¼-inch disk drive (so that four drives can fit in the same space now occupied by two) and a monitor that can fit into the drive enclosure to turn your PC into a portable unit.

DB: Tell us about these half-sized drives.

JM: They come double-sided, double-density with 320K of memory and cost about the same as a Tandem single-density, which is about $315. You can install up to four of them.

DB: Can you show us your portable monitor?

JM: This is our new idea to make the IBM a fully portable computer.

DB: Can you turn it on and show it to us.

JM: Well, it goofs up a little bit right now, but I can get it going. We also have a carrying case for it.

DB: What does the portable cost?

JM: We really don't have a cost at present. We're test marketing it right now and drawing reactions. The keyboard lies here, with plenty of room for cables, and the PC stands here.

DB: How many characters per line on the screen?

JM: It's a full 80 by 25 screen.

DB: That's a very interesting idea. What's the reaction of the people who have seen it at the show?

JM: Some amusement, some shock, and some very interesting counter ideas. People seem to like it a lot, but at the same time they don't want the thing to turn into an Osborne. But it's totally different. It is driven off the color graphics board, which means that I can run this monitor and the standard monitor at the same time if I have to. For example, if you go into your hotel room and you want a larger monitor, no problem—plug it in, that's all there is to it.

DB: It's really a new concept in portability.

Into the Wild Blue Yonder

Feeling that I had more than enough material for this article, I motioned to the photographer, and we headed back toward the *PC World* booth. Along the way, however, I bumped into two unusual women who I couldn't resist interviewing. The first was wearing a vinyl space suit with the words *Air Force* blazoned across it.

DB: Are you really in the Air Force?
AF: No.

DB: Can we take your picture?
AF: Sure.

DB: What company are you working for?
AF: Avant Garde Creations. I'm Mary Carol Smith, and I'm the president.

DB: And you sell a flight simulator?
AF: No, we sell a video game called *Jump Jet*.

DB: What does Jump Jet *do?*
AF: It's our answer to *Chop Lifter*, I guess.

DB: How does it work?
AF: You have your loyal forces, a fleet of ships including your mother ship. There are some kamikaze pilots that you have to destroy. When you get to the end of the game, the head of the other forces either surrenders to you or, if you haven't completely destroyed your enemies, they come out and bomb you.

DB: Is this going to be on the IBM PC as well as the Apple?
AF: We have plans to have it on the IBM, but right now it's just on the Apple.

DB: Do you have timetable for when it will be on the IBM?
AF: It'll be a few months, at least.

DB: Thanks. I'm sure our readers can't wait.

Who's that Little Guy Following You?
No sooner did I end my conversation with the Space Lady than who did I run into but the Robot Lady, Sharon Smith of RV Robot Corporation. No computer show would be complete without a robot, and this one, RB, though he can't yet talk, is one of the best I've seen.

DB: What does this robot do?
SS: It's for educational and experimental purposes at this point.

DB: Why would somebody buy one? What would they do with it?
SS: It's completely programmable, so it's ideal for studying programming. Rather than having a beginning programmer see things happen on the screen, he or she can actually make this robot do something. It's a mobile, three-dimensional product. The programmer can see the proof of his or her labors.

DB: How does it sense that it's approaching an object?
SS: It has a sonar detector on the front and eight tactile sensors around the bottom.

DB: So if you touch one of these sensors, it causes a reaction.
SS: The program that's loaded into it now tells it to move in a forward motion. The other thing that's interesting about this particular product is that it learns.

As a perennial Faire observer I look for the new product or marketing ploy that will rock the very foundations of our turbulent industry.

DB: It keeps running away from you. It's not very well behaved yet.
SS: It has the rudiments of artificial intelligence, and it learned earlier today that a 45-degree left turn when it meets an object allows it to keep moving. When a 45-degree left turn doesn't work, however, it resorts to random response.

DB: Amazing—it turns differently according to the situation that it's in.
SS: Right. It remembers its environment—it remembers successful responses—but if those successful responses don't work time and again, it resorts to random response.

DB: Are you going to add other features to it?
SS: Yes, we have an arm under development and data telemetry is also under development. A robot that has learned its environment, for example, will be able to communicate that information directly to a second robot; the second robot won't have to relearn the same environment.

DB: I can't wait to try one.

Back in Safe Harbor
Upon returning to the *PC World* booth, I was deluged with the usual questions from subscribers and advertisers. We had traveled through only a very small section of this marvelous event. The West Coast Computer Faire has such richness that I could do this again and again and it would never be redundant.

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Codes, Ciphers, and Computers: An Introduction to Information Security (Bosworth) Describes the fundamentals of secret communication and provides an understanding of computer security through cryptography. Details and illustrates traditional cryptography techniques developed before computers, and discusses more recent concepts for the highest levels of information and data security. **#5149, $14.95**

Microcomputer Systems: Hardware / Software Design (Blasewitz and Stern) Emphasizing the design and integration of microcomputer systems and peripherals, this book offers a complete look at the world of microprocessor design and application. The book zeros in on information needed to become proficient in the design and use of microcomputers. **#5123, $27.50**

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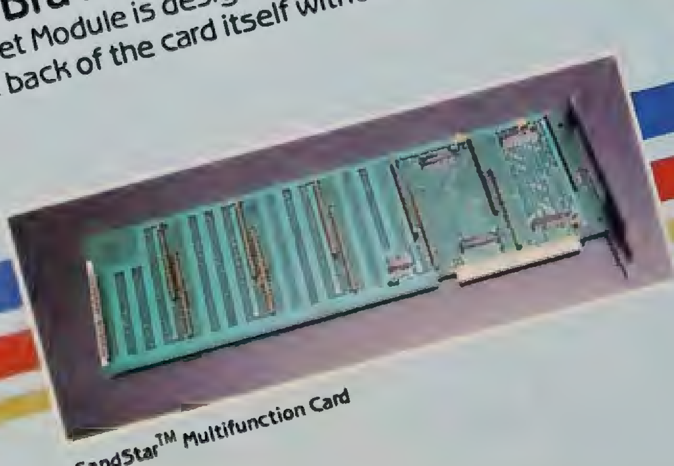

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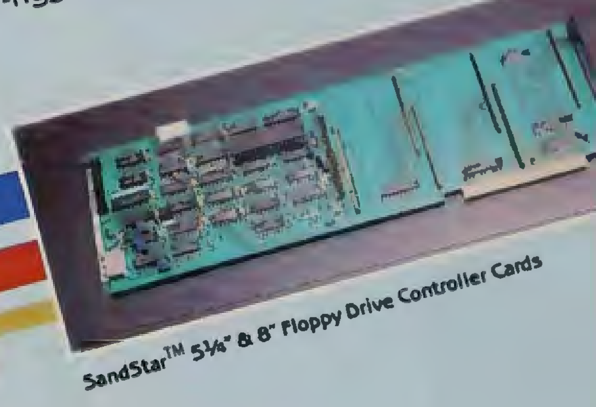

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A> I DO

Something old, something new—the first on-line wedding

Owen Findsen

There have been weddings on water skis, weddings under water, and weddings in free-fall. It is probable that there have been weddings on 10-speed bikes and weddings while jogging. Weddings taking place under novel circumstances seem to be a fair indication of a new craze about to sweep the nation; whenever a game, sport, or pastime reaches fad proportions, some couple is bound to want to be the first to be married doing whatever it is that's currently trendy.

On February 14, Valentine's Day 1983, the first wedding via computer took place in Grand Prairie, Texas; Oakland, California; Columbus, Ohio; Ottawa, Ontario; and dozens of other cities across the continent. The wedding was held on CB Simulator, a telephone-linked computer network that is a service of the CompuServe Information Network. If the rule of novel weddings holds true, CB Simulator will be the next fad to sweep the nation—a teletext version of the citizens band (CB) radio fad of a few years back. Before long we'll probably be hearing country and western songs about CB Simulator, wearing T-shirts with slogans about it, and watching a made-for-TV movie about a CB Simulator love affair.

Only one CB Simulator wedding has taken place so far, but there have been a number of romances and countless flirtations. There seems to be something curiously amorous about chatting with distant strangers via keyboard, monitor, and modem. The computer revolution may turn out to be more emotional than anyone ever imagined. "If this is the first CompuServe wedding," one wag observed, "how long can it be before the first Radio Shack-up?"

Personal Computing (Very)

CB Simulator is designed to be similar to CB radio. Users log on to any of a number of channels and use "handles" rather than their names for identification. CB Simulator differs from CB radio in that the hookup is nationwide rather than limited to a few miles around an individual's radio. In addition, using a keyboard rather than voice communication seems to make users feel more confident about saying what's on their minds.

"It gets pretty wild at times," said Rae Lynn Stephens of Arlington, Texas, whose handle is "Canoeist." Stephens is a friend of "Silver," the computer bride, and was responsible for the on-site arrangements for the wedding. "When everybody's got a handle, there's no way to know who is male and female and who is married or unmarried. So people feel each other out by asking questions. Once they think they've got you pegged, the questions get more and more personal. Then they're asking you to switch over to the private conversation channel so they can set something up to meet you.

"I'll start talking about what *we* are doing and they see the *we* and figure out that I'm married. Still, it's a great way to flirt."

People play all kinds of games over CB Simulator. They arrange complicated games of Dungeons and Dragons. They attend imaginary parties—hot tub parties are particularly popular. Sex is an important topic of conversation, with people typing things into their keyboard that they would never say if anyone knew who they were. CompuServe does monitor and can jam a transmission if somebody gets too crude, but almost anything goes and people freely indulge in romantic fantasies.

Long-distance Love

"It all started as a joke," explained Silver, who is really Debbie Fuhrman and works for National Car Rental at the Dallas Fort Worth Airport. "It wasn't going to be a real wedding." Her partner in the joke was George Stickles, whose CB handle is Mike. George is the manager of American

```
(CHRISDOS,CBIG SYSOP) THE WEDDING OF <MIKE> TO <SILVER>.......
(CHRISDOS,CBIG SYSOP) PERFORMED BY THE REV. TIM PAYTON....
(CHRISDOS,CBIG SYSOP) REV. PAYTON:
([ MINISTER ]) WE HAVE COME HERE ON THIS VALENTINES DAY TO UNITE
      THIS MAN AND THIS
([ MINISTER ]) WOMAN IN HOLY MATRIMONY.
([ MINISTER ]) MARRIAGE IS ONE OF THE MOST IMPORTANT MOMENTS IN
      LIFE AND SHOULD
([ MINISTER ]) NOT BE ENTERED INTO UNADVISEDLY OR LIGHTLY BUT
      DISCRETELY AND
([ MINISTER ]) SOBERLY. MARRIAGE IS ALSO ONE OF THE MOST JOYOUS
      OCCASIONS
([ MINISTER ]) IN OUR LIFE AND SHOULD BE A TIME FOR MUCH
      HAPPINESS.
([ MINISTER ]) SO PLEASE JOIN YOUR RIGHT HANDS AS WE STATE THE
      VOWS.
([ MINISTER ]) DO YOU GEORGE TAKE DEBBIE TO BE YOUR LAWFUL WIFE
([ MINISTER ]) AND DO YOU PROMISE BEFORE GOD
([ MINISTER ]) TO LOVE HER,COMFORT HER, HONOR AND KEEP HER IN
      SICKNESS AND
([ MINISTER ]) HEALTH
([ MINISTER ]) SO LONG AS YOU BOTH SHALL LIVE?
([ MIKE & SILVER ]) MIKE: I WILL
([ MINISTER ]) DO YOU DEBBIE TAKE GEORGE TO BE YOUR LAWFUL HUSBAND
([ MINISTER ]) AND DO YOU PROMISE BEFORE GOD
([ MINISTER ]) TO LOVE HIM, COMFORT HIM,
([ MINISTER ]) HONOR, AND KEEP HIM IN SICKNESS AND IN HEALTH
([ MINISTER ]) SO LONG AS YOU BOTH SHALL LIVE?
([ MIKE & SILVER ]) DEBBIE : I WILL
([ MINISTER ]) DO YOU GEORGE GIVE THIS RING TO DEBBIE AS A TOKEN
      OF YOUR
([ MINISTER ]) LOVE FOR HER?
([ MIKE & SILVER ]) MIKE : I DO
([ MINISTER ]) IN THE PRESENCE OF GOD
([ MINISTER ]) CONSENTED TOGETHER
([ MINISTER ]) TO BE JOINED IN THE BONDS OF MATRIMONY I NOW,
      ACCORDING TO
([ MINISTER ]) THE ORDINANCES OF GOD AND IN THE NAME OF THE STATE
      OF TEXAS,
([ MINISTER ]) PRONOUNCE YOU HUSBAND AND WIFE.
([ MINISTER ]) YOU MAY KISS THE BRIDE
([ MIKE & SILVER ]) [[[[[[[[[[[[[[[[[[[ KISS ]]]]]]]]]]]]]]]]
```

The Ceremony

(The following has been edited.)

```
(SCOOP) <<<FLASH>>>>
(FARQUOR-ORGANIST) ALL==> (BRIDAL CHORUS.......)
(GANDOLF-USHER!) ALL RISE
(THE 34 KID) MAZEL-TOV
(BERSERKER) (RISING)
(*:JASMINE:*) <WIPING EYES>
(LOOLOO) I LOVE YOU BOTH!
(MOM AND DAD OF BRIDE) CONGRATULATIONS GUYS
(..ZIPP..) <SNIFF><SNIFF>
(*=>POLISH PRINCE<=*) (ROYALLY RISING)
(GANDOLF-USHER!) CONGRATULATIONS***************
(WIZ OF KESMAI) WHAT'S HAPPENING?
(ADMIRAL JAMES T KIRK) STANDING AT ATTENTION
(SCOOP) <<<<FLASH>>>>>
(MARGARITA) I TIP MY GLASS TO YOU
(*:JASMINE:*) CONGRATULATIONS!!!
(WIZ OF KESMAI) SOMEONE GET MARRIED?
(HALEH ISFAHANI) A TOAST TO THE BRIDE AND GROOM!!
(FARQUOR-ORGANIST) ALL==> (DA DA DE DEEE DA DA...)
(*:JASMINE:*) <THROWING RICE AND BIRDSEED!>>>
(NANCY) YES, WIZ..  RIGHT HERE ON CB
(CHRISDOS,CBIG SYSOP) ALL=> WEDDING MESSAGES MAY BE LEFT IN
     SECTION 3 OF CBIG !!
(HALEH ISFAHANI) (SNIFF) I ALWAYS CRY AT WEDDINGS!
( [<<>>] - CATERER ) ALL THE TABLES ARE SET UP
( [<<>>] - CATERER ) FOOD IS WAITING
(CUPCAKE <BRIDESMAID>) MIKE AND SILVER--BEAUTIFUL CEREMONY!!!
(POSTMAN IN TUX) YUM!!! WHERE?
(ZFLYR<HONEYMOON EXPR) DRINKS ARE IN ORDER!!!!
(FARQUOR) ALL=> RRRRRIIIIIIIIIICCCEEE  "" ""'  '''"''"''   ' '
(APOLLO 18) BEST WISHES FROM SEATTLE.......
(*:JASMINE:*) M & S==>BEST WEDDING IN YEARS!
(GANDOLF-USHER!) WE ARE TOUCHED....AND DRUNK!
(MARGARITA) HERE HERE
(*:JASMINE:*) .*.*.*.*.*.*.*.*.*.*
(CHRISDOS,CBIG SYSOP) SPEECH
(CHRISDOS,CBIG SYSOP) SPEECH
(MOM AND DAD OF BRIDE) SPEECH!!!!
(*:JASMINE:*) FARQ==>MY RICE LOOKS LIKE THIS .*.*.*.*.*
(CHRISDOS,CBIG SYSOP) CHAL => I WANT 8X10 GLOSSIES
(FARQUOR) ALL==> """-_-_-_----"''''_-''''''''''<RICE AND
     ITALIAN ALMONDS.>
(CHALLENGER [PHOTOG]) CHRIS==> YOU GOT 'EM!
(ZFLYR<HONEYMOON EXPR) <><><><><><><><><><><><
(LOOLOO) MIKE AND SILVER: COMPUSERVE IS GIVING YOU YOUR
     CONNECT TIME THIS EVENING!!!!!!!!!
(SCRUT (DRESSED IN SU) TO MIKE AND SILVER ON THEIR DAY OF
     UNITING...
([ MINISTER ]) THX AND NIGHT ALL!!!!!
(MOM AND DAD OF BRIDE) THANK YOU MINISTER
([ MANAGER (WITNESS) ) ____COPIES OF GUEST LIST ARE AVAILABLE___
(CUPCAKE <BRIDESMAID>) GNITE MINISTER!
(SCRUT (DRESSED IN SU) <<< RAISE GLASS>>
(NEWLYWEDS) THANK YOU EVERYONE!!!!!
(T.J.HOOKER) GOOD LUCK MIKE & SILVER::::::::::::::::::
(** PSYDOC **) THREE CHEERS!   HIP, HIP, HOOORAY!
(HALEH ISFAHANI) NEWLYWEDS==>THANKS FOR SHARING THIS MOVING
     OCCASION WITH US ALL!!
([ MANAGER (WITNESS) ) HOORAY!
(POSTMAN IN TUX) HOORAY!!!
(NANCY) SO, CHRIS...  ARE YOU PLANNING TO GET MARRIED THIS WAY?
(HORTO) WHERE IS THE RECEPTON?
(<<ONJ>>) GOOD LUCK MIKE AND SILVER!!
(- BLIP -) A GIFT TO NEWLYWEDS:   OUR FRIENDSHIP AND SUPPORT!
(MARGARITA) BEST WISHES MIKE & SILVER!
(HALEH ISFAHANI) GOODNIGHT, AND BEST WISHES FOR A LONG AND HAPPY
     MARRIAGE!!!
```

The Reception

Photocopy in Grand Prairie, Texas, where the actual wedding took place.

Debbie started chatting over CB Simulator last summer when she was living at home with her parents in Phoenix. She had plenty of flesh-and-blood dates, but she preferred the kind of people she was meeting on the computer monitor. "I called myself Pretty Lady at first," Debbie said. "That way I could get lots of guys to talk to me." After a while she found herself talking to Mike more than to anyone else, and Mike started getting jealous of the other handles he saw on the screen. "He made me change my handle," Debbie said. So Pretty Lady became Silver. Silver and Mike were so much in love that, although they had never met, they conducted a pretend wedding over CB Simulator.

"That was back in October," said Silver. "We were just kidding around, inviting all our friends to a computer wedding. It was so much fun that when Valentine's Day was coming up, we thought we'd do it again."

> The computer revolution may turn out to be more emotional than anyone ever imagined.

But by then things had changed—Silver and Mike had finally met in person, and Silver had moved to Dallas to be near him. "They were running up an awful bill on CompuServe," Rae Lynn Stephens said, "so Debbie came down over Thanksgiving to meet George, and that's all it took."

Stephens said that George (Mike) is "a real card. You can never tell what he's going to do next." What he and Debbie did next was issue invitations to a Valentine's Day wedding over CompuServe, just as a joke. But at CompuServe headquarters in Columbus, Ohio, they didn't know it was a joke. One of the people who was to be in the wedding was "LooLoo," and LooLoo is Pat Phelps, CompuServe publications manager. LooLoo was to be matron of honor. She had seen the opportunity for publicity and had already alerted the press about the first computer wedding. It was on Thursday afternoon that Silver and Mike first realized that they were getting married—really getting married—on Monday.

"I guess we would have gotten married, a regular wedding, sometime in the spring," Debbie said. "We really hadn't talked about it." Asked if her father was paying the CompuServe tab for the wedding service, Debbie said, "No, but he promised to buy the paper for the printouts." Debbie sets the CompuServe bill for the courtship at about a thousand dollars.

The press was expecting a computer wedding, but not between Silver and Mike. A news story in the *Chicago Tribune* was getting lots of attention. The romantic pair was "Chrisdos" and "Zebra 3." Chrisdos is Chris Dunn, a computer technician from New York City, described as a shy loner. CB Simulator was ideal for Chrisdos; even though he was still always alone, through his computer he had hundreds of friends, including Pam Jensen, an animal keeper at the Chicago Lincoln Park Zoo. Pam is Zebra 3, and although her favorite gorilla, Sinbad, is quite broken up about it, Chrisdos and Zebra 3 have become quite an item on CB Simulator.

Modem Marriage

But Silver and Mike beat Chrisdos and Zebra 3 to the altar, or to the keyboard in this case. The affair was set for 9 p.m. Texas time. The bride and groom shared the same terminal, while in another room the minister officiated on a separate terminal. Chrisdos acted as master of ceremonies, keeping the chatter under control. To keep out troublemakers, the ceremony was scrambled and only those who had been given the password *lovein* were on-line for the ceremony.

It began with casual conversation on an open channel, but as the 9 p.m. wedding time approached things got more serious. Fewer people were chatting. Most were "lurking," or watching without talking. Anyone who is on-line with CB Simulator can contribute to the conversation by typing up to 80 characters on their keyboard. Pressing ENTER sends a comment through CompuServe's Columbus computer and onto everybody's screen. Typing garbles a line or two of the typist's screen, but the message comes up neatly on other screens, preceded by the channel number and handle.

As a newspaper reporter, I had been invited to observe from the offices of Sive Associates, the Cincinnati-based advertising agency for CompuServe. We observed on a 40-column color monitor that displayed blue capital letters on a yellow background, lending a circus atmosphere to the proceedings. An 80-column monochrome monitor wedding would have been more dignified.

As the wedding approached, the screen looked something like this:

CHRISDOS) All right everybody, lurk
LOOLOO) A hush falls
HEAVY BREATHER)
ZULU) Where are the bride and groom?
MIKE) Awaiting
ZULU) Who's got the ring?
GANDOLF) I've got it
CHRISDOS) Organist?
ZULU) Dum dum dee dum dum dum dee dum
HEAVY BREATHER)
MINISTER) We have come here on this Valentine's Day to unite this man and this woman in holy matrimony.

With the exception of the "Heavy Breather" poking his ENTER button from time to time, the wedding went without a hitch. After the ceremony there were [[[HUGS]]] and

[[[KISSES]]] for the bride and groom and many on-screen SOB and SNIFF messages. Zulu typed, 'Love your dress, honey.'

In Phoenix, Silver's parents typed in their congratulations. In Columbus, matron of honor Loo Loo was attending another, conventional wedding, but took time out at the reception to watch a monitor as Silver and Mike typed their vows. Mike and Silver were envious when they heard that their guests at the reception in Cincinnati were drinking champagne.

There was television and press coverage in Cincinnati, and Silver was interviewed via keyboard on the 11 o'clock news. Another TV crew was taping at Silver's parents' house in Phoenix.

After the ceremony a user check showed 66 computer terminals online, from Seattle and Oakland to Fort Lauderdale and Quebec City. The names of the cities scrolled on and on up the screen. The joking was over. People began signing off or turning to other on-line services. A happy wedding party dissolved into dozens of lonely individuals across the continent sitting in the silent glow of their monitors.

Silly? Perhaps. Undignified? Maybe. There are those who will say that this small event is an example of how the computer is dehumanizing our lives, turning us into machines. But that's not what I saw. I saw people using computers to expand their horizons, to reach out to each other. The machine was never in control. It was a vehicle to put people in touch in a new way but for the same old reasons, love and understanding. Silver said that she won't miss talking to Mike on CB Simulator. Now they'll sit together at the computer terminal and talk to others.

Owen Findsen is a reporter who writes about computers for the Cincinnati Enquirer.

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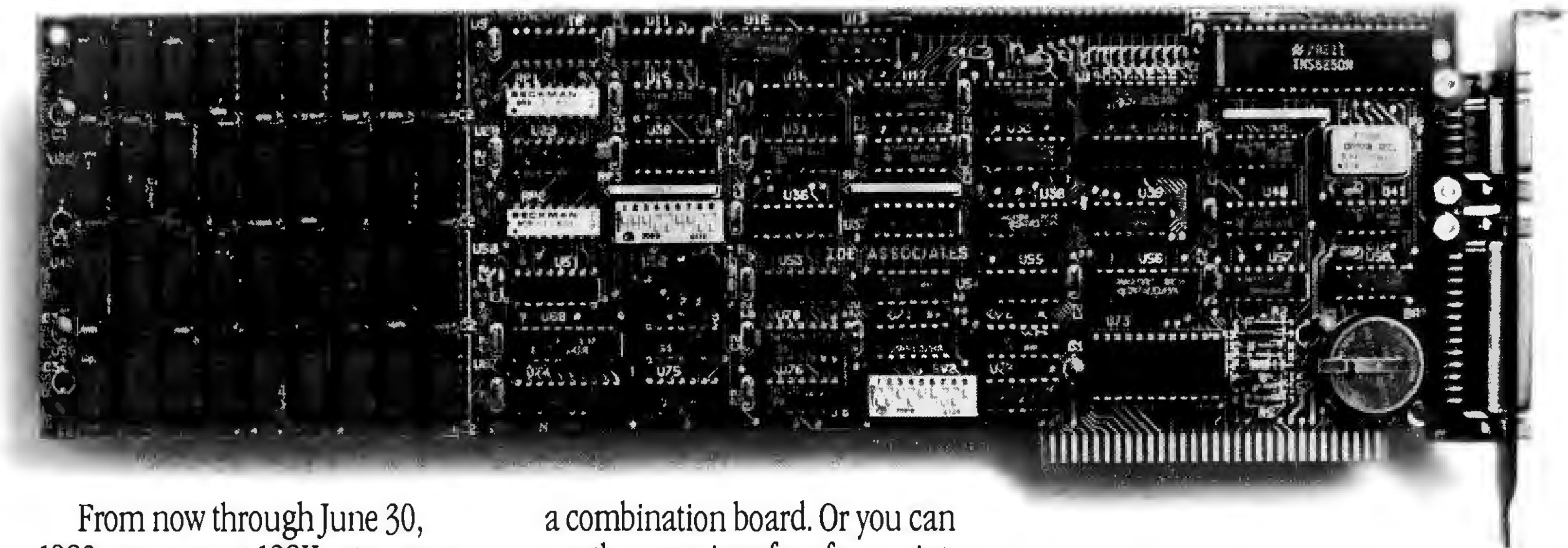

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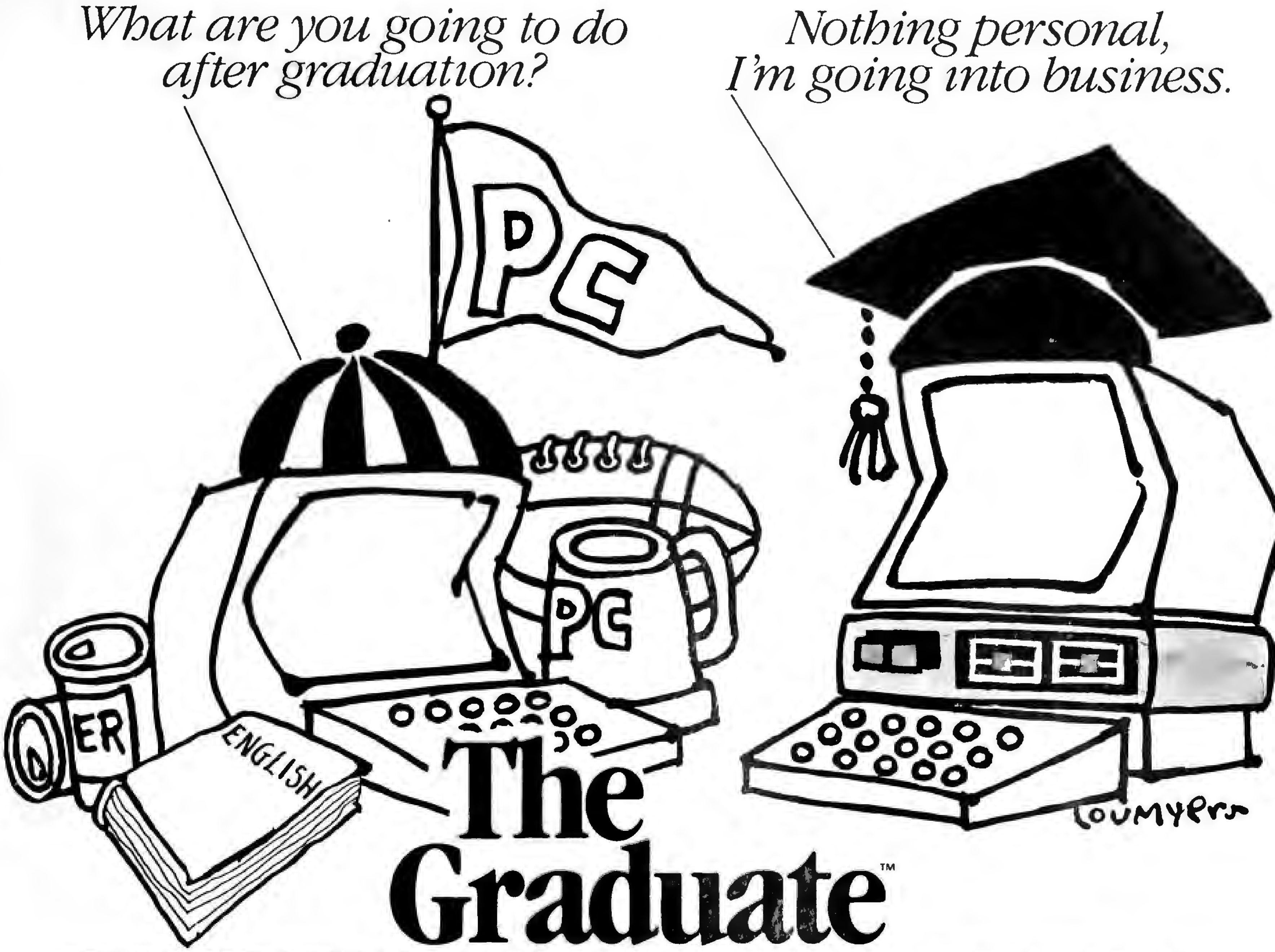

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Purchasing Computer Power

Use a four-step outline to weigh the cost versus the benefits of memory or storage expansion for a small business.

Mark Phillips

In a world where successful businesses are made or broken by relatively small changes in productivity, the benefits provided by storage and memory expansion devices for the IBM PC can be critical. Many manufacturers have entered the field with hardware and software products ranging in price from under $100 to several thousand dollars. These products include hard disks for storage expansion, RAM boards and electronic disk emulation software for memory expansion, and software utilities such as print spoolers for increased flexibility.

The Business Plan

Choosing the best storage and memory expansion devices for a company is difficult enough for those who are knowledgeable about computers. But the choice is more difficult for the typical business person who is unfamiliar with the latest hardware and software developments. He or she must research technical information as well as balance business requirements against budgetary restrictions.

In general, purchasing additional storage for the PC should be approached in the same way as purchasing any large fixed asset; while not as large as some investments, storage devices such as hard disks carry the same kinds of long-term consequences.

Determining the fixed assets a company needs most requires an understanding of a firm's general business plan, methods of operation, predicted growth, and future markets. Surprisingly, many companies, both large and small, neglect to formulate a plan before plunging into business. However, this plan is the key to successfully understanding a company's goals and determining where improvements in productivity are most needed.

The Decision Process

Once the business plan is established, the next step is to establish a logical procedure for choosing appropriate storage devices. Doing so requires following a specific outline in order to identify what a business expects to achieve with storage and memory expansion and to determine the most cost-effective purchase. The outline should include the following four steps:

1) *Analyze the features of the various storage and memory expansion devices.* Businesses can choose among a number of products to enhance the productivity of the PC. Roughly, these devices fall into three categories: hard disk drives capable of mass storage, increased RAM capacity and multifunction RAM boards, and special software utilities such as print spoolers that allow the PC to perform several tasks simultaneously (see Table 1). A more detailed discussion of these products will follow later.

2) *Examine the nature of the business.* Does the firm require access to and storage of very large numbers of documents, customer files, or similar data? If so, a hard disk would be a good choice because of its large storage capacity. Does the company use software (such as *WordStar*) that returns frequently to a disk drive for program instructions or additional data? If so, memory expansion with RAM boards and electronic disk emulation software might be the wiser choice.

3) *Consider the office environment and the employees who will use the storage devices.* Are space, noise, or aesthetics critical? Who will operate the PC? Is there a sufficient budget to cover the cost of the device and possible training? Is there more than one PC or are other units a future consideration? Does the business work with copy-protected programs that can't be transferred to a hard disk?

4) *Create and implement a comparative rating system.* This system should evaluate the business requirements determined in the previous two steps against the advantages of each product analyzed in the first step. Budgetary restrictions must also be considered at this point.

Hardware and Software Options

Researching the alternatives for storage and memory expansion to determine the most cost-effective options for a business requires substantial time and effort. After considering the benefits and disadvantages of each option, discuss the final contenders with a knowledgeable salesperson or consultant.

Hard Disk

For the company that manages a great deal of information, a hard disk provides the greatest benefits. Although it's usually the most expensive addition to a computer system (typically $1500 to $3000), the hard disk offers tremendous amounts of storage, is relatively easy to use, and operates more rapidly than floppy disk drives. If used as a centralized disk from which information is shared, a hard disk can support several computers in a network.

Some hard disk drives for the PC can be installed internally (in place of one of the regular floppy disk drives). An internal hard disk significantly reduces the fan noise of external units and makes efficient use of space in smaller offices. External units are mounted in cabinets designed to complement the PC's styling. Tecmar offers a subsystem cabinet that is identical to the PC system unit. Inside are a separate power supply, additional expansion slots, and the hard disk drive in either 5- or 10-megabyte versions. Two alternatives are the new XT, which comes with a hard disk installed, or the IBM hard disk expansion unit for both the PC and the XT.

Computer consultants report that businesses frequently forget about data backup. This issue becomes important when you are dealing with the large amount of data stored on a hard disk. Critical data may be next to impossible to duplicate without a backup system. One consultant says that some of her clients had thought they could effectively rely on floppy disks to back up data from a hard disk. They had never stopped to realize how much time and energy this backup method would take each day. Various backup systems are available. Corvus has designed a system that stores backup data on a videotape recorder.

Increased RAM

The memory expansion obtained with RAM boards is cheaper and more easily accomplished than the storage expansion a hard disk provides. Anywhere from 64K to as much as 512K can be obtained on memory expansion boards for the PC. Prices range from $200 to $1000. The additional memory is helpful with many programs. With more memory, for example, *WordStar* performs print spooling and block moves more efficiently, and *VisiCalc* produces larger spreadsheets. An added benefit of RAM boards is that they don't use desk space.

Many manufacturers include electronic disk emulation software free or at a nominal charge with the purchase of a RAM board. This software addresses available memory just like a disk drive. Electronic disks function with much greater speed than mechanical disks. One risk involved in using electronic disks, however, is that all stored information is erased if the power fails or is turned off. As a result, data must be transferred to some other medium or it will be lost.

Electronic disk emulation is especially useful to businesses that have heavy word processing demands, because it allows faster access to data than mechanical disks. Even mass mailings on a limited scale can be handled when appropriate mail-merge software and an address list are loaded onto the electronic disk.

Competition has brought multifunction RAM boards into the picture. With only five slots in the PC main system unit, expansion space is at a premium. Adding combination boards is an easy way to ensure system growth in the future, and they usually don't cost much more than boards containing RAM alone.

Software Utilities

Perhaps the most cost-effective purchase for increased productivity is a multitasking program such as a print spooler, which dumps a file to be printed into memory and frees the PC to handle other chores. This type of software usually costs under $100, so it should bring an immediate return on the investment as a result of time and salary savings. Using multitasking programs in conjunction with RAM expansion should further increase productivity.

Rating System

To decide which method of storage and memory expansion is likely to bring the highest return on your investment, use a comparative rating system. First, list the hardware and software options under consideration and then your business goals in order of priority. Assign a weight to each goal according to its priority. Out of four priorities, for example, the highest priority receives a weight of 4, the next highest a weight of 3, and so on.

Hard Disk

Access time faster than floppy disk drive

Flexible, relatively secure mass storage

Easy to connect and operate

Requires extra controller board and modification of PC-DOS to address hard disk

Backup more difficult than floppy disks (can use removable cartridge, cassette tape, and videotape)

Large external units require additional office space; internal units replace one floppy drive inside PC chassis

Some units may have objectionable fan and operating noise

Can operate in a network environment

Illegal to transfer copy-protected programs to hard disk

Expensive: $1795 to $5000

RAM Board

Extremely rapid access (faster than hard disk) to electronic storage; certain programs (*WordStar, SuperCalc*) will operate more rapidly

Data stored in RAM subject to loss through power outages

Easy to operate

Easy to copy data to other medium (floppy disk or hard disk)

No desk space required

Quiet; fully electronic

Other functions (clock/calendar, additional printer ports) combined on some boards

Electronic disk emulation and print spooler software increase flexibility

Moderate Cost: $200 to $1000 (depending on optional functions such as clock/calendar and printer ports)

Electronic disk emulation software free or at a nominal charge with purchase of RAM board

Software Utilities

Permit multitasking such as print spooling

Operation easy and fast; improve productivity and speed of office tasks

Quiet

Inexpensive: $40 to $150

Table 1: Business Considerations for Hard Disk, RAM Board, and Software Utilities

Next, assign a score to each option according to its ability to achieve your goals. For example, if mass storage takes your number one spot, give the hard disk the highest score, say a 10, and the other devices proportionally lower scores. If speed and ease of operation weigh more heavily in your business, give the high score to RAM expansion. Do the same with each business goal.

To produce a score that reflects the importance of each option in relation to your business goals, multiply the assigned weight of a goal by the assigned score of an option. Total the scores and see which option brings the greatest benefit.

Finally, decide which of the highest-scoring devices are most affordable. If the top-scoring choice exceeds the budget, consider the second choice or a combination of less expensive alternatives. The process of elimination will determine the most beneficial, cost-effective options for your business.

The following discussion takes the hypothetical XYZ Company through an analysis of the best hardware and software options to meet its business requirements.

The Business

XYZ Company sells office supplies and equipment to small- and medium-sized businesses throughout a city of some 500,000 people. During each of the past three years, XYZ has shown a 10 percent annual increase in sales, which has been mostly offset by inflation. This year, as a result of the poor economy, the firm expects income to remain flat, with sales of approximately $1.5 million. XYZ maintains some 650 regular accounts and has from 100 to 150 walk-in customers daily. The average sale involves seven items totaling nearly $100. XYZ extends 30-day credit to its regular clients.

Last year, to help track inventory and handle correspondence, XYZ invested in an IBM PC with 64K of memory and two double-sided disk drives. Smith, the owner, and her assistant are the only people using the computer. Smith purchased inventory, spreadsheet, and word processing software. The company's budget prohibited additional purchases.

Smith is now interested in accounts receivable and accounts payable management. While the company could rely on its floppy disk drives for the bulk of its current requirements, Smith realizes account management would be easier and quicker with larger mass storage. At the same time, she wants to manipulate more of XYZ's sales and inventory records to predict sales trends. However, sales analysis software requires at least 128K of memory.

Complicating matters, a new office-supply company down the street with extremely competitive pricing has begun to attract XYZ's walk-in retail traffic. XYZ's budget allows the firm to spend a maximum of $4000 for both hardware and software this year. But obviously the company would like to keep overhead low by reducing expenditures for fixed assets.

		Hard Disk		RAM Board		Sales Analysis Software		Accounts Receivable/ Payable Software	
Weight Factor	Business Goals (in priority order)	Assigned Score	Weighted Score	Assigned Score	Weighted Score	Assigned Score	Weighted Score	Assigned Score	Weighted Score
4	Sales Analysis and Projections	3	12	10	40	10	40	1	4
3	Cost Containment	2	6	10	30	8	24	8	24
2	Ease of Operation	7	14	10	20	3	6	5	10
1	Improved Business Management Techniques (accounts receivable/payable)	8	8	5	5	5	5	10	10
Total Scores		20	40	35	95	26	75	24	48
Price Range		$1795–5000		$200–$1000		$350–$500		$800–$1000	

Table 2: Comparative Rating System for XYZ Company

XYZ's dilemma can be summarized this way: the firm could concentrate on the relatively inexpensive RAM card and see much more immediate amortization of the cost. Or it could select a hard disk and opt for a more long-term capital expenditure, which conceivably could result in manpower and other overhead savings.

Goals

To begin a logical analysis, Smith reviews the business' needs and establishes a list of goals for any new PC accessories, including secondary areas of convenience such as ease of operation, space, and noise. Next, she examines the time spent each month on bookkeeping. While the firm could realize some manpower savings through automating its accounts, competition is the more immediate concern.

XYZ is reasonably secure in its steady corporate customer base because the new firm refuses to extend credit. But walk-in business appears vulnerable. In spite of its inventory control system and an attempt to hold the line on prices, XYZ is having difficulty meeting the price competition from the nearby store. XYZ must continue to attack overhead and excess inventory, and reexamine its market position.

Smith believes her money will be better spent on a more powerful system for analyzing and forecasting sales and reviewing XYZ's market segment than on automating the firm's account management techniques. Analysis of current sales could lead to better inventory control. This in turn would help hold down costs and reduce lost sales resulting from items not being in stock.

So Smith values the company's need for automated accounting systems below sales analysis. Although these systems would be helpful, Smith decides XYZ's manual systems could be used for another year.

XYZ's final business priorities are: 1) sales analysis and projections 2) cost containment 3) ease of operation and 4) improved account management techniques.

Options

Smith then evaluates the hardware and software best suited to XYZ's requirements. First she reviews hard disks and RAM expansion boards. Earlier research showed the importance of increased internal memory with RAM for any complex analyses. While a hard disk would make account storage more efficient, without the expanded memory the hard disk really couldn't assist the store's immediate goals of sales analysis and cost containment. The sales analysis software is a higher priority than the accounting software because it addresses the firm's primary goal of achieving a better competitive position; however, accounting software would reduce labor costs.

> Purchasing additional storage for the PC should be approached in the same way as purchasing any large fixed asset.

Rating

Smith lists XYZ's business requirements in order of priority and then lists the hardware and software options that could support those requirements, as well as the cost of each. She judges the ability of each option to achieve every goal by using the comparative rating system described earlier.

For sales analysis and projections, Smith assigned the hard disk 3 points, cost containment 2 points, ease of operation 7 points, and improved business management techniques 8 points—a total score of 32. She applied the same approach to a RAM board and the sales analysis and accounting software (see Table 2).

Upon reviewing the capabilities and costs of both software packages, Smith finds a hidden benefit. With the money saved by not purchasing a hard disk this year, the company could purchase the accounting software as well as the RAM board and sales analysis software. With the accounting software in place, XYZ could begin to phase in an automated business management system this year, thus accomplishing an even lower priority goal. Total cost for all purchases would run approximately \$1900: \$400 for a multifunction RAM board, \$500 for the sales analysis software, and \$800 to \$1000 for the accounting software.

The succinctness and flexibility of this comparative rating system make it ideal for analyzing the cost versus the benefits of any major purchase. Additionally, for those who use a spreadsheet program, the listing and scores fit the format of *VisiCalc* or similar programs. With a spreadsheet, managers can perform any number of "what if" analyses to see how various combinations satisfy both business requirements and budgetary restrictions.

Small businesses can easily follow the four-step analysis presented in this article. After doing so, a company can rest assured that its decision about storage and memory expansion has a foundation in a logical appraisal of reasonable alternatives, rather than leaving decisions concerning profitability to luck.

Mark Phillips specializes in business and financial writing in the Seattle area.

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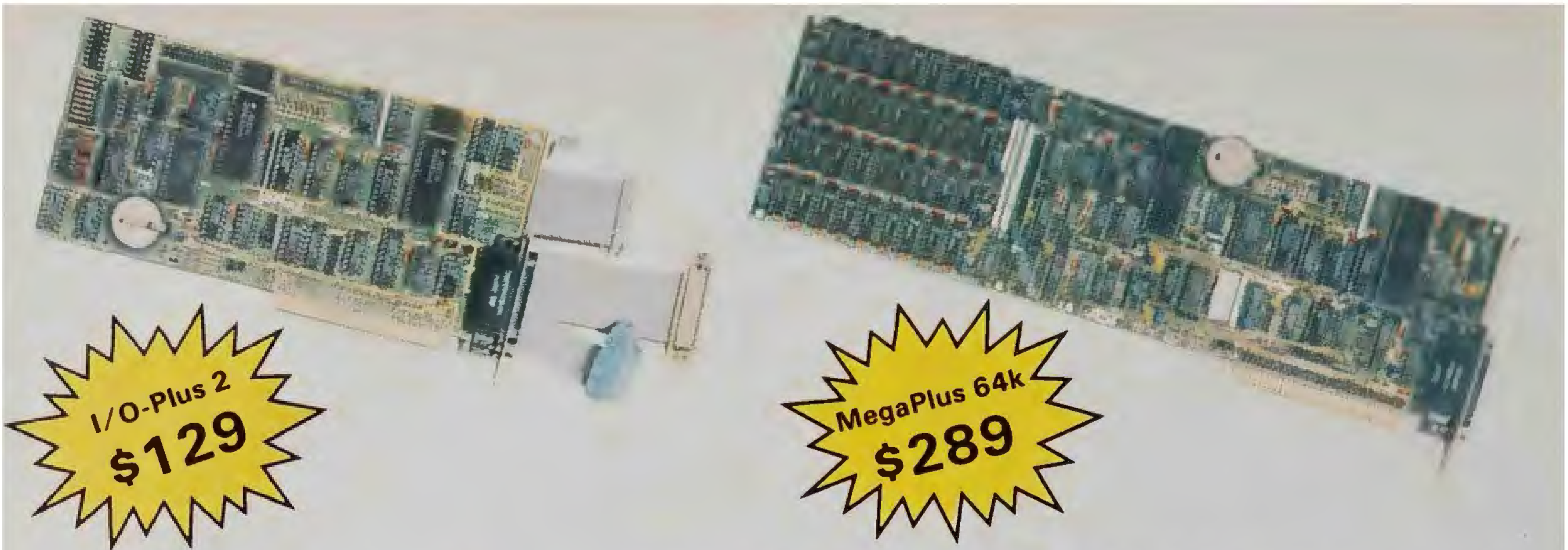

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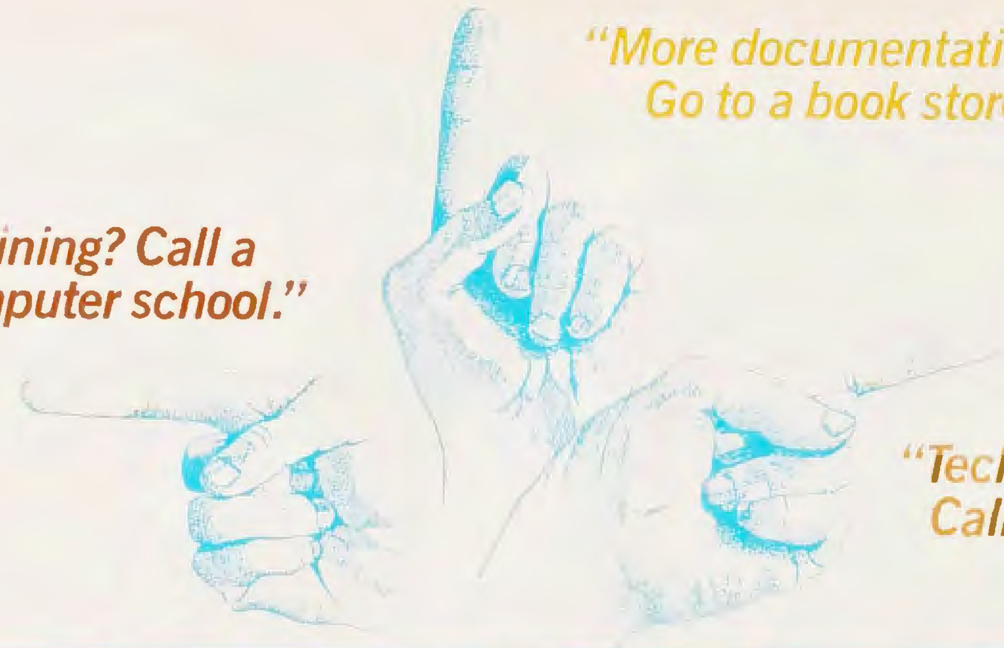

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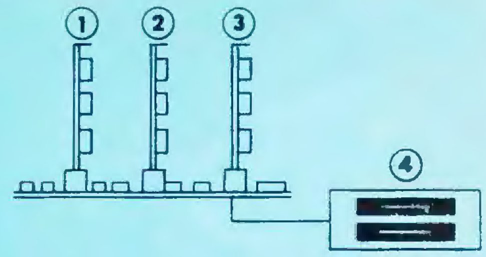

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Edited by Andrew Fluegelman

We're receiving a wealth of *.* submissions—some simple, some sophisticated, and all very useful. With the complex submissions however, we're becoming concerned that we accurately reproduce listings, routines, and tables. Our copy editors have therefore requested that we inaugurate the Star-Dot-Star Disk Incentive Program. Here's the deal: If you submit your *.* item to us on a PC-DOS disk in standard ASCII or *WordStar*-readable form, we'll return your disk plus an additional free disk as thanks for making our editing job a bit easier.

Now to sample the wares. We guarantee that the lead item this issue will come to the rescue at some time during your computing career.

Saving Lost Files

Have you ever erased a file due to a typing error or a momentary short circuit in your brain? Don't panic, cry, or swear. Your file is retrievable.

DOS does not actually erase a file from the disk when you issue the ERASE or the DELETE command. Instead, DOS slightly changes the way a file is stored on the disk by replacing the first letter of the "erased" file in the file allocation table with an *e*. This *e* tells the system that it can write over the file's disk sectors. So your file is still on disk and is retrievable as long as you don't write or save any information on the disk until you use DEBUG to restore it.

It is important that you do no further operations with the disk. Place your data disk in drive B, and place your DOS disk in drive A. Reboot the system by pressing Ctrl-Alt-Del. The file retrieval process can then be performed by the following steps:

```
A>DEBUG
```

This command calls up the DEBUG program, which prompts you with a hyphen. Type

```
L 100 1 03 08
```

This command loads sectors 03-08 from the 1 (B) disk drive. Type D. This command displays data from the sectors that were loaded by the L command. You will see eight lines of numbers and letters across the screen. The lines begin with two 4-character addresses separated by a colon. The segment address is on the left of the colon and the offset address is on the right. The line endings on the far right of the screen show file names and coded information about the file. Continue issuing the D command until you see your erased file, now listed with an *e* as its first letter on the right of the screen. Note the offset address of your file's line. Type E and the offset address. For example, E 0100.

Press ENTER and the screen automatically displays both the line's segment address and offset address followed by E5, the hexadecimal value for an ASCII e. Type 40 (the hexadecimal value for an ampersand) after the period. Here is an example of what should appear on the screen:
-0983:0100 E5.40'

Now issue a WRITE command using the same disk number and sectors specified in your load command by typing

```
W 100 1 03 08
```

Now quit the operation by typing Q. Call up your directory. Your erased file, now with an ampersand as its first character, will be listed, and you can rename it back to its original form.

Richard R. Sands
Portland, Oregon

This hint led PC World *staff members to experiment with the DEBUG program on files stored on A, B, and C drives. In each case we modified the L and W commands to correspond with the correct disk drive designation: 0 for drive A, 1 for drive B, and 2 for drive C.*

We successfully used the DEBUG command on the emulated C drive of a PC loaded with the JEL *electronic drive software from Tall Tree Systems and on the C drive of an IBM XT hard disk. In both instances the C drive was designated by 2 in the L and W commands, but we had to experiment with the sector numbers. For example, on the emulated C drive we used*

```
L 100 2 02 10
```

and on the C drive of the XT we used

```
L 100 2 10 20
```

We suggest you use these sectors as starting points.

The WordStar WIP File

You can greatly improve the performance of *WordStar* by writing your text file on an E-drive (emulated electronic disk drive—see "Faster than a Spinning Floppy" in this issue). If you are working on a long document and making use of extensive searches, block moves, and reformatting, the annoying delays caused by floppy disk access can be reduced to less than a second.

The problem, of course, is that you're in big trouble if there's a power glitch. Even if you have assiduously saved to disk with Ctrl-KS, your saved file is no more permanent than your power supply.

The following command sequence can be assigned to a key macro with a utility such as *Keynote* or *ProKey*.

```
10 REM
20 REM This program makes the DOS command FLIP ---
30 REM
40 REM Copyright (c) 1982 Thomas J. Foth
50 REM Permission granted to copy and distribute this source with
60 REM inclusion of this notice but not for profit
70 REM
80 REM Author makes no warranty, expressed or implied, as to
90 REM the correct nature and operation of this software.
100 REM
110 REM Command syntax
120 REM
130 REM FLIP |NUM | |ON |      - Flip numeric pad on or off
140 REM      |CAP | |OFF|      - Flip caps lock on or off
150 REM or
160 REM FLIP |MONO |           - Flip to monochrome adapter
170 REM      |COLOR|      |40| - Flip to color adapter in either 40 or
180 REM                   |80|   80 column mode
181 REM
182 REM
190 FOR I = 1 TO 258 : READ N : C = C + N : NEXT
200 READ N : IF N <> C THEN 330
210 RESTORE : OPEN "R",#1,"FLIP.COM",1
220 FIELD #1,1 AS N$
230 FOR I = 1 TO 258: READ N:LSET N$=CHR$(N)
240 PUT 1:NEXT:CLOSE
250 END
260 DATA 184,64,0,142,216,179,64,190,93,0,191,203,1,185,3,0,252,243,46,166
262 DATA 131,249,0,116,19,179,32,190,93,0,191,206,1,185,3,0,243,46,166,131
264 DATA 249,0,117,44,190,109,0,46,161,198,1,38,59,4,116,26,190,109,0,191
266 DATA 200,1,185,3,0,243,46,166,131,249,0,117,44,128,243,255,32,30,23,0
268 DATA 205,32,8,30,23,0,205,32,190,93,0,191,209,1,185,4,0,243,46,166
270 DATA 131,249,0,117,25,128,14,16,0,48,184,7,0,205,16,205,32,186,222,1
272 DATA 140,200,142,216,180,9,205,33,205,32,190,93,0,191,213,1,185,5,0,243
274 DATA 46,166,131,249,0,117,226,190,109,0,46,161,218,1,38,59,4,117,8,177
276 DATA 32,187,2,0,235,15,144,46,161,220,1,38,59,4,117,197,177,16,187,0
278 DATA 0,176,207,34,6,16,0,10,193,162,16,0,139,195,205,16,205,32,79,78
280 DATA 79,70,70,67,65,80,78,85,77,77,79,78,79,67,79,76,79,82,56,48
282 DATA 52,48,10,13,70,76,73,80,32,105,103,110,111,114,101,100,58,32,73,110
284 DATA 118,97,108,105,100,32,112,97,114,97,109,101,116,101,114,10,13,36
286 DATA 24871
330 PRINT "Checksum Error: verify data statements"
340 END
```

Listing 1

Giving this macro command will save your working file to a file on drive B called WIP (for *work in progress*) and return you to your present cursor position in the E-drive text file.

^K1^QR^KB^QC^KK^KWb:wip<ENTER>
y^KH^Q1^K1

Some comments on the macro: ^K1 sets a place marker, ^QR moves to the beginning of the file, and ^KB marks the beginning of a block. ^QC moves to the end of the file and ^KK marks the end of a block. At this point the entire text file has been marked as one block.

^KWb:wip<Enter>

writes the block to the file WIP on drive B. The letter *y* is necessary because, once the file B:WIP has been created, *WordStar* will ask you whether you want to overwrite it. The remaining commands erase the marked block, return to the place marker, and erase the place marker.

If you have assigned this macro command to a keystroke, such as Alt-S, it is executed very quickly with an E-drive. You'll find this macro a convenient way to back up without breaking your work flow. Since the backup file is always called B:WIP, you do have to remember to save the file on disk under another name when your writing or editing session is completed.

A.F.

Flip Lock

One of the most conspicuous failings of the PC keyboard is the lack of indicators regarding the status of the CapsLock and the NumLock keys. Why else would people keep trying to come up with the definitive way of correcting the problem? If you're willing to type 384 bytes worth of data statements, you can create a DOS.COM file to do the job.

Listing 1 is a BASIC program that creates a program file called FLIP.COM. Enter the program while in BASICA to make it run. After entering line 340, be sure that the DOS disk is in drive A and that the write-protect tab is removed. Then either press F2 or type RUN <ENTER> . If a message appears saying 'Checksum error; verify data statements', a mistake has been made entering the numbers in lines 260 through 286. Otherwise a new file will have been created on the DOS disk called FLIP.COM.

Now go back to DOS by typing SYSTEM and run the new program. It can be used by entering any of the following command lines:

FLIP CAP ON sets keyboard to uppercase letters.
FLIP CAP OFF sets keyboard to lowercase letters.
FLIP NUM ON sets numeric keypad to numbers.
FLIP NUM OFF sets numeric keypad to cursor control keys.
FLIP MONO changes default monitor to the monochrome display.
FLIP COLOR 40 changes default monitor to a 40-column color graphics display.
FLIP COLOR 80 changes default monitor to an 80-column color graphics display.

Now you might say that it's easier to reach over and press the CapsLock or NumLock key than to type in this command. That may be true; however, you still have to remember to do that. By including these commmands in an AUTOEXEC.BAT file, the computer will remember to do that procedure for you. The procedure to set up an AUTOEXEC.BAT file is covered on page 2-16 of the DOS manual. Remember that this will work in DOS only. To do the same thing in BASICA you need to include the lines in Listing 2 in your BASIC programs (they may be included near the beginning of your program or as a GOSUB routine elsewhere in the program).

Tom Foth
Madison, Wisconsin

FORTRAN vs. BASIC

We have performed a benchmark test using FORTRAN and BASIC on several computers. The program was a simulation of the dynamics of a "floating-ring seal" used in high-speed turbomachinery. This is a typical scientific/engineering application that involves lots of number crunching. The motivation here was to assess the speed of the IBM PC when it is used for engineering or scientific applications, and to compare it with

```
800 `START NUMERIC SHIFT
900 DEF SEG=&H40:B%=PEEK(&H17)B%=B% OR &H20:POKE &H17,B%
905 `START UPPER CASE SHIFT
910 DEF SEG=&H40:B%=PEEK(&H17)B%=B% OR &H40:POKE &H17,B%
915 `RESTORE CURSOR MOVEMENT SHIFT
920 DEF SEG=&H40:B%=PEEK(&H17)B%=B% AND &HDF:POKE &H17,B%
925 `RESTORE LOWER CASE SHIFT
930 DEF SEG=&H40:B%=PEEK(&H17)B%=B% AND &HBF:POKE &H17,B%
935 `SWITCH TO 40 COLUMN COLOR
940 WIDTH 80:DEF SEG=0:A=PEEK(&H410):POKE &H410,(A AND &HCF) OR
    &H20:WIDTH 40:SCREEN 1:SCREEN 0:LOCATE,,1,6,7
945 `SWITCH TO MONOCHROME DISPLAY
950 WIDTH 40:DEF SEG=0:A=PEEK(&H410):POKE &H410,A OR &H30:WIDTH
    80:LOCATE ,,1,12,13
```

Listing 2

other personal and mainframe computers. All tests were performed in single-precision. The results are shown in Figure 1 (numbers in parentheses indicate timing with the Intel 8087 Math Coprocessor and appropriate libraries).

In a further test we ran the NBS Methane properties package on the IBM PC under FORTRAN 3.03. Execution time was 16.5 seconds without the 8087, and 2.5 seconds with the 8087. A time of 90 seconds was obtained for this program on the Xerox 820.

Two results deserve special comment. First, both the original IBM release of Microsoft FORTRAN and the new 3.03 release (presently under Beta Test) are laughably slow. Note that even the 3.03 version is practically as slow as the 8-bit FORTRAN of the Xerox 820. This result is presumably due to Microsoft's decision to write its FORTRAN in Pascal, thus burdening it with all of Pascal's inefficiencies. Even Microsoft's own BASIC Compiler is faster. These FORTRANs are therefore nearly useless as serious tools for engineering work, and we can only hope that some enterprising firm will fill the need for a fast FORTRAN for the IBM PC.

Next, the BASIC Compiler with the 8087 does not achieve anything like the speed improvement that FORTRAN does. Whether this is due to inefficiencies in the MicroWare BASIC 8087 library or to problems with the BASIC Compiler itself is an open question.

Jim Glass
Chris Landis
Source mail

Bug Hunt

I have run into an annoying error in IBM BASIC. It's the VAL function. VAL is used frequently to detect the presence (or absence) of a numeric sequence at the beginning of a string. VAL is also often used to extract the leading numeric content of a string. I've used both in programs running in MBASIC under CP/M. These same programs do not work properly in MBASIC under PC-DOS.

For example, a string with *E* or *D* (or lowercase *e* or *d*) causes an overflow error. It appears that on the PC BASIC is looking at the *E* or *D* as part of a scientific notation instead of a simple alpha character. That's in violation of the functionality of VAL.

Attempting to convert the string '15%' causes a syntax error. That one is a total mystery to me. Strings such as '15#' and '15!' convert OK.

Try these for yourself: `X$="E45"` or `X$="D45"` or `X$="5E45"` or `X$="15%"` and type

```
PRINT VAL(X$)
```

If VAL sees a purely numeric string, it works alright. If the string has alpha characters in it, however,

.

under some conditions VAL will not work as documented. The presence of the percent sign is also apt to cause errors.

Royall Dossett
Excelsior, Minnesota

Timeout, Timeout

In using the PC parallel printer port from BASIC (DOS 1.10), timeout problems can occur if a printer with a large internal buffer is attached. This has been encountered while using a Mannesman-Tally printer with a 4K internal buffer; a similar problem might be expected with the new Epson line of printers.

Within BIOS the timeout interrupt is programmed to occur after an elapsed time of 20 seconds of non-response from the printer. This setting negates the spooling advantage to be gained from the printer's buffer. The problem can be overcome, however, by altering the timeout parameter to a higher value. Since the pertinent code resides in ROM, a direct change could not be made in the existing code. One solution is to reset the appropriate interrupt vector to point to an area outside the BASIC work space (for example, the uppermost 115 bytes of high memory could be used), and PEEK/POKE the necessary code containing the desired modification into that area.

The BASIC program in Listing 3 can be used to affect a timeout parameter change, permitting full use of the printer's internal buffer.

R. S. Parrish
Athens, Georgia

Machine	Language	Seconds
CDC-176	FORTRAN	0.8
IBM 3033	FORTRAN	1.63
UNIVAC 1100/83	ASCII FORTRAN	12.00
TEKTRONIX 4081	FORTRAN	196.00
PDP-11/34	FORTRAN	94.00
IBM PC	BASIC Compiler	866.00
Xerox 820	FORTRAN	3384.00 (773)*
IBM PC	IBM FORTRAN (original)	4440.00 (1711)*
IBM PC	FORTRAN 3.03	3284.00 (585)**
IBM PC	BASIC Interpreter	11935.00
Apple	BASIC Compiler	5153.00
Apple	BASIC Interpreter	16937.00

* Using MicroWare 8087 Library
**Using Microsoft 8087 Library

Figure 1: Benchmark Test

Stop Step

The instructions in Listing 4 explain how to insert STOP commands between each line of a BASIC program, thereby making it easier to debug the program, and how to remove the STOP commands.

Press F9 continuously until the automatically generated line numbers exceed the highest line number of your program. Then press Ctrl-Break to exit from the automatic line number generator mode.

Run the program. The program executes one line at a time, enabling you to examine all intermediate results and discover any errors. Correct the errors, adding new line numbers if needed, but do not add any line numbers that end with 5 (e.g., 15, 25, 35, or 45). Then press F5 to continue.

If you have previously redefined F5 to its original setting, then define it as follows:

KEY 5, "CONT"+CHR$(13)

If the line that the program stops at prompts you to input data, do so.

If the program stops but gives no prompt and doesn't respond with 'Break in (line x)', you have probably encountered a line with the INKEY statement. To continue, press the appropriate key. When the response on the screen is 'break in (the line number)', you may use the LIST command (perhaps to determine which variables are in the line on which the program execution was broken). Subsequently, you can have the value of the variable printed (PRINT Varname) or add new line numbers.

Finally, press F5 to continue beginning with the next line following the line at which the program execution was broken. However, with some changes to your program, you may not be able to continue by pressing F5. In the event the computer re-

```
10  'Routine to modify the printer timeout value
20  'Currently in DOS 1.1, it is set to 20 seconds
30  '
40  'DEFINT I-N
50  NEWVALUE=60              'set value as desired
60  DEF SEG=&HF000           'peek at BIOS
70    DIM M(114):J=0
80    FOR I=&HEFD2 TO &HF044:M(J)=PEEK(I):J=J+1:NEXT
90  M(43)=NEWVALUE
100 DEF SEG=&H1E00           'poke into high memory of 128K system
110   FOR  I=0 TO 114:POKE I,M(I):NEXT
120 DEF SEG=0                'alter interrupt vector
130   POKE &H5C,0:POKE &H5D,0:POKE &H5E,0:POKE &H5F,&H1E
140 END
```

Listing 3

```
LOAD "PROGRAM"
RENUM 10,10                 'to renumber the line numbers beginning
                            with ten and incrementing by ten.
KEY 9, "STOP"+CHR$(13)      'defines the function key.
AUTO 15,10                  'generates line numbers automatically
                            beginning at fifteen and incrementing by ten.
```

Listing 4

sponds with 'Can't continue', you will have to rerun the program.

To remove the STOP commands, type

AUTO 15,10

Hold down the ENTER key until the automatically generated line numbers either exceed the highest line number of the program or are no longer followed by an asterisk. Then press Ctrl-Break.

If you wish to debug again with the current program in memory or with another program, you don't need to include the statements that define the function keys (e.g., KEY 9).

Here is the entire procedure, without explanations.

LOAD "PROGRAM"
RENUM 10,10
KEY 9, "STOP" + CHR$(13)
AUTO 15,10
<F9>
<Ctrl-Break>
RUN
<F5>
AUTO 15,10
<ENTER>
<Ctrl-Break>

Gary J. Goldstein
Tampa, Florida

Eye of the Beholder

I have found editing with *WordStar* more enjoyable and easier on the eyes when the displayed text is in reverse video (RV) instead of normal default mode. In RV mode the characters are black on a white background, which I find more appealing. Also, highlighting of blocks and soft hyphens is more pronounced.

To modify your current version of *WordStar*, enter the following commands:

>DEBUG WS.COM
-E 028B 70
-E 02D5 70
-W
-Q
>

These commands assume that you have DEBUG and *WordStar* on the same drive. Remember to press the ENTER key after each command. After you've entered the commands, run *WordStar* (WS.COM) just as you would normally.

Try the modification for yourself and see if you like it as much as I do.
Vic Westhall
Upper Marlboro, Maryland

Printing in French
A number of owners of the IBM PC, *WordStar* 3.24*, and NEC Spinwriters have voiced interest in being able to access the special print characters that are available on some of the NEC thimbles. I have solved this problem with a French Pica 10 thimble in two ways that may help those who have been struggling with similar problems.

Using DEBUG from PC-DOS and the appropriate ASCII codes for this particular thimble, the four user patches on *WordStar* can be programmed to access whatever special character is desired and that is available on the print thimble (in this cas diacritical markings). This is, however, a rather cumbersome process, and all those embedded commands do not look very attractive on the screen. The more direct approach to this problem is to access the diacritical markings on the French Pica 10 directly from the PC keyboard. The following keys will generate these markings:

\ = ç
¦ = ù
{ = é
} = è
~ = ¨
@ = à

While the text of the screen document will still show the embedded commands and not the French characters, this is a faster, easier, and more attractive method than using *WordStar*'s user patches. The ideal solution to this problem is a program that will allow the user to display the characters on the screen as they will look on the printed page, but until that day comes along, my suggestion will produce most of the special diacritical markings needed to produce French text.
Robert F. O'Reilly
Syracuse University
Syracuse, New York

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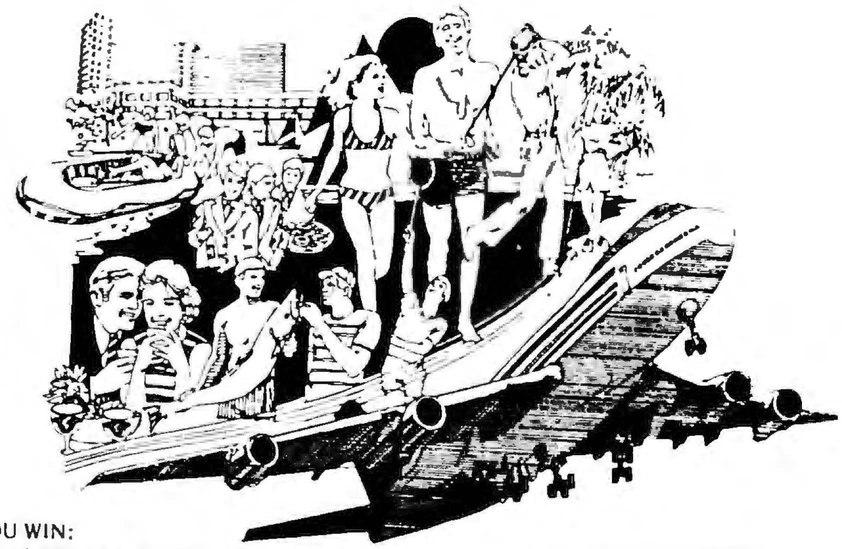

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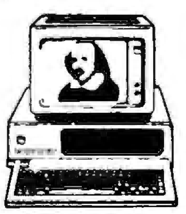

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• 256K	395	289
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Joystick	65	49
Versa Computing		
Versa Writer Graphics Tablet	299	249

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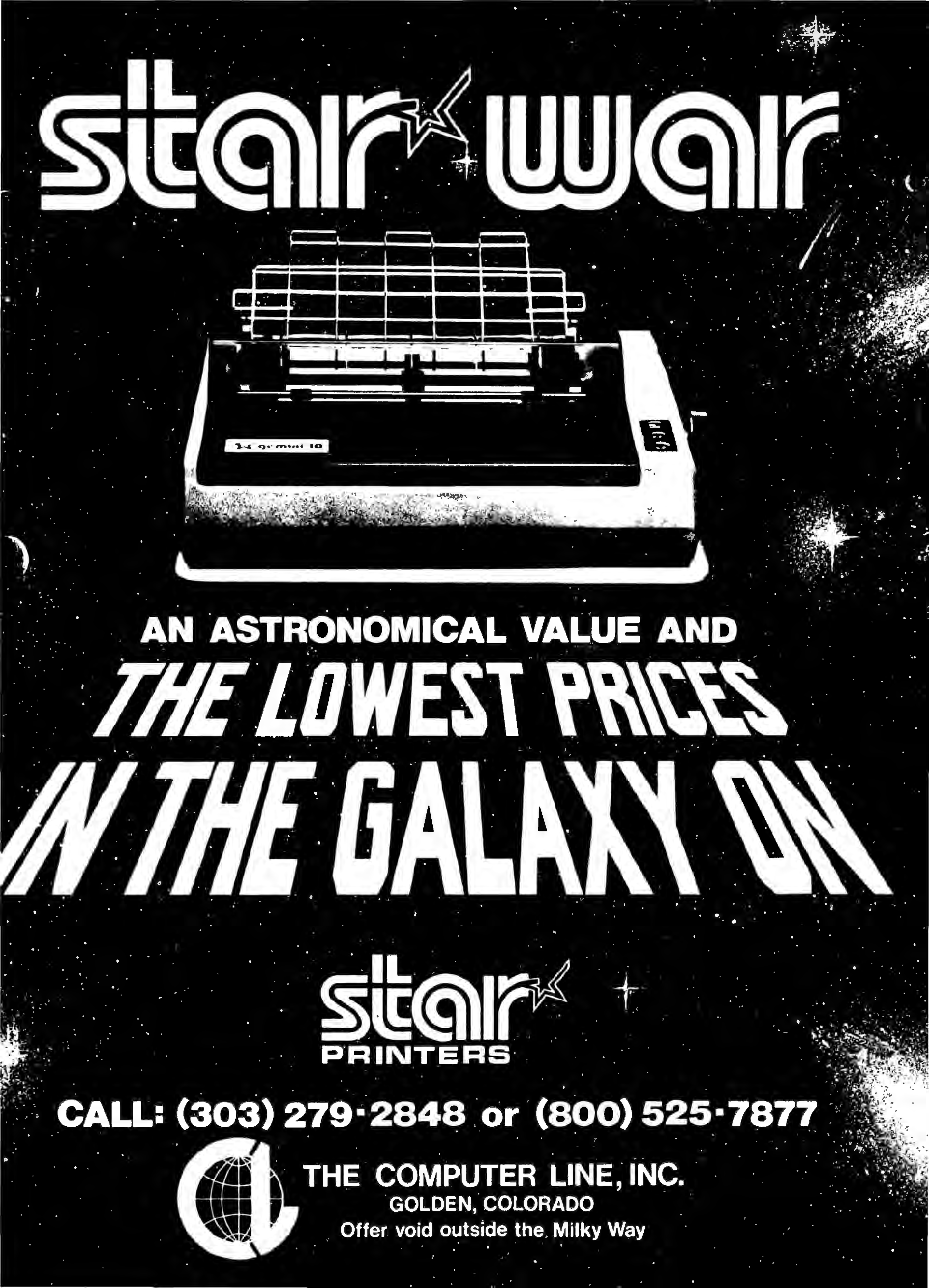
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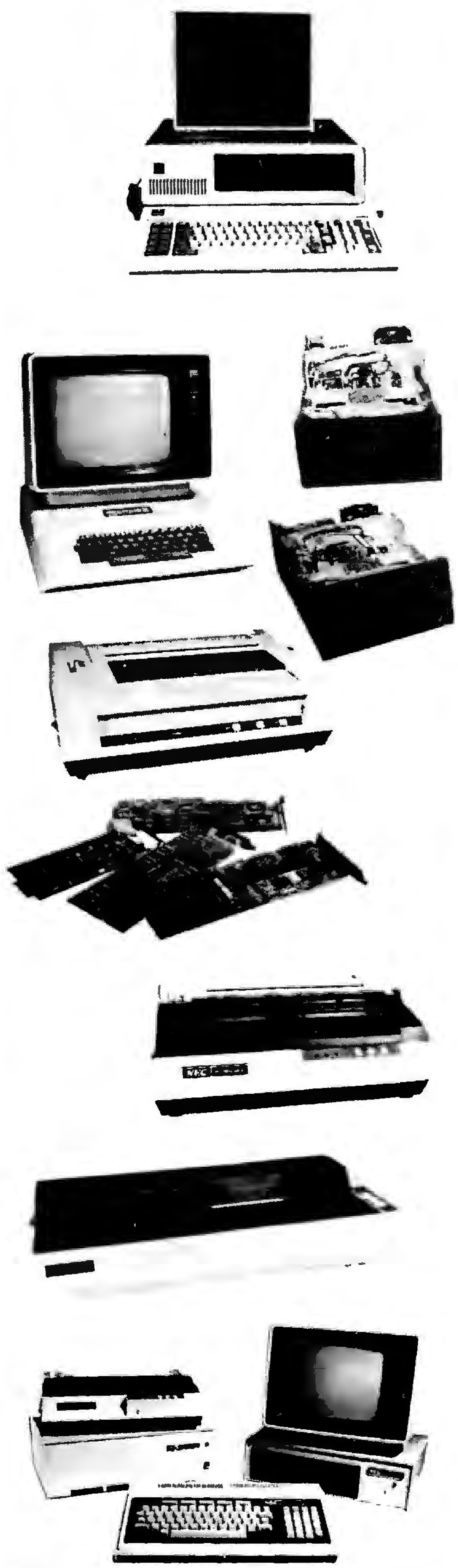

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Complete System **$1690**
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BBS Watch

Starting Your Own Bulletin Board System

Gene Plantz

Past columns of *BBS Watch* covered the process of calling and using a bulletin board system, but we haven't yet talked about what it takes to start your own BBS. I've received many inquiries from user groups, retail stores, and individuals who want to run their own bulletin board systems for the IBM Personal Computer. This column will tell you what it takes in hardware, software, and manpower to get a system up and running.

Planning

Bringing a bulletin board system on-line requires \$3500 to \$4000 worth of computer equipment, about \$300 in software, and a person to maintain day-to-day operations.

Before putting the equipment and software together, you should sit down and make some decisions about the way your bulletin board system will work and the services and features you want to offer callers.

Think about these questions: What hours will the bulletin board system be on-line? Will the system be restricted to a certain group of callers, or open to everyone? Will callers be able to upload and download programs? What communications speeds will be needed? Where will the computer equipment be located? Will someone maintain the system on an ongoing basis?

The busiest hours for a bulletin board are 7 p.m. to midnight. If you decide that your bulletin board will be a part-time system, it is unwise to limit its operation to daytime hours since most callers will be people who have 9 to 5 jobs and want to dial your system after work.

Restricting access to members of a group, such as an IBM PC user group, prevents many knowledgeable people outside the group from participating in the exchange of information. One of the most important benefits of a BBS is the free exchange of technical information between people more experienced in computers and those just getting started with the machines. Callers also share information about new software and equipment.

> Before putting the equipment and software together, you should make decisions about the way your bulletin board system will work.

Whether the BBS restricts access or not, you need to decide if bulletin board callers will use passwords. Passwords ensure that only the addressee can access personal or confidential messages.

Program uploading and downloading, usually called file transfer, is a popular feature on many bulletin boards. For many people who don't have user groups in their areas, file transferring is the primary way to acquire public domain programs and computer information.

Including file transfer in your BBS increases your hardware requirements and the amount of time the systems operator (SYSOP) must devote to the bulletin board. Many SYSOPs like to keep several utility and applications programs and programs written in different languages in their file transfer list so that callers have a variety of programs to download. To provide enough disk space for such a mixture, some systems use two double-sided floppy disk drives (320,000 characters each), while other bulletin boards use hard disks to increase the number of programs they can keep on-line.

Because people send programs to the BBS (uploading), the SYSOP must periodically check these new files to make sure that the programs were transmitted without error and run properly. When the BBS first starts operation, the SYSOP has to find some public domain programs to put on the system. You can find programs by dialing other bulletin boards and transferring files, or by calling the operators of other systems and asking to exchange some files on disk.

The best communications speed for your BBS depends on several factors. If your system includes file transfer, you should consider a dual speed modem, one that supports both 300 and 1200 baud. At 1200 baud files are transferred four times faster than at 300 baud. Many people are now changing to the faster speed because 1200 baud modem prices have dropped from \$1000 to the \$400 to \$700 range. If you decide to offer a message exchange system only, 300 baud will satisfy most of your callers' needs.

Regardless of which speed you decide to use, you will need a modem with auto-answer capability. With this feature the modem can answer the phone after a specified number of rings and tell your BBS software that a call has been received. Most bulletin board systems do not need an auto-dial feature on their modems.

BBS hardware should be located in an area with adequate ventilation and electrical connections. The hardware also has to be near the telephone line that will be used for the BBS. The equipment should not be placed where someone could accidentally unplug the electrical connection or be tempted to play with the keyboard. For these reasons placement is an especially important consideration if you have small children or curious pets in your home.

If you plan to run your BBS 24 hours a day, you should contact your local telephone company and request a new telephone line to be used for the bulletin board only. Request the cheapest telephone service that the phone company offers. Since you will not use the line for outgoing calls, try to get a "zero measure unit" package. You will not need to rent or buy a telephone handset, but you will need to give the phone company the FCC registration number on the system's modem.

Even if you decide to run a part-time BBS, installing a new phone line is still a good idea. Although you ask callers to phone only during specified times, you will receive calls at all hours from people who think the system runs 24 hours a day.

Finally, perhaps the most important consideration is the manpower required to maintain and oversee the bulletin board system. The SYSOP should be a person who knows about telecommunications and the IBM PC. He or she must be prepared to answer callers' technical questions about the system. The operator should also get to know the callers' equipment, software, and areas of interest and expertise.

At least once a week the SYSOP should make backup copies of all the message files and the new transfer files on the system. If the bulletin board is accidentally unplugged or loses power because of a blackout, this precaution will ensure that the system can be put back on-line with most of its information intact. While making backup copies, leave the phone off the hook so that callers receive a busy signal. If callers hear the phone ring without an answer, they may think the system is no longer operating.

The amount of time a person needs to devote to a BBS varies according to the system's use. A busy 24-hour system requires more disk file maintenance and question response time than a part-time system. For a full-time system you can expect that the operator will have to spend at least 1 hour a day tending to chores.

Equipment

The minimum equipment for running a BBS on the IBM PC is 64K, one disk drive, an asynchronous communications adapter, a modem with auto-answer capability, and a telephone line. This minimum system is suitable for a BBS that has few callers and offers user-to-user messages only.

A system offering more extensive services such as file transfer, sophisticated message handling with passwords, and restricted system access requires 192K of memory and two double-density disk drives. A hard disk is useful for faster access to files and greater storage capacity. Some systems have software that sends caller information and logging errors, if any, to a printer. In this way the SYSOP has a printed record of every call the system receives.

Software

Once you know the features your BBS will offer, it is time to choose software to control the computer. Surprisingly, few companies sell complete, ready-to-run bulletin board system software. The most popular commercial product on the market is *HOSTCOMM* by Janadon. Check each software package to find out if the package contains the utility programs—such as message, user, and mailbox files—necessary to maintain the BBS support files. Look for a program that makes the SYSOP's job as easy as possible while providing callers with the greatest number of features. Be sure to ask your dealer if the software you are considering works with the type of equipment you will use. Find out how much memory the software requires and if it supports different baud rates from the modem. Ask if it works with DOS 2.00 as well as DOS 1.10.

Public domain programs that run bulletin boards can be obtained from other systems. These programs are usually poorly documented, but they provide an inexpensive way to set up your BBS. A benefit of public domain programs is that you have the source code (the original statements and commands written by an author that define what a program does), so you can make changes if you want to. The disadvantage is that you must use an interpreter or compiler to make changes if you do adapt the program. Source code is not usually offered with commercial programs.

Test Run

Once all the hardware has been hooked up and the operating system (most IBM PC bulletin boards run under PC-DOS) and BBS files have been loaded into the system's disk storage, it is time for a test run. Start the BBS software according to instructions. When your system is initialized and awaiting a caller, place a call from another terminal and telephone line to make sure everything works. You will probably want to have a friend call from his or her terminal while you watch your screen.

Test all the functions described in the bulletin board software documentation until you are sure you understand how the software works. People will most likely ask for explanations when things don't work, so you must know the software very well. Remember to test any special functions that are limited to the SYSOP, such as renaming and deleting messages or modifying the file transfer list.

Advertising

Once the system is up and running, it's time to let people know about your bulletin board. Call other IBM PC bulletin boards and leave messages describing your system, its location, hours, modem speed(s), and features. You should also write to the IBM PC magazines and ask them to include your system in their BBS listings. Type up notices describing your system and ask local computer retailers to post them.

Setting up and running a bulletin board takes planning and research, but it is not beyond most computer enthusiasts' capabilities. If you have questions about some of the points mentioned here, contact a SYSOP in your area for more information. If you have already purchased bulletin board software, talk with the author of the program. If you can't find any SYSOPs in your area and have no luck tracking down program authors, I will be glad to try to answer questions. Please mail your questions to the post office box listed below and include a phone number where you can be reached. I will respond as soon as possible.

Send correspondence to Gene Plantz, P.O. Box 95638, Hoffman Estates, IL 60195. CompuServe: EMAIL 70040,245; Source: SMAIL STG476

HOSTCOMM by Janadon
NF Systems, Ltd.
P.O. Box 76363
Atlanta, GA 30358
404/252-3302
List Price: $170
Requirements: 128K, 320K disk storage, Hayes Smartmodem, (printer suggested)

IBM PC Bulletin Boards

Following is a partial listing of the IBM PC bulletin boards on-line in the United States. The list is updated as the author receives information about new bulletin boards.

CompuServe now has a bulletin board for IBM PC users. The bulletin board has messages and uploading and downloading options. Once logged on to CompuServe, type `GO PCS131` after the '!' prompt. If you have trouble accessing the BBS, call CompuServe's customer service number, 800/848-8990.

201/678-6670
New York, New York
SYSOP: Donald David (TC7057)
24 hrs

213/649-1489
Culver City, California
SYSOP: George Peck
24 hrs, download & upload, messages

213/390-3239
Source: TCG147
Santa Monica, California
SYSOP: Marc Schoenberg
24 hrs, download & upload, 10 MB disk, 300/1200

215/250-0173
Easton, Pennsylvania
SYSOP: Jerry Lotto
24 hrs, download & upload, 300

301/949-8848
Rockville, Maryland
SYSOP: Rich Schinnell
24 hrs, download & upload
(Passwd = IBMPC)

301/251-6293
Gaithersburg, Maryland
SYSOP: Larry Jordan
24 hrs, communications info
(Passwd = IBMPC)

301/460-0538
Bethesda, Maryland
SYSOP: Ramona Landberg
24 hrs, upload newsletter articles

301/937-4339
Beltsville, Maryland
Small People Software
SYSOP: Chet Rhodes
24 hrs, games, messages

312/259-8086
Chicago, Illinois
SYSOP: Gene Plantz
(PCMODEM)
24 hrs, download & upload, messages, 300/1200

312/376-7598
Chicago, Illinois
SYSOP: Pete Coniceak
24 hrs, download & upload, messages, 300

404/252-9438
Atlanta, Georgia
SYSOP: Rod Roark
24 hrs, messages, download & upload, tips, news

416/499-7023
Toronto, Canada
SYSOP: Doug Peel
24hrs, download & upload, messages, 300/1200

608/262-4939
Madison, Wisconsin
PC Users Group
SYSOP: Read Gilgen
5 p.m. to 8 a.m. weekdays, 5 p.m. Fri. to 8 a.m. Mon., download & upload, messages

703/680-5220
Dale City, Virginia
Dale City Info Exchange
SYSOP: Tim Mullins
24 hrs, news, new product review—all PCs

703/560-7803
Vienna, Virginia
ABBS with IBM PC Conference
24 hrs, download & upload, messages

703/978-0921
Fairfax, Virginia
SYSOP: Bruce Churchill
(Hostcomm)
24 hrs, software eval/purchase
(Passwd = IBMPC)

703/978-9592
Fairfax, Virginia
SYSOP: Don Withrow
(Hostcomm)
24 hrs, download & upload, tips
(Passwd = IBMPC)

714/624-1767
Claremont, California
SYSOP: Laurance Staples
24 hrs, software eval/purchase
(Passwd = IBMPC)

913/842-5749
Lawrence, Kansas
24 hrs, download & upload, messages

BBS of the Month

Beginning this issue *BBS Watch* will feature a different IBM PC bulletin board each month. The bulletin board's file transfer programs will be listed so that readers can see what types of public domain programs the BBS offers.

Culver City, California, IBM PC Bulletin Board System 213/649-1489

Files available for transfer:

KEYLOC.HEX	3K	Lock the Shift, Ctrl, and Alt keys
KEYLOC.DOC	2K	Documentation for above
MAIL1.BAS	24K	BASIC mail list generating program
MAIL1.DOC	3K	Documentation for above
MEMORY.HEX	3K	Set memory DIP switches from your keyboard
MEMORY.DOC	3K	Documentation for above
PWRUPCLK.HEX	2K	Set date/time in one command
PWRUPCLK.DOC	.4K	Documentation for above
DM.BAS	1K	Set up dot matrix printer for *WordStar*
LQ.BAS	1K	Set up letter quality printer for *WordStar*
DMLQ.DOC	.9K	Documentation for above 2 files
RV-EDIT.BAS	12K	BASIC full screen editor
RV-EDIT.DOC	9K	Documentation for above
GRAFNEW.BAS	5K	Plot curves on Epson or other dot matrix printer
PEEKPOKE.DOC	3K	BASIC PEEK and POKE tips
GUMUP.DOC	7K	Additional documentation for some programs
XFERDIR	6K	This file

CATALOG.HEX	2K	Alpha Disk Directory
CATALOG.DOC	.1K	Documentation for above
SORT.BAS	3K	Sort arrays in memory
FASTDISK.BAS	.5K	DOS 1.0 speedup program. Creates SPEEDUP.COM
BIORYTHM.BAS	5K	Biorhythm to printer or screen
HELPFILE.DOC	1K	PC BBS command list
MAILHELP.DOC	2K	PC BBS MAILBOX commands
NEWS.DOC	varies	PC BBS news
DESCRIPT.DOC	.5K	PC BBS system description
OSCAR.BAS	9K	Amateur radio satellite finder
XREF.BAS	6K	Generates cross-reference of BASIC program
HAMMODEM.BAS	3K	Demonstrates amateur radio with SMARTMODEM
PACMAN.BAS	12K	Play it slowly on the PC
PACMAN.HEX	30K	Play it faster and better than .BAS
UNPROTCT.HEX	.2K	"Unprotect" protected BASIC programs
UNPROTCT.DOC	2K	Documentation for above
ATTRIB.BAS	.3K	Sets up video attributes
DOC	.4K	Documentation for above
BEEP.HEX	.3K	Does a BEEP in DOS. Helps with batch files
BEEP.DOC	.4K	Documentation for above
CD.HEX	1K	Displays name—information—directory for a disk
CD.DOC	.3K	Documentation for above
CLS.HEX	.4K	Clears the screen in DOS
CLS.DOC	.2K	Documentation for above
CRETURN.BAS	.9K	Puts linefeeds in a downloaded program
CRETURN.DOC	.5K	Documentation for above
DISKRTN.HEX	20K	Look at a disk directory—hide & recover files
DISKRTN.DOC	.5K	Documentation for above
DSKPGM2.BAS	2K	Create a batch file to copy a disk alphabetically
DSKPGM2.DOC	.5K	Documentation for above
FILTER.BAS	2K	Filter nasty codes out of a file
FILTER.DOC	.5K	Documentation for above
FK.HEX	5K	Latest function key program with new features
FK.DOC	5K	Documentation for above
GRAFTRAX.HEX	2K	Print your screen three different ways on your Epson

GRAFTRAX.DOC	2K	Documentation for above
HEXCNVRT.BAS	9K	Convert a file to HEX for downloading & back again
HEXCNVRT.DOC	1K	Documentation for above
HOST.BAS	14K	A HOST program for your PC. Go on the air!
HOST.DOC	.4K	Documentation for above
LF.HEX	1K	Produce a different kind of sorted directory
LF.DOC	.2K	Documentation for above
SHIFTBS.HEX	.4K	Change the Shift key to the backslash (\)
ATTRIB.DOC	.4K	Documentation for above
SHIFTBS.HEX	.4K	Change the Shift key to the backslash (\)
SHIFTIBM.HEX	.4K	Change the Shift to the standard character
SHIFTBS.DOC	.5K	Documentation for above 2 files
SPOOLER1.HEX	2K	Set up a print spooler for your PC
SPOOLER2.HEX	2K	Set up a print spooler (different printers)
SPOOLBAS.BAS	2K	Continue spooling when going from DOS to BASIC
SPOOLER.DOC	1K	Documentation for above 3 files
SYSTAT.HEX	3K	Print the status of drives plus other system info
SYSTAT.DOC	1K	Documentation for above
TUNE.HEX	1K	Play one of five different tunes in DOS
TUNE.DOC	.2K	Documentation for above
UTSCAN.BAS	1K	Scan a BASIC program for a particular string & print
UTSCAN.DOC	.4K	Documentation for above
VDEL.HEX	2K	Delete files through a prompt. Prevents disasters
VDEL.DOC	.2K	Documentation for above
WAIT.HEX	.3K	Pause the system for 3 seconds in DOS and then go on
WAIT.DOC	.1K	Documentation for above
XREF.HEX	60K	Faster cross-referencing of a BASIC program
XFER.DOC	.9K	Documentation for above
PC-TALK.BAS	42K	PC terminal & communications programs
PC-TALK.DOC	40K	Documentation for above
ESCWDWN.BAS	.6K	PC-Talk fix
AUTODIAL.BAS	1K	PC-Talk fix
LONGDIR.BAS	1K	PC-Talk fix
INSERTCR.BAS	.9K	PC-Talk fix
FILENOTE.DOC	1K	Documentation for above 4 files
TIMEFIX.BAS	.5K	Fixes PC-Talk connect-time calculation
PC450.BAS	.6K	Supports 450 baud with PC-Talk

User Group Dispatch

User Groups Go to the Faire

Anna Bunker

The West Coast Computer Faire has become a San Francisco tradition. "A tradition," according to Jim Warren, founder of the Faire, "that sprang up out of the early days of computing." The first two or three West Coast Computer Faires were attended by computer hobbyists and professionals. In those days the personal computer was viewed as a hobby, and there wasn't much, Warren says, that you could do with a computer if you weren't willing to play with it.

User groups have also grown out of those early days when breakthrough innovations were brewed up late at night in basements or garages. Warren was a member of one of the original Silicon Valley user clubs along with Steve Wozniak and Steve Jobs of Apple. As a result Warren has always supported hobbyists, clubs, and professional organizations, which in his opinion are "the part of the computer community from which innovation and creativity have grown." Warren gives free booth space to nonprofit user groups attending the Faire.

The 8th West Coast Computer Faire was held March 18-20 in San Francisco. The San Francisco IBM PC Users Group, Diablo Valley PC, and the Silicon Valley Computer Society were among the groups attending.

Ray Young, president of the San Francisco IBM PC Users Group, has attended the Faire as a spectator for the past five or six years. He has witnessed the success of other groups at the Faire in gaining membership, building finances, and publicizing their activities.

The San Francisco IBM PC Users Group started in June 1982. Before the Faire its paid membership had reached 95 and the attendance at monthly meetings averaged between 60 and 70. The group publishes a first-rate newsletter, *Blue Notes*, that is full of programs, patches, reviews, announcements, gossip, and monthly columns. Some of the other services the group offers its members include a library of public domain software (available to group members for $5 a disk) and discounts on software and hardware purchased in bulk by the group.

Not for Profit

Warren gave the San Francisco group free booth space at the Faire. Though the space dedicated to nonprofit groups was in the wings of the building and not in the center of the main floor, it was located in a well-frequented area—right next to the IBM room.

Warren also donated funds to print 5000 fliers for the group. The only expense the group incurred was the cost of copying public domain software and printing back issues of *Blue Notes* to be sold at the Faire. The cash outlay came from members and totalled $3200. The group sold 419 disks, 84 packages of *Blue Notes* back issues, and 29 memberships. The net sales totalled $1867, but half of the disks and three-quarters of the newsletters were left over and will be sold at future meetings and computer shows.

Worth the Effort

Group members handed out nearly 4000 fliers and membership forms at the Faire. Judging by the interest generated, they expected to double their membership in the following weeks. The first meeting the group held after the Faire confirmed these expectations: 125 people attended, twice the average pre-Faire attendance. The group sold $1000 in memberships and public domain software, bringing its finances back into the black.

Many of the manufacturers exhibiting at the Faire stopped at the group's booth. Impressed with the quality of *Blue Notes*, they gave the group free software for review. The group also received free copies of books and magazines.

Many groups at the Faire attended an open IBM PC user group meeting. The San Francisco Bay Area groups came up with a proposal to join forces so that they could cooperate in some future ventures.

Having a booth at a computer show can be an important step in a user group's growth.

Young was at the group's booth all three days of the Faire. He had donated his hardware, so he "didn't want to wander too far away." He enjoyed meeting people and finding out what they expect and need from user groups. "Personally," says Young, "one of the benefits that I got from the Faire was being able to meet the people—getting their feedback and finding out what they were interested in."

The group was able to serve as a source of information for novice users attending the Faire. Members gave advice to people who were considering buying a computer. According to Young they didn't always recommend the IBM PC to those whose needs could be served by another, less expensive computer.

Judging from the San Francisco IBM PC Users Group's experience, having a booth at a computer show can be an important step in a user group's growth. Young advises groups to sign up for shows as far in advance as possible. His group signed up for next year's West Coast Computer Faire while they were at this year's since spaces were already going fast.

In order to sell merchandise at a computer show in California, a group needs a resale number, which can be acquired directly from the state Board of Equalization provided the group has a bank account. Groups planning to attend computer shows should check the laws of the state where the show will be located.

Future Shows

Computer shows are a good place to build membership and finances and to contact other groups, users, manufacturers, and publications. Many organizations sponsor computer shows, but not all of them donate space to nonprofit groups. Check *World Events* for information on shows. The following are major show sponsors:

Computer Faire donates booth space to nonprofit groups. It is sponsoring The IBM PC Faire, August 26-28, 1983, at Civic Auditorium and Brooks Hall in San Francisco. Computer Faire, Jim Warren, 345 Swett Rd., Woodside, CA 94062, 415/851-7077.

Northeast Expositions donates booth space to nonprofit groups.

It is sponsoring two PC '83 shows: June 17-19, 1983, at Civic Auditorium and Brooks Hall in San Francisco; and October 8-10, 1983, at the Bayside Exposition Center in Boston. Northeast Expositions, National Computer Shows, 822 Boylston St., Chestnut Hill, MA 02167, 617/739-2000.

The Interface Group does not offer free space to nonprofit groups. It sponsors the COMDEX shows and The Computer Showcase Expos nationwide. The Interface Group, Inc., 300 First Ave., Needham, MA 02194, 800/325-3330.

The CW Conference Management Group does not offer free space to nonprofit groups. It is sponsoring the Executive Microcomputer Conference and Exposition, June 23-25, 1983, at the Sheraton Centre in New York City. CW Conference Management Group, 375 Cochituate Rd., Rt. 30, Framingham, MA 01701, 617/879-0700.

H.A. Bruno, Inc. does donate space to nonprofit groups if they meet certain criteria. It is sponsoring PC Expo, June 8-10, 1983, at the New York Coliseum in New York City. H.A. Bruno Inc., Ralph Ianuzzi, Jr., 110 Charlotte Pl., Englewood Cliffs, NJ 07632, 201/569-8542.

We welcome reader participation and suggestions. We would like to receive subscriptions to group newsletters so that we may report on group ideas and activities. Address pertinent information to User Group Dispatch, PC World, *555 De Haro St., San Francisco, CA 94107.*

User Group Directory

PC World publishes a User Group Directory every month. If your group is not in this list but would like to be, send the group's name, address, contact, and other information to *User Group Dispatch, PC World,* 555 De Haro St., San Francisco, CA 94107.

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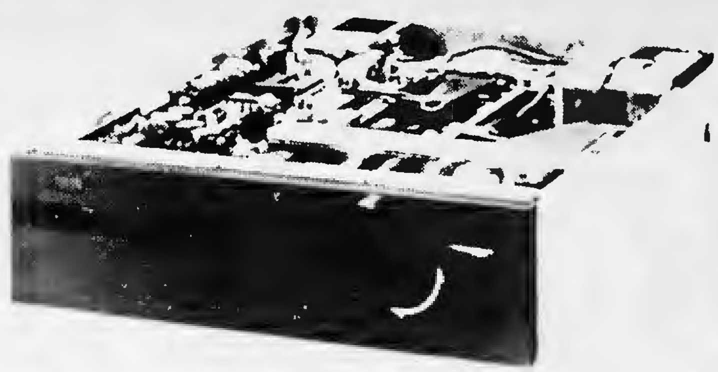

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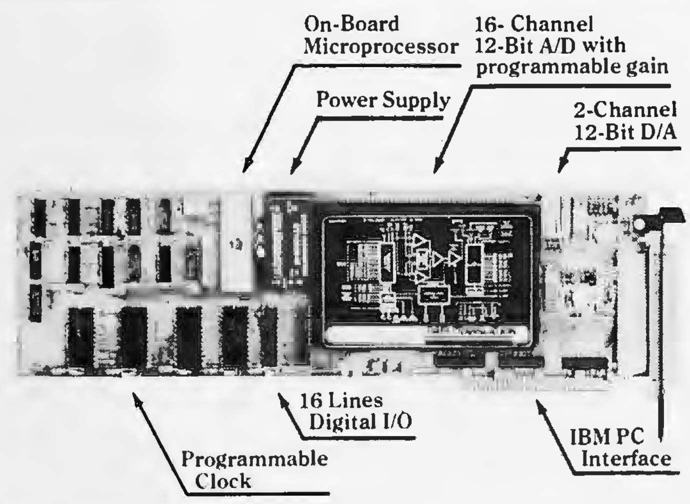

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The Help Screen

PC World Offers Answers and Advice at Every Level.

Karl Koessel

We at *PC World* receive numerous letters from PC users asking for help and advice. Some of the requests are quite broad. One reader wants to know how to use the internal calls and interrupts of DOS. Other readers would like a tutorial on DEBUG. (Authors, take note!) Subjects like these call for entire articles, but some requests are more specific. In response to these questions, we have created *The Help Screen.* If you have questions about the IBM PC or compatibles, send them in and we will track down the answers and share them with our readers.

Spaced Out

Q. *I have been using an Ohio Scientific C4-Mp for four years. Because of its disk drive problems and other shortcomings, I have recently purchased an IBM PC. I typed the BASIC program that I use on my OSI to keep track of my Coast Guard Auxiliary Division records of Public Education Classes into the IBM, but it will not run. I keep getting 'subscript out of range', and as there are no subscripts greater than 10, I cannot figure out what I am doing wrong. I am enclosing copies of the program listing for both machines in hopes that you or some clever staffer will immediately see the error of my ways. Any help would be most appreciated.*

Herman A. Goetz VFC
U.S. Coast Guard Auxiliary
Levittown, New York

The following lines are excerpted from the IBM PC listing sent by Mr. Goetz.

```
290 FOR K=1 TO N 'Print headings
300 PRINT TAB((K-1)*10-1);H$(K);
310 NEXT K
315 UL$="————"
320 FOR K=1 TO N 'Underline headings
330 PRINT TAB((K-1)*10+1);UL$;
340 NEXT K
```

A. The problem here is simple but elusive. BASIC uses parentheses for two slightly different purposes. One use is to enclose subscripts for variables. For example, ALIAS(1), ALIAS(2), and ALIAS(3) are three different variables, each of which may be set to a different value. Parentheses are also used by some BASIC statements and by almost all BASIC functions to enclose the arguments required for a particular operation. For example, to find the square root of 4 we type

```
PRINT SQR(4)
```

and the computer responds with

```
2
Ok
```

If we type

```
PRINT SQR (4)
```

(note the space between the R and the opening parenthesis), we will receive the same result. However, if this extra space is included before the opening parenthesis in the functions SPC(*n*) or TAB(*n*) (as in line 330), BASIC will not recognize the intended function; instead, BASIC interprets the intended function as a subscripted variable. Although BASIC will properly interpret all other statements, functions, and subscripted variables containing spaces before parentheses—e.g., KEY (*x*) ON, SIN (*y*), and VARIABLE (*z*)—it would be wise to avoid having spaces before any parenthesis in all statements, functions, and subscripted variables of a BASIC program.

Display Dilemma

Q. *I loaded a BASIC program on my monochrome PC, typed RUN <ENTER>, and then, deciding to run a different program, pressed Ctrl-Break. Next I pressed Ctrl-Home to clear the screen. The screen was immediately covered by approximately (I didn't count them) 25 evenly spaced horizontal lines. I've had my PC for only about two weeks and was very frightened. I quickly turned the system unit off. When I turned the PC on again, the lines were gone. I thought Ctrl-Home was supposed to clear the screen. Can you explain what happened? Did I do something that damaged my PC? Is my monochrome display or its adapter card defective? Should I take my machine in to be serviced?*

Deborah A. O'Connor
Indianapolis, Indiana

A. Put your fears aside. It is virtually impossible for input from the keyboard to damage your PC, and your computer is not defective. What you saw were underlined blanks. The monochrome display and adapter card are able to produce a variety of types of characters: green characters on a black character cell, black characters on a green character cell, blinking characters, bright characters, underlined characters, and other combinations. (A character cell is a box in which characters are printed. The monochrome display has 80 cells per line.) In BASIC the COLOR statement is used to indicate the type of character to be printed on the display.

Do you want to see those lines again? Load BASIC and type `COLOR 1,0` `<ENTER>`. Notice that the Ok prompt and the following blank are underlined. Now press Ctrl-Home. There are the lines! Ctrl-Home prints blanks in each character cell, but

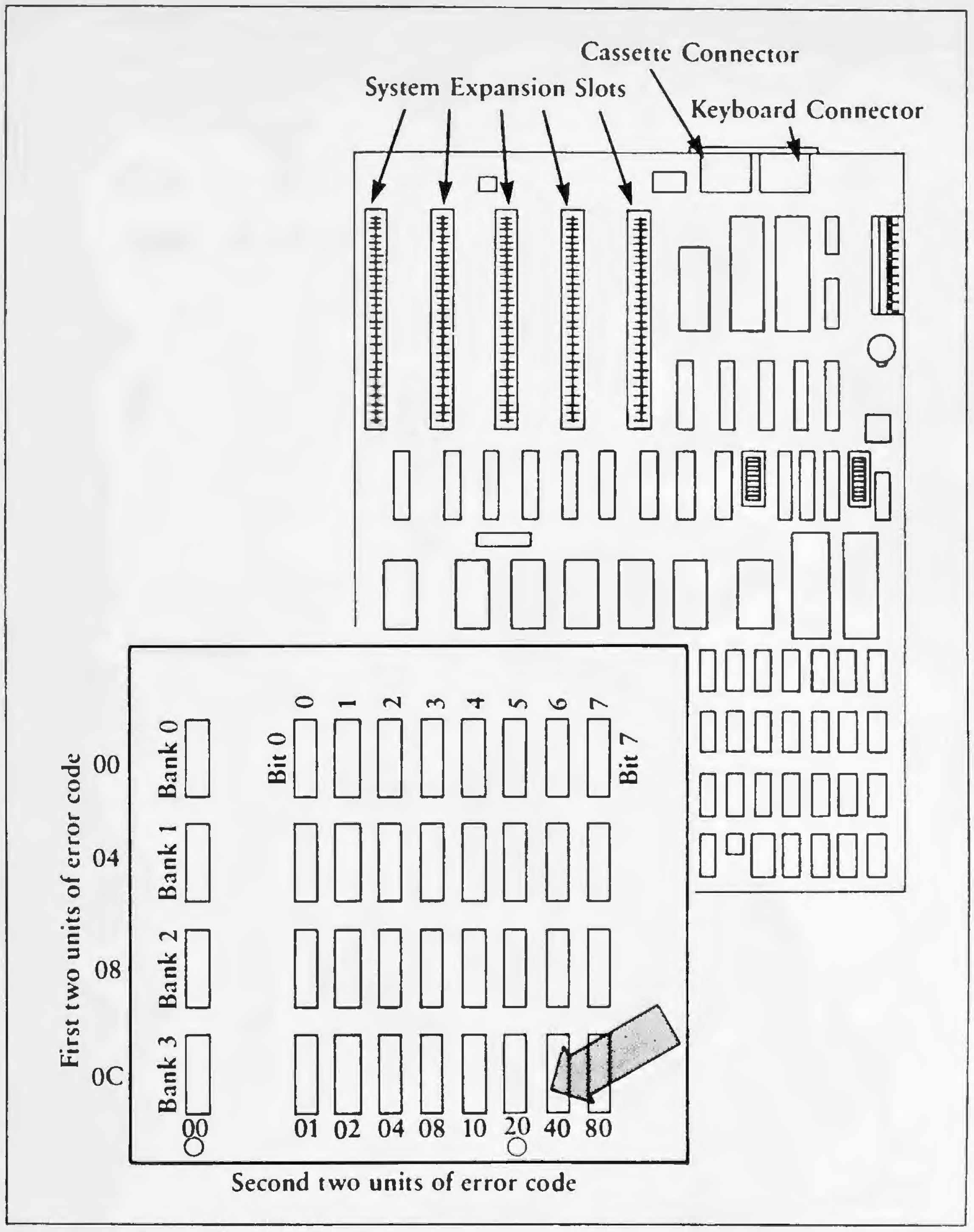

Figure 1: Decoding Parity Errors

these blanks happen to be underlined. Now type COLOR7,0 <ENTER>. Notice that the Ok prompt and the following blank are not underlined. Press Ctrl-Home and, presto, the lines are gone! When you pressed Ctrl-Break, you simply halted the program while the underline mode was in effect. To learn more about the different types of characters possible on the monochrome display, consult your BASIC manual, pages 4-43 through 4-46.

Check Those Chips

Q. What does 'Parity Check 1' mean? One morning, two months after delivery of my PC, I turned on the system unit and instead of the usual beep and drive A access, I saw some numbers (and a letter?) flash on the top line of the screen, and then the screen displayed 'Parity Check 1' and I could not get keyboard response (Ctrl-Alt-Del wouldn't reset the machine). Looking in the Guide to Operations *manual under Problem Determination Procedures (PDP) only indicated that the problem was in the system unit, which would have to be serviced. The next afternoon my dealer called to say that the system unit had been repaired. I was told only that the repair was simple and that since the machine was still under warranty there would be no charge. Can you tell me what was wrong and what was done to fix it?*
Robert Goldman
Kansas City, Missouri

A. 'Parity Check 1' means that there is a defective memory chip in the computer. The first four characters of the error message that flashed on your screen indicated which chip needed to be replaced. (The last three characters were 201, indicating a memory problem.) Your dealer compared the error message's alphanumeric code with a chart like the one shown in Figure 1 to determine the failing chip. If the bad chip is on the system board, the first digit of the error message is 0. For example, the error message '0C40 201' corresponds to the memory chip at Bank 3, Bit 6 (identified by the arrow in Figure 1). If the first digit of the error message is not 0, the failing memory chip is on an expansion board, and a chart for that particular board is required to determine which chip is bad.

Replacing a chip is fairly easy, assuming you have the tools and parts. The system unit must be opened and all installed expansion boards carefully removed. Next, using a chip-pulling tool, the bad chip may be removed. A new chip is gently pressed into the chip socket. Care must be taken to correctly orient the notch on the end of the new chip. If the chip is placed backward in its socket, it will rapidly become hot enough to burn an unsuspecting finger after the machine is turned on. Finally, the system must be reassembled and tested using the diagnostic disk in the *Guide to Operations* manual.

Do you have any questions concerning the PC or the new compatibles? Although we haven't the time to answer every question that comes in, we will print the answers to the more interesting questions as well as any frequently asked questions. If you have questions, don't be shy—ask! Send them to The Help Screen, PC World, *555 De Haro St., San Francisco, CA 94107.*

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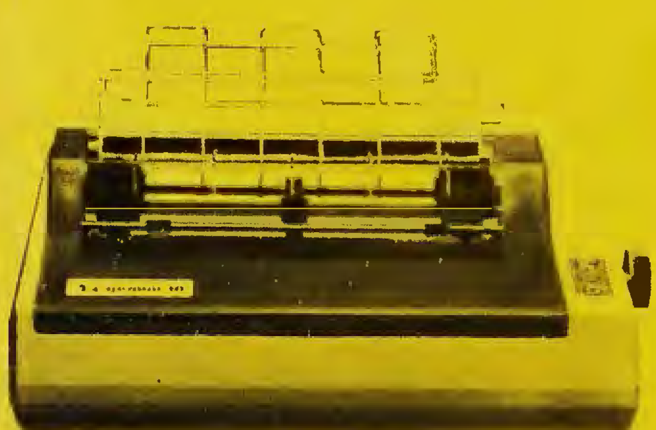

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World Events

A Calendar of Regional, National, and International Events

Edited by Patricia Navone

June 3-5
East Coast Computer Faire
Hynes Auditorium
Boston
A personal computer show featuring software and computer-related products and services.
National Computer Shows
822 Boylston St.
Chestnut Hill, MA 02167
617/739-2000

June 6-8
National Educational Computer Conference
Baltimore Convention Center
Baltimore
Technical programs, scientific papers, seminars, and exhibits. Focus on educational computing. Over 100 computer and publishing companies exhibiting.
Gerald H. Leach-Lewis
IEEE Computer Society
1109 Spring St. #300
Silver Spring, MD 20901
301/589-8142

June 7-10
Hong Kong Computer '83
New Hong Kong Exhibition Centre
Hong Kong
Second international computer technology exhibition held in Hong Kong. Over 130 exhibitors expected, both manufacturers and suppliers of computer services.
Terry Hill
Industrial and Trade Fairs International, Ltd.
Radcliffe House, Blenheim Court
Solihull, W. Midlands, B91 2BG, UK
021/705-6707

June 13-16
Syntopican XI International INFO WORD PROCESSING
Moscone Center
San Francisco
Aimed at the information systems practitioner in office environments.
Prestige Expositions, Inc.
201/444-0505

June 14-16
Ohmcon/83 Electronic Show and Convention
Detroit
Ohio and Michigan's newest and most comprehensive electronics and high-tech exhibition and convention. Directed at OEM marketplace.
Dale Litherland
Electronic Conventions, Inc.
999 N. Sepulveda Blvd.
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June 14-16
InteRobot/International Robot Conference and Exhibition
Long Beach Convention Center
Long Beach, California
Show for factory automation products and services, largely robotics. An applications-oriented technical program with sessions on research, education, and human factors.
Tower Conference Management Co.
Bill Harrington
143 N. Hale St.
Wheaton, IL 60187
312/668-8100

June 17-19
PC '83
Brooks Hall Civic Auditorium
San Francisco
International conference and exposition featuring IBM PCs. Seminars, including PC applications, technical information, and general sessions for users.
Northeast Expositions
822 Boylston St.
Chestnut Hill, MA 02167
800/841-7000

June 20-23
Microcomputers in the Science Lab
TERC offices
Cambridge, Massachusetts
Hands-on workshop for teachers and administrators at all levels, elementary through college.
Technical Education Research Centers, Inc.
8 Eliot St.
Cambridge, MA 02138
617/547-3890

June 22-23
Toronto Computer Show
Automotive Building
Canadian National Exhibition
Toronto
Computer show for dealers. Features hardware and software. Two-day conference on word processing, PCs, office automation. Management workshops.
Whitsed Publishing Ltd.
P.O. Box 190
Port Credit, Ontario L5G 4L7 Canada
416/271-1601

June 23-25
Executive Microcomputer Conference and Exposition
Sheraton Centre
New York City
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CW Conference Management Group
375 Cochituate Rd. Rt. 30
Framingham, MA 01701
617/879-0700

June 26-August 7
Computer Tutor Camps at Stanford University
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Four 2-week sessions for children aged 11 to 17.
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Computer Tutor Camps
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Larkspur, CA 94939
415/461-7533

June 26-30
NCGA '83
McCormick Place
Chicago
Fourth annual National Computer Graphics Association conference and exposition. Approximately 185 exhibitors expected.
NCGA
8401 Arlington Blvd.
Fairfax, VA 22031
703/698-9600

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Computer Tutor Camps at Dartmouth College
Hanover, New Hampshire
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June 27
International Institute on Microcomputers in Education
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Stanford University
Stanford, CA 94305
415/497-2102

June 27-29
Videotex '83
New York Hilton
New York City
International conference and exhibition examining business and consumer applications of Videotex technology.
Sally Summers
London Online, Inc.
1133 Avenue of the Americas #3314
New York, NY 10036

July 5-8
Software Development Workshop
TERC offices
Cambridge, Massachusetts
Hands-on workshop to train teachers and administrators at all levels, elementary through college.
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Cambridge, MA 02138
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July 11-22
Summer Institute in Math, Science, and Computer Literacy
Trinity College
Vermont
For teachers and administrators at all levels, elementary through college.
Technical Education Research Centers
8 Eliot St.
Cambridge, MA 02138
617/547-3890

July 25-29
Siggraph '83
Cobo Hall
Detroit
A computer graphics conference with special emphasis on CAD/CAM robotics.
Siggraph '83 Conference Office
111 East Wacker Dr.
Chicago, IL 60601
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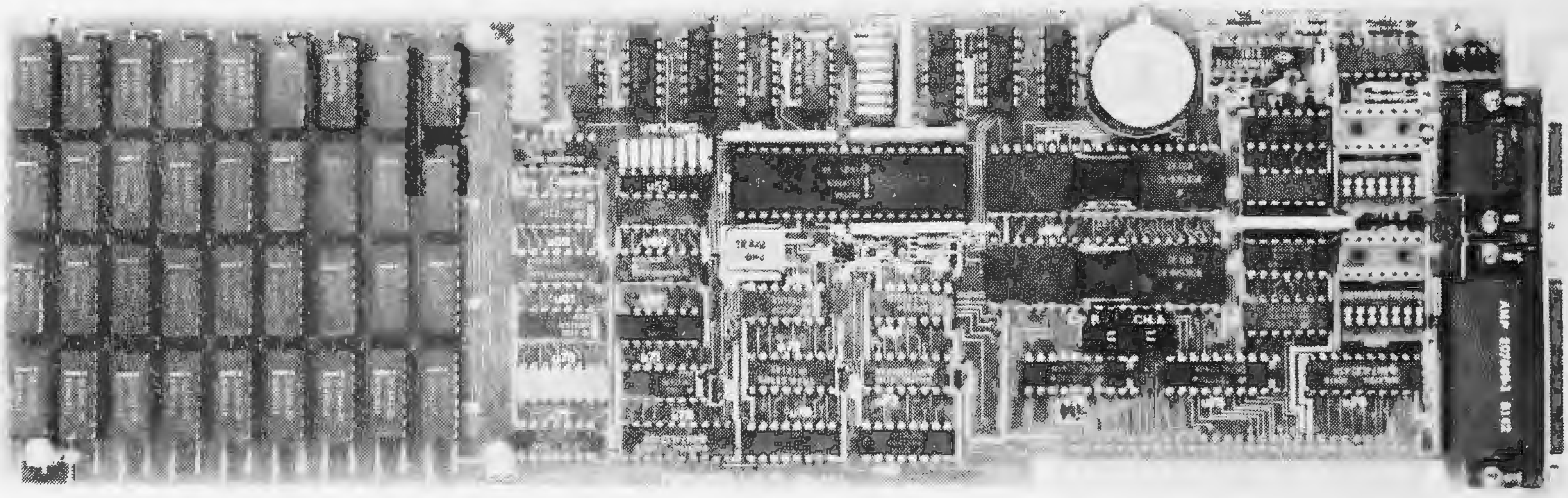

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The memory section of the PDI464 provides up to 256KB of fully socketed expansion memory with parity generation and checking. Four memory sizes are available from 64 up to 256KB to meet a variety of needs. Regardless of memory size ordered, each PDI464 is tested with a full compliment of 256KB of memory to ensure trouble-free future expansion. Disk-based memory diagnostics are included which can test memory integrity and report problems down to the chip level.

Two asynchronous serial channels are provided which are completely compatible with IBM serial channels. Each channel can be selected to reside at one of four addresses to allow for future expansion. A unique feature is provided which allows simple selection of data terminal or data communication equipment [DTE/DCE] configurations, thus eliminating the need for special cables or null modems. Each channel comes complete with a 6 foot RS-232 cable.

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Comprehensive documentation is provided with numerous illustrations to simplify installation procedures. All documentation fits neatly into existing 3-ring binders provided with the Personal Computer.

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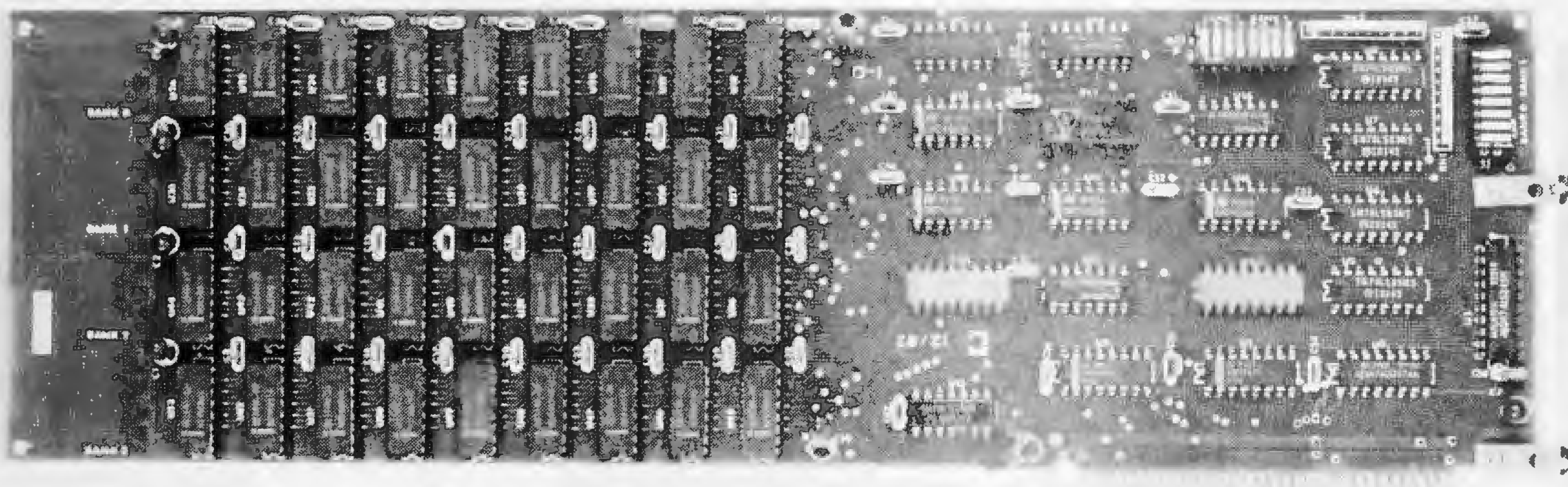

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MAXELL MD2 DS	10/60	39
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BUSINESS

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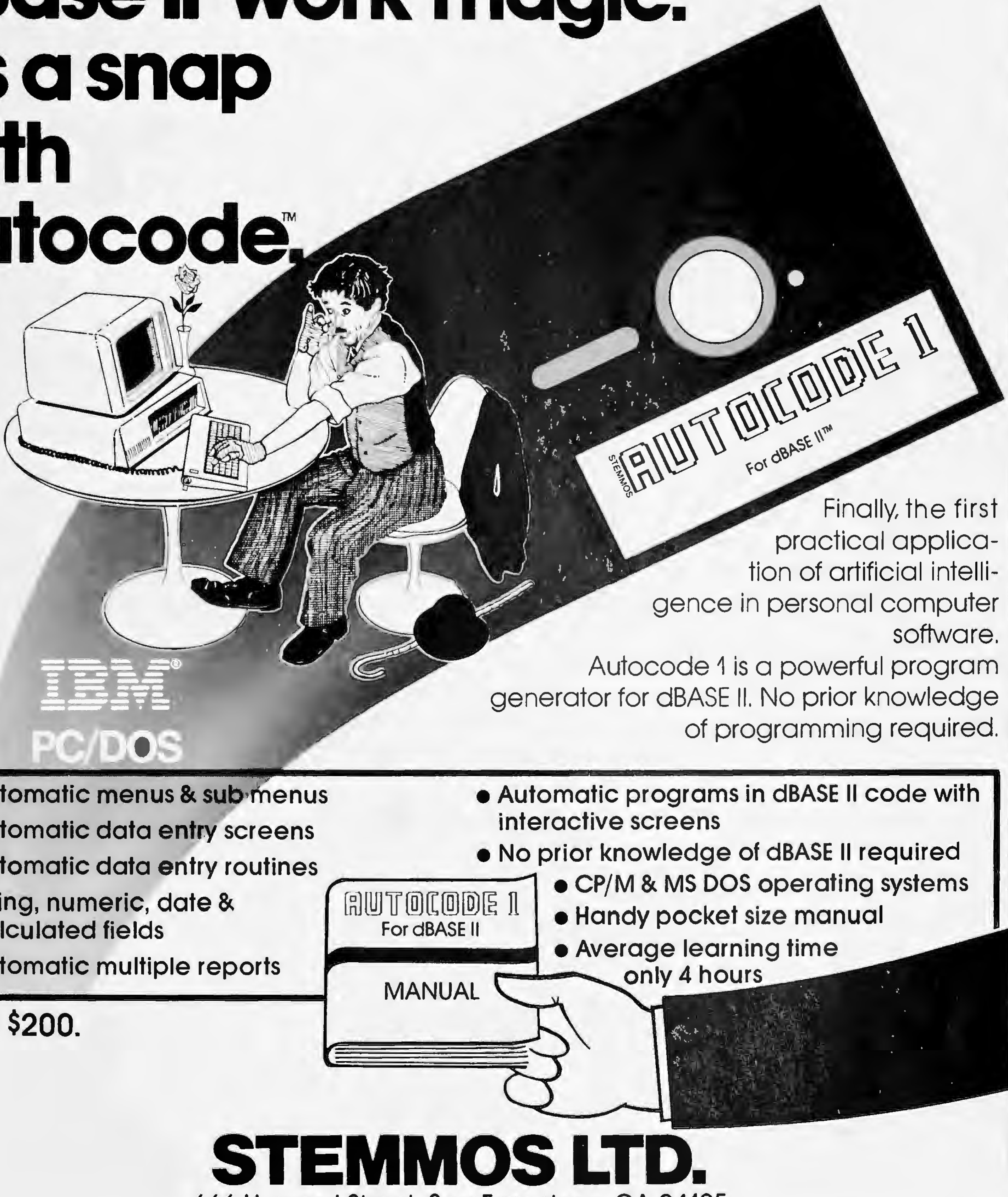

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Medical

Threshold
Medical office management software featuring automatic insurance preparation w/teleprocessing to Blue Shield & Medicare, unattended statement processing, total security w/audit trails, statistical information, complete inquiry & management reports & online help. List $5,500. *Physicians Practice Management, Inc., 1810 South Lynhurst Ste.# Q, Indianapolis, IN 46241, 317/248-0357*

Physicians Practice Management

Physician's Office System
POS/1 is a medical billing and accounts receivable system. POS/1 facilities: immediate access to patient status by account number or name, automatic RVS or ICDA codes with manual overrides, receivable aging report, track next visit date, menu driven with online help screens. $950. *Chen Information Systems, Inc., 1499 Bayshore Hwy., # 205, Burlingame, CA 94010, 415/692-4358*

CHEN

Operating Systems

Development System Tools
Operating System Development Tools Universal Development Interface and iRMX86 implementations for PC DOS/ MS-DOS based systems. A complete family of Develop-

ment Tools. See display ad this issue. *RTCS/Real-Time Computer Science Corp., P.O. Box 3000-886, Camarillo, CA 93010, 805/482-0333*

RTCS REAL-TIME COMPUTER SCIENCE CORPORATION

Personal

PerFin
Simplify your money management. Provides 40 user-defined categories, checkbook, budgets and reports. Handles checks, cash and credit transactions. Only $65. NUTRITION/EXERCISE PROGRAM COMING SOON. (Custom software and consulting services. Available for small and large systems.) *Digital Engineering Group, Inc., 11999 Katy Frwy. # 150, Houston, TX 77079, 713/531-6100*

Real Estate

DSS Real Estate Analyzer
Designed for real estate professionals involved in analyzing sales or purchases of properties, syndications, or complex limited partnerships. Provides operating statements, cash flow & tax analysis, IRR, partnership investor analysis, loan and depreciation schedules. *Decision Support Systems, 3234 Prospect Street, N.W., Washington, DC 20007, 202/342-8172*

DSS Decision Support Systems

Sort

Opt-Tech•Sort/Merge
Extremely fast Sort/Merge program for the IBM-PC. Can sort or merge multiple files containing fixed or variable length records. Run as a DOS command or call from BASIC, plus many other features. Compare before you buy any other. Write or call for more info. $75. *Opt-Tech Data Processing, P.O. Box 2167, Humble, TX 77347, 713/454-7428*

DP

Stock Market

Stock Portfolio Reporter
Provides up to the minute information on key parts of investor's stock account. Market price updates by DOW JONES; easy link to Hayes Smartmodem. Sort by P/E, gain/loss, yield or any item in SPR's 8 useful reports. Friendly menu displays & manual. Requires 128K, 2dd. Demo disk avail. $179. VISA/MC welcome. *Micro Investment Systems, Inc., P.O. Box 8599, Atlanta, Georgia 30306, 404/892-3194*

MICRO INVESTMENT SYSTEMS, INC.

Market Trend Analyzer
Graph, tabulate, do moving averages and other computations using major market, technical (3 exch.), psychological and fundamental indicators. Package $300 with 3 months data. Demo/manuals available separately with credit. Historical and update data available. 128K, 1 or 2 drives, mono/color. *Personal Equity Computing, Inc., P.O. Box 2105, Dept PCW, Ocean, NJ 07712, 800/431-6082, NYS 914/331-6663*

PECS™

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Historical stock prices from the Dow Jones service.
*Retrieve historical quotes
* Automatic portfolio update
* Chart Hi-Lo-close, volume
* Chart Moving averages
* Chart Relative strength
* Chart to Epson printer
* Chart comparison of stocks
* Chart on volume
* Spreadsheet compatible
Package $395, Demo $49. *R & D Software Associates, Box 2727, Reston, VA, 22090, 703/620-2509*

Systems

Multiple Users Under PC-DOS
MultiLink turns PC-DOS into an efficient multi-user multitasking operating system. Additional users are supported by attaching inexpensive CRT terminals or modems to serial ports on the PC, and can run normal applications designed for PC-DOS. Includes host communications software for public dial-in. *Software Link, Inc., 6700 23-B Roswell Rd., Atlanta, GA 30328, 404/255-1254*

Tools

Disassembly Cross-Reference
The ultimate research tool for the assembly language programmer. Captures output from the PC-DOS DEBUG utility; prints a disassembly listing marking each referenced address, then a sorted cross-reference of all hexadecimal byte and word values. $49. *SofTool Systems, 8972 E. Hampden Ave. # 179, Denver, CO 80231, 303/793-0145*

STS

Utilities

Diskette Catalog
DC keeps track of all your files on all your disks. Functions include add, alphabetize, delete, list, and search. Entries are handled by DC, not your typing. Written in machine lang. for speed, DC can hold 3000 files (w/ 96K). For PC Dos (all) 1 drive, 80 col. display, 64 K. $20 plus $1 for MC/VISA. *Creative Programs Unlimited, 16533-37th Avenue NE, Seattle, WA, 98155, 206/367-7949*

CPU

Funkey
Program the function keys to suit your own needs. Funkey makes using word processing, spreadsheet and other applications programs easier and faster. Uses are limited only by the imagination. See display ad. *Bourbaki Inc., 431 Main St., Boise, ID 83702, 208/342-5849*

Alta Link
Alta Link-intelligent communications package allows IBM PC to communicate with other PCs and mainframes across asynchronous telecommunications lines. Menu control using function keys. User control over-baud rate, line control, communications port. 30 user function keys. Many other functions. $97. VISA/MC. *Alta Systems, Inc., P.O. Box 9802 #181, Austin, TX 78766, 512/836-7351*

PrettyPrinter for BASIC
Are your BASIC programs over 100 lines long? Then you need the PrettyPrinter for BASIC. It prints BASIC programs so you can read and un-

derstand them: indented and block structured (like PASCAL), keywords in lowercase, remarks highlighted, cross reference. 64K required. Just $39 or write for details. *Personal Computer Things, Inc., P.O. Box 207 - PCW, Centreville, MD 21617*

The Creator™
An amazing way you can generate word processing, mailing lists, Data Base Management, invoicing programs, and more without any programming knowledge. Now your computer can write its own programs! All in a matter of minutes. Not only that, but a lot more can be produced as well (even program lines.) *Software Technology for Computers, 430 A Main St., Watertown, MA 02172, 617/923-4334*

Peeks 'n Pokes for the IBM PC
BASIC and Pascal programmers - discover the secrets of the PC! Find out how to access and modify configuration, keyboard, disk, printer, communications, and monitor status. Perform DOS and BIOS function calls! Learn how to find more Peeks 'n bels or to a listing. Also allows recovery of files erased inadvertently. Requires PC-DOS 2.0, 1 disk. $30. *ErgoSoft, P.O. Box 454, Oakhurst, NJ 07755, 201/493-8352*

ARCHIVES V Diskette Backup
Reduces diskette back-up costs by 90 percent. The PCs' built-in cassette interface can save six full diskettes on one ninety minute audio cassette. The utilities process only required information reducing transfer time and tape usage. Specify 64K or 96K version when ordering; $39.95. *Indiana Digital Corporation, P.O. Box 3755, South Bend, IN 46619, 219/288-7280*

ARCHIVES V

Alta Systems Packages
Super Zap ($47) accesses file/absolute disk sectors. DIR-lift, sector saving, customization. PC Toolbox ($37) EDIR-formatted info about files. List-file printing, total printer control. File Utility-assign/remove "hidden" status, recovers deleted files. Comes with other utilities. VISA/MC. *Alta Systems, Inc., P.O. Box 9802 #181, Austin, TX 78766, 512/836-7351*

User Groups

Newsletter/Software Exchange
International PC Owners Inc.
This group publishes a newsletter IPCO INFO every other month and runs a software exchange. The software exchange consists of about 160 user developed programs for the PC. Membership in the US is $20/year. Send for free catalog of programs. *International PC Owners, Inc., P.O. Box 10426, Pittsburgh, PA 15234, 412/561-1857*

PC World Directory *is a comprehensive listing, by category, of products and services for the IBM PC, lookalikes, and compatibles. It provides rapid access to the burgeoning PC marketplace for both readers and advertisers.*

FORMAT: The standard format includes a product ID, a 300-character descriptive ad, and company name, address, and telephone number. Use of a company logo is optional.

Advertisers may choose among categories already being used or may create their own. Display advertisers can cross-reference their current ad to the PC World Directory *for increased exposure at low cost.*

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See you next issue!

Just Announced

The Wide World of PC Products

Edited by Adrian Mello

In the fast-paced personal computer marketplace *Just Announced* acts as an alert service to keep you abreast of the latest developments in IBM PC and compatible technology. Information for this department is provided by manufacturers; these write-ups are not reviews. Many of these descriptions will be followed up by reviews in this or future issues.

Hardware

Boards

RAMPLUS

A multifunction board that allows memory expansion with 64K chips and will permit use with 256K chips when they become available. The board requires a system with 64K already in place. Maximum memory expansion using 64K chips is 256K. A memory-mapping feature allows a maximum memory of 1 megabyte with 256K chips. In addition to memory expansion, the board includes serial port, parallel port, and clock/calendar with battery backup. List price: $575. Raytronics, 4901 Morena Blvd., Bldg. #900, San Diego, CA 92117, 800/854-1085, 619/270-4000.

AddRAM Plus

A multifunction board that provides up to 512K of memory expansion, two serial ports, and a clock/calendar. A system must have 64K in place before the board is installed. The board includes software that performs disk emulation and print spooling for a parallel or serial printer. Tascmaster software provides an extension to the MS-DOS operating system and creates a multitasking environment for up to 9 background tasks. Tascmaster can be used with the disk emulator and print spooler and is compatible with software running under PC-DOS. List price: 64K $595, additional 64K increments $125 each. Profit Systems, Inc., P.O. Box 1039, Berkley, MI 48072, 313/559-0444.

Quadlink

A board that emulates a 64K Apple computer and allows a PC to use Apple software. The only system requirement is a single expansion slot. Apple's DOS 3.3 software is translated by the board into language the IBM PC can understand, so that most programs designed for the Apple II, Apple II Plus, or Apple IIe are compatible with the PC.

No conversion or reformatting of disks is required to run Apple software. The user can change between the Apple and IBM modes with a single command. Without any modification, Apple programs will appear on the IBM's monochrome or color monitor and can use Apple high-resolution color graphics. All peripherals that can normally be used with the PC will operate with the Apple software.

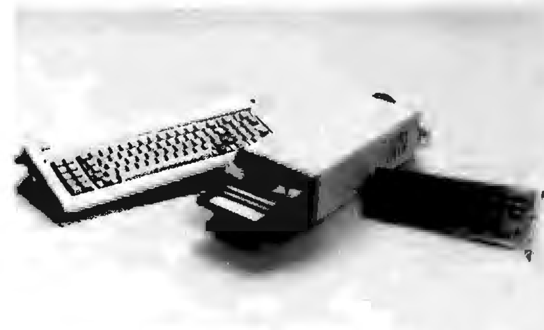
Quadlink comes with 64K, a parallel port, serial port, and a game port that is both Apple and IBM compatible. It will be available in late June. List price: $680. Quadram Corporation, 4357 Park Dr., Norcross, GA 30093, 404/923-6666, TWX: 810-766-4915.

Storage Devices

V1200

An unusual storage device that uses a removable cartridge to hold up to five 5¼-inch floppy disks for a total of 6 megabytes of formatted storage. It requires 64K and uses single-sided, 170 tpi (tracks per inch) floppy disks. The device is aimed at users who are familiar with floppy disks and offers the media transportability associated with floppies. Files cannot run over the 1.25-megabyte capacity of a single floppy in the cartridge.

The controller board included with the V1200 uses an expansion slot in the system unit. The V1200 uses five of the eight logical drives that can be attached to the controller. Up to four regular floppy disk drives can be attached, either four 5¼-inch drives or three 8-inch drives and one 5¼-inch drive. A disk emulator included also uses one of the controller's eight drive options. Switches on the controller allow it to read and write automatically to the preset disk configuration. The V1200 also includes software, a cable, and one cartridge with five floppy disks. List price: $1549. Vista Computer Company, Inc., 1317 E. Edinger, Santa Ana, CA 92705, 714/953-0523, Telex: 910-595-1565.



V1200 multiple floppy disk drive and Diskmaster disk controller card, Vista Computer Company

Miscellaneous

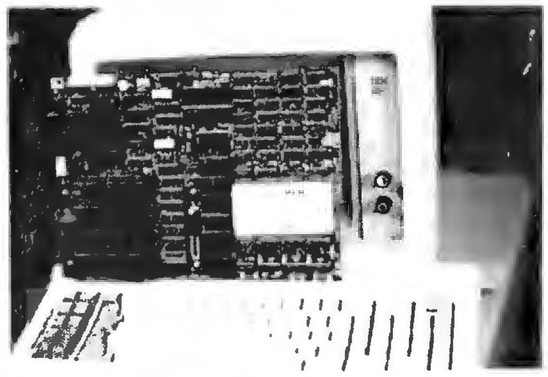
DAS Series 500
A measurement and control system that allows the PC to interpret real-world analog signals and control remote instruments. The system requires 192K and one disk drive. The basic 500 unit holds the power supply and base board with 12 expansion slots that enable the unit to perform a variety of functions. A set of six expansion boards called Analog Input Modules (AIM) permits direct connection of analog devices

DAS Series 500 measurement and control system, Data Acquisition System

such as thermocouples, photodetectors, and strain gauges. The offset and gain of each signal channel are programmable and range is switch selectable.

An interface card that uses an expansion slot in the PC system unit and software are also included with the basic 500 system. The software is an extension of the BASIC operating environment that includes a library of machine language subroutines. The software enables application development that can be drawn upon with BASIC and take advantage of the speed of machine language operations, essential for real-time measurement and control procedures. Statistical and graphics functions, and conversion to engineering units are additional features of the software. List price: System 500, $2045. Three preconfigured systems are available: 510 measurement system $2900; 520 measurement and control system $4100; 530 high-accuracy measurement system $4400. Individual modules for specific configurations may be purchased separately. Data Acquisition Systems, Inc., 349 Congress St., Boston, MA 02210, 617/423-7691.

PC System Memory Enhancement
Memory expansion that is achieved without using any PC expansion slots. Add-MEM makes the necessary modifications to the PC motherboard, removes the resident 16K chips, and replaces them with 64K chips. The user must carry in the system unit to an Add-MEM service location or remove the motherboard and mail it to Add-MEM. Users may have systems configured with 128K, 192K, or 256K, after which 64K upgrade kits are available to augment memory to a maximum of 256K on the motherboard. List price: 128K $192, 192K $256, 256K $320, 64K upgrade kits $80 each. Add-MEM, 22151 Redwood Rd., Castro Valley, CA 94546, 415/886-5443.



PC System Memory Enhancement, AddMEM

Systems Software

Utilities

UltraFAST
Three utilities—a disk emulator, a parity error handler, and a dynamic memory allocation program—that use 8K of memory and require one disk drive. *UltraFAST* emulates up to four double-sided, 40-track drives. Any combination of mechanical and emulated drives can be used and allocated to drive locations A through D. This configuration can be performed from the keyboard. The program also allows the user to execute a warm boot from the keyboard. List price: $39.95. Daystar Systems, Inc., 10511 Church Rd., Ste. L, Dallas, TX 75238, 214/341-8136.

D2BAKRST
A program that allows the user to back up hard disk files on floppy disks. The program requires 64K and one disk drive. The user can back up hard disk files longer than the storage space available on the floppy disk by initially giving the drive's maximum storage limit. Once the backup operation begins and the storage limit is reached, the user is notified. The user

must then remove the full floppy disk and replace it with another so that the rest of the file can be copied. Files that have been backed up to floppy disks can also be restored to the hard disk. List price: $35. D2 Enterprises, P.O. Box 871, Shalimar, FL 32579, 904/651-3108.

D2FORM
A utility that allows the user to design forms on screen. The program requires 64K and one disk drive. The length and mapped location of each field on screen is stored automatically in a file, and the file can be recalled without using data statements. The coordinates and size of each field are provided on the printed copy of the form. List price: $45. D2 Enterprises, P.O. Box 871, Shalimar, FL 32579, 904/651-3108.

SimpliFile
A program that organizes file menus and simplifies file selection. Requirements for the program are 32K and one disk drive. *SimpliFile* displays a chart that lists files, one to a line, by name, size, and date of last change, and by the user's description. The user may scroll forward and backward if the file list extends beyond a single screen.

Simplified commands can be executed by pointing the cursor arrow to the desired file and then pressing a single character for each of the following operations: backup, copy, erase, rename, list, and view the file contents in text or hexadecimal. A number of files can be executed at once by marking them with an *M* and issuing a single command for backup, erase, or list. The user can sort files by name, type, or size. List price: $100. Durant Software, 2532 Durant Ave., #250, Berkeley, CA 94704, 415/540-0912.

Peeks 'n Pokes
A package of programs and functions for BASIC and Pascal programmers that requires 48K, one disk drive, and an 80-column monitor. Assembler subroutines that perform the same functions as the BASIC commands PEEK, POKE, INP, and OUT are included for the Pascal programmer. With *Peeks 'n Pokes* the user can access system configuration, unprotect interpretive BASIC programs, and read and change the keyboard status. The program features techniques that allow the user to pass data from one program to another using safe locations in RAM and perform DOS/BIOS functions including print screen, boot system, get/change default drive, change video mode, and read/write the screen. The user can change printers, monitors, and communications adapters without altering hardware. List price: $30 (plus $2.50 for shipping). Data Base Decisions, 14 Bonnie Ln., Atlanta, GA 30328, 404/256-3860.

Norton Utilities 2.00
A new version of a set of utility programs that supplement and match the new features of DOS 2.00. A system is required with 64K and one disk drive. The utilities have been upgraded to work with the new disk formats and directories of DOS 2.00. Hard-disk versions of the key utilities have been added to support IBM's new 10-megabyte hard disk. Three utilities have been added: LABEL, BLOAD, and SSAR. LABEL allows users to add, change, and remove volume ID labels. BLOAD converts programs to the BASIC BLOAD format. SSAR (special search and repair) is a new file recovery program that has been added to the three preexisting file recovery routines. List price: $80; to owners of previous versions $20. The Norton Utilities, 2210 Wilshire Blvd., Santa Monica, CA 90403, 213/399-3948.

Applications Software

Finance

OptionCalc
A financial forecasting tool that calculates the value, expiration date, and hedge ratio of put and call options. It requires 64K, one disk drive, and a color/graphics adapter. The Black and Scholes model is used to determine the call value, and the arbitrage method is used to evaluate the put value. The screen is divided into input and calculated results. "What if" calculations are possible. One-page hard copy reports are produced with the PrtSc key. *OptionCalc* has a relatively free style of input. Dates can be entered in a number of ways. Words that aren't misspelled too poorly can be interpreted by the program. List price: $65. Savant Software, P.O. Box 42888, Houston, TX 77042, 800/231-9900, 713/556-8363.

Accounting

EZ Entry
An order entry and invoicing program designed for small-business and personal use. It requires 64K and two disk drives. The user can maintain a file of 200 product codes and

prices and 500 orders per single-sided disk. Invoices can be sorted by number, account, state, or date. A utility for interfacing with accounting software is available. Invoices and reports can be customized with a letterhead if printed on IBM's dot matrix printer. List price: $99.95. Systemics, 3050 Spring St., West Bloomfield, MI 48033, 313/851-2504.

Spreadsheets

StretchCalc

A program that extends the abilities of *VisiCalc* to provide graphics and sorting and rearrangement of spreadsheet columns and rows. A system with 128K, one disk drive, and the IBM Color/Graphics Adapter is required. The program allows users to produce eight types of charts and graphs: bar, stacked bar, pie, and high/low/close charts; and line, scatter, dot, and area graphs. Any portion of a spreadsheet can be represented with a graph without leaving *VisiCalc*.

The program provides two additional commands to reorder data on the spreadsheet. A Sort command rearranges the spreadsheet based on the numeric values in any column or set of columns. A Rearrange command repositions the spreadsheet columns by giving the command and listing the desired order of the columns. These two commands can be used for either a permanent change to the spreadsheet or for temporary viewing.

Another feature of the program allows the user to store command sequences and invoke them with a single character command. The last 75 keystrokes are constantly retained by *StretchCalc* to allow the user to store the sequence and reuse or edit it. A *Mini-StretchCalc* product without graphics is also available. List price: *StretchCalc* $99, *Mini-StretchCalc* $49. Multisoft Corporation, 18220 S.W. Monte Verdi, Beaverton, OR 97007, 503/649-9458.

Data Management

Info-Gen, Info-Reporter, Info-Sort

A series of integrated data management programs that require 64K and two disk drives. With *Info-Gen* the user can create a customized data base. The program helps the user define files and determine calculations and report formats. *Info-Gen* provides entry and update screen formats, but the user has the option of creating a customized version.

Info-Reporter interfaces with *Info-Gen*'s data files to produce hard copy reports. Using the printer spacing chart displayed on the screen and the sequence definition function the user designs customized report formats. *Info-Reporter*'s features include multiple headings, footings, calculations, and subtotals. *Info-Sort* reads and sorts 1000 records in less than 10 seconds. List price: *Info-Gen* $245, *Info-Reporter* $125, *Info-Sort* $95. LM Systems, Inc., 1340 E. Katella Ave., Anaheim, CA 92805, 714/937-1641.

PFS:File, PFS:Report, PFS:Graph

An integrated data management series that requires 64K and two disk drives. *PFS:File* files, retrieves, and summarizes data. Data forms are user designed. Samples forms are provided. Forms can be up to 32 pages long with up to 100 items per page. Files can be sorted and merged.

PFS:Report accesses the information in *PFS:File* to produce presentation-quality reports. The report formats are user designed with up to 16 columns per report. Totals, subtotals, averages, subaverages, counts, and subcounts can be included in every column. *PFS:Report*'s features include sorting, page numbering, and title printing and centering. Eight report formats can be saved to disk.

PFS:Graph produces bar, line, or pie charts from data in *PFS:File* or *VisiCalc* DIF files. It interfaces with a wide variety of printers and plotters including Epson printers, the IBM Graphics Printer, and the HP7470A plotter. List price: *PFS:File* $140, *PFS:Report* $125, *PFS:Graph* $140. Software Publishing Corporation, 1901 Landings Dr., Mountain View, CA 94043, 415/962-8910.

Word Processing/ Text Editing

MemoPlan

A word processing package designed for the composition of memos, letters, and reports by the inexperienced word processor. It requires 64K and two disk drives. *MemoPlan* features a split screen that allows the user to work on two documents simultaneously, transferring material from one document to another. Five files may be open at the same time. The user can flip from one to another with one keystroke. *MemoPlan* features right justification, text reformatting, word wrapping, centering, scrolling, and proportional spacing. Blocks of text or lines can be moved, copied, or deleted. Deleted text is saved and can be "undeleted."

MemoPlan automatically saves documents during power outages with backup files. List price: $195. Chang Labs, 5300 Stevens Creek Blvd. #200, San Jose, CA 95129, 408/246-8020, Telex: 334431.

Graphics

MicroCAD

A three-dimensional graphics modeling system that allows the user to plot up to 4000 points. It requires 64K and two disk drives. With *MicroCAD*, the user can design objects by moving the cursor on the screen. The objects can be rotated, appended, moved, viewed in perspective, and edited. The user may also display spreadsheet data from *MicroCAD*'s electronic spreadsheet or *VisiCalc* files as high-resolution graphs. Points and lines are entered directly on the screen. Images are edited either by changing *x,y,z* coordinates or by changing bearings and line lengths. Circles and other geometric shapes can be drawn, and objects can be stored and recalled. Text can be mixed with images on screen, allowing the user to label objects. List price: $500. Computer Aided Design, 764 24th Ave., San Francisco, CA 94121, 415/387-0263.

DIFmaster

An integrated series of utility programs designed for graphic display of spreadsheet data stored in DIF files. The programs require 64K, one disk drive, and a color/graphics adapter. Though a color/graphics monitor is required, the user has the option of switching to a monochrome monitor.

CHARTDIF displays spreadsheet data in bar chart form. PLOTDIF provides a three-dimensional display of spreadsheet data that allows the user to visually observe and compare values and trends.

GRAPHDIF reads and displays spreadsheet data in scaled, three-dimensional line graphs. GRAPHDIF gives the user the option of high- or low-resolution plotting. The user can either select automatic sizing or determine the column size, the row size, and the scale for the height of the vertical values. The graph may be redrawn on a different scale.

SCATRDIF constructs a scatter diagram of a two-column spreadsheet with two values in each row. It performs linear regression calculations, plots *x* and *y* intercepts, draws the appropriate regression line overlaid on the points, and calculates the correlation coefficient of the two values. The correlation coefficient allows the user to determine whether the values in the first column have a direct relation to the values in the second.

DIFmaster also includes the Graphics Drawing System, a set of mechanized routines that allow the user to create diagrams, charts, and graphs. All the charts, graphs, and diagrams produced with DIFmaster can be saved to disk or printed out. List price: $79.95. Starside Engineering, P.O. Box 18306, Rochester, NY 14618, 716/461-1027.

Graphics Utility

A graphics package that can be used as a stand-alone graphics generator or to create character sets and shapes for a BASIC program. It requires 64K, one disk drive, and a color/graphics adapter. Character sets may be designed with different sizes and fonts. Shape size may vary, with the maximum size 39 by 39 pixels. Shapes may be combined and saved as one large picture. Three subroutines demonstrate how to incorporate the shapes into a program. The subroutines include animation, accessing a string binary array, and separating characters out of the binary array. List price: $85. Savant Software, P.O. Box 42888, Houston, TX 77042, 800/231-9900, 713/556-8363.

Games

Suspended

An adventure game that challenges players to save as many people as possible by repairing a damaged planet. The game requires 48K and one disk drive. The players remain in a state of suspension while they direct the actions of six robots, their only source of communication with the outside environment. Players use a 600-word vocabulary to communicate in complete sentences with the game's program. *Suspended* has advanced levels of play. List price: $49.95. Infocom, Inc., 55 Wheeler St., Cambridge, MA 02138, 617/492-1031.

Tachyon

A fast-moving, arcade-style video game with color graphics, multiple screens, and sound effects. It requires 64K, one double-sided disk drive, and a color/graphics adapter. Players travel through the galaxy aboard *The Avenger*, a star cruiser equipped with scanners, energy shields, lasers, and computer-driven torpedoes. The object is to destroy the attacking enemy before *The Avenger* runs out of energy. The cruiser can restore its resources at refueling stations. List price: $39.95. Mirror Images Software, Inc., 1223 People's Ave., Troy, NY 12180, 518/274-2335.

Spyder, Hide and Sink, and Tachyon games, Mirror Images Software

Spyder

A fast-action, arcade-style video game with color graphics and coordinated sound effects. The game requires 64K, one disk drive, and a color/graphics adapter. Players defend themselves from the web-spinning spiders that descend from the roof of the cave or crawl across the floor. Once a player is caught in a web, a new round begins. List price: $39.95. Mirror Images Software, Inc., 1223 Peoples Ave., Troy, NY 12180, 518/274-2335.

Hide and Sink

A strategy game with color graphics that requires 64K, one disk drive, and a color graphics adapter. The player's naval fleet, hidden on a 10 by 10 sea grid, is pitted against the computer's fleet of equal strength. Hits and misses are displayed along with the status of both fleets. The game includes a nighttime option. List price: $29.95. Mirror Images Software, Inc., 1223 Peoples Ave., Troy, NY 12180, 518/274-2335.

Accessories

P.C. Stand

A stand for the IBM PC system unit that provides storage space for the keyboard when the computer is not in use. When the computer is being used, the stand makes it possible for the keyboard cord to run under the system unit, eliminating the need for extension cables. The stand raises the monitor for viewing comfort. List price: $34.95 (plus $2 shipping and handling). Personal Computer Accessories, 4456 Partridge Ct., San Jose, CA 95121, 408/578-7798.

PC Stand, Personal Computer Accessories

IBM PC BASIC Reference Guide

A four-panel, 6-by-12-inch reference card that lists and defines BASIC statements, system controls, input/output processing statements, memory statements, error messages, video and graphic controls, basic functions, and arithmetic operation symbols. List price $2.95. John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158, 212/850-6000.

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Products

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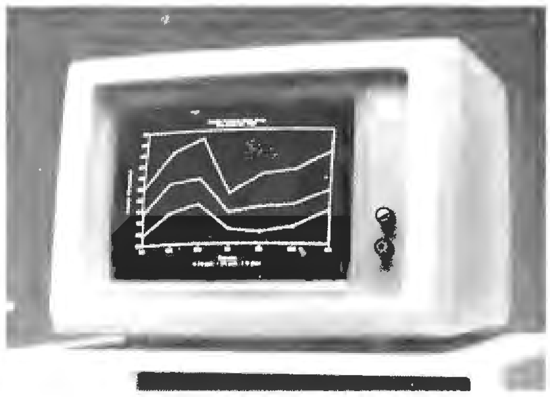

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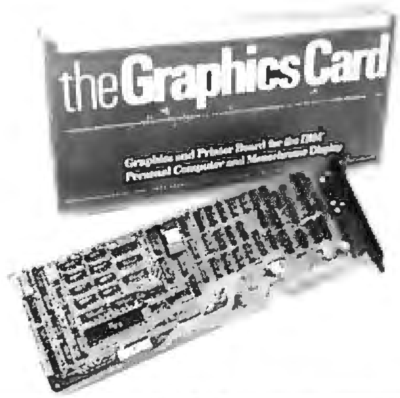

HERCULES

Graphics software requiring the IBM Color Graphics Adapter is not compatible with the Hercules Graphics Card. Hercules compatible software from other vendors includes programs for business graphics, CAD, and word processing with scientific characters. Call or write for more information.

(About Our Gatefold)

The image inside the facing gatefold cover was created by Jim Ludtke, magazine illustrator and cofounder of Brain Boy Studios of San Francisco, California, using an IBM Personal Computer with the Plantronics COLORPLUS card and software.

Jim said he had "literally never touched a computer before." Because of the linear, mechanical quality of his airbrush work, however, he found the transition to electronically generated graphics relatively easy.

Although learning to use the computer did have some pitfalls, as when he lost his first image through neglecting to save it to disk, on the whole Jim found working with the IBM PC and COLORPLUS "fascinating."

"The big reward of using the computer is the fact that you can work up your ideas on the screen and then alter an almost finished piece of art, which you cannot do with paints."

The Plantronics gatefold is a regular feature of *PC World*. Each month we ask a different artist, architect, or designer to experiment with this system and create an image.

At the end of the year a *PC World* blue-ribbon panel will evaluate the series and award a cash prize and a plaque to the artist who makes the most dazzling use of COLORPLUS. If you would like to be considered for the contest, please contact our editorial department.

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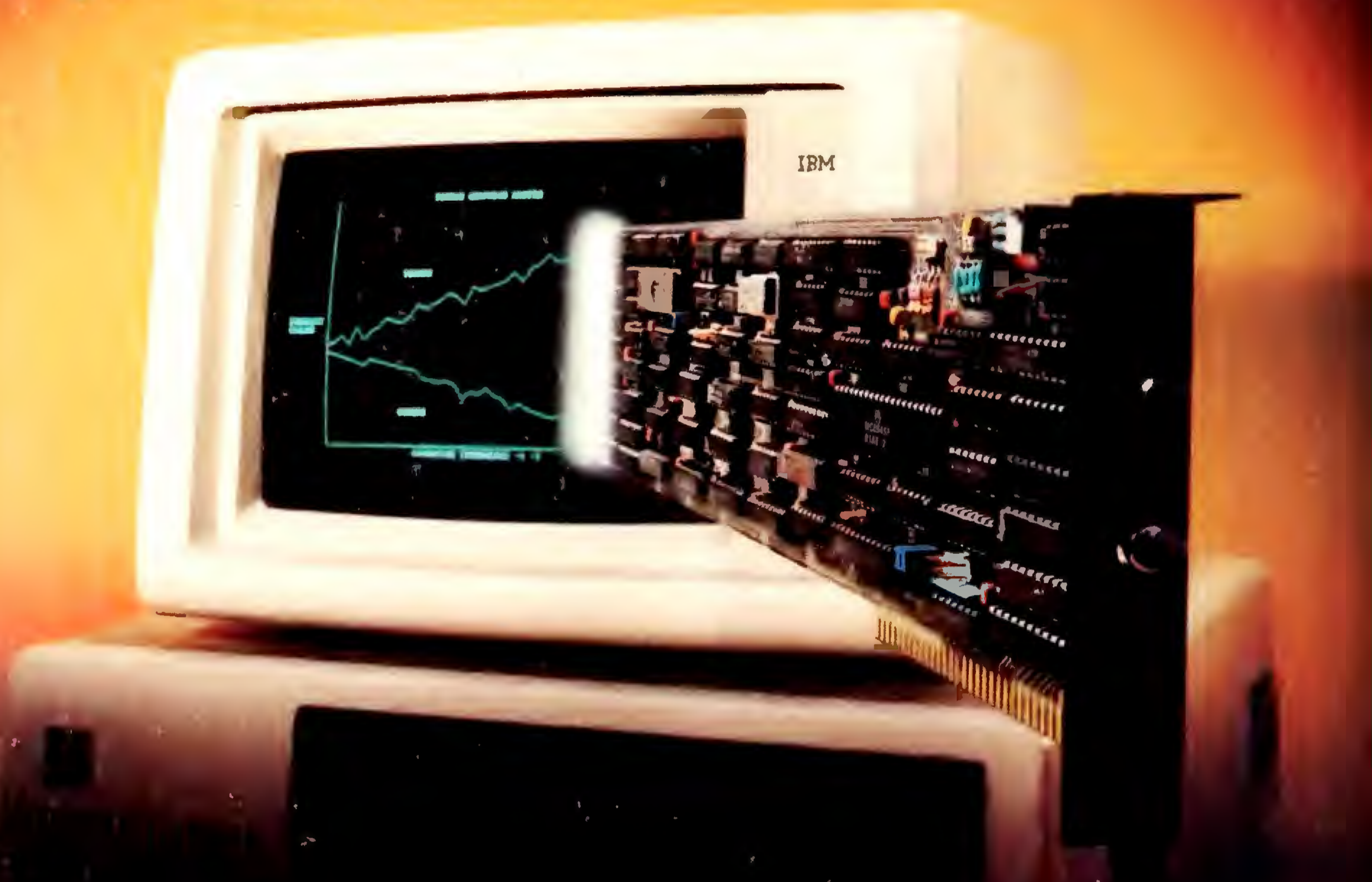

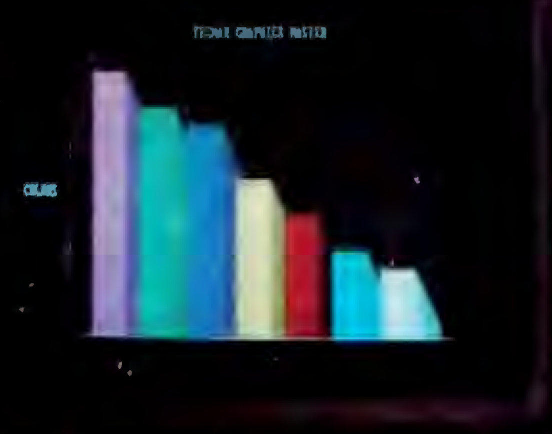

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