PC W◍RLD

PC Compatibility

How Compatible is Compatible?

20 New PC "Lookalikes"

The Battle for Software Supremacy

Lotus 1-2-3 and Context MBA

Do-It-Yourself RAM

How the PC Thinks

Welcome to
PC W●RLD

*(See "A Letter From David Bunnell" on pages 14-15 for more about the staff of PC WORLD,
our future plans, and your role in shaping PC WORLD's future.)*

FLY SORCIM

PC WORLD

Columns

Departments

Photo credits: Charley Franklin, 40; Bruno Joachim, 234; Ed Kashi, 1, 146, 252; Nick Pavloff, 100; Fred Stimson, cover; Mick Wiggins, 62, 180.

AMDEK...your guide to

COLOR-II MONITOR

High resolution 560(H) X 240(V) • RGB video input • 80 X 24 character display capability • 16 color intensity modulation for IBM

COLOR-I MONITOR

260(H) X 300(V) line resolution • Built-in speaker & audio amplifier • front mounted controls

MODEL 310A MONITOR

Easy-view amber phosphor CRT • Composite video signal • 18 MHz bandwidth • 900 lines (center) resolution IBM-PC compatible

MODEL DXY PLOTTER

Economical X-Y coordinate plotter • 10" X 14" plotting range • Centronics interface • ROM expandable • 4 pens, holders and chart hold-downs included

YOUR COMPATIBILITY CHART

MORE COMPATIBILITY INTERFACES DUE SOON . . . CHECK FACTORY

COMPUTER	MONITORS							PLOTTER	3" MICRO-DISC DRIVE	NOTES
	VIDEO-300	VIDEO-310	COLOR-I	COLOR-II	COLOR-IIA	COLOR-III	COLOR-IV			
IBM-PC	•	•	•	•	★	•	★	•	•	★ Special Cabling Required
APPLE III	•			★	★	★	★	•		★ Special Cabling or Converter Required
APPLE II	•		•	★	★	★	★	•	•	★ DVM Board Required
ATARI 800	★		★							★ Opt. Atari Cable Required
VIC-20			★							★ Opt. VIC Cable Required
TRS-80	★									★ Opt. TRS Cable Required
Osborne	★									★ Opt. Interface Required
TI-99			★							★ Opt. TI Cable Required
Commodore-64	★		★							★ Opt. Commodore Cable Req.

Simple answers to your questions about the IBM Personal Computer.

If you're personally interested in personal computers, but want to know more, these definitions, descriptions and details should help.

"Just what is a personal computer, and how can I use it?"

The IBM Personal Computer is a computer designed for a *person*. It's a tool to help accomplish just about anything a person needs to do with information. It can help a businessperson solve complex problems just as surely as it can help a small child improve his or her arithmetic.

A PERSON   A PERSONAL COMPUTER

"Suppose I've never had my hands on a computer. How 'easy' will it be?"

As with any new tool, you'll want to get comfortable with the IBM Personal Computer before putting it to serious use. You'll have some step-by-step reading, but our instructional literature involves you from the start. And the computer is on your side too— interacting with you as you learn.

GUIDE TO OPERATION

There's no reason why you can't be executing programs and feeling good with the results within your first week. After a month, it should be clear that you've made a good investment, and you'll probably be telling your friends why they should get one.

"Is the IBM Personal Computer simpler or more advanced than others?"

Both. Our system has been engineered with many advanced design features (see the chart) but their purpose is to make it simpler for you. Our ten function keys are a good example. We added them to save you a lot of time and error. They are *advanced* features that add to *simplicity* and ease of operation, and that is typical of our total design.

David Bunnell

The Second Generation of Personal Computing

The IBM Personal Computer (which instantly became known as the PC) was born eight years after the personal computing era began. Today, over a quarter of a million 16-bit "second-generation" IBM PCs are up and running. These machines are easier to master and infinitely more useful than their 8-bit ancestors, and, as a result, millions of new users will soon join the already solid base of PC enthusiasts.

The IBM PC's unprecedented popularity has tempted more than a dozen companies to develop "look-alike," or "clone," PCs, which offer varying degrees of compatibility. With the original, Big Blue may unwittingly achieve a level of standardization in personal computing that seemed totally impossible less than two years ago.

Early in the PC's development, the importance of its 16-bit architecture was controversial. At first, the PC seemed to offer more power than we could imagine using. Many argued that 8-bit machines could adequately manage almost all personal computing chores; a 16-bit machine, they said, was simply more engine than the average user would need.

But 16-bit machines can have 10 times or more the internal memory of an 8-bit system. With this additional memory, programmers are now writing applications software with more extensive user interfaces and capability, as well as more room

to combine previously separate applications such as word processing, spreadsheets, graphics, and communications.

The second-generation PC applications software has only recently been introduced to the PC world. This software was the one missing part of the second-generation concept. With the help of the 16-bit PCs that run them, these second-generation programs have the potential to increase the personal productivity of PC users. Examples of such software are *1-2-3*, *Visi/ON*, *Flight Simulator*, and *TK!Solver*.

One of the mightiest of these second-generation programs is *1-2-3*, the brain child of Mitch Kapor,

founder of Lotus Development Corporation. With the help of Vern Rayburn, formerly of Microsoft, and Chris Morgan of BYTE magazine, Kapor is publishing this "spreadbase" software, a hybrid of spreadsheet and data base management programs.

1-2-3 allows you to manipulate charts, spreadsheets, and lists in an amazingly short time. It also lets you jump from calculating to sorting to graphics with ease, making it ideal for business accounting and financial planning. Young executives itching to compete with their more seasoned superiors will use *1-2-3* just as their bosses used *VisiCalc* to climb the corporate ladder.

1-2-3 exemplifies how second-generation software can help PC users in their professional pursuits. But there's more to life than work, and the PC is an integral part of pleasure too.

Flight Simulator, for example, is intriguing and enjoyable, but it is not a mere game. It is just what it claims to be in its sales literature—"a second-generation, real-time flight simulation program." The program was written by Bruce Artwick, an expert in high-performance graphics, and it is published and marketed by Microsoft.

Modeled after a single-engine Cessna 182, *Flight Simulator* displays a complete instrument panel on the bottom half of the monitor. Out of the top half, you can look out the window in eight directions or read

David Bunnell

your radar screen. I must confess I've never flown an airplane (although I have been a passenger in a single-engine Cessna), but *Flight Simulator* gave me the illusion of flying. From my first take-off to my last unfortunate crash, I flew that plane as if my life depended on it.

No discussion of second-generation software would be complete without *TK!Solver*. When Dan Bricklin and Bob Frankston showed me a test copy of *TK!Solver* running on an Apple III at Software Arts, I immediately envisioned its practical applications. The more I've thought about *TK!Solver,* the more I see a wealth of applications. *TK!Solver* is a tool kit designed for automating the solution of any calculation in a fast, easy, and almost error-free fashion.

The brilliance of this creation is that it will inspire future creations, including a library of *TK!Solver* models, each tailored to solve a particular set of problems. And while exploring the more obvious applications of the program, new applications will be found. *TK!Solver* will inspire greater use of calculations in all areas of science, high-technology, and ultimately business and education.

By taking advantage of the increased capabilities of the 16-bit machines, second-generation applications will strengthen the personal computing power of every PC user. Combine this movement with a related boom in communications technology and more accessible information banks, and it's easy to see how the personal computer will lead to unparalleled levels of personal freedom and power.

The consequences of these developments demand our immediate attention. With *PC WORLD* we hope to bring these changes to you to help you use the powers of your second-generation PC more efficiently and successfully.

So welcome to *PC WORLD* and to the second generation of personal computing.

THE SOLUTION IS IN THE VISISERIES.

No matter what kind of problems you're trying to solve with an IBM Personal Computer, there's a program in the ever-expanding VisiSeries™ line that will give you the solution. Faster, better, smarter.

Take our VisiCalc® program for the IBM Personal Computer. It's #1 in the business. Because it takes the work out of working with business numbers. The VisiCalc program is the powerful "electronic worksheet" that speeds planning and budgeting. You can ask "what if?" and see the answers immediately. So you can analyze the impact of decisions before you make them.

Our VisiTrend/Plot™ program makes it easy to analyze data and see the results in easy-to-understand charts and graphs.

With our VisiFile™ program you can organize, maintain and more effectively use the information your business needs.

Is a lot of your workday taken up with scheduling projects and estimating costs? Our VisiSchedule™ program will help you do it better, with a lot less work.

And for helping you manage your valuable time, organize your personal information, nothing could be of more value than our VisiDex® program.

Our VisiCalc Business Forecasting Model™ package will give you vital financial information about your business.

And our Desktop/Plan™ program will speed and automate all your financial and business planning.

Put the VisiSeries programs to work on your IBM Personal Computer.

Get all the details from your VisiCorp retail computer dealer. Or write Customer Services, VisiCorp, 2895 Zanker Road, San Jose, CA 95134.

THE VISISERIES
FOR THE IBM
PERSONAL COMPUTER
FROM
VISICORP™

A Letter From David Bunnell

Dear Readers:

In future issues of *PC WORLD* this space will be reserved for your letters. We want you to play an active role in the future shape and development of *PC WORLD*. Naturally, we encourage you to write frequently.

As Publisher and Editor-in-Chief of *PC WORLD*, and on behalf of everyone connected with its creation, I want you to know that we are sincere in our goal of providing you with the best personal computer magazine possible. It takes more than a paycheck to inspire the staff to produce such a high-quality product. The talented people whose work contributes to *PC WORLD* are motivated in a large part by love. Some do it for the love of personal computing; some do it for the love of their work, and in many cases we do it for the love of each other.

It may seem a little strange to be reading about love in a computer magazine, but I've written about stranger things in computer magazines before, and since I'm the publisher, I somehow get away with it.

The truth is we had quite an adventure getting here. It's been much more than a rocket ride fraught with logistical hurdles. The creation of *PC WORLD* demanded a level of individual courage rarely seen in the publishing world.

PC WORLD was launched on November 29, the opening day of the COMDEX computer show in Las Vegas. At that time we were 12 people whose office consisted of the aisles of COMDEX.

Armed with makeshift rate cards and business cards, a good story to tell, and a lot of determination, our four sales managers— Noreen St.
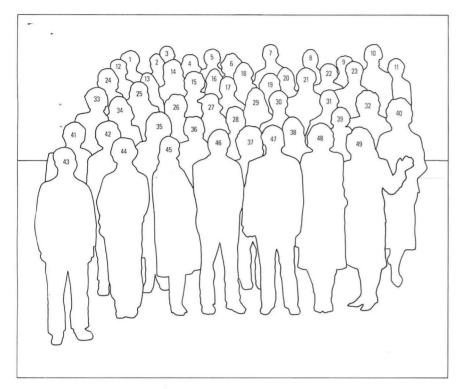
Pierre, J. Mark Doss, Meredith Browning, and Rodney Brooks— worked their way up and down the aisles from morning until evening, talking to every company exhibiting PC-related hardware and software. By night they continued their work at the industry parties.

Meanwhile, our Editor Andrew Fluegelman, and Associate Editors Steven Cook, Jeremy Joan Hewes, Harry Miller, and Kearney Rietmann paid close attention to anything new that might signal a change in the PC market. They found a vast array of PC "lookalikes," new machines that in varying degrees claim compatibility with the original and come from an assortment of manufacturers. Included is a watch company, three or four well-financed entrepreneurial startups, a few established computer companies, and at least one guy working out of his garage.

Associate Publishers Cheryl Woodard and Jacqueline Poitier spent much of their time talking to reporters and coordinating our frantic activities. Meanwhile, I stood around with a big smile on my face, speaking to my friends in the personal computer industry. The *PC WORLD* story is an exciting one. Our vision of the best magazine for PC users and our new-found resources for producing such a magazine made for interesting conversation.

We left COMDEX with 100 pages of ads and enough editorial subjects for the next few issues. Back in San Francisco, we moved from place to place until we finally found our home in a cavernous, remodeled soap factory. We staffed *PC WORLD* with more than 50 employees and dozens of free-lance writers, artists, and photographers. We sent out thou-

1. Mick Wiggins 2. Bill Cox 3. Eric Brown 4. Christine Whyte 5. Harry Miller 6. Anna Bunker 7. Andrew Fluegelman 8. Kearney Rietmann 9. Katie Seger 10. Steven Cook 11. Rick Thng 12. Ralph Ames 13. Phyllis Stewart 14. Noreen Giannini 15. Joe Matazzoni 16. Clare Bouey 17. Jayne Boyer-Sturtevant 18. Evelyn Spire 19. Pat Murphy 20. Cindy Hamburger 21. Ed Holm 22. Jeremy Joan Hewes 23. D. Rodney Brooks 24. Lorretta Giglione 25. Jan Dente 26. Ellyn Hament 27. Nan Cassady 28. Laurie Ferguson 29. Lorrie Poch 30. Dennis McLeod 31. Frances Mann 32. Jacqueline Poitier 33. Noreen St. Pierre 34. Sarah Cox 35. Carol Watson 36. Art Wilcox 37. Lindy Wankoff 38. Lorraine Campos 39. Brooke Hazard 40. Meredith Browning 41. Janet McGinnis 42. Christopher Van Dyke 43. Adrian Mello 44. Karl Koessel 45. Niki Stranz 46. Joe Wollenweber 47. David Bunnell 48. Cheryl Woodard 49. Susan Keller

Not Shown: J. Mark Doss, Daniel Farber, Margie Spiegelman, Lisa Stahr, Monica Thorsnes

sands of subscription letters and nearly doubled the amount of advertising space we had rounded up at COMDEX.

One of our first goals was to develop an all-electronic office, the first step toward an innovative office network we plan to set up here. Most of our articles come in over a modem, and all copy is telecommunicated to the typesetters after thorough checks for technical and grammatical accuracy. All of this is accomplished using PCs.

We feel we're on the right track here at *PC WORLD*, but changes and refinements may be necessary. Your feedback will be carefully considered; we will attempt to please as many *PC WORLD* readers as possible. Our magazine will always contain key technical information, as well as articles that can be read and understood by novices.

Because we know that personal computer applications will affect everyone, we hope to be a broad-based publication filled with reader-friendly information, beautiful images, and lively advertisements. You should be able to find advertisements in *PC WORLD* that contain a wealth of information. Because our ad rates are competitive with other computer magazines, and because the PC market is so explosive, we expect to see more and more companies selling their wares on our pages.
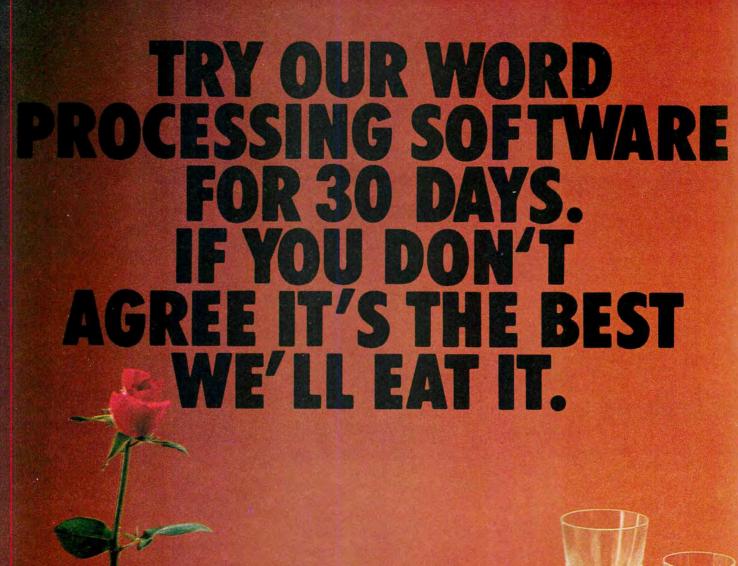
During the course of my experience with personal computing, I've seen many companies come and go and many start-up operations become huge corporations. It is a phenomenon that will continue for many years before the dust finally settles.

It still amazes me that the people here work as hard as they do— why someone from editorial drives through a flooded highway to pick up the screen photos displayed in these pages, or why someone in the art department brings in a sleeping bag during the final days of production. People don't usually do these kinds of things for the sake of a job. I am proud to work with the people at *PC WORLD*. Over the course of the coming months and years we want more than just a fat magazine. At *PC WORLD* it's the people who matter.

Sincerely,

David Bunnell

David Bunnell

TRY OUR WORD
PROCESSING SOFTWARE
FOR 30 DAYS.
IF YOU DON'T
AGREE IT'S THE BEST
WE'LL EAT IT.

The Spelling Bee Is Over

Listen. We're going to let you in on an industry secret: It's not hard to make a good spelling checker.

You see, although spelling checking is new for microcomputers, it's been around on big computers for *years.* And when you get past all the talk, most spelling checkers work the same way. They compare what you've written with a dictionary—and report the errors.

So is there *any* difference? You bet: the dictionary, and the price.

Who Checks The Checker?

The hardest part of a spelling checker to make is the dictionary. It's hard to pick the right words—and spell every one of them perfectly. That's why some popular spelling checkers don't even contain real dictionaries. They use formulas called "hash tables." Which make a hash out of your spelling some of the time.

Other spelling checkers "borrow" their words from printed dictionaries —or copy them from old word lists. Or give a programmer who can't spell "programmer" a chance to write his first dictionary. And as though all this wasn't bad enough, a lot of these companies want to charge you $100, or $200 or even $300!

Random House to the Rescue

The Random House ProofReader is based on the famous Random House Dictionary. It is the result of decades of careful work. And it was adapted for computer spelling checking by professional editors, linguists and scholars. So you can depend on it.

Of course, our program is darn good, too. It's fast. It doesn't take up too much disk space. It shows you the error and the sentence it's in. It lets you correct the mistake without reediting. And if you don't know how to spell a word, it suggests the spelling. It even corrects your correction.

The Random House ProofReader comes in sizes to fit all systems: 20,000 words (55K), 32,000 words (74K), 50,000 words (108K) and 83,000 words (180K). You can add your own words with a single keystroke. And it works with all CP/M®, IBM Personal Computer®, and TRS-80® Model I/III word processors.*

How much does the Random House ProofReader cost? Only $50.00. Why do we sell it for $50 when the others want up to $300? Don't ask us. Ask them.

The Random House ProofReader $50

For orders or information, call 505-281-1634. VISA, Master Card accepted. Or write Random House ProofReader, Box 339 Tijeras, New Mexico 87059. Please enclose $50 and specify your computer model, disk size and memory. Dealer inquiries invited.

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Journey to the New World

Many of you are veteran travelers in the world of personal computers, while others are starting out on your first journey. In common, we are gathered at this launching of *PC WORLD*, filled with the vision of new lands to explore and the promise of new adventures. Before we set out, it seems appropriate that we take a tour of our new flagship and glance at the course we have charted.

If you flip through the following pages, you'll notice that *PC WORLD* is built in four sections. The lead section, "State of the Art," is our compass, a signpost of personal computing trends. We'll report on technologies under development and try to predict when and how they might be implemented in the systems you use. We'll speculate on where the trends will take us and how they will affect the growing popularity of personal computing. We'll also keep a lookout for issues that may bear on your use of personal computers—and perhaps play an advocate role by commenting on those issues. At the end of "State of the Art" you'll find *PC World View,* our monthly roundup of PC news, opinions, and musings.

The second section of *PC WORLD* is called "Review." This is where we will offer in-depth evaluations of new hardware and software. The products featured in the "Re-

view" section will be in their final versions, ready for release; *PC WORLD* reviews will report on tested performance. We hope to bring to your attention outstanding and innovative products—regardless of whether they are introduced by well-known companies or small vendors. If a product does not live up to its promise, we will say so.

"Hands On" is the third section of *PC WORLD*. Here we will cover personal computer applications from the user's perspective. We'll publish articles by experts in the fields of writing and word processing, financial planning and modeling, data management, graphics and design, education, and games. "Hands On" will show how existing hardware and software can be put to practical use. We'll also feature articles designed to further your understanding of how computers work and how they can be programmed. Included in this section will be "*.*," our regular department of user-contributed discoveries.

The final section, "Community," will report on how PCs are becoming integrated into our work routines and culture. We'll talk with computer pioneers and personalities about their visions of the PC Society. We'll look at the new organizations emerging to educate and support us in the use of personal computers. Because the PC is affecting our notions of who we are and how we relate to each other, *PC WORLD* will both document our

changing community and play a part in creating it. Two major new forces in our community are computer user groups and the far-ranging possibilities of networking. We'll track both those developments with our regular departments, *User Group Dispatch* and *BBS Watch.*

Throughout our reporting and evaluating, we will maintain a personal perspective. The sweeping changes predicted for the computer age will ultimately be effected by the users of PCs—not the computer industry. We sincerely want to hear from you, our readers, so *PC WORLD* can serve your needs. We want to find out how you are using your PC and what information you want to see in the magazine. Starting with this issue of *PC WORLD,* a reader response form will be included inviting your suggestions and comments. Please fill it out and mail it in.

That is our vision as we set out on our journey. We can't predict exactly what lies beyond the horizon, but we're confident that many discoveries await us. We have a worthy ship and a dedicated crew, and we hope you will join us in our explorations.

In future issues of PC WORLD, *this column will feature guest commentaries on a range of personal computer topics.*

MAYBE YOU NEED OFFICE FILER™

Are you stuck in a data jam? Heard about those fancy data base management systems that take more time to learn and maintain than they save? Thinking of hiring another clerk? DON'T DO IT!

Meet Office Filer.™ The one-of-a-kind electronic filing system that operates several **times** faster than any of its competitors. And it's a snap to use.

Office Filer conforms to **you** and **your** needs so you don't have to learn complicated file/field specifications. Quickly and easily you create fill-in-the-blank forms that make data entry a breeze.

Office filer stores all newly entered data as files which can be sorted by up to eight different categories (such as company name, zip code, or product line). And you won't worry about security or time-consuming maintenance: Office Filer protects your files by password and allows you to update automatically.

The same text editor that creates your forms also custom-formats your reports. Data can be selected and printed in virtually any format you can imagine; from mailing labels and form letters to invoices and purchase orders. And Office Filer data is fully compatible with most word processing and mailing systems .

Break out of the data bottleneck with the simple sophistication of Office Filer...the file manager that's easy to get to know and easy to work with.

Office Filer runs on the IBM-PC™ and will soon be available for CP/M-86™ systems. $395 from Digital Marketing Corporation or your local computer dealer.

OFFICE FILER
The Electronic Filing System

Office Filer is a trademark of TOMAX Software, Inc.
CP/M-86 is a trademark of Digital Research, Inc.

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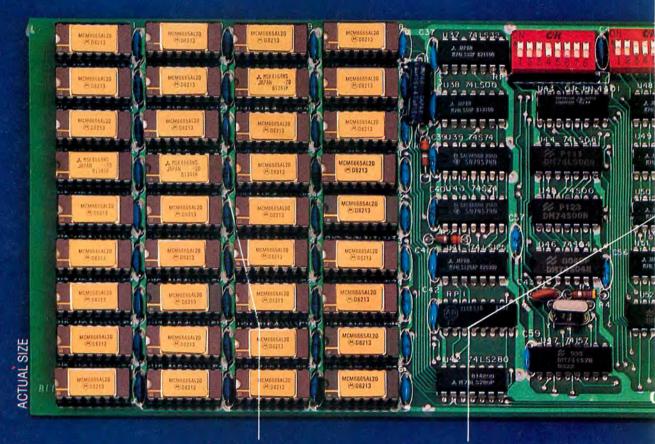
Photo shot on location at General Office Equipment, Walnut Creek, California.

QUADBOARD™

THE FIRST AND ONLY BOARD YOUR IBM PC MAY EVER NEED.

Your IBM personal computer is a very versatile piece of equipment. Perhaps more versatile than you realize. New applications and functions are being developed every day. Now with Quadboard by Quadram you can keep your options open for tomorrow's technology. Following in the tradition of Quadram Quality, four of Quadram's best selling IBM boards have been combined into one board. Your remaining slots will be left free and available to accommodate future expansion needs and uses which you may not even be able to contemplate today.

ACTUAL SIZE

PROVEN DESIGN.

Quadram has been shipping IBM boards with each of the Quadboard functions on separate boards since December, 1981. They are still available as separates (including a Dual Port Async Board) for those who desire a quality board but do not need to keep slots open for future expansion. And they all come with a one year warranty from the leader in technology applications.

256K MEMORY EXPANSION.

Socketed and expandable in 64K increments to 256K, full parity generation and checking are standard. A Quadboard exclusive feature allows parity to be switch disabled to avoid lock-up upon error detection. The dip switches also allow it to be addressed starting on any 64K block so that it takes up only as much as it has memory installed. Memory access and cycle time naturally meet all IBM specifications.

CLOCK/CALENDAR.

Quadboard eliminates the hassle of manually inputting the date on system boot-up by providing for the clock and all software routines necessary for inserting the appropriate programs on your diskettes. The internal computer clock is automatically set for compatibility with most software routines which utilize clock functions. On-board battery keeps the clock running when the computer is off.

Number One A

Communications

Async #1

Printer

Clock

Battery

64-256K
Memory

CC-332 For use with

AST-3780
• An IBM 2780/3780 RJE
Emulator • Supports Bisync
point-to-point communications
protocol • Allows file transfer
between Host & IBM PC • Ideal
for IBM **System 34, 38, 4300**

AST-SNA
• Emulates IBM 3274
Model 51C Control Unit
• Emulates 3278 Display Sta-
tion • Emulates 3287 Type
Printer • Optional 3770 Emula-
tion • Cluster Controller
Operation • Protocol Con-
verter Support

Advanced Comm.
Card (CC-232)
• Programmable to com-
municate in Bisync, SDLC,
HDLC, and Async protocols.
• Two Ports of RS 232
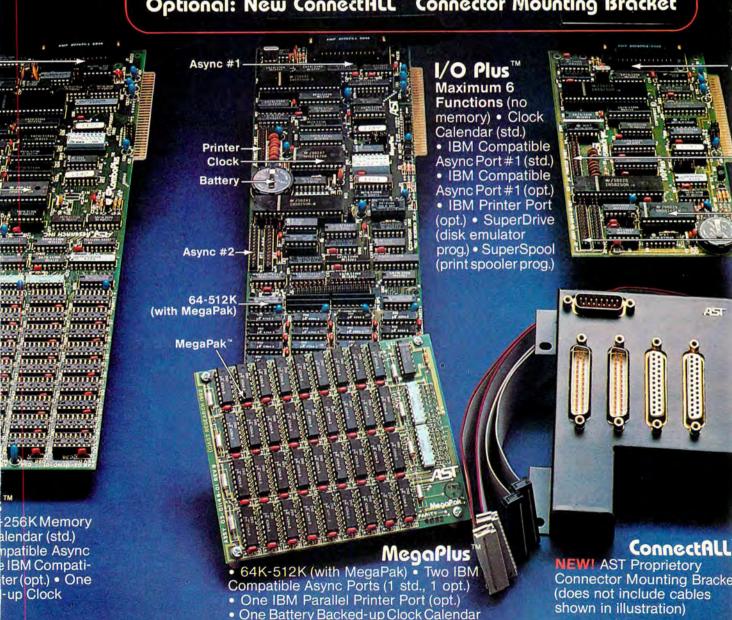
ComboPlus
• Features 64K
• One Clock Ca
• One IBM Cor
Port (opt.) • One
ble Parallel Prin
Battery Backed
Calendar (opt.)

Add-On Produc
Multifunction Cards

Async #1

Printer
Clock
Battery

Async #2

64-512K
(with MegaPak)

MegaPak™

I/O Plus™
Maximum 6 Functions (no memory) • Clock Calendar (std.)
• IBM Compatible Async Port #1 (std.)
• IBM Compatible Async Port #1 (opt.)
• IBM Printer Port (opt.) • SuperDrive (disk emulator prog.) • SuperSpool (print spooler prog.)

256K Memory
alendar (std.)
npatible Async
e IBM Compati-
ter (opt.) • One
-up Clock

MegaPlus™
• 64K-512K (with MegaPak) • Two IBM Compatible Async Ports (1 std., 1 opt.)
• One IBM Parallel Printer Port (opt.)
• One Battery Backed-up Clock Calendar std.) • Ideal for Concurrent CP/M, MBA, VISI Series software packages.

ConnectALL™
NEW! AST Proprietory Connector Mounting Bracke (does not include cables shown in illustration)

AST Research Inc. Retail Dealer List (Partial)

ALABAMA
Computerland
Birmingham (205) 942-8085
Olensky Bros. Computers
Mobile

ALASKA
Computerland
Anchorage (907) 272-1518
General Computer Services, Inc.
Anchorage (907) 338-6263

ARIZONA
Computerland
Mesa (602) 962-6732
Phoenix (602) 956-5727
Tucson (602) 790-8220

CALIFORNIA
Computerland
Burlingame (415) 348-7731
Fremont (415) 794-9311
Glendale (213) 246-2453
Hayward (415) 538-8080
Lawndale (213) 371-4624
Los Angeles (213) 627-7154
Newport Beach (714) 975-0953
Oakland (415) 839-5230
Pasadena (213) 449-3205
Redding (916) 241-7922
Sacramento (916) 920-8981
San Diego North (714) 434-3300
San Jose (408) 253-8080
San Rafael
Santa Clara Valley (408) 246-4500
Torrance (213) 543-2621
Tustin (714) 544-0542
Ventura (805) 656-7711
Visalia (209) 739-1033
West Covina (213) 960-6351
West Los Angeles (213) 559-3353
Compu-Sales
Lawndale (213) 370-3224
Computers R Us
Santa Ana (714) 556-7774
Computer Valley
Walnut (714) 594-9748
Gateway Computer (Hdqrs.)
Huntington Beach (714) 895-3931
Micro Age Computer
Santa Ana (714) 558-7789
Micro Computer Systems
Santa Ana (714) 541-4685
Micro Personal Consulting Inc.
Panorama City (213) 361-8700
Western Micro (Dist.)
Irvine (714) 557-6533

COLORADO
Computerland
Boulder (303) 494-4443
Colorado Springs (303) 574-4150
Englewood (303) 694-3083

CONNECTICUT
Computerland
Meriden
Stamford (203) 964-1224

FLORIDA
Computerland
Fort Myers (813) 939-7800
Jacksonville (904) 731-2471
Miami (305) 442-4112
American Micro Computer Ctr.
N. Miami Beach (305) 944-3062
Timeshare of FL
Miami (305) 233-8377
Tech Data (Dist.)
St. Petersburg (813) 577-2794

GEORGIA
Computerland
Athens (404) 548-5263

IDAHO
Computerland
Boise (208) 344-5545

ILLINOIS
Computerland
Arlington Heights (312) 870-7500
Champaign-Urbana (217) 359-0895
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How Compatible Is Compatible?

Steven Cook

When IBM introduced the PC in 1981, many companies quickly redirected their resources to provide products for the new machine. An array of hardware and software for the PC became available almost overnight, boosting sales of the PC and, as a result, inducing more companies to design new products.

This huge base of hardware and software itself represented yet another new market, one that did not go unnoticed—the PC clones. A few companies started designing their own versions of the PC, offering lower prices and features such as portability (see "Send in the Clones"). The attraction of these new computers is that they are compatible with the IBM PC: they can use products designed for the IBM machine. Or can they?

In the strictest sense, a truly compatible machine would be illegal; it would be a physical and electronic copy of the IBM PC and would certainly incite the wrath

> There are almost as many kinds of compatibility as there are products for the PC.

of IBM's legal department. There must be some differences between an IBM PC and a machine claimed to be compatible.

Likewise, each of the so-called compatible machines must be different from the others. In light of all those differences, how can anyone claim to sell a PC-compatible computer?

The answer lies in the interpretation of compatible.

One extreme is an illegal copy of IBM's product, and on the other is a machine with nothing in common with the PC except perhaps the ability to read data from PC format disks.
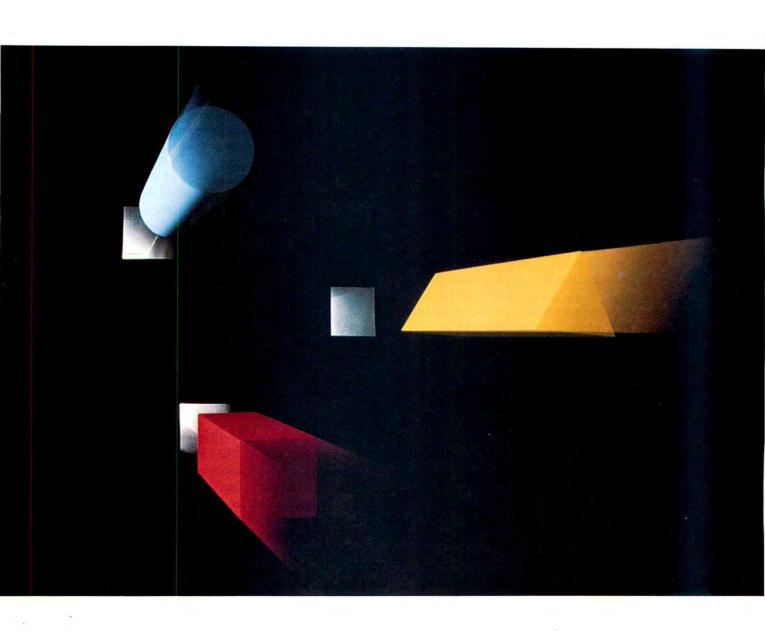
How compatible is compatible? The editors of *PC WORLD* set out to find an answer to that question. What we determined is that the answer depends on whom you ask. It also depends on who asks the question. Compatibility is a many-sided issue. There are almost as many kinds of compatibility as there are products for the PC.

Hardware VS Software

Compatible machines fall into two broad categories: those that are software compatible with the PC and those that are also component compatible. A component-compatible machine is one that can use plug-in circuit boards designed for the PC.

Component compatibility is a feature that may or may not be important to prospective buyers. Those who do not intend to use the boards designed for the PC will probably be willing to do without component compatibility. This is especially true if the machine includes, or can be upgraded to include, 256K or more of memory, serial ports, parallel ports, a clock, or similar moderate enhancements.

Quite a few things about the PC's hardware make it unique in terms of software, but a hardware manufacturer can duplicate PC features so closely that software would have to be specifically written to detect the differences. Software can also be written in ways that avoid letting even huge differences cause problems.

DOS to the Rescue

Software authors can avoid potential compatibility problems with the aid of the Disk Operating System. The PC-DOS supplied by IBM is not an IBM product—it is licensed to IBM by Microsoft. The same program is available to other hardware manufacturers under the name MS-DOS, and most manufacturers that put MS-DOS on a computer call it PC compatible. To understand how software incompatibilities arise, you must know the purpose of the Disk Operating System. For this discussion, the disk aspect is irrelevant, so all further references will be to the Operating System (OS).

The OS is a special program designed to insulate applications programs (such as word processing programs) from the environment—the hardware you use to run the applications program. Part of the OS is custom-tailored by the hardware manufacturer to be properly connected to the different parts of the machine. This part of the OS is called the basic input output system, or BIOS ("by-ose").

The user interface is the part of the OS that "connects" to the applications programs. In some ways the interface is almost sacred; it is rarely changed, and if changes are made, they are usually done in ways that have no effect on any other part of the interface. Changes to the user interface are always noted by a new version number, such as DOS 1.0, 1.10, and 2.0.

This two-part design is the beauty of the OS. Because the user interface is always the same, programmers can write software that refers to the appropriate part of the interface rather than to the hardware itself. When the OS is installed in a different machine, the hardware manufacturer designs a BIOS (to connect the OS with the hardware) so that each part of the user interface will accomplish its intended purpose.

As an example, imagine a machine that has a printer connected to memory location zero. When an applications programmer wants to send characters to the printer on that machine, it is simple to write instructions to "send character to location zero."

Before the applications program can be used on a different computer, such as on one that has the printer connected to location ten, a programmer must make changes. Because of the OS, the applications programmer need only write the original program to "send character to printer." The OS installed by the manufacturer of the first machine sends the character to location zero. The manufacturer of the second machine instructs the OS to send printer characters to location ten.

What Price Compatibility?

The example of sending characters to the printer applies to all information that goes into or out of the computer, including to and from the disk drives (hence the name Disk OS). The problem with passing data via the OS is one of speed: some programs must transfer data faster than the OS can support. This is especially true for games and calc programs because the entire screen must be rewritten each time the image on the screen moves.

The only way to achieve the required speed is to refer directly to the hardware. When this is done, the insulation provided by the OS is lost, and the program becomes "married" to the machine. Only computers that use the same design for the screen interface will be able to use that program.

One way to allow direct references to the screen display hardware without tying a program to any one machine is to use an installation program. If an applications program must circumvent the OS, the program is supplied with a special utility program that allows you to select your particular brand of hardware from a menu, and then makes the necessary modifications. The question is whether the machine you choose is popular enough to be included in the menus of the various installation programs.

The PC has other unique features that are useful to programmers who want to achieve sophisticated results. The most commonly used of these features are short, special-purpose programs that are stored in ROM on the PC system board. These programs are part of the BIOS routines written by IBM to connect the OS to the hardware.

The programs stored in the BIOS ROM belong to IBM, so they may not be duplicated by any other hardware manufacturer. The few programs that use these BIOS routines will not function on any other machine

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> Software authors will soon realize the disadvantages of writing programs designed for a particular machine.

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unless the manufacturer of that machine has ensured that every program in the BIOS ROM has an equivalent program in the compatible machine.

Duplicating the functions of the PC's BIOS ROM without duplicating the ROM itself is difficult, but at least one manufacturer, Compaq, has apparently managed to do it. This kind of duplication will be more difficult for the next company because it will have to avoid copying Compaq's programs as well as IBM's.

Software authors will soon realize the disadvantages of writing programs designed for a particular machine. As the number of PC-compatible computers grows, it will become more attractive to sell programs that run on as many different machines as possible. This means that programs must be written to perform their functions while remaining within the limits of the OS.

Garbage In, Garbage Out

Some compatibility problems, however, are beyond the control of the OS. The characters displayed on the screen are one such problem.

The PC can display 256 characters. Of these, 128 are the standard characters as defined by the American National Standards Institute. The others are nonstandard characters assigned by IBM. These include all the graphics characters, game symbols, and foreign language characters.

If a program uses any of the special characters, there is a possibility that a "compatible" machine may not display the correct image. The OS sends character values to the computer's video display; the actual image displayed is determined by the hardware.

The keys on the keyboard are another feature that

Levels of PC Compatibility

Level 1: Media compatible. Machines that have the ability to read and possibly to write disks in the format used by the PC.

Level 2: Processor compatible. Machines that use an 8088 microprocessor or an 8086. While the two microprocessors are functionally identical, the 8086 can perform some operations more rapidly, which may cause problems for a few timing-sensitive programs.

Level 3: Operating system compatible. Computers that support MS-DOS, CP/M-86, or some other popular PC operating system.

Level 4: Component compatible. Machines that can use plug-in circuit boards designed for the PC.

Level 5: Character set and keyboard compatible. Machines that display the same characters as the PC for each of the 256 character codes and that have keyboards that include all the same keys as the PC's.

Level 6: Video compatible. Machines that use the same video interface as a PC. The video must be memory mapped and located at the same memory addresses used in the PC.

Level 7: System compatible. Machines that duplicate the PC's entire architecture. RAM, ROM, I/O, and all other addresses reside in the same locations as those in the PC, including the routines in the BIOS ROM.

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are not controlled by the OS. The keyboard must have several special keys to be PC compatible; a program that requires Alt-X to exit cannot be used on a machine that does not have an Alt key.

Incompatibilities such as those caused by the screen interface, the character set, and the keyboard should not exist on any machine billed as PC compatible. There is a tendency to view PC hardware compatibility and MS-DOS compatibility as the same thing, which they are not. MS-DOS compatibility is a more general form of compatibility that must be supported by careful design of the applications software. True PC compatibility is exactly that: the ability to use any product designed for the PC.

MS-DOS is not the only operating system that can be used on the PC. Although MS-DOS is currently so prevalent that it is thought of as the universal operating system for the PC, innovations may bring another operating system into prominence. One possibility is an operating system that would accept programs written for the PC, intercept PC-specific references, and redirect them to achieve the intended result. Such an operating system may one day provide the key to PC compatibility.

Compatibility Ratings

The specific features of the PC that are duplicated by a supposedly compatible machine are what determine the level of that machine's compatibility. Although there are no clear-cut guidelines for measuring compatibility, the descriptions in "Levels of PC Compatibility" may provide some insight to the various claims being made.

Most PC-compatible computers fit into the third level; they use the same disk format, an 8088 or 8086 microprocessor, and are supplied with MS-DOS. Some machines achieve the fourth, fifth, and sixth levels with the plug-in bus, the character set, and the video interface, but only a few offer the total compatibility described by the seventh level.

Caveats to Consider

Before you select a PC-compatible computer, examine your motives. What you intend to do with the machine should dictate the products you consider. Once you have made a choice, you are limited to using only those programs and boards that are able to function with the machine you buy.

If you are not concerned about using plug-in circuit boards designed for the PC, you can select from a much wider range of computers, but you forfeit the ability to use boards that may be developed, as well as software designed to be used in conjunction with those products.

If you select a component-compatible machine, be sure that the electrical specifications are identical to those for the PC. For example, if the power supply is not as large as the PC's, you may find yourself with a machine that cannot support enough memory. Maybe the designers cheated a little when they designed the bus itself; perhaps they feel they improved the design while maintaining compatibility. Such deviations may not show up until years later, but they can cause trouble if they do. Although no such problems have come to light, the potential exists.

If you must have 100 percent compatibility with the PC, you are probably better off buying the IBM product. If 100 percent compatibility is not your first concern, you

> What you intend to do with the machine should dictate the products you consider.

can avoid problems by first deciding what hardware and software you intend to use, and then testing it on the machine before you buy.

Compatibility and the Market

Most manufacturers provide only limited compatibility. Basically, it is a matter of marketing objectives: they are trying to capitalize not on the popularity of the PC, but rather on the wealth of software that is available because of it.

Another reason is that many compatible machines were already on the drawing boards when IBM announced the PC. That the PC uses the 8088 microprocessor must have been a godsend to those manufacturers, and IBM's decision to use a commercially available operating system was almost too good to be true.

Nothing lasts forever. The design of the PC was more than a year old before the first unit was even built, and with technology continuing to advance at a fantastic rate, it is foolish for anyone to become enmeshed in the PC standard—someone is bound to come up with a better way.

Steven Cook is the Technical Editor of PC WORLD *and has been working with and writing about microcomputers since 1978. Prior to joining* PC WORLD *he worked for* OSBORNE/McGraw-Hill *where he coauthored several books.*

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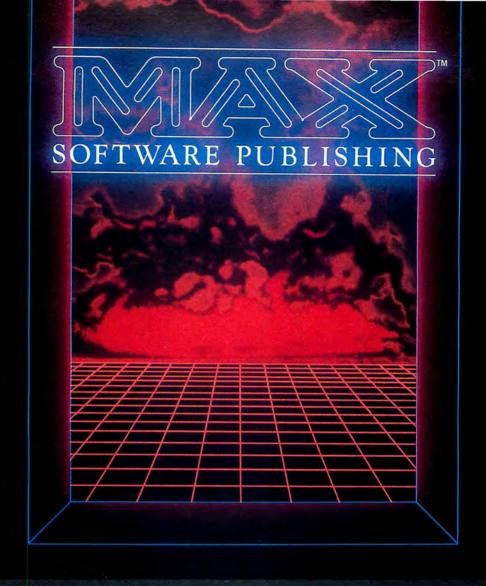
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The View from MS-DOS 2.0

*PC WORLD discusses the dominance of the IBM
PC and compatibility issues with Microsoft.*
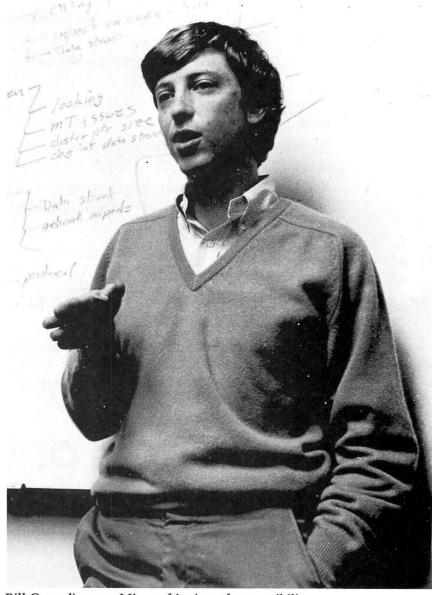
Edited by Andrew Fluegelman

In preparing "How Compatible is Compatible?" *PC WORLD* Editor Andrew Fluegelman, Technical Editor Steve Cook, and Associate Editor Harry Miller traveled to the Bellevue, Washington, headquarters of Microsoft. As the proprietor of the MS-DOS operating system (distributed for the PC by IBM as PC-DOS), Microsoft has been working closely with most of the computer manufacturers who are introducing machines that are "compatible" with the IBM PC.

   PC WORLD discussed Microsoft's view of the compatibility issues with Microsoft Chairman of the Board Bill Gates, MS-DOS Product Marketing Manager Chris Larson, and Language Product Marketing Manager Tandy Trower. The following is an edited version of that far-ranging talk.

   PCW: As you see it, how is the fantastic success of the IBM Personal Computer—and the fact that virtually every PC is running MS-DOS—going to bear on the compatibility issue?

   MS: Compare what's going on now with what went on back in the 8-bit world. In the case of Apple, there was really only one machine, so you never talked about being Apple-DOS compatible versus being compatible to the Apple machine. There was an infinitesimal amount of software that ran on the Apple that you could carry around to another machine.

Bill Gates discusses Microsoft's view of compatibility

At the inception of the PC, Microsoft pushed for it to be based on a 16-bit design, knowing that would mean that none of the 8-bit software could run on it. There's still some confusion in people's minds about that, particularly because of the Z-80 cards that people can plug in. It's our view—looking at all the major packages that existed in the three primary 8-bit software bases [Apple, TRS-80, CP/M-80]—that every single one of the major packages has now been moved up to the 8086/8088 [processor] MS-DOS base.

PCW: What's the difference between the MS-DOS base and the IBM PC software base?

MS: MS-DOS compatibility allows programs to run on more machines; some software can move from machine to machine, being MS-DOS compatible, whereas other software depends on things that you find only on the IBM PC. That would be a fairly simple picture, except that because of the dominance of the IBM PC, some hardware manufacturers are doing their best to share some of those extra PC hardware characteristics.

The PC itself has two video cards, which means that some programs work from the monochrome adapter and some work from only the color/graphics adapter. So the PC isn't even compatible with itself if you take the strictest interpretation of the word.

PCW: Do you foresee operating system compatibility as eventually being more relevant?

MS: Most of our customers are merchandising their machines as MS-DOS compatible. In fact, Zenith, North Star, and Wang—all those companies are strictly MS-DOS, and they're careful to avoid anything that would make it look like they're trying to follow IBM. They're following our standards; if they don't, then they're stuck on a treadmill, where if something changes in the future, they might have to play catch-up. They're convinced that they'll get the wealth of applications strictly by being MS-DOS compatible. The brand-name

machines will all be at the MS-DOS level.

PCW: Even though the PC is so popular?

MS: When the PC was introduced, the entire software industry focused its efforts on the PC. Just about

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The PC isn't even compatible with itself if you take the strictest interpretation of the word.

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everybody who was developing software for CP/M-80 or the Apple moved over to the PC. The educational people, the game people, the data base people, the word processing people—it's almost scary how many people are doing IBM PC software. You name a category of software, and we can name two dozen PC programs in it, and there are probably two dozen more we're not even aware of. We used to think we knew about all the stuff going on in the industry. It's just not possible anymore.

A lot of software is out there now, and the primary marketplace for it is the PC. Right now, the percentage is very much skewed toward that one machine, but that will change, although it will probably never drop below 50 percent.

If a company wants to come in and take advantage of the PC— especially a company that's new to the industry—it has to try to do some of those things. For any company that has its own brand name, however, that approach doesn't make sense. It would probably be a negative factor because of what it says about their future direction; it might prevent them from coming up with some of their own innovations.

PCW: By "those things" do you mean writing software for the PC-specific hardware?

MS: Right. It's a classic thing; there's a trade-off between innovation and standards. Standards allow

you to share efforts and all the software investment, and yet standards stifle better graphics, better non-keyboard input devices, or other improvements. We'd really like to underline one point: even IBM will seek to preserve only certain characteristics of its machine as it evolves. The architectural definitions don't match, bit and byte, what the PC is. It's too much of an anchor around somebody's neck to say that every bit and every byte will be in the same place forever.

Certain programming practices won't survive improvements by IBM. Some software is so married to the machine that it can't adapt. There's really a lot of dirty software on the market now; we'll have to educate the developers about how to write better software.

This has all happened very quickly; in the few cases in which we've pointed out to some of the vendors how their programs could be less dependent on specific manufacturers' hardware, they've readily changed. We've never run into anyone who didn't want to maximize volume. That's why we think the standard should be at the MS-DOS level.

PCW: Are you confident about that standard being set?

MS: In time people will see the distinction between PC compatibility and MS-DOS compatibility. They'll want to have their software run on the widest possible base, so most of the applications will be specifically MS-DOS applications.

Most software authors will consider this "MS-DOS level." They'll either write in a high-level language that insulates them from the hardware differences—BASIC, COBOL, or some other language— or they'll be careful that when they do need to be specific to a machine, they'll detect which machine the software is running on.

PCW: How will they be able to do that?

MS: We'll publish a method for finding out which machine you're on and getting around whatever the

hardware differences are. We need to evolve MS-DOS to provide more and more facilities so that this cheating [bypassing the DOS and writing directly to the hardware] is less tempting.

PCW: You're talking about two approaches. The MS-DOS-level approach is for the operating system to handle the architectural interface. The other approach is to write the applications software directly to the the machine. Is there anything architecturally in the PC that couldn't be handled at the operating system level?

MS: Well, if you've got the identical functionality on your machine, everything can be done, but some people choose to do sound differently, or the graphics resolution and keyboard differently—at some point DOS can't mask those differences underneath.

PCW: What would be an example?

MS: If there's one area in which the operating system is still letting people down somewhat, it's having an OS [operating system] machine-independent facility for high-speed screen addressing.

The way that problem is being solved today by Microsoft is through the use of an "install utility." When you buy an applications program, you get a menu that lists what machines you might be running on. Once you've chosen the specific environment you're running on, the install utility pulls the code out of its library that is specific to that machine. It's identical with what went on with *WordStar* in its 8-bit implementation, only more sophisticated.

For example, you get the install utility with our MS-DOS *Multiplan*. It fits the appropriate code into your *Multiplan* so *Multiplan* can run extremely fast. Likewise, the same install program could operate on our COBOL or any of the other programs that we're coming out with. That install technology will be something that, if other applications ven-

dors want, we can make available.

PCW: Do all programs have to be installed?

MS: Most numerical applications—payroll, inventory, accounts receivable, bowling league statistics—can just use an MS-DOS interface and be fine; all the necessary addressing is handled in the operating system. Unfortunately, some of the more visible applications—more high-volume ones such as spreadsheets and word processors—need high-video bandwidth, so they need something like an install utility. In time that type of facility is something we expect to have down in the OS itself. In MS-DOS 2.0, for example, we have the ability to handle cursor positioning and color directly through the DOS, whereas in 1.0 that wasn't possible.

PCW: You've brought up DOS 2.0. How will that affect compatibility?

MS: DOS 2.0 is a major event in the evolution of MS-DOS because it has all the key things that ought to

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DOS 2.0 is a major event in the evolution of MS-DOS because it has all the key things that ought to be on every machine.

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be on every machine. We'll have some enhanced versions that some people may decide to pick up, but in terms of the level that every application should be able to assume, that's MS-DOS 2.0.

PCW: Is DOS 1.10 a functional subset of 2.0?

MS: Yes, it is. Completely. DOS 2.0 is bigger, so if you've got a 64K system, the DOS takes up more space. You might need more memory

to be able to run your applications.

The answer to your question is yes, absolutely, but there are people who depended on where the buffer sat in DOS 1.10, and of course those buffers have moved, so there are a few applications that are married to DOS 1.10.

The reason DOS 2.0 came up is that we were trying to illustrate where we've seen some gaps in 1.0 and how we're filling those in 2.0. There are things that 2.0 doesn't hit; it's not the be all, end all.

We'll make the OS fill its stated role as much as possible. Graphics will get more fancy, and new devices you can't anticipate will be developed. Sometimes you'll have to improve the OS, but if you're clever, you can often cover an amazing degree of innovation with simple mechanisms.

PCW: What's the difference between PC-DOS and MS-DOS?

MS: There's an element of confusion that's introduced by the fact that it's termed PC-DOS. PC-DOS means MS-DOS when it's running on the IBM PC and when referred to in IBM literature.

PCW: Are similarly numbered versions of PC-DOS and MS-DOS identical?

MS: Absolutely. We're doing new releases from time to time, and in different environments different utilities make sense. The question you should be asking is not "Is it bit for bit the same?" You should be saying "Is the interface—the applications software interface, the way you call it, the way it behaves— absolutely identical?" And the answer is yes.

You want to find architectural interfaces that are stable; then you can make things faster or better or smaller or that will meet those architectural interfaces and still have the benefit of the other investments that have gone on above that level.

PCW: The fast screen handling routines you were referring to— those are not available in DOS 1.10?

MS: They're not part of the DOS, and they're not even in DOS 2.0. That's done by the utility that sticks code into applications.

Left to right: Chris Larson, Steven Cook, Bill Gates, Tandy Tower, Andrew Fluegelman

PCW: But can't some programs be adapted for different MS-DOS machines?

MS: If someone wants to make software run only on a specific machine, it will always be possible. The assumption we're proceeding from is that people who sell software will want it to run on as many machines as possible, and once they're given guidelines and rules, they'll go out of their way to do it.

PCW: How about a graphics-intensive program like Flight Simulator?

MS: That program is written specifically for the IBM PC. We don't have plans for bringing it out for other computers.

PCW: Would that program run without change on another machine?

MS: It would have to be a very compatible machine.

PCW: How would you be able to know what machines are in that category?

MS: That's really for the manufacturer to claim.

PCW: Let's assume that you make it easier for people to write software that's adaptable at the operating sys-

tem level. Consider the example of a user who might have the PC at his or her office and some other MS-DOS-compatible machine at home. Let's leave aside the licensing and copy protection issues for a moment. From a practical point of view, when someone works until 6p.m. at the office and then wants to go home and keep working, what would be involved?

MS: People will label their programs as being MS-DOS compatible. If they need the DOS 2.0 features, then they'll be labeled DOS 2.0 compatible. We expect all those programs to be the largest base of software that's ever existed—larger than any micro or mainframe base you've ever seen. All those programs will carry across.

Then there will be another label that would be machine specific, and those programs probably wouldn't carry across unless you've got a computer manufacturer who claims to have replicated all of that machine's characteristics.

PCW: So there might really be three levels. One you call MS-DOS compatible, a program that will run on any MS-DOS machine. The second is a program that makes use of your install procedure and can be

readily adapted to run on any number of machines with different architectures. The third level would be those that so directly address the architecture of a particular machine that they can't be transported, installed, or converted.

MS: That's right. You can get even more detailed and talk about programs that require a monochrome or a color/graphics adapter, or you can go below MS-DOS and say it uses the 8086 instruction set so it's compatible with any system that has an 8086 processor in it. Essentially, that's what most customers are coming to us and saying—that they have an 8086-based machine and they want to run as much software as possible. It has nothing to do with the specific vendor of that machine; they just pick the 8086 for its merits, and then we give them MS-DOS on top of that.

PCW: You're apparently providing sophisticated support for communications through MS-DOS. That area has been a particular sore spot in compatibility.

MS: This gets tied into a specific discussion of MS-DOS 2.0, but

there's something in called installable device drivers, which allow even communications parameters to get carried quite effectively from machine to machine.

One amazing example of this is GW BASIC. It supports sound, light pen, joystick, graphics, communications, key tracking, data time—all that—and yet it is being ported onto a very high percentage of the MS-DOS machines. That's the first time this has been done. GW BASIC is a very high-level interface: you can carry GW BASIC programs around between these machines quite effectively and still take advantage of a high percentage of their special capabilities.

PCW: GW BASIC is to IBM PC BASIC as MS-DOS is to PC-DOS?

MS: Right. We'd reverse the syntax of your statement, though, and say that IBM BASIC is the IBM version of Microsoft's GW BASIC.

PCW: Well, for the past year, most of the BASIC and DOS applications using your product were on the IBM PC, so people, at least initially, started thinking of them as IBM BASIC and PC-DOS. Thinking colors the compatibility issue and the way it's going to develop. One can only assume that this conception is going to shift and change, but how much it's going to shift and change is still open to speculation.

MS: That's right, IBM has done a superb job, and their success with the PC is a reflection of that work. Some people might say, "I don't really care to get to machines that are not IBM's machines."

PCW: Do you see any of the new machines having architectural features that are major omissions in the PC? Ones that perhaps are going to create a gap in the other direction?

MS: The PC is very flexible. As we said, the video architecture is plug-in, and it's got a plug-in hardware bus. There's very little you can't do to a

PC in its plug-in box. Although at some point it looks a little kludgy [messy], there's nothing that you couldn't retrofit into a PC of any kind.

The industry continues to do a better job, and everyone's going to come out with new products. Intel has chips that run even faster now. Some machines will probably take advantage of that development. Companies like Hercules have done plug-in boards for the IBM PC. The Vector machine has higher resolution graphics built into it than the PC does. This is evolutionary stuff. The

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We've done a better job, but yet an imperfect job on the PC. Some of those imperfections are what MS-DOS 2.0 is about.

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way MS-DOS has been set up and the way the software base has been set up, there's room for more innovation than there was down in the 8-bit architectures.

Look at what happened with the Apple computer. It essentially did not change over a 5-year period, and yet this is a highly innovative industry. Partly, that's because there weren't definitions of nice architecture levels that would allow pieces to be improved and yet have other software pieces continue to work on top of that.

We've done a better job, but yet an imperfect job on the PC. Some of those imperfections are what MS-DOS 2.0 is about. We want to get as many of those install features as possible in the DOS itself.

PCW: How will you do that?

MS: There should be a set of calls for the DOS that allows you to do everything you want to do to the screen by calling the DOS instead of

manipulating the screen directly. When you have hardware-specific codes outside the DOS, that is a case of the DOS failing to do its stated function, which is to insulate all applications from specific hardware features and allow the hardware to change without affecting applications software.

PCW: That's planning for a very high level. You can plan for 16 colors, and then someone decides to have 256. Right away they are outside the DOS.

MS: You can allow for an incredible amount of innovation, even without knowing what form it will take. The installable device drivers we put inside MS-DOS allow for voice devices, IEEE devices, plotters, or any devices like that. We haven't constrained what sort of things you can run through those device drivers.

Take your example of colors. We'll allow 16-bit color specification fields; that's 65,000 colors, which is more than the eye can detect. 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 type of capacity. Sometimes it just boils down to leaving a few bits here and there for expansion.

You've also got to tell people there will be new error codes. When you check for error codes, just because you checked for three out of the four cases, don't assume it's the fourth error because there might be new errors. Make specific checks and have a catchall that says "Error xx" instead of thinking you know all the cases.

Much of it is simple planning ahead. We have all the experience from the 8-bit world. Hopefully, the mistakes aren't too constraining because there are things we want to improve.

PCW: You've also allowed for transporting to new processors. Are we going to find a 68000 version of MS-DOS?

MS: Yes, you can say that. You'll find an operating system called MS-

DOS from Microsoft on a 68000, but that's at the very root of what we've been discussing. Every object code file has machine instructions in it, and that means that every program will have to be recompiled or put under a new version of BASIC or recoded or something.

To talk about compatibility across processors is to talk about compatibility in the weakest possible sense. As far as the computer dealer is concerned, he's got to stock different disks of programs for 68000 and 8086. That's more inventory, and whenever there's a bug, there's that much more to update.

Different processors are the most incompatible thing imaginable. That's why we hesitated when we considered whether we should go from 8 bits to 16 bits. We looked at the installed base and, fortunately, because everyone did development so quickly and the 8-bit software was never what it was cracked up to be anyway, we've gotten over that hump. Now the 16-bit, 8086 programs are the biggest software base, and it would be a real pain to do that development again on another processor.

We hope people have learned their lessons in terms of what to expect. Many people came to expect that a wealth of applications would be available instantly just because operating systems might be rehosted from one processor to another. Not only does applications development take time; it takes demand. We don't want to be critical about any not-so-popular 16-bit microprocessor, but there are some that, even if we put MS-DOS on them, you'd have few applications running. There wouldn't be enough demand for applications vendors to go to the trouble of porting their stuff, or the dealer wouldn't see the value of stocking it, and that's going to affect how many people end up using it.

PCW: Is there a list of specifications or features that MS-DOS supports that might become the de facto standard necessary for a machine to be considered MS-DOS compatible?

MS: We can name a few. The system has to have an 8086. It should have an MS-DOS-compatible disk format, an ASCII character set, and it should run on MS-DOS.

PCW: Those aren't very limiting.

MS: No, they're not very limiting. They're not intended to be— we don't want to stifle the industry. An application that requires sound (other than just the bell) could not be MS-DOS compatible; that is, it couldn't run on all MS-DOS machines.

PCW: So the speaker is not supported as part of the operating system package?

MS: We chose not to build that into the MS-DOS layer.

PCW: How about the monitor?

MS: I guess we could say that we're imposing limitations by requiring a screen as opposed to a hard copy. We require a screen and at least 40 columns of video output.

PCW: It's surprising that you say at least 40 columns and not 80. By doing that, you are establishing the threshold. It becomes important where you are setting it.

MS: There are so many applications that can be done within what we've defined. We expect to see MS-DOS on some very low-cost machines. The only cost concern inherent in MS-DOS is that it requires a disk or a network connection—one or the other.

We should make one thing clear when talking about the minimum requirement for MS-DOS machines: MS-DOS-compatible software has to be able to run in multiple MS-DOS environments. If the software assumes things that are above and beyond the minimum requirements, it has to make sure that it can accommodate the differences above and beyond that minimal set.

For example, if the software uses graphics, it has to poll the machine as to what the graphics resolution is. That's something that the DOS will

support.

PCW: Will the hardware manufacturer have to wire something into the machine to allow the operating system to poll that location, or will it be installed in the operating system?

MS: The best illustration is the way we've done the international system call. An application will call the operating system and get back a descriptor table that will say what is going on in this system. Since the OEM is the one who is duplicating the MS-DOS disk, they'll just set up that table to describe whether they have music, what their graphics resolution is, whether they have the extended character set, and so on. In 2.0, for example, this international system call has options, such as the way to print out the date and the currency sign symbol.

So instead of having a different version of the application for each country and copying and distributing it differently, that application will ask MS-DOS what environment it's running in and then make the appropriate adjustments. You can have one

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MS-DOS-compatible software has to be able to run in multiple MS-DOS environments.

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object code that operates in all those environments.

The same holds true for accommodating some variety in MS-DOS machines. We don't expect to have a common graphics resolution, and yet we expect eventually that 90 percent of all MS-DOS machines will have built-in graphics. Good applications will go in after DOS and work within that set.

PCW: Getting back to the issue of dirty software, you mentioned you were going to try to publish the

portability requirements for interface applications. Why did so much dirty software suddenly proliferate?

MS: Part of the reason is common sense. It's amazing. I guess people are coming onto micros for the first time, and they don't think that they're ever going to run their products on another machine, or they're rushing to get the stuff out. You wouldn't believe some of the stuff that's being done.

PCW: Let's look into the future, say 18 months ahead. Now these compatible machines, or clones, or cousins have come out and the applications software has been written. How do you see the user community making use of this compatibility at the levels we've been discussing?

MS: There will be a clear understanding that there's a large 8086 instruction set (MS-DOS set of software), and what it means to label something as MS-DOS compatible will be well defined.

People will know to ask, "Is it MS-DOS compatible or is it strictly compatible to a specific machine that runs MS-DOS?" Software vendors will stick labels on their packages that say which variety of compatibility is required.

Being really strict, the label will also state which version of MS-DOS; therefore, if the program requires the 2.0 features, it will say "Requires MS-DOS 2.0." People will know that the disks are interchangeable and that there is no reason to look back into the 8-bit software base. There will even be things beyond MS-DOS 2.0 that will increase what you can do while staying within the definition of MS-DOS compatible.

PCW: Is the MS-DOS compatibility "Seal of Approval" something that you will bestow or help people decide they can claim?

MS: We're going to define what the seal of approval is. Whether we come up with an official mechanism for allowing people to use that term has not been decided.

PCW: Despite your efforts to facilitate this, the creators of the software

will ultimately have to know how to make the right system calls and make the right claims. They'll have to be careful in listing their requirements. The first year has been easy: there has been only one machine, two graphics boards, and only about five printers. But people are already confused, and now we're seeing the possibilities explode.

MS: Let's call that the confusion gap. We're doing things to contain it—telling people how they can do things right and label correctly.

We believe that people are very risk averse when they buy software. A high percentage of software sales will be from brand-name reputable vendors, and those people will follow the rules absolutely. There's enough interchange of data, and anybody who publishes a phone number is going to have to bear the cost of not doing things right. It will be properly handled by those people, and that will be a huge percentage of the software market. If you buy stuff out of a box in the back of a magazine, you could get lucky or unlucky.

PCW: There's another level that doesn't even relate to what you're doing. That is the case in which a hardware company claims its machine is PC compatible, or a software publisher develops a program that it claims not only requires MS-DOS, but also requires full PC hardware compatibiity. It may or may not be easy for these companies to know whether they can make compatibility claims. How does that get resolved? How much more can you (or do you want to) be of help?

MS: We're establishing the MS-DOS-compatible software base and doing everything we can to help. The degree to which vendors share characteristics beyond what we call MS-DOS compatible is really up to them, but we don't necessarily recommend it.

As we innovate, we have to make DOS more powerful or educate people about compatibility. Or maybe we need to come up with some test programs that actually verify these claims. We think we're doing just that.

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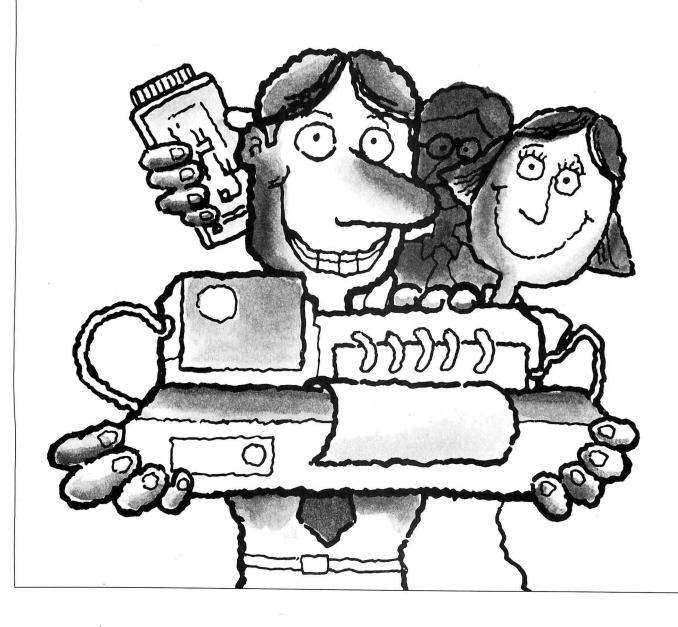
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At this moment, there are no less than 50 personal computers on the market. And more are being introduced every day.

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*Computers come in two parts.
You have to buy both.*

We'd like to help. So here are a few suggestions about how to buy the computer that's right for you.

Computers come in two parts.

One part is the "hardware," which is the machinery itself. The other is the "software," or a program, as it's sometimes called.

Software is the part that tells the computer what to do, the way a driver tells a car what to do.

Without software, a computer can't do anything.

And vice versa.

You have to buy both.

Buy the software first.

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

Start by making a list of the things you want to use the computer for. It can include almost anything—any kind of inventory, filing, accounting, graphics, reporting, record-keeping, analysis—you name it and there's probably a software program that does it.

Next, take the list into a computer store and ask the salesperson to give you a demonstration of the program, or programs, that will do the things you want.

Even though you'll need a computer for the software demonstra-tion, keep in mind the computer is just a vehicle. The software is the driver. And once you've decided on the software, picking out the rest of the computer system will be much easier.

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Look for software that's easy to learn, easy to use, and that does the job in the simplest way possible.

Good personal software should be, as the computer people say, "friendly." Meaning that it helps you do what you have to do without getting in the way.

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Some people, however, will tell you that software has to be complicated to be powerful.

Nothing could be farther from the truth.

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You can read any number of interesting books and magazines about personal computers. You can ask friends who have them. You can look at all the sales literature you can get your hands on. And you should do all those things before you decide to buy.

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The PFS family is designed the way we think all software should be: simple, straightforward and powerful.

Currently, three products make up the family. PFS:FILE, PFS:REPORT and PFS:GRAPH, with more programs on the way. Here's a little more about each of them.

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Basically, FILE works like 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.

FILE lets you arrange your information in "forms" you design yourself. So you can get at and really use your information in ways never before possible.

What's more, FILE lets you change the original form without having to redo the information on it.

PFS:REPORT. Making the most of your information.

REPORT summarizes the information on your forms so you can use it to analyze, plan and make better-informed decisions.

With REPORT, you get presentation-quality reports—sorted, calculated, formatted and printed—automatically, in seconds.

PFS:GRAPH. Instant pictures.

GRAPH gives you presentation quality bar charts, line graphs, and pie charts, in black and white or color, on paper or the computer screen. To get a clearer picture of things and spot trends instantly, you simply enter your information and specify the kind of graph or chart you want. GRAPH does the rest.

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Send in the Clones

More than 20 computers are said to be compatible with the IBM PC. Here's a list of them and what they have to offer.

Lisa B. Stahr

If last year brought in the PC, this year will bring in the clones. Riding on the PC coattails of success, many computer manufacturers have recently announced their own versions of Big Blue's popular personal computer.

Listed here are 21 of those computers: some are desk top, some portable; some have an Intel 8088 microprocessor, some have a Zilog Z-80A; some use 5 1/4-inch disks, some 3 1/2-inch; but all are said to be compatible with the IBM PC. We didn't have the opportunity to test each one, so we can't pass judgment on their claims. We suggest you read "How Compatible is Compatible?" in this issue for some ideas on what makes a computer PC-compatible. Use it and this list to make your own decisions.

AS-100

Using an 8088 microprocessor and MS-DOS, the Canon AS-100 is software compatible with the IBM PC. In its basic configuration, the AS-100 comes with 128K, one parallel adapter, and two double-sided, double-density, 5 1/4-inch disk drives with 640K each. A high-resolution monochrome or color monitor is also included in the basic configuration. The color monitor can display 27 colors, up to eight at the same time.

The AS-100 with a monochrome monitor costs $3,995; the AS-100 with the color monitor is $4,695. A CP/M-86 operating system is also available. Canon USA, Inc., 1 Canon Plaza, Lake Success, NY 11042, 516/488-6700.

Chameleon

Seequa Computer's Chameleon uses an 8088 and a Z-80A microprocessor and runs MS-DOS and PC-DOS. An optional expansion box, available in the second quarter of 1983, will accept IBM PC boards, making the Chameleon hardware compatible with the PC. The box will cost less than $500.

The Chameleon has 128K, a 9-inch green phosphor monitor, two 5 1/4-inch floppy disk drives with 160K each, a PC-style keyboard, one serial and one parallel adapter, BASIC, *Perfect Writer*, and *Perfect Calc*. The Chameleon's graphics are compatible with the PC. Color graphics capability is built into the system although a color monitor is optional. The basic Chameleon system is available for $1,995. Memory can be upgraded to 256K, and to 700K with the expansion box. A second serial adapter, CP/M-80, or CP/M-86 are also available. Seequa Computer Corp., 209 West St., Annapolis, MD 21401, 800/638-6066.

COMPAQ Portable Computer

According to the manufacturer of the COMPAQ Portable Computer, the system runs all popular IBM PC software packages without any modifications. The basic system includes a high-resolution, 9-inch diagonal monitor, a 16-bit 8088 microprocessor with 128K memory (expandable to 256K on the main system board), a 5 1/4-inch floppy disk drive with 320K storage capacity, MS-DOS, and Advanced BASIC. The 28-pound portable also includes adapters for an optional RGB color monitor and a parallel printer, a socket for the Intel 8087 coprocessor, and three IBM PC-compatible hardware expansion slots for extra memory and peripherals. A second 320K floppy disk drive is also available. The basic COMPAQ Computer system is $2,995. COMPAQ Computer Corporation, 12330 Perry Rd., Houston, TX 77070, 713/890-7390.

Corona PC and Portable PC

Corona Data Systems offers two personal computers that are compatible with the IBM PC. The desk-top Corona PC and the Portable PC both feature a half-size, 320K disk drive, a high-resolution green phosphor monitor, 128K memory, serial and parallel adapters, MS-DOS, BASIC

with graphics commands, and a spreadsheet package.
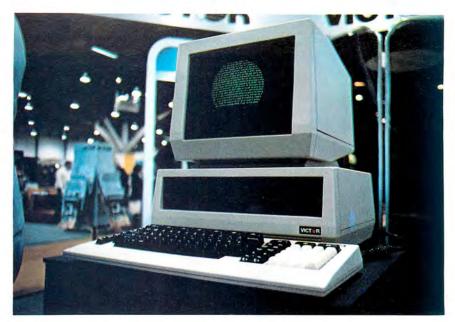
There are four expansion slots in the Corona PC and 3 1/2 in the Portable (one for short boards only). All the boards accommodate interface for components such as hard disk, communications, or color graphics. Memory in either system can be expanded to 512K without using any expansion slots. IBM's color/graphics board can be used in a Corona expansion slot to run graphics or color software written for the IBM PC.

Both Corona systems use an Intel 8088 microprocessor with an optional 8087 coprocessor. Other addons include a second half-size floppy disk drive and/or a 10-megabyte hard disk. In the Corona PC, one hard and two floppy disk drives can be installed directly into the computer with no external attachments. The hard disk is a separate attachment in the Portable.

The list price for the standard-size Corona PC with a single 320K disk drive is $2,595. With a second floppy the price is $2,995. A system with the internal 10-megabyte hard disk and a single floppy disk drive is $4,495. The basic Portable PC costs $2,395 with a single 320K disk drive, and $2,795 with dual disks. The 10-megabyte hard disk for the portable is $2,695. Corona Data Systems, Inc., 31324 Via Colinas #110, Westlake Village, CA 91361, 213/706-1505.

DOT

Although they use 3 1/2-inch disks, all four models of the portable DOT computer are said to be compatible with the IBM PC. The systems run MS-DOS and feature 32K of main memory, a 5-by-9- inch monitor with high-resolution, bit-mapped graphics, a keyboard with ten soft programmable function keys, and one single-sided, double-density floppy disk drive. DOT's 3 1/2-inch disks provide 287K storage capacity. The systems

Victor (top), Eagle (center), and Ollivetti (bottom).

also feature two slots for memory or function expandability. A 90-day warranty is included.

A variety of options is available for the DOT, including a Z-80 microprocessor, that allows users to access programs developed for CP/M-80. The basic DOT Computer is $2,995. The second model, for $3,495, features an additional 32K, two communications adapters, and an MS-DOS/BASIC software package. The third DOT costs $3,795 and adds to the second configuration a built-in 300-baud modem and a time-sharing service. Along with the basic package, the fully equipped DOT offers an additional 32K of memory, dual RS-232C communication adapters, the MS-DOS/BASIC software package, and a built-in 160 cps dot matrix printer. This system lists for $3,995. Computer Devices, Inc., 1015 E. Hillsdale Blvd., Foster City, CA 94404, 800/DOT-WORD, 415/574-5561.

Eagle 1600 Series

The Eagle 1600 Series uses the MS-DOS or CP/M-86 operating system and is software and hardware compatible with the IBM PC. The 1600 Series introductory system includes 128K memory (expandable to 512K), one 5 1/4-inch floppy disk drive (hard disk drives are available), and eight slots for IBM PC boards for peripherals such as printers, telecommunication devices, and color monitors.

The 1600 Series uses an Intel 8086 microprocessor and comes with a 12-inch high-resolution monitor, a detachable keyboard with 24 user-definable function keys, and two RS-232C serial adapters and one parallel adapter for printing and communications. The Eagle 1600 Series is available for $6,995, which includes word processing and financial planning software. Eagle Computer, Inc., 938 University Ave., Los Gatos, CA 95030, 408/395-5005.

Colby (top), Hyperion (center), and Compaq (bottom).

Gazelle

The Gazelle uses an 8086 microprocessor operating at 8 megahertz (as opposed to the 4.7 mHz speed of the PC), and MS-DOS. It also comes with two double-sided, double-density, 8-inch disk drives (which have five times the storage capacity of the 5 1/4-inch PC drives) and can run most of the PC's applications software.

The Gazelle comes with 128K, three serial adapters, one parallel adapter, and an 18-slot S-100 bus system board. MS-BASIC, *Perfect Writer*, and software utilities are included in the $5,995 list price. This system can be upgraded to 1 megabyte of memory. Seattle Computer Products, Inc., 1114 Industry Dr., Seattle, WA 98188, 800/426-8936.

Hyperion and the Hyperion Plus

These two IBM PC-compatible portable computers claim almost complete compatibility with IBM software. The Hyperion and the Hyperion Plus come with an 8088 microprocessor, 256K, a built-in 7-inch diagonal monitor, a keyboard whose layout is similar to the IBM PC's, a serial and a parallel adapter, and time and date clocks with battery backup. The basic Hyperion model has one 320K floppy disk drive and weighs 18 pounds. At 21 1/4 pounds, the Hyperion Plus has two 320K floppy disk drives and a 300-baud internal modem. Both systems run MS-DOS and offer Advanced BASIC with IBM PC graphics compatibility. The *Multiplan* spreadsheet, an executive text editor, an electronic mail terminal and telephone management system, and a travel case are included with the Hyperion Plus. The basic Hyperion retails for $3,395 while the Hyperion Plus sells for $4,995. Dynalogic Info-Tech Corp., 8 Colonnade Rd., Ottawa, Ontario K2E 7M6 Canada, 613/226-1383.

Lee Data Personal Computer

The Lee Data Personal Computer has an 8088 microprocessor, MS-DOS, 128K, and one 5 1/4-inch, double-sided, double-density disk drive with 320K. The Personal Computer was designed to complement Lee Data's line of 3270 terminals. The terminals may be connected to the Lee Data Personal Computer and used as an independent work station. Future models of the Personal Computer may have adapters for alternative keyboards and monitors.

Lee Data claims its Personal Computer has complete software compatibility with the IBM PC. The Lee Data system can also use IBM PC boards, making the computer hardware compatible with the PC as well.

The system comes with one parallel and one serial adapter, and four expansion slots. The computer will be available in 1983 and will cost $2,700. Lee Data Corp., 10206 Crosstown Circle, Eden Prairie, MN 55344, 612/932-0300.

M-20

Olivetti just introduced a CP/M-86 module for its personal computer that makes the M-20 software compatible with the PC. Now using an 8086 coprocessor with its Z-8001 microprocessor, the M-20 runs many of the applications software packages written for the PC.

The basic M-20 system comes with the Z-8001, one 320K floppy disk drive, 128K RAM, a black and white monitor, and a keyboard with 72 user-programmable keys. This basic unit costs under $3,000.

The business model of the M-20 uses the basic configuration, a 320K floppy disk drive, and 160K RAM. Its list price is $3,600. A color graphics monitor is available for $1,850. Other options include one 11-megabyte hard disk drive, 512K RAM, and a variety of dot matrix printers. Docutel/Olivetti, Inc., 155 White Plains Rd., Tarrytown, NY 10591, 914/631-8100.

MAD-1

Available this spring, the MAD-1 will offer MS-DOS and CP/M-86 and use the soon-to-be-released Intel 80186 microprocessor (which is 25 percent faster than the PC's 8088). The base price system will be configured with 128K, a 5 1/4-inch floppy disk drive, two serial adapters, one parallel adapter, a 12-inch diagonal green phosphor monitor, and a keyboard. Also to be included are black and white and 16-color graphics in one board.

The MAD-1 also will be hardware compatible with the IBM PC; any boards made for one machine will operate in the other. The new system will be composed of four basic units: the Computing Module, which along with the central processing unit and 128K memory will include two expansion slots; the Data Module with one floppy and one hard disk drive and a power supply; a keyboard; and a monitor. An optional Expansion Module will feature slots for four additional boards.

The MAD-1 will have a suggested list price in the $3,000 to $6,000 range, depending on the options added. It will be available in 1983. Mad Computer, Inc., 3350 Scott Blvd. Bldg. 13, Santa Clara, CA 95051, 408/980-0840.

MB-16001

Hitachi will introduce the MB-16001 this spring. The system uses MS-DOS and can run many of the applications software packages available for the PC. Hitachi will offer a color monitor with higher resolution than its IBM counterpart.

The Hitachi system comes with an 8088; 128K; one 5 1/4-inch, double-sided, double-density disk drive; and a keyboard with ten function keys. Adapters for a monochrome or color video monitor, a printer, and a light pen are also included. This system

will sell for about $3,500. Hard disk drives, a 30 cps printer, monitors, additional memory, and floppy disk drives are optional equipment. Hitachi Sales Corporation of America, 401 W. Artesia Blvd., Compton, CA 90220, 213/537-8383.

Multi-Personal Computer

With its MS-DOS operating system, the Multi-Personal Computer can run most of the IBM PC's languages and software packages, including *Visi-Calc*, *SuperCalc*, and *EasyWriter II*. The MPC requires its own video graphics board (which also runs in the IBM PC) to use the monochrome monitor.

The standard configuration includes a 16-bit 8088 microprocessor, 128K RAM, one hard disk drive, and one parallel and two serial adapters. The MPC also has eight IBM PC-compatible expansion slots, which allow users to incorporate memory and peripheral boards originally designed for the PC. The basic MPC unit, the 1600-1, also comes with two floppy disk drives with 320K each and sells for $2,995. At $4,995 the 1600-2 features a 320K floppy disk drive and a 5-megabyte hard disk drive. The 1600-3 has a 320K floppy and a 10-megabyte hard disk drive. The optional keyboard and monitor cost an additional $295 each. Other options include a 128K RAM board for $595, a 256K RAM board for $995, and a Z-80 microprocessor board with a full CP/M-80 system for $595. Columbia Data Products, Inc., 8990 Route 180, Columbia, MD 21045, 301/992-3400.

North Star Advantage 8/16

The North Star Advantage 8/16 has greater graphics capability than the IBM PC. The system can run Graphics CP/M or Graphics MS-DOS, which support all North Star Advantage 8/16 graphics features. The North Star Advantage 8/16 system is available with a Z-80A microprocessor, two quad-density floppy disk drives, 64K, a 12-inch green phosphor monitor, and an IBM Selectric-style keyboard with 15 function keys. The system also has an Intel 8088-2 with 64K RAM (expandable to 256K), and either two integrated quad-density capacity disks (with 720K storage) or a combination of a 5-megabyte or 15-megabyte hard disk with one quad disk drive. The list price for the North Star Advantage 8/16 is $4,099. North Star Computers, Inc., 14440 Catalina St., San Leandro, CA 94577, 415/357-8500.

PEC

When used with the optional MS-DOS or CP/M-86 operating system, the PEC is software compatible with the IBM PC. Three other operating systems—CP/M-80, CP/NET, and OASIS—are also available at additional charge. At $1,999 the basic system includes 64K, two single-sided disk drives, Z-80 and 8088 dual processor capability, and a keyboard. A monochrome monitor is $99 extra.

The system has six slots for memory and graphics expansion. The PEC can have up to 512K (for $995) or 1 megabyte internal memory and up to eight serial adapters. The PEC system board has a hard disk interface and can be expanded to 11 megabytes of internal storage. The system comes with its own four-channel RS-232C adapter and high-resolution color/graphics boards. The basic PEC sells for $1,999. Microcomputer Technology, Inc., 3304 W. MacArthur Blvd., Santa Ana, CA 92704, 714/979-9924.

Series 1600

The Series 1600 is a 16-bit microcomputer that is software compatible with the IBM PC. The system features a terminal control unit board with a Z-80A microprocessor and two serial and two parallel adapters. An 8086 or 68000 processor board with 128K, two floppy disk drives, a green phosphor monitor, and a keyboard with a layout identical to the PC's are also included in the $3,300 to $3,500 basic system.

Using the 8086, 68000, or Z-80A microprocessor, the Series 1600 can run with the CP/M-86, MS-DOS, UNIX, or OASIS operating systems. In the $8000 model memory is increased to 1 megabyte for the 8086 and 2 megabytes for the 68000. The system also can have any combination of up to four 5 1/4-inch floppy and four 5 1/4-inch hard disk drives for a maximum storage capacity of 160 megabytes. Datamac Computer Systems, 680 Almanor Ave., Sunnyvale, CA 94086, 408/735-0323.

T-300

When it becomes available in 1983, the Toshiba T-300 will run MS-DOS, concurrent CP/M, and its GW-BASIC, a language much like IBM's BASICA. The basic T-300 configuration will include an Intel 8088 microprocessor, 128K RAM, a green phosphor monitor, and two half-size floppy disk drives that store 520K each. The system will be upgradeable to use 1 megabyte of memory, hard disk drives, and high-resolution color graphics. Toshiba estimates that the T-300 will cost less than a comparably equipped IBM PC. Toshiba America, Inc., Information Systems Division, 2441 Michelle Dr., Tustin, CA 92680, 714/730-5000.

Texas Instruments Personal Computer

A professional computer work station just announced by Texas Instruments is software compatible with the IBM PC. The most basic configuration of the Texas Instruments Personal Computer has an 8088 microprocessor, one 320K floppy disk drive, a monochrome cathode ray tube (CRT), and a CRT controller with four slots. The system also features 64K internal

memory (expandable to 256K) and a keyboard with 12 user-programmable function keys. The list price for the basic configuration is $2,595.

Many options are available for the Professional Computer, including a color monitor, built-in color graphics capability, 5- and 10-megabyte hard disk drives, a built-in modem, and a telephone management system with telephone and voice recognition. Several operating systems are also available, including MS-DOS, GW BASIC, CP/M-86, and Concurrent CP/M. Texas Instruments, Data Systems Group, Literature Response Center (H-642), P.O. Box 402430, Dallas, TX 75240, 800/527-3500.

Victor 9000

With its 8088 microprocessor and MS-DOS, the Victor 9000 can use most PC applications software. An optional utility package called PC COM allows users to transfer software from the PC to the Victor 9000 and vice versa.

For $3,995 the Victor 9000 comes with 128K, two floppy disk drives, CP/M-86 and MS-DOS, two serial and two parallel adapters, four expansion slots, a detachable keyboard with seven function keys, and a monochrome monitor. Victor Technologies, Inc., 380 El Pueblo, Scotts Valley, CA 95066, 408/438-6680.

Wang Professional Computer

Designed to integrate with other Wang products, the Wang Professional Computer is software compatible with the PC. The system uses an Intel 8086 microprocessor and MS-DOS, and it has complete media compatibility with the PC.

The basic system includes 128K RAM; a 320K, 5 1/4-inch floppy disk drive; a keyboard with 16 programmable function keys; a green phosphor monitor; and both RS-232C and parallel adapters. Memory can be increased to 640K with an optional memory expansion board. Other options include a second floppy disk drive with 320K bytes of

additional storage capacity, a 5 1/4-inch hard disk drive with 5 megabytes of additional formatted storage, and a CP/M-80 emulator.

Several Professional Computer configurations are available, ranging in price from $2,695 to $8,945. Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851, 617/459-5000.

Z-100

The Z-100 uses Z-DOS, virtually the same operating system as PC- DOS. Zenith's personal computer also runs CP/M-86 and uses 8088 and 8085 microprocessors. Two configurations

are available for the Z-100. Both come with 128K, two floppy disk drives with 320K each, and a 95-key keyboard. The Low Profile for $3,999 comes with a built-in color graphics chip. For $4,000 the All-in-One features a built-in monochrome monitor. A green phosphor monitor for the Low Profile costs $69.50 and a color monitor is $699. Eight-inch floppy and hard disk drives are also available for both systems. Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025, 312/391-7000.

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Networking in Color

IBM is using the PC as part of its nationwide experiment with color videotex.

Danny Goodman

The versatility of the IBM Personal Computer—its ability to take on a new personality with the inclusion of plug-in hardware and companion software—is one of its strengths and one indication that it will always be in the technological vanguard. Thus it is not surprising to find the PC playing a significant role in an emerging technology that may become the predominant United States corporate and consumer telecommunications medium of tomorrow: color videotex.

Perhaps no other new technology has caused as much confusion as videotex and its close relative, teletext. These two terms are not used or even spelled consistently, which presents a major stumbling block to their acceptance. Another source of confusion is that both technologies basically accomplish the same end—presenting "pages" of information that are viewed on a video monitor. But videotex and teletext use distinctly different transmission methods and have vastly different capabilities.

Teletext and Videotex

For this discussion, *teletext* is a one-way broadcast transmission of information pages to standard TV sets equipped with decoders that convert digitally encoded data to text or simple images on the screen. Teletext

signals can be broadcast by conventional television stations or transmitted by cable stations along with the regular TV picture. Closed captioning for the deaf, which ABC and public television offer on many programs, is a rudimentary teletext service. Consumer teletext services are used in Europe, where subscribers view pages by selecting choices from an on-screen menu and entering them into a calculatorlike keypad connected to the decoder. One limitation of such teletext services is that they can make available only about 200 pages, or screens, of text at any time.

Videotex (spelled without a final t) is a two-way, hard-wired link between a central computer data bank and a video monitor/keyboard combination in a remote location. Many PC owners are familiar with monochrome videotex systems such as The Source, CompuServe, and Dow Jones

News/Retrieval. These information exchange services, lacking color transmission or any notable use of graphics, represent an early generation of videotex.

In today's generation of videotex, color videotex information is painstakingly composed and formatted to be easy to use and understand. These newer videotex systems are also designed to allow communication with the central computer through simple words or numbers rather than elaborate computer commands or codes.

In most cases videotex signals are carried by telephone lines although

some coaxial cable TV systems are capable of such two-way communication. Because the videotex information source is a large computer, subscribers potentially have access to hundreds of thousands of pages, selectable through a succession of menus. And because videotex is a two-way system, users can send information from their keyboards to

the central computer in the form of electronic mail, merchandise orders, bank transactions, or bulletin board notices.

Videotex development is further along in Europe and Canada than in the United States. As a result, several incompatible videotex formats have evolved, causing most American developers to be very cautious about moving into the market. One major exception is IBM, whose European subdivisions have experience developing corporate videotex systems in England and Germany.

IBM's Test System

Before bringing videotex to the United States, IBM built an evaluation system within the company to determine how the system might be accepted and used by a large corporation. Because IBM introduced the PC when it was developing its videotex system, the PC readily became part of the experiment. As part of IBM's videotex network, the PC performs not only intelligent terminal and videotex page design functions, but it stands to broaden the scope of videotex applications because of its potential for combining videotex with laser videodisc media.

At a recent information utilities conference, Peter Grimm, Jr. of IBM's Information Systems Group explained the philosophy behind the experiment: "This videotex system was designed to deliver business information electronically to the casual user, who today most likely does not use a terminal." IBM's designers built a data-gathering component into the prototype system so they could keep track of its usage. The component records such things as the number of pages viewed and the length of time a user spent with each page to accomplish a given task. If a user took a long time on a particular screen in a sequence, the design of that page was suspect. "We needed a full understanding of all the interfaces between the user and the system," Grimm said. "We had to develop a single-minded focus on ease of use."

The complete videotex system is really a network of 300 microcom-

puters and remote terminals around the country that are tied by telephone line (IBM's satellite-linked internal tie line, in this case) to a Series/1 (S/1) mainframe computer. Although the S/1 is the master controller for the system, its software (adapted from a product available in Great Britain) was modified to allow the S/1 to retrieve information from several other computers such as the IBM S/370 mainframe, a popular computer among Fortune 500 companies. The S/1 converts information stored in an S/370 into color videotex pages for distribution to any terminal requesting those pages.

For the test IBM is employing two types of access terminals: the Wolftel 1200 and the IBM PC, both of which use color monitors. The PCs, which comprise about 150 of the terminals in the network, are modified by added plug-in cards from Wolfdata

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Videotex and teletext use distinctly different transmission methods and have vastly different capabilities.

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and are connected to the phone lines by Hayes 1200 baud Smartmodems.

IBM decided to choose one of the several videotex system formats already in use outside the United States for this test. Some of these systems' names may be familiar; Telidon from Canada, Antiope from France, and Prestel from Great Britain are the major contenders. IBM chose Prestel, not as an endorsement of that format's protocols or graphics generation features, but for the sake of convenience. Some Prestel-compatible hardware and software was already available, allowing the company to devote its efforts to customizing the system and studying users' responses.

The Network's News

The variety of available data bases demonstrates the power of IBM's videotex system. This power is largely transparent to the system's users, however; they see colorful images and easy-to- read lists of options that require little or no computer savvy to use. One popular

data base in the IBM system is the Official Airline Guide (OAG). IBM receives the data in videotex form from OAG's publisher. The information is stored in the S/1 computer and is updated monthly. IBM employees can specify their travel plans and see videotex displays of all flights to and from their destinations while sitting at the PC or terminal. At present they can't make reservations on the videotex system, but even that capability may be around the corner.

IBM's company-wide telephone directory is another of the system's data bases. The employee is prompted on screen to type in another employee's name, and then the S/1 computer "orders out" to a remote S/370 system that contains the corporate directory. The search is conducted within the S/370, and the data is sent back to the central S/1 where color and other videotex page formatting is done before the information is fed to the employee's terminal.

The process of passing information to and from remote computers could be used for a variety of applications. Product orders might be entered directly into one of several S/370 com-

◉ State of the Art

puters in various IBM divisions. The videotex software would control information formatting and handling, however, so the S/1 would appear to be doing the work of one mammoth computer.

An even more sophisticated application is currently being added to the system in the form of access to the Dow Jones News/Retrieval service. The challenging part of developing the software for this service was to make the "ordering out" appear as if Dow Jones data resides in the S/1. In fact, the S/1 contains Dow Jones service menus in its standard videotex format, but it obtains the actual data from the Dow Jones computers elswhere. Once a user specifies his or her request, the S/1 (in the guise of a remote IBM 3270 terminal operating at 4800 baud) summons the data from Dow Jones. Upon retrieval, the special S/1 software adds color, graphics, and proper formatting before sending the data to the user's screen. In these instances, the S/1 acts as a conversion tool between existing data bases and videotex terminals.

Use Patterns

IBM's employee study showed that computer novices' use of videotex increased throughout the experiment. The most popular service has proven to be the IBM internal news bulletins produced at several sites around the world. To companies planning videotex systems, Grimm cautions, "Don't throw away an application because you think it's trivial."

Each of the 300 users profiled in the test views an average of 19 videotex pages per day. The heaviest concentration of use occurs at approximately 10 a.m., but that time is expected to shift to late afternoon as the Dow Jones service comes on line.

IBM is now marketing a videotex system centered around the S/1 to corporations in the United States. It

is called the Series/1 Videotex System, or SVS/1. As corporate data processing managers feel pressure from managers in other departments who want both access to the company's computers and personal computer power, the PC as videotex terminal and off-line processor may be an ideal solution.

The PC's Videotex Card

The hardware/software combination that links a PC to IBM's videotex system is manufactured by Wolfdata and works in conjunction with the IBM Color/Graphics Adapter. This

additional graphics card is required to display Prestel's medium-resolution graphics on the screen. In regular color applications, however, the Wolfdata card is bypassed, and the IBM Color/Graphics Adapter controls the monitor as usual, without the necessity of switching cables.

When it's not being used as a videotex terminal, the PC can be used for any regular computing function without modification. The Wolfdata card includes a serial port for asynchronous communications, thus conserving precious expansion slots.

Software

The plug-in card is only part of the PC videotex story. Wolfdata offers several software options to augment the card's capabilities. The firm's basic package turns the PC into a simple videotex terminal with autodial and auto log on. These features help conceal the system's complexity from novices who might otherwise be intimidated by passwords or other

log on procedures. A supplementary program package routes incoming data to the parallel port for printing on the IBM dot matrix (or compatible) printer.

Wolfdata also produces editing software that gives the PC a vital role in a videotex system by allowing novices to design videotex pages for uploading to the central computer. Ordinarily, considerable knowledge is required to build a colorful and effective page; users must be familiar with such things as the alphamosaic building blocks of the Prestel system. The Wolfdata editing software makes most of that technical manipulation transparent to the designer. With design help (proper use of color and graphics, for example) from an outside source, IBM had novices use the Wolfdata editing software to develop many of the pages for its test system.

Another software option is called a "billboard." In this mode videotex pages can be downloaded to a PC disk drive (up to 100 pages on a

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When it's not being used as a videotex terminal, the PC can be used for any regular computing function without modification.

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single-sided, single-density disk) and placed in a loop to cycle through the pages in order. This will be useful for such things as readily updateable silent sales or demonstration tools in retail windows or counter displays.

Wolfdata has designed a videotex microsystem emulation package that operates in a fashion similar to the billboard. This software turns the PC into a self-contained, interactive videotex system that utilizes pages stored on disk. Wolfdata President Tom Lonergan estimates that a PC with a 5-megabyte hard disk could store up to 10,000 pages of videotex.

Future Developments

In the works at Wolfdata is an accessory for the videotex card that controls a laser videodisc player. The combination of laserdisc and videotex allows updated text to be overlaid onto video presentations, complete with sound. Current prototypes show the videotex screen in monochrome over the color laserdisc video picture, but a color videotex overlay is nearing completion.

The videodisc/videotex connection has some fascinating implications for the very near future, according to Lonergan. He cites General Motors showrooms, which today feature videodisc sales pitches for customers. Dealers will be able to use the same disc for a whole model year, updating the overlay data (prices, rebates, and special promotions) by periodically down loading videotex frames to the showroom PC from GM headquarters.

Computer-aided education is another area that could benefit from this combined technology. By using the videodisc as an information base, quizzes could be given on line via videotex, with their results recorded at the central computer.

Tom Lonergan predicts that "The large company user will be the most likely to see videotex over the next couple of years. Eventually corporate data bases may be shared with consumers with videotex terminals." Lonergan also believes that color videotex will be the standard, even among services such as The Source and CompuServe. To back up this forecast, he points to the success of color television. "Once a user has

tried color, there's no going back." CompuServe is already testing color transmission using the Radio Shack Color Computer. "Color is important," says Lonergan, "because it adds dimension, enabling the user to absorb information quickly."
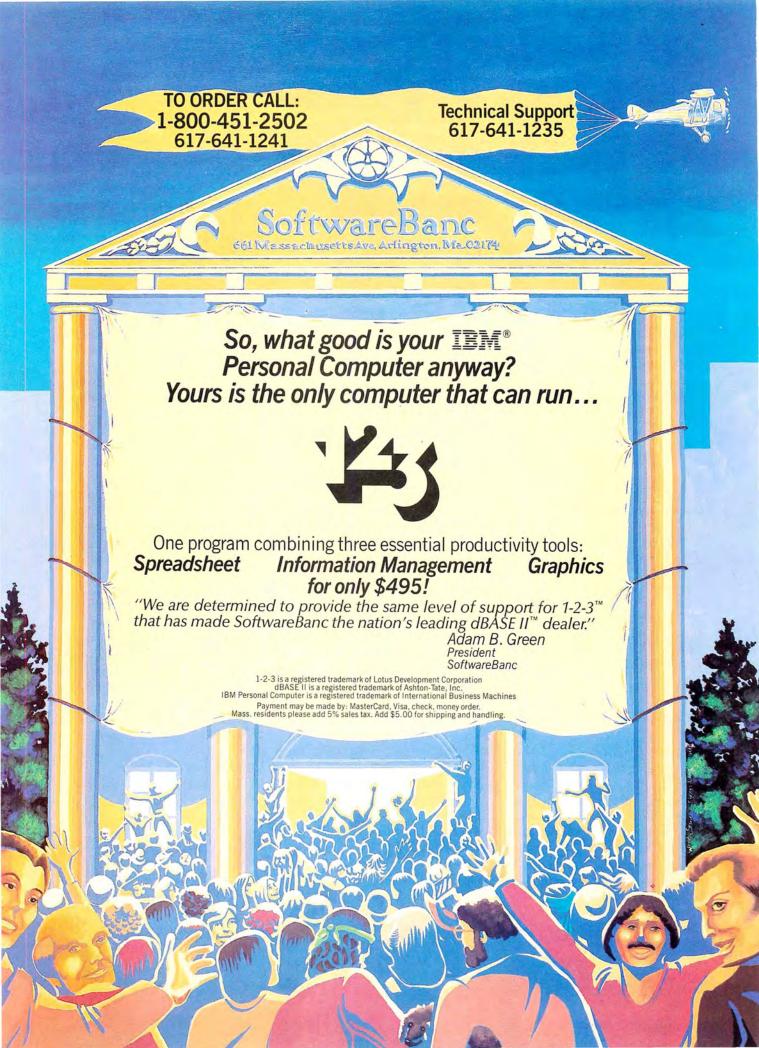
At IBM, Peter Grimm looks to even more sophisticated videotex systems that will develop a profile of each user and anticipate his or her information needs according to that profile. In discussing a future executive who might have just placed San Francisco airline, hotel, and rental car reservations on the terminal, Grimm suggests, "If we had captured a profile of this user and his past uses of the videotex system, we would have discovered an interest in sports and opera. Why not have the videotex system present dynamically to this user indexes of sports and opera events scheduled in San Francisco during the time frame of his trip?"

While this concept may raise questions about invasion of privacy, it is nonetheless indicative of the potential power of color videotex services for business and home. And from all appearances, the PC is poised to be at the forefront of this telecommunications revolution.

PC World *Contributing Editor Danny Goodman is a specialist in home electronics. He contributes regularly to* Playboy *and* Better Homes & Gardens *and is currently writing a book about word processing for the IBM PC.*

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PC W●RLD Views

News and Notes for the Computing Community

Miriam Medom

PC World View is privy to voluminous speculation and rumors about the computer industry, especially about IBM's share of the pie. The *Grapevine* is devoted to ferreting out the most credible and enticing of these items and passing them along with the proviso that they are not necessarily the gospel. Here goes...

Grapevine
Chip Talk

Various computer trade publications have reported that IBM is about to announce an upgraded version of the PC that will use Intel's 80186 microprocessor (also called the iAPX 186) instead of the 8088. One source reports that this chip is faster and cheaper (because it requires fewer accompanying components), so it may be the heart of a low-priced PC possibly costing less than $1,000 for the basic unit. Could this low-priced computer be the rumored Peanut, which will supposedly include a keyboard and small system unit that connects to the TV set? Current speculation is that Peanut will contain 64K of RAM, expandable to 128K, and will be software compatible with the PC. Another source notes that IBM is considering Intel's next-step-up chip, the iAPX 286 (or 80286) as the CPU for a high-priced PC. This chip is said to be better than the Motorola 68000 processor for speed and efficiency.

Roving Reporter

There are rumors in print that IBM will soon announce a personal computer work station designed for the 3270 terminal market. Code-named Rover, this machine reportedly will have a built-in 5 1/4-inch hard disk and the new flat-panel plasma display that IBM has developed. The system is capable of connecting with a mainframe and downloading files, and it can be used for such stand-alone tasks as word processing or spreadsheet calculations when it is not serving as a terminal. Rover may utilize either a new processor designed by IBM or an existing chip such as the 8086 or the 68000. Our reporter has not determined whether Rover will be compatible with the PC or will even be considered part of the PC product line. One of our sources predicts that this and other new products will be announced at the West Coast Computer Faire in March. Time will tell (a phrase we nominate as IBM's official motto).

Star Doings

The inside word from MicroPro International of San Rafael, California, is that their best-selling *WordStar* word processing program will be significantly improved in a redesigned version for the PC. This new superstar (our name, not theirs) will reportedly be memory mapped so that a user may scroll through the text as quickly as the keys can be pressed; there will be a 128K version so that speed and file size will be increased; and—most surprising—the price will be trimmed. Could this new *WordStar* be another debut at the Computer Faire?

Miscellaneous Musings

Still other sources report that IBM has been evaluating several manufacturers' light pens for possible use with the Rover work station or some version of the PC. No slouch at making up for its misjudgments, IBM is also supposedly about to release a board for the PC that combines color and monochrome display capabilities.

Move Over, George Plimpton

A horde of electronics wizards and video junkies crowded into Las Vegas in early January for the Consumer Electronics Show. Among them were a few celebrities who came to pitch products and perhaps to rejuvenate their public images. Jamie Farr of "M*A*S*H," Rich Little, Jonathan Winters, and Mickey Mantle performed in one or another of the 1,000-plus exhibits, and Rona Barrett, among 70,000 others, watched them peddle their respective wares. No doubt most of these pitchmen, not to mention Rona, will be turning up on the tube any day.

PC WORLD's own reporter Danny Goodman was at the show. He reports that although IBM had a booth at the event, it was modest in terms of both products and announcements. Two new programs for the PC were introduced and shown in preliminary versions. One was *Home Budget,* which will sell for $60 and requires 64K, one disk drive (preferably two), and a monochrome display.

The other program was a BASIC Primer, also $60, which requires 64K, one disk drive, and a monochrome or graphics display. This program is a tutorial that covers at least two dozen BASIC commands, as well as the function keys and main keyboard of the PC. Among the commands taught in the Primer are BEEP, PRINT, SOUND, LOCATE,
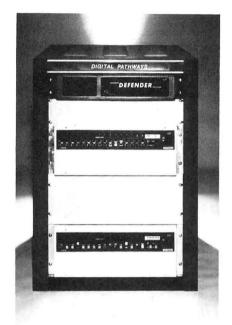
RUN, GOTO, and END.

Only one other product for the PC caught Goodman's attention at the show—a board manufactured by Wico Corporation that contains ports for two unusual game control attachments. One port is for an analog joystick, which differs from a conventional joystick in that its handle stays wherever it has been moved, rather than returning to the center position when the user releases it. This joystick could make game playing a good deal more precise and might also be used to control the cursor or interact with characters on the screen the way a mouse does.

The second port on the board is for a trak-ball controller, the ball-bearing-like device used on some popular arcade-style video games such as *Centipede*. Wico makes both the Trak-Ball controller and the analog joystick. More information is available from Wico at 6400 W. Grosse Point Rd., Niles, IL 60648, 312/647-7500.

CP/M-86 Holds Its Own

As we were going to press Digital Research announced its $60 enhanced version of CP/M-86. The operating system is compatible with single-user, multitasking Concurrent CP/M-86. Enhancements to the original CP/M-86 include a print spooler, a graphics extension (GSX) that allows development of graphics applications programs, and drivers for graphics, printers, plotters, and cards.

Defender, Digital Pathways

First Line of Defense

In an effort to protect computer data from clever thieves and prank callers, Digital Pathways of Palo Alto, California, has invented The Defender. This rather monstrous-looking metal box intercepts telephone calls to a computer system and requires the caller to provide a special identification code. If the caller doesn't know the code, The Defender hangs up after 30 seconds. If the caller gives the correct ID, the machine tells the caller to hang up (in a digitized voice) and then calls that caller back. Sounds like The Defender will definitely frustrate data stealers and code breakers, and it looks pretty fierce besides.

DOS Spoken Here

An informal poll of members' systems was taken at a recent meeting of a PC user group whose members are mostly IBM employees. This survey yielded interesting, if perhaps atypical, results. For example, PC-DOS is the operating system of choice; only 3 people of approximately 300 said that they use either CP/M-86 or the UCSD p-System. The underdogs are gaining though; at the previous meeting, PC-DOS was chosen unanimously. Now with the announcement of the new $60 version of CP/M-86 (see "CP/M-86 Holds Its Own") more people may choose to run their PCs with the well-known operating system from the 8-bit computing world. Other system trivia from this group includes the fact that about half the members use color adapters and monitors; three-fourths have more than 64K of RAM, and half have more than 128K. About 30 members use their expanded RAM as an electronic disk, and another 5 members have hard disks. *PC World View* will be interested to know how those tallies compare with the systems owned by members of other user groups.

Colliding Technologies

Some aphorist may have said it better, but as life gets easier it also gets more complicated. To wit: all the gadgets and gizmos designed to make us more comfortable and pro-

ductive are beginning to get in each other's ways. Here are two reports from the field that illustrate the point; we welcome yours as well.

Battle of the Gadgets

Scratch a PC user and there's a good chance you'll find a gadget freak. Lots of us are into whatever is state of the art, but we found one gadget that's a no-no for your computer room. Wireless telephones work by emitting a radio frequency that communicates between the handset and the base station. That's fine for projecting your voice, but don't get it too close to your PC. We can't speak for every brand, but we accidentally discovered an incompatibilty between the PC and an Extend-A-Phone 400. When we tried to use the phone and the PC at the same time, the PC started acting up. At first we thought it was electronic rivalry—the PC squelching its competition. On closer examination we discovered that the problem lies in radio frequency interference. The FCC requires that computers sold in the United States be free of radio emissions. They are apparently not free, however, from receiving radio frequencies. The output from the electronic phone somehow affected the PC, causing unpredictable results.

Larry Magid and Stu Schwartz

PC Phones Home

E.T. isn't the only one who wants to use the phone; so does the PC. If you have a Cobra Cordless telephone and your PC is within 10 feet of the transmitter (telephone base), radio wave interference produced by the

computers's CPU is strong enough to ring the phone. The frequency with which the PC rings the phone seems to depend on the contents of the program being used in the computer, but a sure bell ringer seems to be a type of FOR...NEXT loop in a BASIC program. After a few prank calls placed by the computer, the PC owner wises up and turns off the telephone.

Big Blue's News

A few items from the news wires and from our correspondents about IBM's doings.

The Early Bird

A 7:30 a.m. call from a Boca Raton spokesperson to reporter Emil Flock netted the following information: IBM withdrew the UCSD p-System to make improvements on it, including adding a pseudo-diskette drive to take advantage of RAM larger than 128K; improving disk input/output (I/O); correcting double-precision arithmetic I/O problems; and adding turtle graphics. The updated version is reportedly available through authorized PC dealers. The FORTRAN Compiler is being revised to correct unspecified problems and add turtle graphics, and the COBOL Compiler is undergoing some corrective revision. As to IBM's policy about warranty and repair of PCs, the spokesperson restated the company's policy of not servicing systems with third-party hardware installed. "Yes, you must remove your Quadboard," he said.

Buying the Hand That Feeds Them

IBM's recent announcement that it has agreed to pay $250 million to acquire 12 percent of Intel's stock has prompted speculation and interpretation. Some observers have pointed out that this move by IBM could be a strong signal to the Japanese that American chip makers will be supported by American firms; others note that IBM is assuring itself a steady supply of chips and a first look at new technologies as Intel develops them. Most observers see this acquisition as a positive move for both IBM and Intel, rather than as any sort of takeover or compromise.

Sprechen Sie PC?

One of our correspondents was wintering in Florida recently and took a tour of the PC production facility in Boca Raton. Our sharp-eyed observer took special notice of the brightly colored warning label on the power supply of each PC being assembled there. It seems that these particular stickers, unlike the ones on earlier PCs, carry their message in four languages: German, Spanish, Italian, and English. Good evidence for the likely distribution of the PC in Europe, probably through newly formed subsidiaries of IBM in Germany, France, and England.

Jargon of the Year

Time is famous for its pronouncements that a trend has arrived and for expressing those judgments in language that ranges from cute to coy. In case anyone missed the latest

of these bestowals of mass culture status—*Time*'s naming the computer Machine of the Year—we're happy to reproduce some of the prose that would have made Henry Luce proud.

Amidst a few dozen kilobytes of facts and folksy anecdotes, *Time* reports that a $34 piece of culinary software, the *Pizza Program*, designates ice cream as an appetizer. In the unlikely bedfellows department, *Time* points out that one woman (who programs at home to be with her young children) has surrounded her computer with laundry and a jar of Dippity Do. (Can you top that, *Newsweek?*)

But perhaps what *Time* does best is to contribute new jargon to the computer vocabulary, gleefully putting its writers' own labels on technology that already has too many descriptions. For example, one microcomputer system itemized in the magazine's cover story is said to include a "Diablo word printer," presumably jargon for a letter quality printer. (Not bad, actually.) A computer convert quoted in the article insists that he is not "a chiphead"— another new term for the lexicon.

Occasionally, a choice of spelling can lead to amusing ambiguity, as with *Time*'s settling on *disc* as the spelling for the almost universal *disk* or *diskette*. At one spot in the text, right next to a photo of a shirtless man hooked up to a computer-operated treadmill, the phrase "Johnson slips a disc" pops off the page. As readers worriedly scan ahead, wondering about Johnson's health, they discover that Johnson in fact slipped a "disc" into his computer, not in his back.

Still, we can't argue with the magazine's choice for its annual hero. We love our computers here at *PC World View,* and we're glad to be part of the in crowd. But we're not so sure we'll admit to being chipheads either.

Acronyms Unlimited

We've heard another intriguing new term from the jargon front that was obviously spawned by the computer age. It's *RYFM* (pronounced riff-um), and it has come into popular use among computer dealers and technicians. Explains one dealer we know, confidentially, "Ninety percent of the questions and calls we get from users can be answered the same way—RYFM—which stands for 'Read your friendly manual.'" Our friend added that occasionally a vexed dealer or technician may replace *friendly* with another word that begins with *f*.

Got any good acronyms or jargon? Send them to *PC World View,* and we may make them household words.

Tin Pan Alley Meets Silicon Valley

"BASIC Ain't the Language of Love" soon may be hitting a high C on the cash registers, computer stores, and record vendors around the country. "BASIC Ain't" is a pop song by Felicia Scherer of—where else?—Boca Raton, Florida. The song has been recorded in two ver-

sions (his and hers) on a 45 rpm by singers Steve and Debbie Brown. According to Scherer, the song "chronicles the highs and lows of a romance beset by bits, bytes, and bauds." If you can't find this future Top 10 hit locally, a copy is available for $5 from Keymont Associates, P.O. Box 273271, Boca Raton, FL 33427. Roll over, Beethoven.

Novel Novel

If *Blind Pharaoh* is any indication, the electronic age has arrived. *Blind Pharaoh* is a 20,000-word novel by Burke Campbell, and it resides on The Source. Campbell batted out this work of fiction in precisely 61.5 hours and sent it to The Source by modem. A few hours later, the 19-chapter novel was on line for all Source subscribers to read. If you want to sample *Blind Pharaoh*, type Novel when logged onto The Source; if you want your own electronic copy, it will take about an hour of 300-baud transmission time to download the entire work.

PC World View welcomes contributions from readers and will pay up to $50 for each item we use. Please include your name, address, and phone number with your contributions. Send them to PC World View, PC WORLD, 555 DeHaro St., San Francisco, CA 94107.
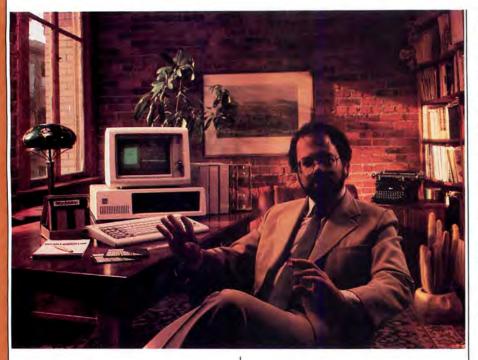
WHY WE CREATED THE FIRST
DOESN'T MAKE YOU WORK

by JIM EDLIN, PRESIDENT—BRUCE

A "writing tool" is what we call our improvement on conventional word processing. My company has just created a writing tool program for the IBM Personal Computer — WORDVISION™ — that breaks new ground in two directions. First, WORDVISION is far easier to use than earlier programs. Second, WORDVISION'S suggested retail price is far lower than prevailing levels. I'd like to tell you how and why we accomplished this.

—————🌰—————

🌰 Today's programs leave plenty of room for improvement.

As tools to assist your personal writing, existing word processors are hamstrung by two leftover influences: Yesterday's computers. And yesterday's jobs.

Existing programs have roots going back to computers much less capable than the IBM PC. Incredibly, these programs still bear the mark of design constraints imposed back when editing was done on teletypewriters that slowly clacked out copy. They also are shackled by designs intended either for a dictator-and-secretary context or the writing of computer programs — which both have different needs from personal writing. The effect is that to learn and use them you have to work harder than is now necessary.

🌰 WORDVISION was designed from scratch for the IBM PC.

In several ways, IBM's Personal Computer is more powerful than earlier machines, small or big. Its built-in display elimi-

nates need for any terminal — either the teletypewriter or newer video kind. The PC's display can be changed from top to bottom in an instant, allowing program features not possible on computers using terminals. Also, the PC screen can show details like underlining and bold printing, either directly or using colors. Another assist is the array of useful keys found on the PC keyboard but not on old-fashioned terminals; these provide easy ways to control a program's operation. And the PC is designed to have plenty of memory which also encourages easy-to-use program design. To use all this power, we began WORDVISION'S design with a clean slate. The result is a program that, unlike

If you understand traffic lights, you already know one of WORDVISION'S *main operating principles.*

its predecessors, won't ask you to memorize arcane codes or keep track of disorienting modes.

WORDVISION includes a set of handsome, full-color key legends that affix to your keyboard and show you the available controls. (Optional replacement keycaps will also be available.) Where other programs suggest you read their manual when you get stumped, WORDVISION is so easy you can usually just read the keyboard instead.

🌰 WORDVISION is designed for your personal writing.

Early word processing programs were designed either for computer programmers or secretaries. But programmers are used to dealing with computer idiosyncracies, and the secretarial process is a linear, static incorporation of someone else's requested changes in how a document looks or what it says. Our writing tool is specifically designed for the more fluid, dynamic process of interacting with your own words — where each new thought may inspire changes anywhere in your text, and you want to see easily how a change would look or sound.

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Spreadbases and Graphsheets: The Second Generation
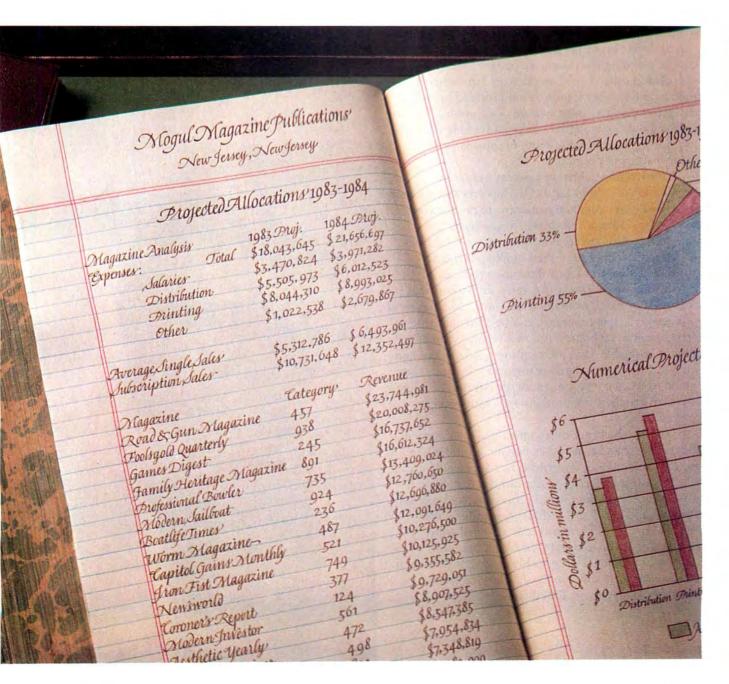
The IBM Personal Computer has created a whole new class of computer users and a plethora of products aimed at its market. One of the most promising new developments in software for the PC is integrated program packages, which combine several major functions into a kind of megaprogram. Capitalizing on the 16-bit computer's large memory capacity, these integrated packages offer interactive versions of such popular—and formerly stand-alone— operations as spreadsheets, graphics, data base management, and word processing.

Because these integrated programs represent a second generation of software, we've chosen to call them spreadbases and graphsheets as a shorthand way of describing their major functions. Some packages, for example, feature strong combinations of spreadsheet and data base operations, while others favor graphics and spreadsheet functions. As the new generation of integrated software develops, we may even encounter a program that does everything perfectly.

Ah, but this generation is still in its infancy, and perfection has not yet arrived. Instead, the reviews that follow examine and compare two excellent first entries into the spreadbase and graphsheet sweepstakes: *MBA* from Context Management Systems and *1-2-3* from Lotus Development Corporation. In "The Spreadbase Race" Harry Miller provides an overview of both programs and emphasizes their data-handling capabilities. In "The Graphsheet Contenders" Andrew T. Williams assesses these programs' spreadsheet capacities and offers a sampling of their ability to turn numbers into pictures.

Both writers reveal strengths and weaknesses in the packages, suggesting that programs face the same problem as politicians: they can't be everything to everybody. To see how hard these programs try, read on.

Mogul Magazine Publications

New Jersey, New Jersey

Projected Allocations 1983-1984

Magazine Analysis Expenses:		1983 Proj.	1984 Proj.
	Total	$18,043,645	$21,656,697
Salaries		$3,470,824	$3,971,282
Distribution		$5,505,973	$6,012,523
Printing		$8,044,310	$8,993,025
Other		$1,022,538	$2,679,867
Average Single Sales		$5,312,786	$6,493,961
Subscription Sales		$10,731,648	$12,352,497

	Category	Revenue
Magazine	457	$23,744,981
Road & Gun Magazine	938	$20,008,275
Foolsgold Quarterly	245	$16,737,652
Games Digest		$16,612,324
Family Heritage Magazine	891	$13,409,024
Professional Bowler	735	$12,760,650
Modern Sailboat	924	$12,696,880
Boatlife Times	236	$12,091,649
Worm Magazine	487	$10,276,500
Capitol Gains Monthly	521	$10,125,925
Iron Fist Magazine	749	$9,355,582
Newsworld	377	$9,729,051
Coroner's Report	124	$8,907,525
Modern Investor	561	$8,547,385
Aesthetic Yearly	472	$7,954,834
	498	$7,348,819

Projected Allocations 1983-

Other

Distribution 33%

Printing 55%

Numerical Project

The Spreadbase Race

Harry Miller

As recently as a few months ago, someone who wanted to computerize his or her business accounting and financial planning faced a choice between the quick recalculation capability of an electronic spreadsheet program and access to information provided by a data management system. Now two software products for the IBM Personal Computer have taken a very big first step toward merging the best features of spreadsheets and data management programs.

MBA (version 2.0) from Context Management Systems and *1-2-3* from Lotus Development Corporation are the first two integrated management productivity tools, or "spreadbase" programs, to emerge in the marketplace. Although they have clearly evolved from the electronic spreadsheet, their graphics and data sorting functions add a new dimension to financial planning and management. Analyses and reports that take weeks by hand, or hours using some combination of previously available programs, can be accomplished in minutes or even seconds. It is now a relatively simple matter to assemble data, perform some calculations and "what-if" analyses, sort and manipulate the data, create a graph for each condition, and write a memo detailing the results and their implications—all with a single program.

These products are called integrated management productivity tools because they contain several of the functions a middle- or upper-level manager would use daily. *MBA* offers electronic spreadsheet, data base, forms, business graphics, word processing, and communications functions. *1-2-3* includes spreadsheet, data base, and graphics. It also provides a limited word processing function and an extensive file and disk management system. The spreadsheet aspects of both of these programs are the subject of "The Graphsheet Contenders" by Andrew T. Williams.

MBA requires 256K, two disk drives, and a color/graphics adapter. It is written in UCSD Pascal and operates under the UCSD p-System. *1-2-3* requires 128K and two disk drives. A graphics monitor is required for viewing the program's business graphics on screen. *1-2-3* is written in assembly language and runs under PC-DOS.

The integration feature is a very important one. The combination of functions allows managers to follow natural thought processes and record an idea about a separate application without leaving the current application. With either of these new products they can move from the data base application they are developing to a vacant part of the spreadsheet and start working on a

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Analyses and reports that take weeks by hand can be accomplished in minutes or even seconds.

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totally unrelated financial model. When the thought is recorded, they can resume the original application, which was preserved just as they left it.

Integrated application programs represent an advance in power and convenience beyond the ability to move from one application to another. This is a new way of working on a computer: jumping from calculating to sorting to graphics easily and conveniently. Data can now be manipulated in ways that were previously awkward. Because these programs are intended for managers, they are based on an extension of the spreadsheet. Data is maintained and accessed in spreadsheet "cells." A cell is simply an area at the intersection of a row and a column where data is stored.

The tabular format is the framework through which all applications are viewed. This worksheet framework is likely to be familiar to executives and managers, who commonly use these ledger-style pages for financial planning and analysis. Thus, when they acquire a computer for such tasks, they will be working with at least one comfortably familiar element. The tabular formats of both *MBA* and *1-2-3* distinguish them from integrated tools designed for clerical personnel, which are usually based on a word processing framework.

Data Management

MBA and *1-2-3* both offer flexible data management functions. While these functions may seem somewhat limited at first glance, a few features, including variable field lengths and easy manipulation of raw data, may make them even more useful than many dedicated data base programs.

All data management programs act upon information organized into records and fields within those records. If a data base was prepared from the names and addresses in a Rolodex file, the information on each card would comprise a record. Each discrete item of information, such as last name, phone number, or city name, would be a field within that record.

Both programs perform the data management functions on data arranged in a worksheet format: the horizontal rows each form a record and the columns are fields within that record (see Figure 1). Creating a data base is then as simple as setting up a table.

With *1-2-3*, the data base size is limited by the size of the worksheet: 2048 rows, or records, and 256 columns, or fields per record. *MBA* allows selective access to data stored on disk rather than just to that on the currently displayed worksheet (the one in the computer's main memory). Therefore, *MBA*'s data base limits are bound by the capacity of the disk—not the size

of the worksheet—and several thousand records are *possible*. The *MBA* worksheet is 999 rows by 95 columns. Since the worksheet can be only 95 columns wide, each record is limited to 95 fields. When compared to most dedicated data management programs, however, these limits can hardly be considered limits at all.

The two programs store and update records differently. Since *MBA* accesses data from the disk file, additions, deletions, or changes to data base records are marked on the worksheet and then saved on disk using the /SU (Storage Update) command. *1-2-3*, on the other hand, operates only on data in the worksheet currently in memory. Therefore, changes and deletions made directly on the worksheet take effect immediately.

Spreadbase Advantages

Storing data in a worksheet format has several advantages. First, the field lengths are variable. Most dedicated data base programs require you to decide on the maximum length (in number of characters) for a field (last name, company name, or city, for example) before you enter data.

Using *MBA*, you just enter the data. Although you will see only the portion of the data that falls within the specified column display width, the data will be stored intact up to the 8,000-character cell limit.

1-2-3 does not handle text as well as *MBA*, but still doesn't require predefined field lengths. While the entire

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> Integrated application programs represent an advance in power and convenience.

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contents of a field must fit inside the display column width, you can easily reformat the column width to accommodate a larger entry. You just select Format Column-Width, and point the cursor to the cell with the larger entry.

A second advantage to a worksheet format is that you can manipulate the data in its raw form very easily; you can compare two records by moving rows around rather than having to perform some intricate sort or search and retrieve procedure. Changing the position of a field in all records simultaneously becomes a simple matter of moving columns, just as you would if you were building a spreadsheet model.

Searching and Sorting

To sort, search, or retrieve records in both spreadbase programs, you simply enter the criteria for the search of a particular field in a cell in the column that contains that field. When you give the command for a sort or search, you must also specify the range of data to be acted upon (the input range), the cells that contain the criteria (the criteria range), and the range that should be used to display the results of the action (the output range).

In both programs records can be retrieved by criteria that match exactly, or by those that meet Boolean logic statements such as greater than, less than, equal to, and not equal to. For example, in *MBA* "or" logic is fulfilled by several adjacent rows in the same column, while "and" logic is designated by entries in several columns on the same row. In other words, if two search criteria are listed on the same line, they must both be met for a record to be selected. If criteria are listed on separate lines, the search will yield records that meet the criteria on line 1 or on line 2, and so on.

MBA is very slow in performing data management tasks. A quick and dirty timing comparison showed that *MBA* took about 15 times longer (32 seconds) to sort a 24-record data base by two key fields than *1-2-3* took to sort a 32-record data base by two key fields (just under 2 seconds). Similarly, *MBA* took 1 minute 10 seconds to retrieve about five records by Boolean logic (greater than a certain number) from the same 24-record data base, while *1-2-3* accomplished the same task in under 3 seconds on a 32-record data base.

Both programs allow search and retrieve criteria to contain "wild cards." In other words, if you don't know the exact spelling of the records you want to retrieve or if you want to pull all the records that start with a certain letter, you can use a wild card symbol for all unknown characters.

The two programs handle wild cards a little differently. In *MBA* you can find every record with the specified field that begins with (X..), ends with (..X), or contains (..X..) the string of characters you provide. *1-2-3* follows the DOS convention for wild cards, using the question mark to symbolize any single character ('D?D' would find *dad*, *did*, and *dud*), and the asterisk for any characters after the ones you provide ('D*' would find *dad*, *did*, and *dud* as well as *dark* or *disaster*).

Special Features

1-2-3's Data Fill feature will fill a specified range with an ascending or descending sequence of numbers in specified equal "steps" (increments or decrements). This feature is especially useful for numbering rows or columns consecutively or preparing values for a graph.

1-2-3 includes a Data Distribution command that calculates a frequency distribution of values in a specified range. You can also define the intervals to be

Figure 1: In a worksheet format each horizontal row forms one record and each vertical column contains one field within that record.

Hotel	# of rms	Region	Category	Rev80	Occ80
Las Vegas	850	E	1	$23,744,922	81.42%
Dallas	**942***	**D**	**1**	**$20,008,080**	**80.82%****
Detroit	705	A	1	$16,737,652	72.60%
N. Orleans	952	B	1	$16,612,324	66.40%
Montreal	738	A	1	$13,409,023	77.78%
Houston	692	D	2	$12,762,867	81.50%
Chicago	710	C	1	$12,760,650	79.42%

*Number "942" forms one field within a record   **Entire horizontal line forms one record

Figure 2: MBA's Expanded Cell Text Storage

Skills	Industry	ZIP	Salary (000)	Age	Deg	Resume
Administration	Insurance, Bank	12234	$25	29		**Enid Smith, Administrator**
Administration	Manufacturing	12234	$22	28		Hermione Bastion, Payroll Administrator
Administration	Manufacturing	12001	$18	26		Ginger Hermes, Payroll Clerk
Analyst	Retailing	90040	$36	30	BA	Harold Michels, Applications Analyst
Analyst, Programmer	Aerospace	90024	$41	41	BS	Adam Fischer, Chief Technical Programmer
Analyst, Programmer	Insurance	90024	$38	42	BA	Angela Lucero, Chief Analyst
Analyst, Programmer	Manufacturing	90024	$35	41	BS	Holt Finison, Technical Programmer
Bookkeeper	Insurance	93219	$29	26	BA	C. Don Miller, Bookkeeper

Enid Smith, Administrator
109 Willamette Fork
Eugene, OR
(503) 555-1212

Education: Riverside Polytechnic High School
             Riverside Business College, Accounting—Assoc. Arts

Experience: 1961–1965   Sunkist Products, Clerk
            1965–1977   Homemaker
            1977–Present   Office administrator in the records maintenance department of the corporate sales division.

   Since reentering the commercial workforce after raising two children, Mrs. Smith has maintained a steady record of growing responsibility and initiative. Her performance reports reflect the high regard in which she is held by both superiors and subordinates.
   Mrs. Smith has received three commendations for extraordinary performance, and she is being considered for promotion to management in the training department.
   Mrs. Smith started as a trainee at a salary level of $14,000 per year.
   Her current compensation is $29,000 per year, plus bonuses.

Figure 3: MBA's Forms Mode Display

used: the program will count the number of records having values that fall between X and Y. The Data Fill command could be used to define equally spaced intervals. The Data Distribution command can be used to determine how many of your customers have overdue balances under $500; how many between $500 and $1,000; between $1,000 and $1,500; and so forth.

The Data Table feature in *1-2-3* sequentially substitutes each of a specified series of entries in one cell of a worksheet and records the resulting values of all formulas that refer to that cell in a table elsewhere on the worksheet. The effect of a data table is to automate a "what if" analysis with a record of the results of different input values.

If you wanted to build a model of a hotel chain's revenue that was based on the level of occupancy, for example, you could create a data table containing several guesses about what the occupancy rate might be (40%, 50%, 60%, 70%, and 80%). You would then specify the range of cells to receive the results of the analysis using each of those guesses.
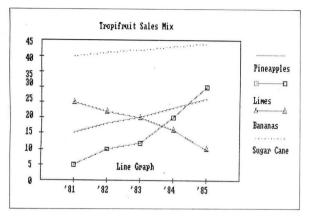
MBA allows a data base to be "indexed" on up to eight fields. Indexing is a method of presorting a data base on selected fields. This procedure speeds up the
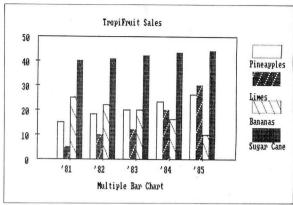
retrieval of records when the search criteria uses the indexed fields. Perhaps the reason *1-2-3* has no indexing feature is that its sorts and searches are already very fast.
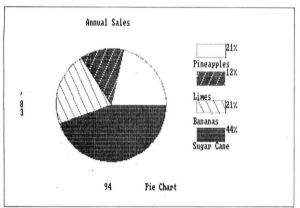
MBA has an interesting and useful data management facility made possible by its large, 8,000-character cell size. If you have large blocks of text attached to data records, the bulk of the text can be hidden when the records are displayed on the screen. Once the records are sorted or retrieved, the cell containing the large block of text can be "expanded" so that its entire contents can be viewed or the record including the entire large text block can be printed. The usefulness of this feature is exemplified in the sample file that contains a list of job candidates (see Figure 2). The full resume of each candidate is a field in the data record, of which only the first word is displayed. Once the candidates who meet certain criteria are selected, their full resumes can be reviewed.
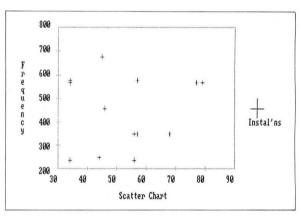
The potential for duplicating records when they are retrieved from a data base with overlapping or repetitive criteria is great. While in most applications this factor
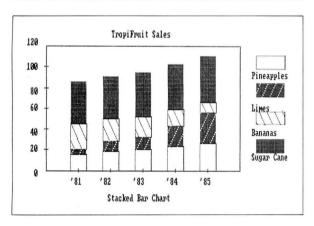
Figure 4: Examples of Spreadbase Graphics

Tropifruit Sales Mix — Line Graph (Pineapples, Limes, Bananas, Sugar Cane)

TropiFruit Sales — Multiple Bar Chart (Pineapples, Limes, Bananas, Sugar Cane)

Annual Sales — Pie Chart (Pineapples 21%, Limes 12%, Bananas 21%, Sugar Cane 44%)

Scatter Chart — Frequency (Instal'ns)

TropiFruit Sales — Stacked Bar Chart (Pineapples, Limes, Bananas, Sugar Cane)

High, Low & Close Chart

TropiFruit Sales — Area Chart (Pineapples, Limes, Bananas, Sugar Cane)

Pineapples and Bananas — Bar Chart with Line Overlay (Bananas, Pineapples)

will be only mildly annoying, in some instances duplication is intolerable. Both programs have facilities for weeding out duplications.

In *MBA* the Unique command acts upon the whole worksheet. After you specify which field should be unique, the program will go through and save the first instance of any value in that field, throwing away successive instances of that value.

In *1-2-3* the Unique function is part of an Extract, or retrieve, operation. If you select "unique" as part of a Data Query command, the program will extract only one copy of any records meeting the criteria that may have been duplicated. Rather than going through the whole worksheet, *1-2-3* only "uniques" records as they are being retrieved.

Forms

Forms in these programs are basically another way of viewing or reviewing worksheet data. Instead of looking at a record as a row of cells, a form treats a record as if it were a separate piece of paper. A common way to work would be to use two windows, having the top window contain the form being used as a data input screen while the bottom window displays the data base to track the effect of the data entry (see Figure 3).

Forms can also be used to browse or analyze data or results. You could scroll through the data base highlighting one field on the form, or you could set up more than one form (two in *1-2-3*, up to four in *MBA*) to be displayed in separate windows on the same screen.

> The forms feature can significantly increase the power of the programs and radically change the interaction between the user and the program.

Forms can also be used to format reports, as a report generator, or to print form letters like a mail merge program. Used creatively, the forms feature can significantly increase the power of the programs and radically change the interaction between the user and the program.

MBA uses a well-documented forms mode that makes creating and using forms very easy. You can create the form with a full-screen editor much like the program's word processing editor. The form can be quite large, and if it's larger than the screen, it will scroll as needed. Copying the title from a column on the

spreadsheet and making it a protected field name on the form is a simple matter. The format will match whatever is on the spreadsheet; it will change if the spreadsheet is changed. One form or several can be named and called up for later use with any given data base.

Using a form in the top window that affects a data base in a spreadsheet in the lower window may take some getting used to. Since the cursor is in the form window, it may be a little confusing when you have to move the cursor vertically to view data that would be accessed horizontally on the spreadsheet. Yet this confusion may be a very small price to pay for a feature that frees the user from the restrictions of the spreadsheet format.

Where *MBA* provides an almost automated forms creation function, *1-2-3* provides the raw tools and an indication of how forms may be used. While it seems that you could create forms in *1-2-3* to match all the forms applications described previously, you'd have to learn a lot more about the program as you were trying.

Forms for *1-2-3* have to be created by "drawing" the format on the worksheet and then creating a little program, using the Typing Alternative described later in this article, to copy data between the form and the worksheet data base.

MBA's forms function is clearly more developed and easier to use than *1-2-3*'s. An *MBA* form can add real polish to almost any application in the data entry and analysis phases.

Graphics

1-2-3 and *MBA* produce the same types of business graphs, but they vary considerably in the way graphs are specified. The most obvious difference is the amount of time the programs r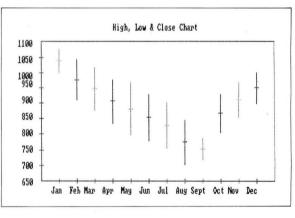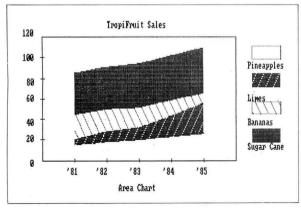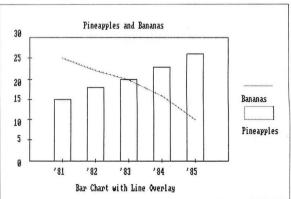equire for creating and displaying graphs. *1-2-3* executes very quickly. When it calculates, sorts, or retrieves data, the program's speed is impressive; when it draws a graph, it is simply amazing. *1-2-3* can draw a new type of graph using the same data literally as quickly as you can press the keys to select it. When the data is changed, the graph changes. The speed with which the program responds to data changes is especially impressive considering that the graph must often be rescaled and its titles changed.

By comparison, *MBA*'s slowness is distressing. It draws a graph on the screen in about 45 seconds, while *1-2-3* can do it in less than 2 seconds. Waiting for the computer to do its stuff is nowhere more frustrating than in this situation. You've gone through the analysis steps and are ready for the results. You don't want to wait and watch while the program painstakingly draws a graph with the answer.

Either program will create line graphs, bar graphs, pie charts, and scatter plots (see Figure 4 for examples of each), but they are called up differently in each program.
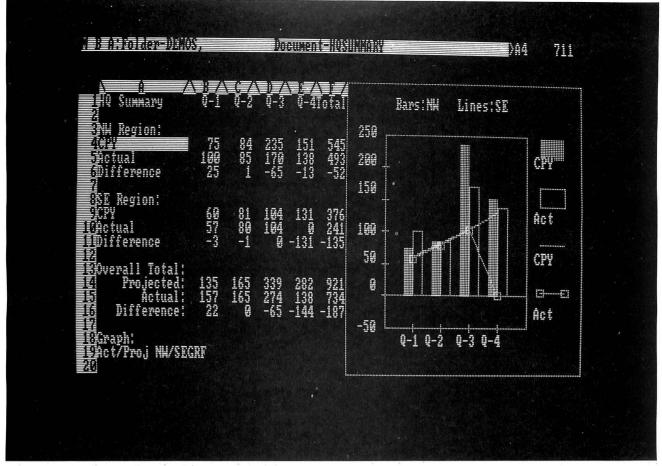
Figure 5: Graphics and Data Share MBA Screen

MBA offers a slightly larger selection of graph types, including perspective bar graphs, stacked bar graphs, high-low-close graphs (on which a vertical line extends from the low value to the high value and a tick mark is placed at the closing or average value), and area graphs (multiple lines with the areas between them shaded in). In addition, MBA allows you to overlay several combinations of graphs using either the same data or the same number of entries in the same space. The following combinations are possible: line with bar, line with stacked bar, line with perspective bar, line with multiple bar, line with scatter, line with area, high-low with stacked bar, high-low with scatter.

1-2-3 has no facility for overlaid graphs. Also, where 1-2-3 allows up to six data ranges to be compared on a multiple bar chart or line graph, MBA allows as many data ranges as can fit on the screen.

The two programs use the graphics monitor differently. MBA allows the screen to be split up into four windows, and some or all of those may be graphics displays. MBA, then, can display text, data, and graphs on the same screen simultaneously. If both monochrome and graphics monitors are available and graphics are desired, MBA will use only the graphics monitor. Since the program displays both text and graphics on the same screen (see Figure 5), you'd be correct in assuming that

MBA will allow graphics to be merged with printed text.

If both monitors are available, 1-2-3 makes use of the graphics monitor to display the graph, while the monochrome monitor displays the corresponding spreadsheet. If only the graphics monitor is used, 1-2-3 temporarily erases the spreadsheet screen to display the graphics. Since the graphics are drawn so quickly (you just can't move your fingers fast enough on the stopwatch to time it exactly), erasing the spreadsheet to view the graph is not a drawback in the analysis stage.

1-2-3 does not allow graphics to be merged with text; graphics must be printed using a special "Graph" program. That would seem to be a significant disadvantage when graphs are being prepared for printing and presentation. Either program will allow graphs to be printed but not viewed on the screen if only the monochrome monitor is available.

When it's time to request a hard copy of the graphics created in the spreadsheet, 1-2-3 really shines. The inconvenience of having to switch disks to run the separate component of the program that prints graphics is far outweighed by the flexibility and polish that this

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component affords. The graph program menu (see Figure 6) allows you to select the "pictures" (the stored images of the graphs created earlier) to be printed, specify the colors for each section of the graph (if you're using a color plotter), choose the typeface for the labels, configure the program to match the printer and interface you're using, select the size of the page, advance the paper in the printer, and print the graph.

The feeling of power that controlling all these parameters gives you is very encouraging, and the ease with which you can do it is incredible. You just point the cursor over here, and the typeface is specified; over there, and the colors of the bars on a bar chart change.

1-2-3's ability to produce multiple typefaces on a standard Epson (or IBM dot matrix) printer is no small feat. Dedicated typeface programs that perform the same kind of translation on the Epson cost between $100 and $200. Two sizes of four typefaces (roman, italic, block, and script) are available.

Word Processing

If you intend to do any appreciable amount of word processing with the current version of one of these programs, there's really no comparison—*MBA* has a useful word processor. *1-2-3* has a fairly primitive line editor that will take a bit of fooling with to produce just a memo. Lotus Development has indicated that a real text processing module is in the works. (Next rev, or next product revision, is a term heard often when a software company is asked about the capabilities of its products.)

To edit a document in *1-2-3*, you just type the text into a range of cells that approximates the area you want covered. Typing errors are corrected in the same way as they are in creating a spreadsheet model—cell by cell. Once the text is entered, you can use the Range Justify command in the edit mode to produce something resembling a memo. Before you use that command, however, be sure that no important data is below the range that you specify. When the program justifies, it uses the full contents of the cell, whether all or part of those contents are displayed. It will use the cells below the range to fit text that runs over, and it will erase and copy over any data previously stored in those cells. Text block moves in *1-2-3* are accomplished by moving cells, so a cell is the smallest unit that can be moved.

MBA's word processing function is complete enough to be useful, but it's not a great word processor. When you first hear about an integrated function program, you can't help fearing that the whole will turn out to be something less than the sum of its parts (or in this case, its counterparts). When you get to *MBA*'s word processing, you realize you were right.

Yes, it's a full-screen editor, but it's not all that easy to use. All text entry is done in the insert mode, and

while in that mode, you can't do anything but enter or erase text with the destructive backspace. When you press Ctrl-C, you can address the full screen.

Ctrl-C "accepts" the text you've entered or the deletion you've specified. Don't be fooled into thinking that it's been saved to disk, however. In fact, even when you use the Save command from the word processing function, the word processing cell still isn't saved to disk. The word processing cell is not saved to disk until the worksheet in which it's contained is saved.

In the communications arena MBA wins by default.

MBA word processing has several standard functions that are well implemented. The find and replace feature cannot ignore upper- or lowercase in the target word or search backwards, but it does search to the end of the text, jump to the beginning, and continue the search until the starting point is reached.

The cursor can move by words or screenfuls to the beginning or end of the text, or by printer pages. The program will tell you where the printed page will end, but you have to search through the text by "jumping" to the end of each printed page; the page breaks aren't displayed.

MBA's block moves or copying is performed by using a memory buffer area called the "savespace." You mark text the program will send to the savespace and then specify that it is to be copied to a new location and whether it is to be retained or deleted at its original site.

Default formatting is governed by a "word processing ruler" that can be edited at any time. The ruler stores parameters for margins, indentation, word wrapping, and page length.

If you haven't used a really good word processor, you'll probably find *MBA*'s enjoyable. It's certainly adequate for the occasional letter or memo. Once you've used one like *WordStar*, however, *MBA*'s word-processing won't be an acceptable substitute.

Communications

In the communications arena *MBA* wins by default. *1-2-3* has no communications capabilities as yet. (Echoes of "next rev"?) To get data from a remote computer into a *1-2-3* worksheet, you'd have to use a separate communications program and then the File Import command. The data would most likely also need some editing to be useful.

Figure 6: Graph Program Menu of 1-2-3

```
GRAPH                                                                          MENU

Color   Font   Size   Pause   Eject   Quit
Assign colors to ranges

SELECTED GRAPHS         COLORS            SIZE   HALF              DRIVES

                        Grid:    Black    Left Margin:    .785     Pictures: B
                        A Range: Black     Top Margin:    .500     Fonts: A
                        B Range: Black     Width:        6.922
                        C Range: Black     Height:       5.000     GRAPHICS DEVICE
                        D Range: Black     Rotation:      .000     Epson MX single
                        E Range: Black
                        F Range: Black     MODE                    INTERFACE
                                           Eject: No               Parallel
                        FONTS              Pause: No

                        1:                                         PAGE SIZE
                        2:                                         Length    11.000
                                                                   Width      8.000
```

```
                                         SHIFT

GRAPH                                                                          MARK

Select font 1
Hit space bar to mark font for selection

             ROMAN1       4744
             ITALIC1      6507
             ITALIC2      9076
             BLOCK1       3597
             BLOCK2       6593
             SCRIPT1      5831
             SCRIPT2      7726
             ROMAN2       9117
```

```
                                         SHIFT

GRAPH                                                                          MARK


Select graphs for output

Hit space bar to mark pictures for selection, F10 to preview.

             TESTBAR      01-04-83
             TESTLINE     01-04-83
             TESTPIE      01-04-83
```

By contrast, *MBA*'s communications feature is simple to use (see Figure 7). Communications occurs in one of three modes: originate, answer, or resume. It can originate calls with phone numbers and log on sequences stored in formulas in cells by simply selecting the appropriate cell. The answer mode allows you to receive a call, and the resume mode allows you to get back to a previously established phone link. The answer mode can take on the appearance of a multitasking computer. You can put the answer mode on standby in one window and open another window to do work of a totally unrelated nature. When a call comes in, it "rings" onscreen with a written message that asks, "Would you like to take this call?" If you choose, you can go to the communications window and answer the call.

In either answer or originate mode you can choose whether to have the full communications session recorded in the current cell. Such capability is very powerful. Every word, from *log on* to *log off*, is recorded right on the worksheet. If the session is longer than 8,000 characters, *MBA* uses its automatic overflow feature to open another cell. Once the session is completed, the data can be cleaned up with the word processor or expanded into many cells to be treated like any other data in the spreadsheet.

It is also possible to exit the communications mode temporarily— do word processing, build a model, or perform other operations in the "local" mode—and resume the communications to transmit what you've just done in a mail file.

A Wait command allows you to tell the computer to wait until midnight when the rates are cheaper, dial up a certain phone number, download data into specified cells, and hang up.

Programming

By eliminating the need to change programs and switch disks between applications, these two programs take a major step toward automating the manager's daily work load. *1-2-3* takes another step beyond that with its use of the data tables described previously, and what it calls the Typing Alternative. With these two powerful features a manager could specify the data to be analyzed and the report and graphic formats for the results of the analysis. These specifications could be contained in a little program that included its own menu and data entry form. From that point on, analysis could be turned over to a clerical assistant, or it could be performed on a large group of data in a batch mode.

This programmability feature is well implemented. It is powerful and flexible enough to compare with an applications generator, but if you don't need it or want it, or if the program you create isn't fully debugged, it doesn't get in the way of using the standard *1-2-3*

features. The programming feature is indicative of a trend in applications software: the ability to change the way the program operates is accessible to the end user.

The Typing Alternative allows you to store sequences of keystrokes for later use. The keystrokes are saved in a cell and could include a sequence of commands or value entries. In other words, you could program a sequence of keystrokes that exactly duplicates the steps of a procedure you do frequently. To use the Typing Alternative, you type in the keystrokes to a specific cell and then assign a range name such as '\A' or

---

The sort is executed so quickly that it may seem like nothing has happened.

'\B' to the cell that contains the beginning of the sequence. Whenever the Alt key and the letter in the cell name are pressed, the keystrokes in the named cell are executed. One cell could include a command that called a series of commands stored in another cell or that turned over control of *1-2-3* to a separate menu that was typed in elsewhere on the worksheet.

MBA's efforts in the same direction constitute a much smaller step. The program will execute whatever formula it finds in a cell that you specify, but it doesn't have any facility for user-defined menus or interactive command strings.

File and Disk Management

1-2-3 includes two file management systems. One that allows copying, erasing, or renaming files is part of the program, but it is not accessed once the spreadsheet is displayed. This first-level file management, the Lotus Access System, seems to be aimed at preventing DOS commands from getting in the way of learning and using *1-2-3*.

In fact, the menu for the Lotus Access System could set the standard for front-end utilities (routines that make the user's interaction with the program easier) on the PC. It would be a great utility to use with any program. You just point the cursor to determine the action, and point it again to specify the files that will be the object of the action. The only time you have to type is when you're changing a name.

A second level manages the storage or retrieval of worksheet files that can be accessed from the spreadsheet commands. File names conform to the DOS convention of eight-character names with optional three-character
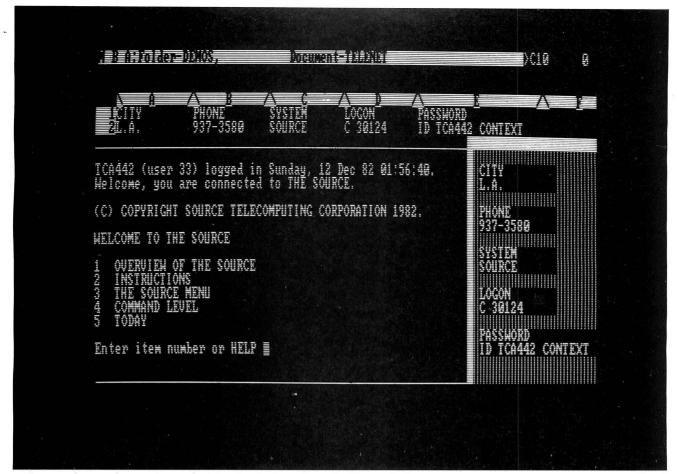
Figure 7: MBA Communications Screen

extensions. Worksheet, graph, and print files are automatically designated with '.WKS', '.PIC', and '.PRN' extensions.

The Lotus Access System performs most of the important DOS functions without exiting the *1-2-3* program. It even improves the DOS commands. As in the rest of the program, the file management commands are specified by pointing the cursor at the desired selection and pressing ENTER to indicate acceptance of the selection. The same procedure is used to select the current disk drive.

The most impressive improvement upon DOS commands is a facility for sorting the file directory. The directory may be sorted by two categories at a time in ascending or descending order. It's easy to request a list of files in alphabetical order with equal entries sorted by file size. File name extension and date and time of file creation are the other sort criteria for the directory. The sort is executed so quickly that it may seem like nothing has happened. It's that fast.

A disk manager allows backup, track-by-track data comparison, and disk initialization. In addition, the disk manager can provide a status report similar to the CHKDSK command in DOS.

From within the worksheet *1-2-3* lets you manipulate disk files in several ways. The File Extract command

allows you to create a disk file from data contained in a section of the current worksheet. The File Combine command allows you to combine all or part of a worksheet from a disk file with the current worksheet. The Print File command will create a disk file from all or part of the current worksheet. The disk file has none of the formulas or relationships, but it can be used by any word processing or accounting program running under DOS.

1-2-3 also has a File Import command that will copy data from a DOS file and enter it into the worksheet. Thus, data from dBASE II or an accounting program could be used on a worksheet.

MBA's '@CPY' command allows copying part of a worksheet stored on disk into the current worksheet (the one in the computer's main memory). Therefore, you could write a part of the current sheet to a disk file by storing the entire worksheet, starting a new, blank worksheet and using '@CPY' to copy a section of the original sheet into the new blank one, and saving the new sheet as a separate disk file. However, since *MBA* runs under the UCSD p-System instead of DOS, the only way file extracting or importing would be useful is in concert with another p-System applications program that

uses an identical disk file format and structure. Because the p-System is not in widespread use, *MBA*'s file interchange with the outside world depends primarily on its communications mode and the telephone lines.

MBA uses its own method of file management that works on a file cabinet model. Each drive, called a volume, can be addressed by a volume name (up to seven characters) or by disk drive number ('#4:' is drive A, and '#5:' is drive B). Each volume, or disk, can hold up to 77 file "folders," and within each folder, files are stored as "documents." Thus a document can be thought of as a sheet in a file folder that sits in a file drawer called a volume.

To get a stored worksheet onto the screen, load in the volume and folder and then the document containing the worksheet. You can scroll through the available document names, but you can't get a list of all the documents on one screen.

Folder names can be up to ten characters long. If the folder name is preceded by a volume, the combination must not exceed 15 characters. Document names can be up to 15 characters long. All this boils down to the fact that the descriptive file names can be almost twice as long as those for DOS or *1-2-3* files.

MBA also has a useful data compression ("Komprs") feature that compresses a work space so that more information can be added to it or compresses a volume on a disk to save disk space.

Ease of Use

Unlike the functions discussed previously, ease of learning and use are personal evaluations; reviews of those aspects of the programs are subjective. *1-2-3* comes with an interactive tutorial disk. The prerelease version had only one tutorial running, but it was excellent. Once you type TUTOR, all you do is follow directions. A series of nine tutorials will be available on the production version. You select one and are introduced to the program's features one by one. The tutorial is designed so that you can't mess it up: the user's responses are all error-trapped so that if he or she types anything but the keys required, the computer just beeps. In an evaluation of the one available tutorial, I watched a computer novice learn how to enter data and perform simple calculations in about 45 minutes. The tutorial kept his interest, and he found it easy to understand without having his intelligence insulted.

The help screens in *1-2-3* are also excellent; they provide clear and sufficient explanations of possible options and actions from the current position on the worksheet, as well as a useful index to other help screens. This hierarchical scheme means that you'll always be able to get an answer to that common question, "What do I do now?" The help screen that appears whenever you press the help key will display

your current options. While it's easy to get lost in the labyrinth of the help screens, all you have to do to escape is press Esc. Doing so will return you to the safety of the worksheet.

MBA's help facility is limited to a one-line explanation of the currently available commands. These explanations are the equivalent of what *1-2-3* provides as prompts as the menu is displayed. If you need help, you probably want a little more than one line.

I used a prerelease version of *1-2-3* for this review, and the documentation I had was barely usable; it was

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> *1-2-3*'s method of controlling the operation of the program points the way to a visual orientation in the way we interact with computers.

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incomplete and not indexed. Therefore, I can't really assess the documentation to come. I can say that I didn't need the documentation to learn the program. With one on-screen tutorial, the help screens, and the one-line descriptions of menu choices displayed as the pointer moves from choice to choice (see Figure 8), I was able to get the program running easily. I admit to knowing *VisiCalc* pretty well, which probably makes me a ringer, but the fact remains: the program is easy to learn. With *1-2-3* all commands are available at all times; there are no changes of context or limitations on when you can use any of the commands you learn.

With *MBA*, on the other hand, I did get to use more complete documentation, and I'm glad to report that the documentation is good. I'm especially glad because, by comparison, the program would be rather difficult to learn without documentation.

The *MBA* documentation meets or exceeds all of IBM's specifications: it includes an extensive tutorial and a reference manual. The tutorial is divided into logical concepts, and those sections contain an appropriate "bite" of material to hold the reader's interest without being overwhelming. Each concept is treated in detail on the left-hand page, with a summary and screen image on the right-hand page.

Program Design Aesthetics

In some applications the way a program's design affects the user's interaction with the computer can be as important as how well functions are carried out. This is especially true for such complex programs as the *MBA* and *1-2-3* integrated productivity tools.

```
A21: 'Hotel                                                    MENU
Fill  Table  Sort  Query  Distribution
Find all data records satisfying given criteria
        A           B         C         D          E          F
21  Hotel        # of rms    Region   Category      Rev80      Occ80
22  Albany         159         A          5     $2,144,364    72.45%
23  Boston         453         A          3     $7,954,839    74.59%
24  Detroit        705         A          1    $16,737,652    72.60%
25  Montreal       738         A          1    $13,409,023    77.78%
26  New York       612         A          2    $12,091,649    76.24%
27  Phila          350         A          4     $7,182,000    78.08%
28  Wash, DC       510         A          2    $10,276,500    89.04%
29  Atlanta        420         B          3     $7,348,819    81.25%
30  Charlotte      210         B          5     $3,812,970    74.25%
31  Miami          632         B          2    $12,696,880    67.12%
32  N. Orleans     952         B          1    $16,612,324    66.40%
33  Richmond       185         B          5     $2,619,600    80.82%
34  Tampa          325         B          4     $6,037,657    66.10%
35  Chicago        710         C          1    $12,760,650    79.42%
36  Fargo          180         C          5     $1,416,492    44.00%
37  KC             605         C          2     $8,547,305    62.43%
38  Milwaukee      489         C          3     $4,265,345    43.45%
39  St. Louis      375         C          4     $6,161,250    72.60%
40  St. Paul       382         C          4     $3,858,968    51.80%
                                                          CALC
```

Figure 8: 1-2-3 Menu with One-Line Description for Query Command

1-2-3's method of controlling the operation of the program by pointing the cursor at full word menu choices points the way to a visual orientation in the way we interact with computers. It is clearly paving the way for future computer controls using a mouse or a voice recognition device. The one-line description accompanying every option and the completeness of the range of options for every command give the feeling that the user's convenience was the highest priority throughout the design of the program.

1-2-3 allows the screen to be divided into only two windows at a time (either vertically or horizontally), while *MBA* allows up to four concurrent windows on a screen. Although it is theoretically possible to have four applications going on in four windows simultaneously, the extra windows are not clearly useful. You could perhaps watch the effect of changing some spreadsheet data on two different types of graphs; however, even with the extra keystrokes required to specify the changes, you could view the same changes on the same graphs in about half the time with *1-2-3*.

At the time this review was written, *1-2-3* could be used with a hard disk or an electronic disk, while *MBA* could not. *1-2-3* worksheet, print, and graphics files could be stored on a hard disk or loaded into an electronic disk. Since the program is copy-protected, you can't just put a copy on your hard disk.

Context Management Systems doesn't plan to have *MBA* support a hard disk until IBM markets its own hard disk and establishes the interface and format standards. However, the program's hierarchical file management scheme described previously is designed to accommodate the larger directories that can be expected when the program is used with hard disks.

Speed
As has already been mentioned, *1-2-3* is significantly faster than *MBA* for virtually all program functions. Speed is a very important measure of performance in these two management programs. For the intended users, time is money. When one program takes several minutes to do what another accomplishes in split seconds, those minutes can add up to hours, and hours of a manager's time can be expensive.

Besides the directly attributable cost of wasted time, a hidden cost of a slow program may be even more significant—the degree to which speed affects convenience and creativity. If a task is easily and quickly executed, a manager will be more likely to perform more iterations of a "what if" analysis and, therefore, will be more likely to find the optimal solution. The cost of such a missed opportunity, although hard to measure, can be great. In addition, waiting for the computer to respond can be detrimental to morale.

The two manufacturers took markedly different approaches to execution speed in the design of their programs. *1-2-3* is written in assembly language, which accounts for its substantial speed advantage. Assembly language, by its nature, is machine specific. That is, *1-2-3* would have to be rewritten to run on another computer that uses a processor chip other than the Intel 8088 used in the PC. *MBA*, on the other hand, uses the UCSD p-System, which is inherently slower than assembly language but is designed to be transportable to other machines and other processors.

Disk access is another factor that affects speed. *1-2-3* performs just about all its important work in the computer's main memory (RAM). Since data moving around in RAM is a totally electronic process, it is very fast.

MBA uses data stored on the disk for many common functions. The process of accessing data stored on a floppy disk entails both electronic and electromechanical activity, so it is somewhat slower. The fact that *MBA* requires twice as much RAM (256K) as *1-2-3* (128K) is a little disconcerting in light of its extensive use of disk access.

In some functions, such as data management, accessing data stored on disk during program operation can be an advantage, since the number of records is limited only by the capacity of the disk rather than the size of the worksheet.

Software that runs too slowly may be a temporary problem cured by faster processor chips in the forseeable future. In that light, *MBA*'s portability may be a more important long-term advantage than *1-2-3*'s speed. But until such sluggishness is corrected, it can be expensive, and several years may go by before other faster processors for the PC become popular.

Who Wins the Spreadbase Race?
Even though *MBA* has been on the market longer, I can't help feeling that *1-2-3* is a more fully developed product. I predict that most people will be drawn to *1-2-3*'s speed, ease of use, and programmability. The people who will want to use one of these integrated packages in a business environment won't want to wait around while *MBA* takes its sweet time, and they won't want to learn *MBA*'s shorthand for commands when full word menus are available elsewhere. *1-2-3* should not only sell better than *MBA*, but I'd expect to see *1-2-3* selling IBM PCs the way *VisiCalc* sold Apple IIs a few years ago: People will buy the computer just to be able to run *1-2-3*.

Of course, the decision about which of these products is more appropriate for various managers and executives will ultimately depend on their particular situations and how they use their computers. If communication of data to be analyzed is likely to be a frequent

1-2-3 is a more fully developed product.

application, or if a heavy word processing load requires that graphics be integrated with text on a single page, *MBA* is the only choice. If programmability and speed are more important, *1-2-3* is the clear winner.

For my money, though, *1-2-3* is a much more impressive package. Mrs. Miller raised her son in New York City where fast is good. And if fast is good, *1-2-3* is great!

Harry Miller is an Associate Editor at PC WORLD *who specializes in microcomputer applications.*

1-2-3
Lotus Development Corporation
55 Wheeler St.
Cambridge, MA 02138
617/492-7171
List Price: $495
Requirements: 128K, two disk drives

MBA
Context Management Systems
23864 Hawthorne Blvd. #101
Torrance, CA 90505
213/378-8277
List Price: $695
Requirements: 256K, two disk drives, color/graphics
    adapter, UCSD p-System

Table 1. Comparison of features of MBA and 1-2-3

MBA	1-2-3
Data Management	
Data base size: limited only by disk capacity; 95 fields per record, several thousand records possible	Same as worksheet size—2,048 records with 256 fields each
Cell size (field limit): 8,000 characters	256 characters
Store and update: done in batches	Immediate
Sort speed: slow (32 seconds for 24 records by 2 key fields)	Fast (2 seconds for 32 records by 2 keys)
Search and retrieve speed: slow (1 minute 10 seconds to select 5 records from a 24-record data base)	Fast (3 seconds to select 5 records from a 32-record data base)
Indexing, up to 8 fields	—
—	Data distribution
—	Data fill feature
—	Data table feature
—	Stores last specified data range
"Unique" feature weeds out duplications	"Unique" feature weeds out duplications
Graphics	
Speed: slow (45 seconds)	Fast (2 seconds)
Types available: line, bar, stacked bar, perspective bar, pie charts, scatter plots, area graphs, high-low-close, overlays possible	Line, bar, pie charts, scatter plots
Graphics monitor: 4-way split screen, allows text and graphs to share screen	Graphics take full screen, data temporarily erased to display graphs
Hardcopy: uses program's predefined colors and typeface	Selectable typefaces and colors

MBA	1-2-3
Word Processing	
Full-screen text editor	Primitive line editor
Communications	
Simple to use: session recorded directly on worksheet	—
Programming	
Limited function	Typing alternative
File and Disk Management	
'@CPY' command to move partial worksheets	File Extract, Combine, and Import manipulation of partial worksheets
Uses a Volume, Folder, Document file cabinet model	Lotus Access System improves on DOS commands; sorts directory
Data file compression feature	—
Ease of Use	
—	Interactive tutorial disk included in package
Help screens	Hierarchical help screens
—	Same commands available at all times in menu with explanations
Good documentation (tutorial)	Documentation not needed to learn program (not available for review)
Speed	
UCSD p-System (portable, but slower)	Assembly language (fast, but machine specific)
Extensive floppy disk access	Performs most functions in RAM

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11:00–12:00 p.m.
"The PC Phenomenon"
Panel members: David Bunnell, president and publisher, PC World; Cheryl Woodard, associate publisher, PC World; Ron Posner, chairman, National Training Systems; Portia Isaacson, president, Future Computer; and Martin Alpert, president, Tecmar.

12:30–2:00 p.m.
"Second Generation Software"
Panel members: Vern Rayburn, executive vice president, and Mitchell Kapor, president, Lotus Development Corp.; Alan Boyd, product acquisitions manager, Microsoft.

2:30–4:00 p.m.
"PC Multiprocessing, Networking, and Communications"
Panel members: Andrew Fluegelman, editor, and Steven Cook, technical editor, PC World.

4:30–6:00 p.m.
"PC Add-Ons—What Is Compatibility?"
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The Graphsheet Contenders

Andrew T. Williams

It has been said before, but it is worth repeating: executives, managers, and other corporate decision makers—the heart of the exploding market for microcomputers and microcomputer software— don't want to become data processing professionals. What they do want is software that will help them make better, faster, and more accurate decisions.

Unfortunately, most software available today is of the stand-alone variety, which requires more computer mastery for each new operation. The principal analytical operations—worksheet modeling, data base managers, graphics, and word processors—are generally provided as separate programs, often from different software manufacturers and perhaps even using different data formats.

This situation dictates that executives must learn several command languages and spend a great deal of valuable time transporting information from one program to another. In some instances information must be printed out and then reentered by hand for use with another program. Even when this interchange can be done electronically, as with the Data Interchange Format (DIF) for *VisiCalc* and other VisiSeries products, the process is inefficient.

Transferring information from one program to another requires that managers adapt to the shortcomings of the software, rather than having the software provide a medium in which they can switch among different functions instantly, as interest dictates and analysis requires.

Two companies, Context Management Systems and Lotus Development Corporation, have recognized the need for integrated software packages that are easy to learn, combine the analytical power of several stand-alone programs, and have been designed with the needs of the executive decision maker firmly in mind. Both of these programs are strong second-generation contenders,

particularly because they combine powerful worksheets with versatile graphics and display functions.

Context was first on the market with *MBA,* a "decision support system" containing a worksheet, a data base, a graphics package, and a word processor capable of wrapping everything up in a single report. An improved version of *MBA,* version 2.0, is now available. Along with the above four functions, version 2.0 includes a well-integrated communications package and the ability to define forms (such as checks, invoices, and tables) for use with data input and output.

Lotus recently joined the contest with *1-2-3.* This program includes a powerful worksheet, a data base component, a graphics package, and some word processing capability.

Both *1-2-3* and *MBA* place the worksheet at the center of their approach to integrated information analysis. This article takes a close look at the worksheet features of the two programs. Both worksheets are in most respects as good as, and in many respects better than, the currently available stand-alone programs such as *VisiCalc* and *SuperCalc.* ("The Spreadbase Race" by Harry Miller considers the other major features of *MBA* and *1-2-3.*)

MBA

MBA provides the executive, the manager, or the professional with a worksheet containing almost 100,000 cells arranged in 96 columns and 999 rows. *VisiCalc,* in contrast, has only 16,000 cells in 63 columns and 254 rows. With *MBA* one can create very large models or models that have several parts on the same worksheet.

The program requires an IBM Personal Computer with at least 256K of RAM, two disk drives, and a monitor. You can use the IBM monochrome monitor, but it won't be capable of displaying or printing graphs. A color/graphics card and a suitable non-IBM monitor are required to utilize the graphics capability of *MBA.* The program does not, however, display output in color. *MBA* is supplied with a run-time version of the UCSD p-System, so PC-DOS is not needed. Finally, the communications feature of version 2.0 requires a serial port and a modem.

The Magic Cell

As with all worksheet programs, *MBA* stores information—text, formulas, functions, and numbers—in cells. Each cell represents the intersection of a row and column in the standard worksheet format. A model is constructed by using mathematical formulas to relate the information in the rows and the columns.

MBA carries this process a step further. Up to 8,000 characters of information can be entered into a single cell. For example, cell A1 could contain five pages of text. Cell A2 could contain the information from a 10-column-by-15-row worksheet. The next three cells, A3 to A5, could contain the commands to create a pie chart, a line graph, and a bar chart based on the information in the worksheet in cell A2. (See "Graphsheet Graphics" for examples of worksheet data displayed as graphs and charts.)

Finally, some concluding text could be located in the last cell, A6. A command to print cells A1 to A6 would produce a short report, with the table and the graphs integrated into the text.

The information in a text cell or a portion of a worksheet compressed into a single cell (using an *MBA* command called Combine) can be edited with the word processing commands. When numbers are combined into a cell, however, they are converted to text and are no longer available for manipulation with the worksheet.

⬢ Review

Fortunately, combining a worksheet into a cell doesn't erase it from its prior location, where it is still available for calculations or for interaction with other worksheets, the graphics functions, and the data base.

The MBA Replicate Command

In the typical electronic worksheet, the replicate command takes information from a cell or range of cells and reproduces it in a different area of the worksheet. This command is one of the most powerful and frequently used commands on any electronic worksheet.

The *MBA* replicate command can do the traditional tasks and more. It can replicate blocks of information, not just ranges of cells, and it can make multiple copies of cells, rows, columns, or blocks. This feature is particularly useful when you are preparing worksheets in which the same labels or groups of labels are repeated or for which several similar tables are needed in an analysis of different options.

Merging Worksheets

MBA has a powerful command, @CPY, that allows you to merge information from one worksheet into another, even when the two worksheets are stored on different disks. To accomplish this operation the range of cells to be merged must first be designated with what *MBA* calls markers. Markers are strings of up to 15 characters

---

MBA's use of markers represents an early step on the road to using full English-language commands.

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placed at the beginning and end of the material to be merged.

The @CPY function makes it easy to consolidate regional, quarterly, or divisional reports into a summary report. The same feature allows you to construct sophisticated, interrelated models that are limited in size only by a system's disk storage capacity.
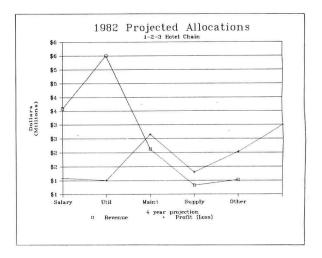
Markers can be used in place of a cell address in any function, formula, or command. For example, the words *Beginning* and *End* might be used to designate the range in the following summation function:
@SUM(BEGINNING...END)
Similarly, if *Start* marks a particular place on the worksheet, the marker can be used in place of the cell address in the Goto command.
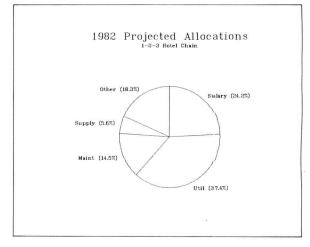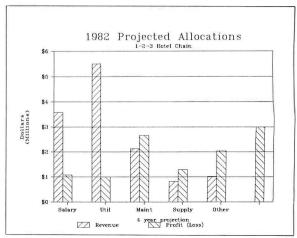
Graphsheet Graphics

Three examples of graphics produced from a numerical worksheet by 1-2-3. See "The Spreadbase Race" by Harry Miller for examples of graphics produced by MBA.
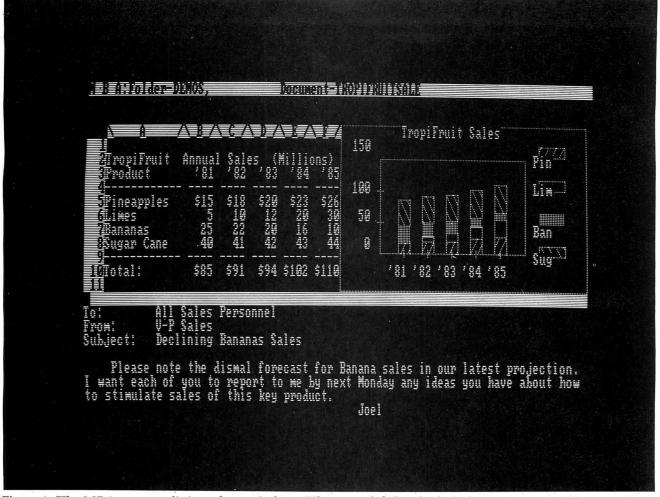
Figure 1: The MBA screen split into three windows. The upper left-hand window contains a worksheet, and the upper right-hand window contains a bar chart based on the information in the worksheet. The window at the bottom of the screen is a word processing window in which a memo is being written.

MBA's use of markers represents an early step on the road to using full English-language commands and away from the abstract grid of the traditional worksheet.

Storage Commands

The MBA storage command is a good example of the trade-off between power (MBA's storage command is powerful) and ease of use. To store or retrieve an MBA worksheet, three pieces of information are required: a disk or volume name, a folder name, and a document name.

You will find this three-level structure convenient if you have a very large number of documents in storage. On the other hand, if you don't have such extensive storage needs, you may find MBA's hierarchy of volume, folder, and document names inconvenient and possibly confusing.
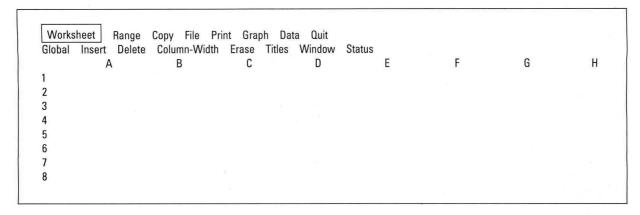
Multiple Windows

Most worksheet programs allow the screen to be split either horizontally or vertically into two parts or windows. This feature makes it a good deal easier to work with large models that can't be displayed on the screen at one time. MBA goes the standard worksheet two better; its screen can be divided into two, three, or four windows.

Having four windows might seem excessive, but actually this can be a very useful feature. One window could be used for a worksheet model. Another might display the data base that would be providing information to the model in the first window. The third and fourth windows could contain two types of graphs—perhaps a scatter plot and a combination bar/line graph—that would be redrawn every time something changes in one of the other two windows.

In previous MBA releases, word processing required the entire screen, so it couldn't be used while you were displaying a worksheet, data base, or graph. With release 2.0, MBA allows word processing in one of the windows of a split screen (see Figure 1). The window containing

Figure 2: 1-2-3's Full-Word Command Structure

| Worksheet | Range | Copy | File | Print | Graph | Data | Quit |

Global Insert Delete Column-Width Erase Titles Window Status

	A	B	C	D	E	F	G	H
1								
2								
3								
4								
5								
6								
7								
8								

If you choose the "worksheet" command the status area changes to:

| Global | Insert | Delete | Column-Width | Erase | Title | Window | Status |

Set worksheet settings

	A	B	C	D	E	F	G	H
1								
2								
3								
4								
5								
6								
7								
8								

Each choice leads you on to other choices. Some of the commands in this example have up to three additional levels of choice.

word processing must be 80 columns wide, which means that only two other windows can be used during this operation. Still, the ability to have a worksheet, a graph, and an area in which to take electronic notes or write a report about what you are presently viewing in one of the other windows is a powerful feature of *MBA*.

Other Features

MBA has all of the standard worksheet commands and functions plus a good deal more. The format commands for dollars and cents and percentages automatically supply a dollar sign or a percent sign to the formatted cells. Titles and numbers can be centered in a column in addition to the typical right or left justification.

MBA provides two types of internal-rate-of-return calculations and statistical functions for calculating the variance and standard deviation of a set of numbers.

Version 2.0 makes full use of the function keys on the PC. Four alternate keys duplicate the cursor movement keys so that you can use the number pad (as if it were a calculator) for rapid data entry. The Goto function starts with a function key, rather than the less convenient greater-than symbol key.

Another feature added to *MBA* in version 2.0 is the ability to display formulas in their locations on the worksheet and to print them with the printer. This is an important aid to spreadsheet model building as well as an easy way to make backup copies of the formulas and functions used to construct a spreadsheet.

Slower Than a Speeding Bullet

For all its useful features, *MBA* is simply not a fast program. Several improvements have been made in the most recent version of the program, however, resulting in speed increases of up to tenfold in certain areas of the package. The areas that have benefited most from these improvements are cursor movement, screen scrolling, and worksheet recalculation.

Recalculating the worksheet still takes longer than it does for a similar *VisiCalc* or *1-2-3* worksheet, but *MBA*'s latest release is three to five times faster than earlier versions. Context spokespeople have acknowledged the slowness of certain parts of the program, but they believe that this shortcoming is more than offset by

---

Wait No More

When an *MBA* function takes longer than you care to wait, you can have the program signal you when the work is finished. That is, the computer's beep will sound whenever an invalid character is entered from the keyboard.

After completing the replicate or recalculate command, enter an invalid character such as &, %, or $ from the keyboard. The character will be stored in the keyboard buffer and executed immediately after *MBA* finishes replicating or recalculating. The PC will beep once for each invalid character entered, so if you want five beeps, enter the character five times.

By using this technique, you can do something else while *MBA* is calculating and still return to the program as soon as it is ready for more input. This certainly beats watching the counter in the upper right-hand corner tick off the time *MBA* is spending on a function.

---

the power of the total package—worksheet, communications, graphics, word processing, data base, and forms.

The communications component, in particular, is a great time-saver. *MBA* can download into designated cells on a worksheet from another computer much faster than the same data could be entered into another program by hand. Clearly, if you can save large amounts of time entering data, this may to some extent compensate for the slower recalculation speed.

Drawbacks

MBA has a number of nettlesome shortcomings. In the much-used function for summation, @SUM(A1...A20), *MBA* requires that the three periods each be typed separately. By contrast, *VisiCalc* and other programs that use this convention recognize the first period and automatically supply the other two. This is a small point, but some other *MBA* commands (the range in a replicate command, for example) follow the *VisiCalc* convention exactly, so this inconsistency leads to confusion.

The program's edit function seems overly complex, requiring several commands to make any change in text. For example, a simple procedure of correcting one wrong character in an entry necessitates the following command sequence:

/EX(character)<Ctrl-C><Ctrl-C>.

Finally, *MBA* doesn't display the contents of a cell on the edit line as the cursor is scrolled across that cell of the worksheet as most other worksheet programs do. The only way to discover or alter the exact contents of a cell (a formula or function, for example) is with the edit command.

1-2-3

1-2-3 from Lotus Development Corporation is built around a worksheet program that offers almost 1/2 million cells arranged in 256 columns and 2,048 rows. If each cell were 1/4 inch high and 1 inch wide (roughly the size of a cell 9 characters wide on the screen), it would take a sheet of paper more than 21 feet wide and 42 feet long to contain it all.

1-2-3 requires a PC with at least 128K of RAM and two disk drives. A color/graphics adapter and a suitable monitor other than an IBM are required to display the graphs generated by *1-2-3*, but the graphs can be printed on an IBM, Epson, or other suitable printer without the use of the color/graphics adapter.

As Easy As...

1-2-3 has many convenient features. They begin with a menu-driven command structure, continue with an extensive use of the PC's function keys, and end with a couple of features that compensate for design flaws in the PC itself.

1-2-3 employs a clear and simple command menu, as Figure 2 illustrates. When you type a slash to indicate that you want to enter a command, the status area at the top of the screen displays two lines of words. The top line lists the choices immediately open to you; the second line shows the set of choices available if you choose the word on the top line that is currently displayed in reverse video (outlined in the figure).

For example, in Figure 2, if 'Worksheet' is chosen, the next set of choices includes 'Global' to 'Status'. Each

Figure 3: Data Table. The values in the interest rate column are the "what if" values. 1-2-3 substitutes each of these values in turn into cell C4, and the results are displayed in the body of the table.

	A	B	C	D	E	F	G	H
1								
2								
3		INTEREST						
4		RATE:	0.01					
5								
6								
7	1	2	3	4	5	6		
8								
9	100.00	101.00	102.01	103.03	104.06	105.10		
10								
11		INTEREST	VALUE IN	VALUE IN	TOTAL			
12		RATE	PERIOD	PERIOD	INTEREST			
13			THREE	SIX	EARNED			
14		0.01	102.01	105.10	5.10			
15		0.02	104.04	110.41	10.41			
16		0.03	106.09	115.93	15.93			
17		0.04	108.16	121.67	21.67			
18		0.05	110.25	127.63	27.63			
19		0.06	112.36	133.82	33.82			
20		0.07	114.49	140.26	40.26			
21		0.08	116.64	146.93	46.93			
22		0.09	118.81	153.86	53.86			
23								
24								
25								
26								

time you press the cursor movement keys to move from one command to the next, the inverse video on the command line highlights the current option and the set of secondary choices changes. There are as many as five menu levels for some commands.

Pointing at full-word menu choices with a cursor is easy, but 1-2-3 does even better. You can also type the first letter of a command without pointing to it. In this way, 1-2-3 acts just like *VisiCalc*. Typing is faster than pointing, and it is probably the preferred method for entering frequently used commands, but the full menu is always there to consult.
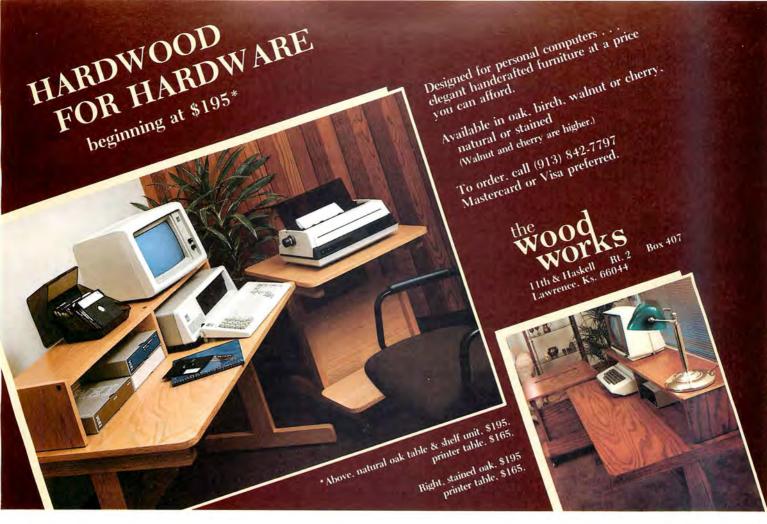
1-2-3 uses the function keys for a number of common worksheet commands, such as GOTO, EDIT, WIND (skip to the other window), and CALC (recalculate the worksheet). The program also uses the function keys to designate absolute cell references (ABS), invoke the graph function (GRAPH), and to call for help (HELP). 1-2-3 comes with a reference template that fits around the function keys and provides a guide to their special uses in the program.

One unique feature of 1-2-3 is its expanding cursor for the worksheet. This one-size-fits-all worksheet cursor is a joy to use. To copy a group of cells, for example, you begin the command, and then, in response to the prompt to designate the source range, you can expand the cursor so that all the cells in the source range are highlighted in reverse video. You know exactly what the source range is because there it is on the screen, glowing green at you.

The target range works the same way. You move the cursor to the place you wish the cells to land, anchor it with a period at the first cell in the target range, and then stretch the cursor to cover the target range. It's as easy as one, two, three.

A great shortcoming of an otherwise very nice computer is the fact that with the PC you can't tell when the NumLock, CapsLock, and ScrollLock keys are engaged. 1-2-3 tells you by displaying 'NUM', 'CAP', or 'SCROLL' in the lower right corner of the screen. I wish my word processing program were as helpful.

The Pesky Dollar Sign

When doing a replication or similar operation, electronic worksheets typically designate whether the cell address used in a function or formula is relative to its current position. 1-2-3 has opted for an uncommon technique for designating absolute cell references.

To designate a cell reference in a formula or function as an absolute cell reference, 1-2-3 uses the dollar sign, which must be typed when the formula is first created (or edited later). Furthermore, 1-2-3 distinguishes between absolute column references and absolute row references. For example, 'A1', would be an absolute reference to cell A1. Cell reference 'A$1' would adjust the column reference with each move while maintaining the absolute reference to row 1.

This technique is only slightly easier to use than it is to describe. It does eliminate the need for both a replicate and a copy function (1-2-3 has a copy function only), and it means you can tell which cell references are absolute by simply looking at the formula or function. In any case, absolute cell references aren't as common as relative references, which the program uses as a default setting. Still, this is one area in which 1-2-3 could be improved.

Data Tables

One of the most useful functions of an electronic worksheet is its ability to generate new results under alternative assumptions. In a sales model, for example, the rate of growth of sales can be varied to examine its effect on profits. Or the number of salespeople can be changed to examine what happens to sales and selling costs. These and an infinite number of other possibilities can be examined quickly and accurately in order to determine what will happen if circumstances change.

With the standard worksheet program, each new set of assumptions generates a set of results that are written into the same cells as the previous results. The only way to compare two sets of assumptions is to copy the results of one set to a new part of the worksheet before doing the next exercise, or to print out the results so they can be compared to what is on the screen. Both of these methods leave something to be desired.
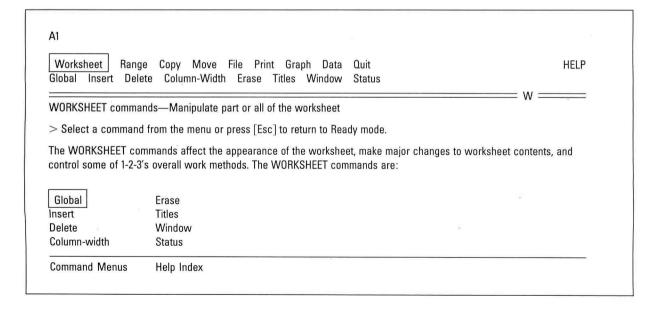
With its data tables, 1-2-3 provides an easy way to compare the results of several "what if" exercises. Figure 3 shows a simple example of a two-way data table. Across the top are references to the particular cells that will change with each change in assumptions. The left-hand column of the table lists the different assumptions, and each cell in the table shows the results of a particular "what if" analysis.

This feature is one that Lotus cites in describing its program as second-generation software, and after looking at 1-2-3, one has to give that claim credibility.

Figure 4: 1-2-3 Help Screens. The top panel shows the help screen that appears when you press F1 and the word "Worksheet" is displayed in inverse video on the command line. Each of the words in the first line (Worksheet Range...Quit) is a possible choice. The cursor control keys move the cursor from choice to choice and the ENTER key selects the current word.

```
A1:                                                                    HELP

  ┌───────────┐
  │ Worksheet │  Range  Copy  Move  File  Print  Graph  Data  Quit
  └───────────┘
  Global  Insert  Delete  Column-Width  Erase  Titles  Window  Status
═══════════════════════════════════════════════════════════ CMD ═══════

1-2-3 Commands

> Select a command from the menu on line 2...
              ...or press [Esc] to return to Ready mode

1-2-3 commands establish overall procedures, copy/move/delete data in the worksheet, set data display formats, transfer
data to/from disk storage, print your work, draw graphs, handle databases, and (whew!) end 1-2-3 execution:

  ┌───────────┐
  │ Worksheet │   Copy         Graph
  └───────────┘
  Range          Move         Print
  File           Data         Quit

Cancelling a Command

Each time you press [Esc] during execution of a command, 1-2-3 backs up one step. Issuing a "Break"—hold the [Ctrl] key
and press [Scroll-lock]—cancels the command and returns to Ready mode.
────────────────────────────────────────────────────────────────────────
  Command Menus      Help Index
```

If you press ENTER when the above screen is displayed and the cursor is on the word "Worksheet" in the body of the help screen, the following will appear.

```
A1

  ┌───────────┐
  │ Worksheet │  Range  Copy  Move  File  Print  Graph  Data  Quit         HELP
  └───────────┘
  Global  Insert  Delete  Column-Width  Erase  Titles  Window  Status
═══════════════════════════════════════════════════════════ W ═══════

WORKSHEET commands—Manipulate part or all of the worksheet

> Select a command from the menu or press [Esc] to return to Ready mode.

The WORKSHEET commands affect the appearance of the worksheet, make major changes to worksheet contents, and
control some of 1-2-3's overall work methods. The WORKSHEET commands are:

  ┌────────┐
  │ Global │       Erase
  └────────┘
  Insert          Titles
  Delete          Window
  Column-width    Status
────────────────────────────────────────────────────────────────────────
  Command Menus      Help Index
```

Real Help

The first problem with most software is learning how to use it. This is particularly true of packages like *1-2-3* and *MBA* that include the features of four or more separate software programs and, therefore, must include about four times as many commands as stand-alone programs. Integration should lead to some standardization of the command language, and thus to some advantage in learning; yet a formidable task still remains.

Context's approach has been to screen authorized dealers carefully and to require *MBA* salespeople to complete a training program. This program provided by the manufacturer comes in addition to an extensive program of tutorials in the manual and a package of on-screen help messages.

Lotus' approach is somewhat different. Along with the software package, you receive a disk containing a number of interactive tutorials. This disk provides an introduction to the program, the major format options, and the command language. While the disk won't replace a live teacher, it does provide a dynamic and

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1-2-3 is certainly a state-of-the-art electronic worksheet program.

---

interesting way to learn the basics. In the near future more tutorial disks should be accompanying integrated programs, including *MBA*.

In addition to the tutorial disk, *1-2-3* includes a complete, well-written package of over 200 interrelated help screens. The help messages are activated with the F1 function key, and they sometimes continue and branch to many additional screens. (See Figure 4 for an example.)

Many of the help screens include diagrams and are actually more complete reference guides than many programs' written documentation. Not only are the help commands excellent, but they also contain references to pages in the manual so that users have access to a fully integrated information system.

Pluses and Minuses

1-2-3 is certainly a state-of-the-art electronic worksheet program. It runs as quickly as the standard versions of *VisiCalc* and *SuperCalc* and is much faster than *MBA* 2.0. Moreover, the program is designed to be both powerful and easy to use.

The plain-language menus are great, and the on-screen indicators for CapsLock, NumLock, and ScrollLock make up for hardware deficiencies in the design of the PC. The data tables give *1-2-3* powers that haven't been available on popular worksheet programs until now.

1-2-3 has some shortcomings, however. One is its

inability to display graphs and a worksheet on the same screen at the same time. A second is its inability to include worksheet, graphs, and text easily in a single report. A third drawback may be *1-2-3*'s branching help screens. They allow a great deal of choice, but at times I felt like Alice in the Red Queen's maze—running down different paths with no guarantee that the answer I was looking for would be at the end.

Finally, the way *1-2-3* designates absolute and relative cell references in functions and formulas requires some adjustment. It is so different from the industry standard that an experienced user of one of the other programs may have some difficulty making the transition.

All Things Considered

MBA and *1-2-3* are two exciting programs. They are exciting not only because of what they do—and because they do it so well—but also because of the future toward which they point. Serious worksheet users can look forward to many improvements in existing programs, and, undoubtedly, to second-generation offerings from other manufacturers.

If you have to choose between *MBA* and *1-2-3*, it will probably come down to a consideration of features. For someone who writes many short reports that contain a mixture of graphs, tables, and text, *MBA* is a better program. For someone who needs to send and receive information quickly and easily between PCs and other computers, *MBA* is the only choice.

But for someone who primarily needs an electronic worksheet program with a sophisticated data base, graphics, and some word processing, *1-2-3*—at $200 less than *MBA*—is almost certainly the program of choice.

Andrew T. Williams is a contributing editor to PC WORLD. He teaches at the School of Business Administration at the University of California, Berkeley, and is currently writing a book about electronic spreadsheets for the IBM PC.

MBA
Context Management Systems
23864 Hawthorne Blvd. #101
Torrance, CA 90505
213/378-8277
List Price: $695

1-2-3
Lotus Development Corporation
55 Wheeler St.
Cambridge, MA 02138
617/492-7171
List Price: $495

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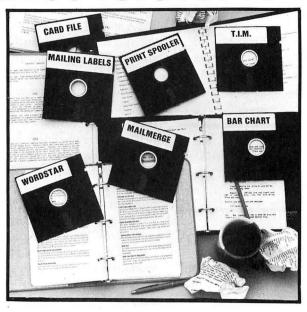
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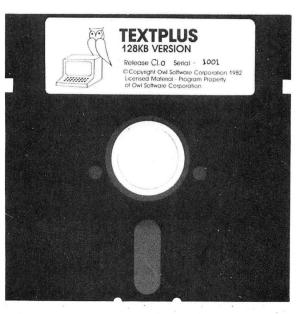
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the other doesn't!

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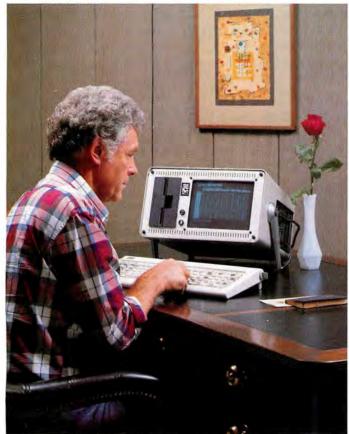
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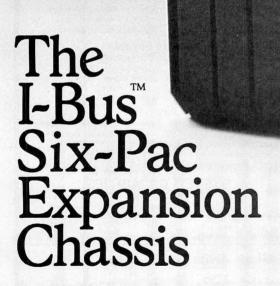
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boards, chances are your PC will run out of power before it runs out of slots. An I-Bus Expansion Chassis is the perfect answer, for its own 40W power supply quietly powers its own slots, with a negligible amount of power drawn from the PC.

It's only $695, including 18″ interface cable (or $755 with the extra-long four-foot cable). Send in today—if you plan to think big with your IBM PC.

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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 fingertips 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.

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's sophisticated graphing commands enable 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!

To fully understand just how much power 1-2-3 adds to the personal computer you'll want to go to your nearby 1-2-3 dealer for a full demonstration. For his name and address (and more information if you want it) call 1-800-343-5414.

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

The 8088 Is My Copilot

Microsoft's Flight Simulator launches the PC into the wild blue yonder.

Andrew Fluegelman

You're in a wild spin, hurtling out of the sky and heading directly for Seattle's Space Needle at 160 miles per hour. In a desperate last-ditch move you clutch your keyboard, press F2, pound the CursorDown key three times, and pull out with barely 200 feet to spare.

There was a time when you could meet PC owners and assume that they knew how to negotiate a word processing block move or a spreadsheet lookup table. It's now a good bet that they also know their way around the controls of a Cessna 182. *Flight Simulator*, a real-time, graphics and sound simulation program designed by Bruce Artwick, just might be the most innovative and exciting as well as the hottest-selling piece of personal computer software since *VisiCalc*. The program is also likely to be the most effective booster for aircraft piloting since Charles Lindbergh.

The View from the Cockpit

Load the program disk into your system and you are sitting in the pilot's seat of a Cessna 182-class, single-engine, high-performance land airplane resting on the runway of the "default" airport, Meigs Field in Chicago. Out the front window (your system's color or black-and-white monitor), you can see the runway and, in the distance, the John Hancock Tower.

The lower part of the PC screen displays complete aircraft instrumentation: altimeter, turn coordinator, tachometer, and airspeed, attitude, heading, and rate of climb indicators (see Figure 1). You're also presented

> **Flight Simulator is likely to be the most effective booster for aircraft piloting since Charles Lindbergh.**

with a fully functioning magnetic compass, an omni-bearing indicator, NAV and COM radios, a transponder, a clock, fuel and oil gauges, and indicators for landing gear, lights, magnetos, and carburetor heat. The engine purrs along at about 500 rpm.

With the numeric keypad you control the craft's ailerons, elevators, elevator trim, rudder, flaps, and throttle (see Figure 2).

Hit full throttle (F2) and start down the runway. The field markers rush by as you accelerate. When your airspeed reaches about 55 knots, pull back on the stick (CursorDown). You've got just enough runway for

the field to disappear beneath you as you climb over Lake Michigan.

Cut back on the throttle (F8), ease the stick forward a bit (CursorUp), and climb steadily toward the Hancock Tower. Your altimeter reads 1,500 feet—not high enough to clear the building. Bank left (CursorLeft) and start a sharp turn. Hang on to your stomach as the world tilts beneath you. Look out the left front window (hit ScrollLock and CursorLeft) and watch the top of the tower float by.

Level off at about 2,000 feet and head toward the Sears Tower and Midway Airport. As they get closer and appear with more detail, check out the left rear window (ScrollLock End) and keep your bearing on Meigs Field. Bank left around the Sears Tower, and head South towards Gary, Indiana.

Check your radar (NumLock). Zoom in and out for perspective as you position yourself along the edge of Lake Michigan and begin your turn back toward the field. Check your compass heading—005.

Get a front window view again as you approach the airport. Check that your landing gear is down. Cut the throttle. Flaps 10 percent (F3). Altitude 1,500 feet, airspeed 70 knots, 1,700 rpm, rate of descent 500 feet per minute. The runway markers come into view. Ease the throttle, 20 percent flaps. The field elevation is

Approaching Seattle at 5,800 feet, Mt. Rainier on the horizon

592 feet. At 600 feet, cut the throttle and nose up. Touchdown. Pump the brake and come to a rolling stop.

Exhale, wipe the sweat off your palms, and rush to your software dealer. For $50 you can fly your PC from Boston to Seattle in the most absorbing experience available on microcomputers.

Flight Tips

The *Flight Simulator* manual is not a substitute for a flight training course, but it describes the controls of the "PC-182" with enough detail to get you aloft. The following observations might help you get back to the ground in one piece.
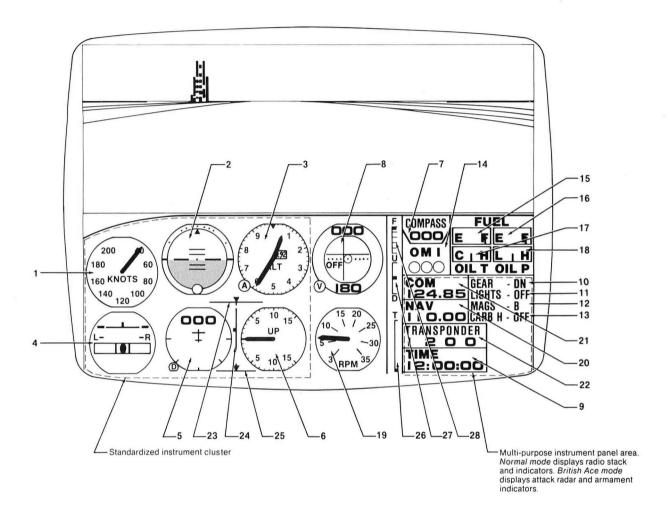
The aileron and rudder controls are very sensitive. A tap or two on the CursorLeft or CursorRight keys is enough to put you into a steep turn that takes you a full 360 degrees in 2 minutes. Hold the turn by centering the ailerons with the Numeric 5 key. To bank out of the turn, tap the opposite cursor key, and then level the plane with a tap on the Numeric 5 key when the horizon indicator reads level. You must anticipate bringing yourself out of turns. If you choose to run the program without the auto-coordination feature, you have to work the ailerons and rudder separately with CursorLeft/Cursor-Right and Ins/GrayPlus. Managing these controls is not difficult; just keep the "ball" on the turn coordinator centered.

The elevator controls, which point the nose up or down, are unlike the responsive aileron controls and they work very strangely. Hitting CursorUp or CursorDown once will lower or raise the elevators by a tiny increment—the elevator position indicator probably won't move. It takes eight of these fine adjustments to move the indicator. On the other hand, if you hit CursorUp or Cursor-Down in rapid succession, each key hit will count for eight fine adjustments, and the position indicator will move with each hit. This feature is documented rather obscurely in the *Flight Simulator* manual. Until you get the hang of making the fine or gross adjustments, you will have difficulty controlling the plane.

The high-pitched sound you hear when you pull back too far on the stick is the engine stalling. Move the stick forward (CursorUp) or increase the throttle (F4) to correct this problem. For some reason this is not mentioned in the manual, although you can figure it out yourself after crashing into a Wisconsin cow pasture a few times. And remember that hitting CursorDown moves the elevator position indicator—and the nose of the plane— *up.*

Figure 1: The 3-D Display and Instrument Panel
(Reproduced by permission of Microsoft Corporation)

Standardized instrument cluster

Multi-purpose instrument panel area.
Normal mode displays radio stack and indicators. *British Ace mode* displays attack radar and armament indicators.

The Standardized Instrument Cluster
1. Airspeed indicator (knots)
2. Attitude indicator (artificial horizon)
3. Altimeter
4. Turn coordinator with slip/skid indicator
5. Heading indicator (directional gyro)
6. Vertical speed or rate of climb indicator

Other Instruments and Indicators
7. Magnetic compass
8. Omni-Bearing Indicator with glideslope
9. Clock
10. Gear indicator
11. Lights indicator
12. Magnetos indicator
13. Carburetor heat indicator
14. Outer, Middle, and Inner marker lights
15. Left wing fuel tank gauge
16. Right wing fuel tank gauge
17. Oil temperature gauge
18. Oil pressure gauge
19. Tachometer

Radios
20. NAV radio
21. COM radio
22. Transponder

Control Position Indicators
23. Aileron position indicator
24. Elevator position indicator
25. Rudder position indicator
26. Throttle position indicator
27. Elevator trim indicator
28. Flap position indicator

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If you've never flown an airplane, the relationship between the elevators and the throttle may be elusive. You might expect that the elevators control the craft's altitude and the throttle the speed, but it's more complex than that. The Zen of flying is explained in the *Flight Simulator* manual with the pithy statement "Raising the elevators converts airspeed into vertical velocity." To understand this idea, think of what would happen to an automobile's speed if you went up and down hills without adjusting the accelerator.

Landing the *Flight Simulator* is more difficult than landing a real airplane because you can't judge distances or spot runway detail when you are lining up your approach. Until you get fairly close, use the radar and compass headings to get a bearing on the runway.

On your approach, maintain enough altitude, about 800 to 1,000 feet above the field, to keep a good view of the runway. When the runway markers pop into view, descend at no more than 500 feet per minute and 70 knots airspeed. (These tips come courtesy of "Captain" Stu Schwartz.)

Using *Flight Simulator*'s Editor

A Pilot's Perspective

Few people would suggest that mom and apple pie are less than wonderful. I have not read any reviews that suggest that the Microsoft *Flight Simulator* program is less than wonderful either.

But how well does the program simulate actual aircraft flight? My answer is "Not very well." The graphics in *Flight Simulator* are outstanding, but even though vision is important in maintaining control of an aircraft in flight, other senses also play important roles. The feel of the controls, the sounds of the engine and the slipstream, and the kinesthetic (seat-of-the pants) sense provide the necessary information for precise aircraft control.

These indicators (except for some minor sounds) are missing from *Flight Simulator*. In an aircraft, when flying straight and level, for example, you can feel a change in pitch long before you get a visual clue that the aircraft is deviating from its flight path. That feeling is reinforced by a change in sound as the engine labors or increases speed slightly. Yes, I know that the rpm remains constant when you are flying an aircraft with a constant speed propeller, but those propeller changes are not instantaneous. (A constant speed propeller varies the pitch of the propeller blades—usually via oil pressure—to maintain a constant rpm in the engine.)

The counter-intuitive operation of the elevator controls, which control the up and down motion of the aircraft, is the most annoying aspect of the program. The up arrow means down, and the down arrow means up, so every time I want to take off or descend, I have to look at the control keys instead of out the window. It seems that VFR (visual flight rules) is not really VFR after all.

Using the elevator controls to make a loop only loosely resembles the real thing. You start in a dive to get up the necessary speed to complete the loop. Then you pull up just short of the beep setting on the elevator. If you set the elevators at an intermediate setting (up 6 or 7), and if your airspeed is about 180, you can manage a loop, but doing it with the *Flight Simulator* is much more difficult than in a real aircraft.

A few aspects of the program do attempt to add realism to the flight simulation. As the airspeed builds, for example, the controls require less deflection to accomplish a maneuver. Making the controls more sensitive like this is a nice touch, but it feels like you have a tiger by the tail when you try to do an aileron roll at the 180 knots indicated.

There are only a few errors in the otherwise well-written documentation. For instance, page 72 contains an incorrect explanation of the use of the rudder in a turn. There is more drag on the outside, or up, wing in a turn than on the inside, or down, wing. Consequently, the only function of the rudder in a turn is to yaw, or position the aircraft to the inside of the turn.

Another error is that in *Flight Simulator* none of the airports mentioned on page 75 require an automatic direction finder (ADF) and distance-measuring equipment (DME) to make approaches. (There are certain requirements for entering an airport Traffic Control Area for each of the named airports, but that's beyond the scope of this review.)

Also worth mentioning is the fact that I have never flown into Kennedy, Los Angeles International, or O'Hare airport without encountering another aircraft in the sky. Approaches at these busy airports are illegal without an ADF or DME.

As you may have discovered by now, no aspersions cast on mom or apple pie would affect how we feel about them. I suspect that a few minor complaints about *Flight Simulator* won't diminish our pleasure in experiencing it. If you want to learn how to fly an airplane, plunk down the cash (lots of it) for a private pilot course. If you just want to have fun, power up *Flight Simulator* and go to it. Happy Flying!

Allan D. Pratt

Allan Pratt has flown several kinds of aircraft, including most Cessna models, many Piper models, Mooneys, T-6's, DC-3's, and Bonanzas. He currently flies Boeing B-737's for United Airlines.

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function is a good way to practice your landing technique. This function enables you to position the plane on a correct approach to the airport and then save that situation. If you crash, you'll be taken back instantly to the approach situation without having to take off again and line up the field. It's also helpful to suspend the simulation during landing practice (press P) so you can analyze all your indicators and take appropriate action.

The Editor function permits you to specify just about any combination of flight parameters (such as aircraft position and environmental factors) and store them in program memory or on disk for instant access. You can also choose one of four locales: Chicago, Boston-New York, Seattle, or Los Angeles. If you like to fly out of Seattle in the evening instead of Chicago at noon, you can set up one of the 30 User Modes for the SEA-TAC Airport coordinates and take off from there.

The most reliable method for storing flight parameters is to "write" your specifications to a new mode. Precede the specification with a 1 (for example, to write to mode 21, indicate 121). If you can figure out how to get there, the view of Puget Sound at dusk from 5,000 feet is spectacular.

For Aces Only
Once landing safely no longer presents a challenge, enter the *Flight Simulator*'s "reality" mode, call up a couple of cloud and wind shear layers, and get set for white-knuckle adventures. You'll have to work to keep the proper elevator trim, but that's just the beginning. Tune in your NAV radio, keep an eye on your bearing indicator, and be prepared for any emergency. If you've got a copilot, have him or her hum the theme song from "The High and the Mighty."

There's also a game mode, "British Ace," that transports you back to 1917 so you can declare war, engage in dogfights, and exchange bombing
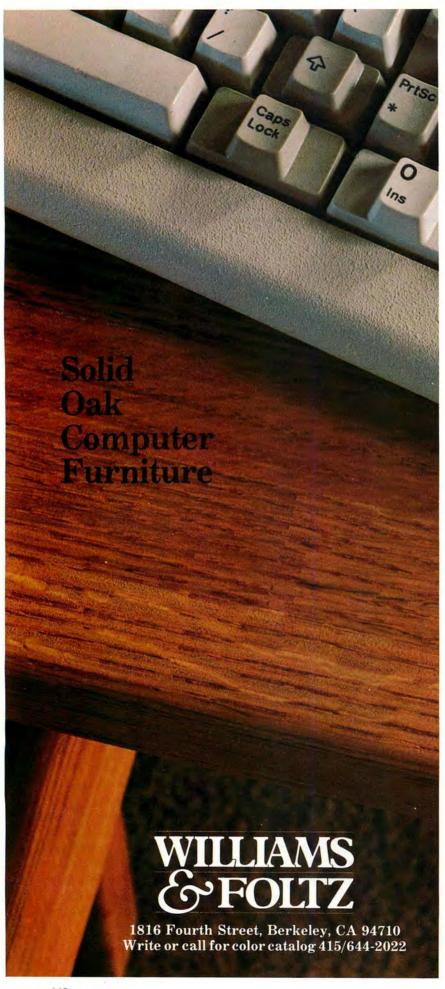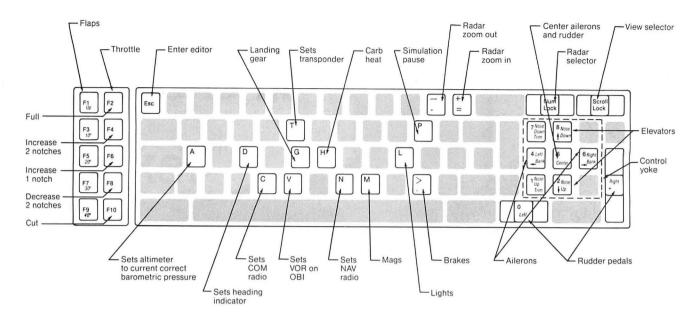
Figure 2: Complete Control Key Set
(Reproduced by permission of Microsoft Corporation)

Labels (clockwise from top left): Flaps, Throttle, Enter editor, Landing gear, Sets transponder, Carb heat, Simulation pause, Radar zoom out, Radar zoom in, Center ailerons and rudder, Radar selector, View selector, Num Lock, Scroll Lock, 7 Nose Down Trim, 8 Nose Down, Elevators, 4 Left Bank, 5 Center, 6 Right Bank, Control yoke, 1 Nose Up Trim, 2 Nose Up, Right, 0 Left, Rudder pedals, Ailerons, Lights, Brakes, Mags, Sets NAV radio, Sets VOR on OBI, Sets COM radio, Sets heading indicator, Sets altimeter to current correct barometric pressure, Cut, Decrease 2 notches, Increase 1 notch, Increase 2 notches, Full. Function keys: F1 Up, F2, F3 10°, F4, F5 20°, F6, F7 30°, F8, F9 40°, F10. Esc key. Letter keys: A, D, G, H, L, C, V, N, M, >, T, P.

missions with the German Air Force. You may want to spend all your flying hours battling the Red Baron, but playing war games might be missing the point of the program. There is a satisfaction that comes from flying this simulated plane safely, and that is a different experience from simulated war.

Quirks, Bugs, and Suggestions

Flight Simulator can display remarkable graphics in color, but only on a composite-type color monitor or a color TV with an RF modulator attachment. The program looks great on a 19-inch color TV screen. If you have a video cassette recorder, try connecting the color/graphics adapter phono output plug to the VCR camera input and use the VCR's built-in RF modulator. If you have the higher-priced and generally higher-quality RGB-type color monitor, you'll get very high resolution graphics, but with only a shaded, monochromatic effect. The results you'll get with a monochrome monitor that runs off the graphics board (such as the NEC green screen) are marginal, since you might not be able to distinguish the horizon. The program will not operate on the IBM Monochrome Monitor.

Flight Simulator appears to have a few bugs. Occasionally, the program gets confused and intermittently displays land areas as water. If you're flying over water and look straight down (ScrollLock Numeric 5), you'll always see land. If you pound furiously at the controls, you might hang up the program or send yourself into some remote location with strange coordinates. On the positive side, the *Flight Simulator* doesn't have to be stored in a hangar and doesn't require regular maintenance.

One improvement might be to offer a version of the program for systems with 128K or more of memory and provide correspondingly more ground detail. In the present version the Chicago and Seattle locales have much more detail than Boston-New York and Los Angeles. Libraries of other locales could be offered on disk so PC pilots could tour Paris by air or explore the Andes.

This engrossing program is not a substitute for seat-of-the-pants experience, but it will give you practice flying by the book and offer some powerful fantasies in the process. As you're coming in for a landing at the remote airstrip atop Catalina Island, it's hard to believe you're flying the same gray box that keeps track of your accounts payable.

Andrew Fluegelman is the Editor of PC WORLD *and has never piloted an airplane.*

Flight Simulator
Microsoft Corporation
10700 Northrup Way
Bellevue, WA 98004
206/828-8080
List Price: $50
Requirements: 64K, one disk drive, color/graphics adapter

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714/848-1922

The PC in a New Key

Keynote, a program that allows you to assign new functions to the PC keys.

Burt Alperson

Logicians, mathematicians, and computer scientists are fond of the words, *elegance*, and *parsimony*. These terms are used to describe events or processes that accomplish enormous amounts of work without much effort. They may describe, for example, a brief set of assumptions that pushes an entire logical system around, a proof that validates an important proposition in a few lines, or a computer program with a small, intuitively obvious syntax and great power.

Gerard Cerchio's *Keynote* is an elegant, parsimonious program. Its easily mastered syntax of nine commands is capable of a wide range of useful tasks. The stated purpose of *Keynote* is deceptively simple: to assign an indefinite number of strings to selected keys or key combinations on the IBM PC. At first glance you might think that the only use for such a program is to save a few keystrokes. If you use CHKDSK frequently, you could assign the command to a function key; if you frequently need to format disks, you might assign FORMAT B:/S/1 to another function key, and so on. You can accomplish these tasks simply by striking the appropriate function key.

But using the program for this purpose alone is like using your computer for operations that could be performed by a pocket calculator. While BASIC and Pascal might be described as languages that allow you to construct programs of command sequences, *Keynote* is best described as a language that allows you to construct systems of programs.

With *Keynote* you can develop "turnkey" systems, specially designed programs that enable people who know little about computers to carry

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Almost 60,000 characters may be assigned to a single key.

---

out complex operations. The program may be used to create extensions to or replacements for batch programs. It can be used to pass a sequence of parameters from DOS into BASIC programs, to supply a front end for DOS or applications programs like *WordStar*, or to revise the command structure of applications programs. Because of excellent human engineering and lucid and concise documentation, the full syntax of *Keynote* can be mastered in less than half an hour.

Initialization Commands

Keynote's command set may be classified into initialization and utility commands. The program must be initialized with a KEYON or KEYIN command before it can operate. KEYON invokes a reduced version of the program that requires less disk storage space than the alternative command, KEYIN. Either initialization command will take a modifier, which allows user control of the amount of central memory reserved for key assignments. KEYIN takes an optional modifier, SCREEN, that is useful when using the monochrome monitor.

KEYIN has a run-time system that allows key assignments to be changed while an applications program is running. Such changes affect key assignments only, not the applications program. If initialization has been accomplished with KEYIN, a key can be reassigned at any time by typing Alt-K. This capability is particularly useful in word processing; it enables you to repeat the same word, phrase, or paragraph over and over. Typing Alt-K assigns the string to a key. From then on striking the key will print the entire string. In theory, almost 60,000 characters may be assigned to a single key. This capacity should meet the needs of most users.

Utility Commands

The remainder of the syntax is small and intuitively obvious. You can assign one or more keys at a time with the commands KEY or KEY MANY. The set of assignments can be reviewed (KEY LIST), saved on disk (KEY SAVE filespec), loaded from disk (KEY RESTORE filespec), and cleared completely (KEY CLEAR). The set of assignments can be suspended temporarily (KEY OFF) and subsequently restored (KEY RESTORE).

Keynote provides a useful editing facility. When keys are being reassigned, the GrayMinus Key on the extreme right of the keyboard functions like the character copy key, F1, in EDLIN. If you discover a mistake in a long *Keynote* string, the GrayMinus key will restore characters up to the mistake. You can then correct the mistake and complete the string by pressing the GrayMinus key or typing other characters, as appropriate. The full *Keynote* syntax is only eight commands plus the editor. The only additional tool required is your imagination.

Developing a Data Base Management System

The Psychology Department at California State University at Los Angeles is developing a *Keynote* system to keep track of the scheduling history of classes. Because of the way the California State University system is funded, classes can be cancelled without notice if they don't match a formula developed by the state legislature. If a data base management system could produce information on the prior scheduling history of classes, the likelihood of such cancellations could be reduced.

Since the university budget cannot guarantee competent help to maintain the data base, the system should be designed to be run by novices. A turnkey system is clearly what is needed; the operator has to know only how to insert disks and turn on the machine.

A turnkey data base management system is almost a contradiction in terms. Many powerful data base managers are available for the PC. While their command syntax may be simple for someone who is accustomed to dealing with computers, this same syntax resembles word salad to someone who has never dealt with a computer. This is a job for *Keynote*.

Because it has sufficient power for this application and because of its

---

Figure 1: Main Menu for a Turnkey Data Base Management System

Psychology Department Course Management System

Choose an option by pressing one of the 10 function keys on the left side of the keyboard

F1...ENTER NEW INFORMATION
F2...MODIFY INFORMATION
F3...DELETE INFORMATION
F4...PRINT INFORMATION
F5...FIND INFORMATION
F6...PRINT A REPORT
F7...QUIT FOR THE DAY

Important note: be sure to follow the backup procedure in the manual after pressing F7 if you have used F1, F2, or F3.

---

low cost, Jim Button's *PC File* was chosen as the basic data base tool. *Keynote* was used to tailor the program specifically for this application.

After inserting the disks and turning on the machine, the operator is greeted with the menu shown in Figure 1 instead of the usual *PC File* menu. This menu is brought up with a simple AUTOEXEC.BAT program that loads the *Keynote* key set and prints the menu with a TYPE com-

mand. The most important aspect of the menu is that it is phrased in the language of the specific application rather than the usual data base language.

Keynote makes each data base operation automatic. The operator doesn't need to know anything about data base language. Imagine, for example, that the operator has entered the system to produce a report called "Class, Time, Professor, Enrollment." The report should produce a list of classes taught in the department over the last three years in course number sequence. Within each class, times should be listed from earliest to latest. Within each time period, professors who taught the course should be listed alphabetically, and, finally, the enrollment for the class should be listed.

Without *Keynote* the following commands would have to be supplied to *PC FILE*:

```
SOR   ENTER
CLASS   ENTER
5  ENTER
TIME   ENTER
4  ENTER
PROFESSOR ENTER
10  ENTER
ENTER
A  ENTER
LIS  ENTER
CTPE  ENTER
P  ENTER
CLASS, TIME, PROFESSOR,
   ENROLLMENT  ENTER
A  ENTER
ENTER
```

With the *Keynote* turnkey system the operator prints a report by pressing F6 at the main menu (see Figure 1). This response produces another menu listing the available report formats. Alt-E on the second menu is identified as the appropriate response to produce the "Class, Time, Professor, Enrollment" report.

Two keystrokes replace 82, and the operator need know only the name of the report. Since *Keynote* can assign 97 of the keys on the PC keyboard, ample capacity is provided for different alternatives in most applications.

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If 97 different functions are not sufficient, multiple disks can be added to the system. Current plans for this system include the use of one disk for printing out hard copy reports on the entire data base. A second disk is being developed to present screen displays of selected information.

A Customized Application

Development of a front end or an automatic command system for DOS operation can be simplified considerably if frequently used or long com-

Many of the commands invoke the familiar DOS functions, but others require some explanation. The F1 assignments call an alternative to the DIR command, which generates a sorted directory and an indication of available space. F5 and F6 invoke a simple BASIC program for automatic dialing and redialing of the Hayes modem. The JEL, JET, and E-Disk assignments invoke utilities concerned with electronic disk operations.

F8 and Alt-F8 are designed to coordinate with one another. F8 recalls the menu shown in Figure 2. Alt-F8 restores these key assignments if they have been changed by another

because it shows how *Keynote* macros and batch programs can interact. The purpose of this assignment is to call up BASICA with my choice of function key assignments rather than IBM's. The *Keynote* assignment of BAS to this key calls the batch file BAS.BAT. The content of the batch file is:

```
KEY OFF
BASICA KEY
KEY RESTORE
MODE 80
TYPE KEY.DOC
```

KEY OFF suspends *Keynote* assignments to allow BASIC assignments. The KEY program called in the second line consists of:

```
1000 KEY 1,CHR$(27) + "LIST "
1010 KEY 2,CHR$(27) + "RUN" + CHR$(13)
1020 KEY 3,CHR$(27) + "LOAD" + CHR$(34)
1030 KEY 4,CHR$(27) + "SAVE" + CHR$(34)
1040 KEY 5,CHR$(27) + "RUN" + CHR$(34) + "C"
       + CHR$(13)
1050 KEY 6,CHR$(27) + "RUN" + CHR$(34) + "B"
       + CHR$(13)
1060 KEY 7,CHR$(27) + "CLS:SYSTEM"
       + CHR$(13)
1070 KEY 8,CHR$(27) + "EDIT "
1080 KEY 9,"A:"
1090 KEY 10,"B:"
1100 KEY ON
1110 NEW
```

Since this program assigns CLS:SYSTEM to F7, the key has now become a toggle between BASICA and DOS. Striking the key while in BASICA invokes the third line of the batch program, which restores the suspended *Keynote* assignments. All that is left to do is clear the screen, MODE 80, and print the DOS menu, TYPE KEY.DOC.

F2 has one of the most useful assignments. It consists simply of the word GO and a carriage return. Each of my applications program disks contains a batch file called GO.BAT. The purpose of this file is to start the main program in the way I prefer to use it. A useful *WordStar* disk, for example, might contain the GO.BAT file:

KEY RESTORE WS.KEY (Sets up *Keynote* assignments for *WordStar*)

Figure 2: Menu for a DOS Front End

Standard Key Set for General Utility Disk

F1 }	CAT A:		F2 }	Start Program
A-F1 }	CAT B:		A-F2 }	Clr E-Disk/Start Pgm
S-F1 }	CAT C:		S-F2 }	JEL Status
F3 }	CHKDSK		F4 }	COPY
A-F3 }	VDEL		A-F4 }	JET A: = >C: (^)
S-F3 }	Clear Electronic disk		S-F4 }	JET A:< =C: (v)
F5 }	Personal Phone		F6 }	Business Phone
A-F5 }	EDLIN		A-F6 }	PG
S-F5 }	DIR A:/P		S-F6 }	TYPE
F7 }	Customized BASICA		F8 }	Display Keys
A-F7 }	Clear Keys		A-F8 }	Reset Keys
S-F7 }	JET A: = >B:		S-F8 }	JEL Set B: = >ELECTRONIC
F9 }	A:		F10 }	JEL Set A: = >ELECTRONIC
A-F9 }	B:		A-F10 }	JEL Set SYS = >128K
S-F9 }	C:		S-F10 }	JEL Set SYS = >320K

---

mand strings are made available at the touch of a key. The set of key assignments shown in Figure 2 is useful for a General Utility disk. This is the key set I use in my own system. The system is usually booted with the key set, and the disk containing the set is generally in place between applications programs.

program and then prints the menu shown in Figure 2. Alt-F3 and Alt-F6 call utility programs written by J. P. Garbers that delete files in a convenient way and print ASCII files in DOS, one page at a time.

F7 is an interesting assignment

CAT B: (Shows sorted directory and
available space on Drive B:)
B: (Changes logged drive to B:)
PAUSE (Pauses for disk change if more
space is needed)
A:WS (Invokes *WordStar*)
A: (Changes logged drive to A: on
exit from *WordStar*)
KEY RESTORE STD.KEY (Restores original
General Utility *Keynote*
assignments)
MODE 80 (Clears screen)
TYPE KEY.DOC (Prints General Utility
Keynote assignments on screen)

> The full *Keynote*
> syntax is only eight
> commands plus the
> editor.

More elaborate GO.BAT con-
figurations are useful for automatic
operation of *WordStar* and other
applications programs with an elec-
tronic disk, but this would take us
too far afield.

The specific content of the
GO.BAT file changes from disk to
disk. But the *Keynote* assignment of
GO and a carriage return to F2 is
constant for all *Keynote* files. All
programs begin with F2. The fact
that this is consistent with IBM's use
of F2 for RUN in BASIC is not
accidental. Since the function keys
are now in use for other purposes, I
have borrowed J. P. Garbers' set of
key assignments from his FK pro-
gram for the DOS-EDLIN editing
commands: SKIP/COPY (formerly
F2) is now CursorUp, COPY-RE-
MAINING (F3) is End, SKIP/DE-
LETE (F4) is CursorDown, and
MOVE-DISPLAYED (F5) is Shift-
Tab. In addition, HOME clears the
screen in DOS because of the assign-
ment of MODE 80 and a carriage
return to the key. These assignments
feel natural after a short time and are
easy to remember.

Each program disk has its own

◉ Reviews

Keynote file, and the batch file produces an automatic return either to the General Utility or a specialized DOS *Keynote* set on program completion. Obviously, many other assignments are possible. The above assignments should provide some hint of the flexibility and power available with a *Keynote*/DOS front end.

Taming WordStar

Of course, *Keynote* can be used to customize software. *WordStar* is an excellent candidate for such treatment. The program itself is superb, but MicroPro has obviously taken many shortcuts to get the product to market. Several of the key assignments could be improved, and *Keynote* macros can be used to automate many actions.

Keynote comes with a sample *WordStar* assignment file designed by Andrew Fluegelman. The file is filled with excellent suggestions and is an ideal starting point for customizing *WordStar* to fit your own habits and preferences.

The first task is to make *WordStar* key assignments consistent with DOS. With *Keynote* the backspace key, rather than the Del key, can carry out the destructive backspace function. Del can now delete the character above the cursor instead of using Ctrl-G. Word by word cursor movement may be invoked with Ctrl-CursorLeft and Ctrl-CursorRight instead of the usual *WordStar* assignments, Ctrl-A and Ctrl-F.

Two guidelines are helpful in making additional key assignments. Wherever possible, keys should be arranged in functional groups that are easy to remember. Secondly, important or frequently used commands should have special locations (like F1 or F10) or natural key combinations that allow easy one-handed operation (like Ctrl with F5 or F6, Shift with F7 or F8, or Alt with F9 or F10).

One set of assignments that is consistent with these guidelines is the current margin-tab set. All frequently used commands dealing with margins and tabs are controlled by the function keys in combination with the Shift key (original *WordStar* commands are shown in parentheses):

Margin

SET Left at Cursor	Shift-F3	(^OL Esc)
SET Right at Cursor	Shift-F4	(^OR Esc)
SET Left at Column ?	Shift-F7	(^OL)
SET Right at Column ?	Shift-F8	(^OR)

Tab

SET at Cursor	Shift-F1	(^OI Esc)
CLEAR at Cursor	Shift-F2	(^ON Esc)
SET at Column ?	Shift-F5	(^OI)
CLEAR at Column ?	Shift-F6	(^ON)
CLEAR All Tabs	Shift-F10	(^ONA ENTER)

Decimal Tab

SET at Cursor	Shift-F9	(^OI# Esc)

The key assignments shown in Figure 3 represent an attempt to apply the two guidelines and take advantage of any mnemonic aids that are supplied by the labels printed on the keys. *Keynote* is not limited to altering command assignments

---

Figure 3: Sample WordStar Assignments

Blocks
MARK Beginning of Block: F5 (^KB)
MARK End of Block: F6 (^KK)
MOVE Block Here: Alt-F5 (^KV)
COPY Block: Alt-F6 (^KC)
DELETE Block: F4 (^KY)

Centering
CENTER Text: F7 (^OC)

Cursor Movement
MOVE Word Left: ^[left arrow] (^A)
MOVE Word Right: ^[right arrow] (^F)
MOVE to Line Beginning: [HOME] (^QS)
MOVE to Line End: [END] (^QD)
MOVE Top L. Screen: ^[HOME] ([HOME])
MOVE Bottom Screen: ^[END] ([END])
MOVE to Beginning: ^[PgUp] (^QR)
MOVE to End: ^[PgDn] (^QC)

Deletions
DELETE Left Char: [back space] ([Del])
DELETE Char Above Cursor: [Del] (^G)
DELETE Word to Right: Alt-F1 (^T)
DELETE Whole Block: Alt-F4 (^KY)
DELETE To End Of Line: Alt-F2 (^QY)
DELETE Whole Line: Alt-F3 (^Y)

Find and Replace
Find: F3 (^QF)
Find & Replace: F4 (^QA)
Again: ^F2 (^L)

Help
Set Help Level: F1 or Alt-H (F1)

Indented Paragraph
Set Paragraph Tab: F2 (F2)

Reforming
REFORM Paragraph: F9 (^B)
REFORM to End of Document:
 ^F9 (^QQ^B1)
REFORM Paragraph & RESTORE Cursor:
 Alt-F9 (^B^QP)

Line Spacing
SINGLE: Alt-[1] (^S1)
DOUBLE: Alt-[2] (^S2)
TRIPLE: Alt-[3] (^S3)

Print Control
UNDERLINE: F8 (F5)
BOLDFACE: Alt-F8 (F6)
SUBSCRIPT: Alt-[−] (^P^V)
SUPERSCRIPT: Alt-[+] (^P^T)

Save and Exit
PANIC! Don't Save: ^F1 (^KQ)
SAVE, RESUME, RESTORE Cursor:
 Alt-F10 (^KS^QP)
SAVE & EXIT Wordstar: ^F5 (^KX)
SAVE, Go To NO-FILE MENU: ^F6 (^KD)

within *WordStar*. *Keynote* sequences may also be used to store formats that can be called up with a single keystroke. A format for memos provides a good example.

Before *Keynote*, I had to store a memo template on disk. Typing a memo required reading the template in, setting my preferred operating parameters, setting up for single-spacing, setting tabs, and setting margins. The alternative was typing in the following sequence:

```
^JH^OH^OS1^OR78 ENTER ^V^ONA ENTER
^OI5 ENTER ^OI12 ENTER ^OI52 ENTER
^P^BMEMORANDUM^P^B^OC ENTER ENTER
ENTER ENTER ^P^BTO:^P^B ENTER
ENTER ^P^BFROM:^P^B ENTER ENTER
^P^BCOPIES TO:^P^B ENTER ENTER
^P^BSUBJECT:^P^B cursor up cursor up
Cursor Up Cursor Up Cursor Up
Cursor Up CursorUp CursorUp
Tab Tab Tab ^P^BDATE: ^P^B
```

I now use *Keynote* to produce the following output:

MEMORANDUM
DATE:

TO:
FROM:
COPIES TO:
SUBJECT:

Besides producing the template, this *Keynote* sequence also sets margins, tabs, single-spacing, turns off hyphen-help, turns off insert mode, sets the help level to 1, and produces the appropriate dot commands for 12-pitch type, a page offset of 6, and no page numbers. It leaves the cursor sitting one space after 'DATE:' so that I can begin typing immediately. Since all this is accomplished by pressing Alt-M, some time and effort are saved.

Other available formats I use include the required publication conventions for my journal articles, a CRT and Disk output format, parameters for 8.5-by-5.5-inch pages (the size of the IBM manuals), a set-up for my personal and business stationery, several letter closings (choice depends on how formal I want to be), a log format for documents from The

Source, and fast utility assignments that allow me to return to a given format for an existing document.

Key Notes

Tall Tree Systems of Los Altos, California, is marketing its *JFORMAT* electronic disk program with Cherchio's *Keynote* in one package. However, certain versions of the programs are incompatible; the only version of

---

> With *Keynote* you can create your own customized, integrated system of applications programs.

JFORMAT that is compatible with *Keynote* is version 1.71. It should be noted that earlier releases of *Keynote* did not function in the same way as the the program described here. There were also a few bugs and problems when the previous version was used with the monochrome monitor. These problems have been cleaned up in the new version.

Much to their credit, the authors of both programs have liberal and fair update policies. Individuals who own the earlier versions may contact Tall Tree Systems for updates of *JFORMAT* and Gerard Cerchio for updates of *Keynote*. Revised documentation is included in the update package for both programs.

Keynote provides an easy-to-use systems capacity, which may turn out to be one of its greatest assets. One recent trend in commercial software for the PC is the development of integrated packages of programs. A single package might contain data base management, spreadsheet capability, and report generation. Frequently, these packages deserve the label jack of all trades, master of none.

With *Keynote* you can create your own customized, integrated system of

applications programs. You can choose a set of programs, each one optimized for a given purpose. *Keynote* can then be used to relate these programs to one another to ease transitions between programs. All this can be accomplished without recourse to the languages in which the applications programs are written. *Keynote* works with the command syntax of the programs involved.

Keynote is an important program for the PC. It opens up the machine in ways that are unique and powerful. The more you use this program the more you will be aware of its great potential. Cerchio has produced a gem. No matter how you choose to use it, you will find that the payoff is many times greater than the effort expended. That is what elegance is all about.

Burt Alperson is a professor in the Psychology Department at California State University at Los Angeles. He developed the department's first computer programming class in 1975.

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IBM-PC Compatible Expansions Slots Beyond Professional Configuration[1]	8 Slots	0	?
Resident Floppy Disk Storage	Dual 320K (std)	Dual 160K (Opt) Dual 320K (Opt)	?
Resident Cache Buffer Hard Disk Storage	5M/10M	—	?
OPTIONAL OPERATING SYSTEMS (Supported by Company)[2]			
MS-DOS (PC-DOS)	Yes	Yes	?
CP/M 86	Yes	Yes	?
MP/M 86	Yes	—	?
OASIS-16	Yes	—	?
XENIX	Soon	—	?
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Cache Buffer Hard Disk	Yes	—	?
Time/Calendar Board	Yes	—	?
IEEE Bus Controller	Yes	—	?
8" Floppy Disk System	Yes	—	?
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Tape Cartridge System	Yes	—	?

[1] For comparison purposes, typical professional configurations consist of 16-Bit 8088 Processor, 128K RAM with Parity, Dual 320K 5-inch Floppies, DMA and Interrupt Controller, Dual RS-232 Serial Ports, Centronics Parallel Port and Dumb Computer Terminal or Equivalent.
[2] Columbia Data Products also supports CP/M 80® with an optionally available Z-80 CP/M Expansion Board.
*As advertised in BYTE Magazine, August 1982

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ProKey Chimes In

Keyboard enhancers ProKey and Keynote: two excellent programs that will greatly increase the power of your system.

Lawrence J. Magid

Keynote and *ProKey* both perform essentially the same function—they allow you to redefine keys on the PC keyboard. With either program you assign a macro file to a key so that pressing the key produces another character, a string of characters, a sequence of commands, or an entire paragraph. With these programs, long command sequences and tedious text typing and data entry are a thing of the past.

Since *Keynote* is reviewed elsewhere in this issue, this article does not discuss the features common to both programs but focuses on the significant ways in which *ProKey* differs from *Keynote*.

Definable Keys

With either program you can redefine the PC keys to work by themselves or in conjunction with the Alt, Shift, and Ctrl keys. You can define Alt-D, for example, to produce the DOS DIR (directory) command. The programs also enable you to redefine any of the cursor control keys, such as the arrows, Home, or PgUp and PgDn, to work by themselves or with the Ctrl key. The function keys at the left of the keyboard can be redefined to work by themselves or with the Alt, Shift, or Ctrl keys.

While *Keynote* allows you to redefine the Backspace key, version 2.0 of *ProKey* does not include this feature. *ProKey* version 3.0 reportedly will include the ability to re-

define the Backspace key in addition to a new feature that will allow the alphabet and top-row number keys to be combined with the Ctrl key.

One interesting *ProKey* feature is the ability to insert variables of any length into the keyboard macro files. When you define the key, you indicate where in the string the variables should go. When the redefined key is pressed, the program displays the first part of the string variable on the screen and pauses for you to enter the variable. The program then continues with the remainder of the defined strings.

This feature is particularly handy for marking text for underlining or boldface. To underline or boldface, most word processing programs require you to place a mark before and after the word or string of text to be emphasized. If you assigned Alt-U to underlining, for example, you could press Alt-U to insert the begin-underline marker. You could then type the word or text string to be emphasized and press ENTER. The program would make the end-underlining marker appear.

Unlike *Keynote*, *ProKey* gives you the option of defining the string variable as having a fixed length. This feature can be used to create special macro files for creating and filling in forms with a single keystroke. Another unique *ProKey* feature allows you to have one key

definition call another key definition or even redefine another key. This "nesting" ability is a useful feature. If you can keep from getting lost in the nest, you can turn the keyboard enhancer into a powerful system programming tool.

Changing Keys

In *ProKey* you define a key by entering Alt-equals from within DOS or any applications program. You then press the key you are redefining in a step that *ProKey* calls "the name of the key" (this step is the same as

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> Keynote is simpler to learn, but ProKey has more features.

Keynote's "designate key"). This procedure can be a little confusing since no prompts appear on the screen to guide you. After pressing the key you want to define, you enter the character or string that the key is to become. Again, no screen prompt appears. You conclude the definition by pressing Alt-minus.

The "name of the key" procedure can be used for defining a key sequence, such as Alt-S, to call up a standard letter closing. To define this

sequence you begin by pressing Alt-equals; a colon will appear on the screen. No screen prompts appear, except to let you know that a definition is in progress; the cursor moves from the bottom of the character it's resting on to the top. Type Alt-S, press ENTER four times to create four blank lines, give your name, and type Alt-minus.

If you plan to use a variable string within your definition, such as an alternate letter closing, type Ctrl-minus to tell *ProKey* to pause, and type Ctrl-minus again to terminate the pause.

One interesting *ProKey* feature causes the applications program you're using to execute commands as you define them. In contrast, *Keynote* suspends the operation of an applications program or of DOS activity while you define a key.

This *ProKey* feature is both good and bad. It enables you to define a key as you use it, with the program providing feedback as to whether you are correctly following the assignment procedure. This is handy when you are defining a key to carry out a sequence of commands because you can actually see the commands perform as you define them. However, you might not always want the commands you are defining to be executed immediately. I found it confusing when my word processing program implemented a series of commands as I was defining them.

Editing Macros

Changing a key definition affects the definition of that one key only; the rest of the definitions in the macro file remain intact.

Keynote provides a limited editing feature that allows a previously defined string to be redefined one character at a time. *ProKey* macros, on the other hand, can be edited via any DOS word processor or text editor because *ProKey* writes macro files as standard ASCII DOS files. (*Keynote* writes binary files that cannot be manipulated by a text editor.) A good macro editor would be a welcome addition to both programs.

Ease of Use

Both programs have good documentation and are relatively easy to use. Because of its screen prompts, *Keynote* is simpler to learn, but *ProKey* has more features. An associate of mine created special macros for DOS, *WordStar* and *dBASE II*. Her assistant, who had never used a computer, learned to enter and manipulate data, copy disks, and write memos in a couple of days. This rapid progress was due in large part to my friend's creative use of her keyboard enhancer.

Music in Either Key

If you haven't already done so, go out and buy one of the programs. They differ in price, features, and ease of use, but they perform their tasks so admirably that I recommend both without hesitation.

PC WORLD Contributing Editor Lawrence J. Magid is vice-president of Know-How Personal Computer Learning Centers.

ProKey
ProSoftware
P.O. Box 5850, Seattle, WA 98105
206/632-3603, 800/227-3800
800/792-0990 in CA
List Price: $75
Requirements: 64K (96K with Word-Star), one disk drive

Keynote
Advanced Software Interface
2655 Campus Dr. #260
San Mateo, CA 94403
415/572-1347
List Price: $99.95
Requirements: 64K, one disk drive

WordStar
MicroPro International Corporation
33 San Pablo Ave.
San Rafael, CA 94903
415/499-1200

dBASE II
Ashton-Tate
9929 W. Jefferson Blvd.
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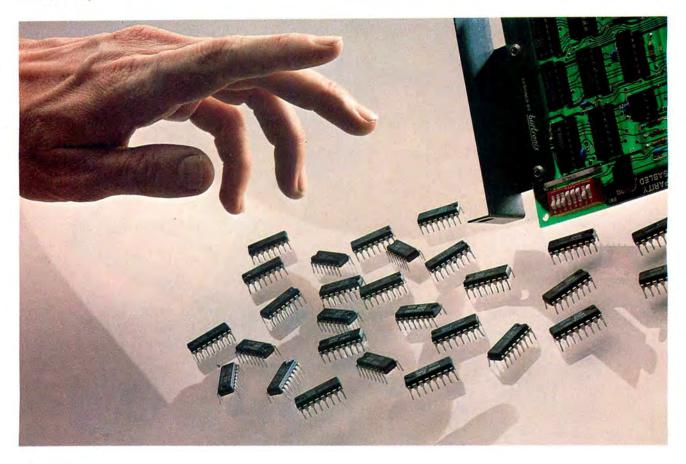
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Do-It-Yourself RAM

Charles Kelly

You can put a lot of memory into your PC. One important feature of the IBM PC is its 16-bit architecture, which allows it to access a memory address space of up to 1 megabyte as compared to an 8-bit computer, which addresses 64K only (see "Bits, Bytes, and Ks").

You may need to increase the memory in your PC for several reasons. Many sophisticated programs require more than 64K; one such program is the *EDIX + WOR-DIX* word processing software that requires 128K.

Others are the Ada compiler by Telesoft that requires a minimum of 320K on the PC, and the IBM Pascal compiler that requires 128K.

For one disk drive systems increased memory reduces the time required to copy a floppy disk. The operating system must read information from the disk into main memory, and the information is then copied to

a different floppy disk. If your PC has only one disk drive and 64K, you have to exchange source and target disks during the copying process. If you add enough memory to your system (192K for single-sided disks and 284K for double-sided disks), you can avoid exchanging disks during the copy process.

Extra memory beyond that required to run a program can be used as an electronic disk drive, or a disk emulator. Electronic disk software controls temporary information storage, which allows the operating system to treat a portion of main memory in the same way that it treats a floppy disk drive. For example, the operating system can create a file directory on, read files from, and write files to an electronic disk drive.

Reading and writing to an electronic disk drive is extremely fast because mechanical devices are not involved. But because information stored in an electronic disk is temporary, it must be copied to permanent storage, such as a floppy disk, before the system's power is turned off. Electronic disks are also subject to information loss due to power surges or interruptions.

Memory Expansion for the PC

The PC has two types of memory: read-only memory (ROM) and read-write memory, which many people refer to as RAM (random access memory). In reality, both types of memory are random access memory, but the incorrect terminology seems to have taken hold.

ROM is similar to the write-protected contents of a floppy disk. In the PC, ROM contains low-level input/output (I/O) programs, a BASIC interpreter, and a bootstrap loader that provides initial operating instructions when you power up the PC.

Read-write memory enables the computer to implement applications such as running sophisticated programs and electronic disk software. The first 64K of read-write memory is located on the system board shown in Figure 1. Although the PC can be configured with as

little as 16K, most units have been shipped from the factory with 64K.

If you want to use more than 64K, a memory expansion board must be placed in one of the system-expansion I/O slots shown in Figure 2. Most of the popular memory boards allow you to add an additional 64K, 128K, 192K, or 256K.

The PC has only five I/O slots. Manufacturers of memory expansion boards for the PC have responded to the five-slot limitation by designing memory boards that contain additional features such as clocks, serial and parallel ports, and hard-disk adapters. Tecmar of Cleveland, Ohio, responded to the five-slot limitation by creating an expansion chassis that contains six additional I/O expansion slots.

Saving Money with Chips

If you want to minimize expenses while expanding memory in the PC, you should buy a memory expansion board and memory chips from different sources.

Most memory boards come with the first 64K installed. You have the option of purchasing additional memory from mail order outlets, computer systems retailers such as Sears or ComputerLand, or computer components dealers.

If you want to add 192K to an expansion board that already contains 64K, the chips will cost from $500 to $600 at Sears or ComputerLand. Electronics dealers sell identical components for as little as $168.75, which represents a savings of at least 66 percent.

Most board manufacturers and computer retailers buy memory chips from the same sources. The generic name for the memory chips you need is 4164, 200 nanosecond dynamic memory chips. These chips are available from several manufacturers. Chip quality varies

because some manufacturers do more testing than others.

When buying memory chips, be aware that they are coded according to the date of manufacture. A chip coded 3581 was produced during the thirty-fifth week of 1981. Buy chips manufactured after 1980. You can assume that chips manufactured before 1980 have passed among too many wholesalers, job-lotters, and distributors, which increases the possibility of static damage.

If you frequently receive shocks when you touch doorknobs or metal objects, avoid handling memory chips until you neutralize the static electricity source.

Installing Memory

Installing memory chips is simple: (1) open the PC chassis, (2) remove the memory expansion board, (3) populate the memory board, (4) set the switches, and (5) close the chassis. Before installing memory, review the precautions mentioned in "Static Awareness."

Opening the PC Chassis

Looking inside a computer for the first time, I was very disappointed. I expected to find shining wheels and odometers with spaces for all the bits and bytes. Instead, I found quiet, passive circuit boards. Nothing moved or blinked; the blazing speed of computers was nowhere evident. And the CPU showed no animation.

Before you open the PC, remove all the cables and connectors at the rear of the chassis (see Figure 3). If you did not perform the original installation, you might want to draw a small diagram and tape labels on each cable.

After you have removed all the cables, loosen and remove the two hex nuts in the lower rear corners of the PC chassis (see Figure 3). If your monitor sits atop the chassis, remove it and put it in a safe place. The cover of the chassis slides directly forward and moves very easily. You will probably want to work on a surface large enough to enable you to reach both the front and the rear of the chassis. After you slide the cover to the front of the chassis, a small upward movement of the cover will remove it from the chassis. Place the cover aside; you won't need it until reassembly.

After opening the chassis, take a few moments to familiarize yourself with the components (see Figure 1).

Looking from the rear of the chassis, you will see the power supply and cooling fan in the left-hand corner. The floppy disk drives are in front of the power supply. The system board (mother board) lies flat in the bottom of the chassis. Standing upright are the expansion boards. You have probably filled three or more of the five expansion slots on the system board. If you have not used all five slots, you will see the white plastic expansion sockets that contain adapters for the expansion boards.

The board that has a blue connector ribbon and is closest to the floppy disk drives is the floppy drive controller board (see Figure 4). At the upper front corner of the disk drive controller you may see an adapter with bent or broken pins. Don't be alarmed about these pins; your board is not defective. The long board that stretches from the rear to the front of the chassis is the display adapter. Your system may have the IBM asynchronous communications (RS-232C) adapter. This is a small board, and you will be able to see the external connector (see Figure 5). You should be able to identify the memory expansion board, since there are only five possible slots, and you have already identified at least two other boards: the controller board and the display adapter. If you cannot identify the memory board, reassemble the system and ask the service technician at your PC dealer to identify it for you.

Removing the Memory Expansion Board

After you have identified the memory expansion board, loosen and remove the small screw at the rear of the chassis. The memory board will fit snugly into the expansion adapter. Remove the board by rocking it gently from back to front—not sideways. Be careful when removing the board; the adapters are subject to damage. The amount of force to use is about the same as lifting a heavy dictionary. If you think you are using too much force, ask your service technician for assistance.

If your board is one of those designed by AST Research, Microsoft, Quadram, or Tecmar, it has four rows, each of which contains nine sockets for memory chips (see Figure 6). If your board does not have sockets for chips, the chips will have to be soldered. And because solder has a lingering odor that will permeate both your office and your psyche, return such a board to your dealer and purchase another.

The memory chips and the sockets into which they are inserted are rectangular. One of the two short edges of the chip contains a semicircular notch (see Figure 7). The notch indicates the direction the chip should face. If your board already contains 64K of memory (nine chips), notice the direction of the notches. Each chip

Figure 1: PC System Board

Figure 2: Input/Output (I/O) Slot

Expansion boards   Power supply and cooling fans

Vacant expansion slot

RAM chips   System board   Floppy disk drive
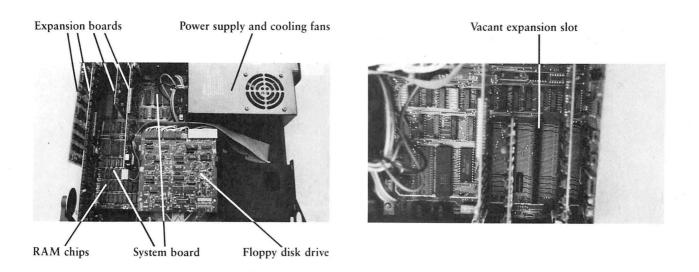
Figure 3: Rear of PC Chassis (Reproduced from the IBM Personal Computer Guide to Operations, 2-7).

(IBM monitor) 9 pin D connector

Hexnut   Power supply fan   Color composite signal phono jack   Hexnut

Video power (IBM monitor)   Keyboard   Cassette   Parallel printer connector

System power   Color direct drive 9 pin D connector
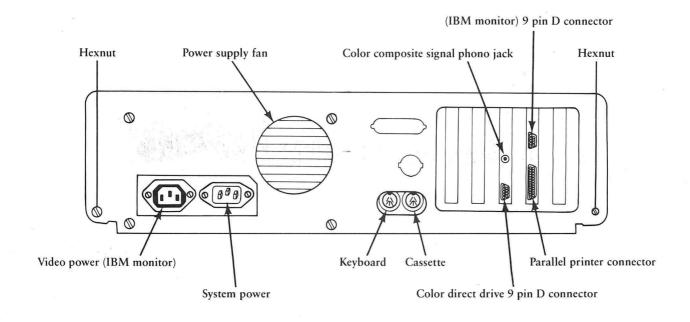
Figure 4: Floppy Drive Controller Board
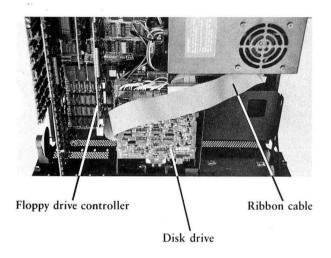
Figure 5: Display Adapter and IBM Asynchronous Communications Adapter

Floppy drive controller   Ribbon cable

Disk drive

Display adapter   RS232 adapter
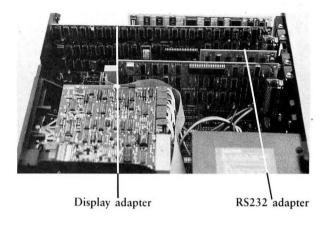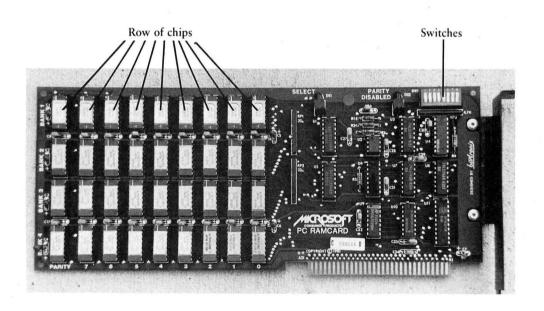
Figure 6: Memory Expansion Board

Row of chips   Switches

installed should have the notch facing the same direction. The Microsoft board I use has a line drawing on the board that indicates the notch position of each chip. If you cannot determine the direction of the notches, ask your dealer for advice.

Populating the Memory Board

After determining the correct position of each chip, you are ready for installation. According to industry jargon, "the board is populated with 200 ns 4164's." If your board already contains chips, select the next row of nine sockets and install the chips in that row (see Figure 6). Don't leave any gaps (empty rows). If you are going to install more than 64K (nine chips), test your system after the first 64K is installed. The system should boot up correctly. Once the first installation of 64K works correctly, install the remainder of the memory. The easiest way to insert memory chips is to use a CMOS insertion tool. You can buy one of these inserters for about $10 from an electronics supply store. I use a 14-16 CMOS safe inserter manufactured by OK Machine and Tool Company of Bronx, New York. Insertion tools usually come with complete instructions. When you are ready to insert the chips, review the static prevention measures in "Static Awareness" one more time. If you are not using an inserter, be sure that you do not touch the connector pins.
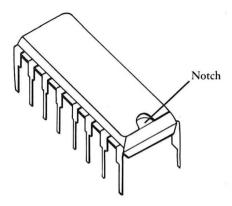
Regardless of the tools you use, avoid bending the connector pins. The chips and the sockets usually form a close fit; install the chips carefully. The trick to easy insertion is to align each pin on the chip with its socket before you push any pin into any socket. If you keep the chip parallel to the socket, you shouldn't have any trouble.

Setting Switches

After you have installed the chips on the memory board, you will have to set two groups of switches. One group is located on the IBM system board (see Figure 8) and the other is on the memory expansion board (see the documentation that accompanies your expansion board). The switches on the memory expansion board indicate the amount of memory on that board; those on the system board indicate the total amount of memory in the system. The total memory in the system includes the 64K located on the system board. If you have a total of 192K in the system, for example, the switches on the memory expansion board will indicate 128K, and the switches on the system board will indicate 192K.

The switches on the system board are located near the floppy disk drive (see Figure 8). There are two groups

Figure 7: Memory Chip

Notch

Static Awareness

Dynamic memory chips can be damaged by static electricity. Take precautions to minimize harmful effects. Your workroom may contain many sources of static electricity. If you frequently receive shocks when you touch doorknobs or metal objects, avoid handling memory chips until you neutralize the static electricity source.

•Don't work in a room that has a carpet made of nylon or another artificial fiber. If you use your PC in a room with this type of carpet, put down an antistatic mat or use some antistatic spray on the floor area around your PC.

•Don't wear polyester clothing. (This may be a good rule for success in business as well as successful memory installation.) Wear cotton clothing and sneakers with rubber, not synthetic, soles.

•Don't wear nylon socks while installing memory chips, and remove your wristwatch before touching the chips.

•Leave the chips in antistatic containers until you are ready to use them, and handle them as little as possible after you remove them.

•Touch only the nonconducting edges when handling the memory board; do not touch the edge connectors.

•Remove any residual charge from your hands by touching a metal object such as the PC chassis before handling memory chips.

•Don't handle pens or coffee cups made of plastic, vinyl, or Styrofoam while you are working.

Figure 8: System Board Memory Switch

— Switches
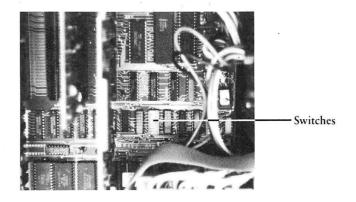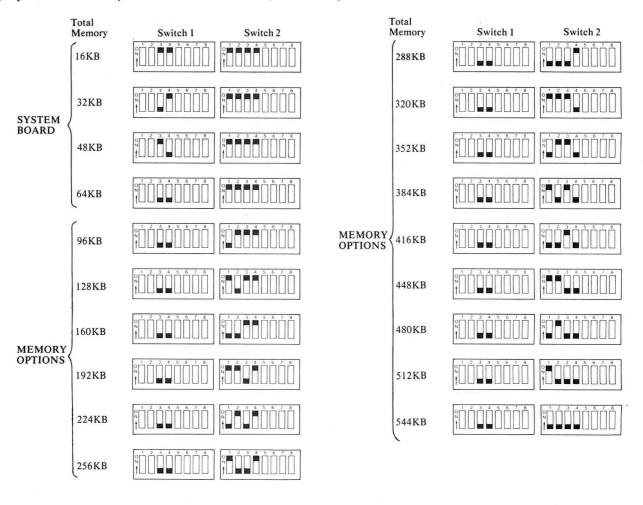
Figure 9: System Board Memory Switch Settings
(Reproduced courtesy of IBM from the IBM Personal Computer Technical Reference Manual)

of eight switches, each of which is encased in blue plastic. In Figure 9 these groups are referred to as Switch 1 and Switch 2 respectively. Determining the correct position of each group of switches is important because they control different peripheral subsystems within the PC.

Look at Figure 9 to find the setting for each switch on the system board (according to the amount of memory you are installing). To set the switches on your expansion board, refer again to the documentation provided by the board manufacturer. These switches are extremely fragile. Tom Yuen of AST Research reports that the major problem with circuit boards is customer damage to resettable switches. Having been warned, be careful.

Closing the Chassis

If you have successfully completed the previous steps, your work is almost complete. Relax and pat yourself on the back, but don't get careless. Put the memory expansion board into the slot from which it was removed. Align the edge connector of the memory board with the expansion adapter on the systems board. Press down firmly on the front and rear of the memory board until it slides into the adapter.

Replace the small screw that fastens the memory board to the chassis. Replace the chassis cover, replace and tighten the two hex nuts, and reconnect the cables.

After you have reassembled your PC, run the diagnostics program that accompanies the system. You are interested in the amount of memory that it reports. This number should correspond to the total amount of memory that your PC contains. There is a slight possibility that your system will refuse to boot up. This problem usually has an explanation: one or more chips are not operating, or you have not set the switches correctly. If you have purchased your chips from a reliable dealer, the switches are the likely problem.

If the switch settings are correct and you still have a problem, be sure that you installed all the chips facing in the proper direction. If you suspect that one or more chips are malfunctioning, you have two options: return the chips to your dealer and have them checked, or reconfigure your PC to its original memory arrangement by removing the chips you installed. Then begin adding chips again, one at a time, until you locate the bad chip(s). A chip is bad if your system won't boot up.

If you have followed the precautions given in "Static Awareness," the possibility that you will have trouble with the chips is minimal.

Once you have installed additional memory, your PC will require additional time to power up. My PC with 320K takes 36 seconds to power up and present a prompt. Your PC will also consume more power after

Bits, Bytes, and Ks

No bits or bytes exist physically inside a computer. Only circuits subject to varying electrical voltages are found there (a theoretical physicist might even deny the existence of voltages). Bits and bytes are simply units used for measuring storage space in either the main memory of computers or on peripheral storage media such as magnetic tape, floppy disks, or hard disks.

A bit is an abstract representation of an internal on or off state inside the computer. It is represented by either a 0 or a 1, and a byte consists of eight consecutive bits. An 8-bit byte can be used to represent any one of 256 characters, such as numbers, letters, or special characters.

One byte, or one character, is a small amount of information. A more common unit of information is 1 kilobyte (1K), which is equivalent to 1,024 bytes.

Another unit of information is the megabyte (MB). One MB is equivalent to 1,024K, or 1,048,576 bytes.

Bits and bytes, however, are too abstract for everyday discussion of computer applications such as accounting problems or video games. Few people talk about the number of bits or bytes in their customer lists, spreadsheet reports, or word processed documents. For these applications the words *bit* and *byte* are translated into terms such as variable, file, document, debit and credit, or card and suit. But for computer memory and storage the abstract bits and bytes serve their purpose just as inches and feet serve theirs for size, length, and distance.

you install additional memory. My electricity bill has increased by about $20 a month since I purchased my PC; I haven't yet determined the amount attributable to add-on memory.

Charles Kelly is a professor in the Business Department at the University of San Diego, where he teaches courses in data processing and finance. He has been working with computers since 1967.

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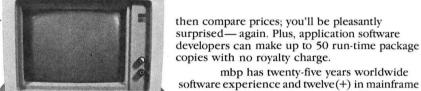
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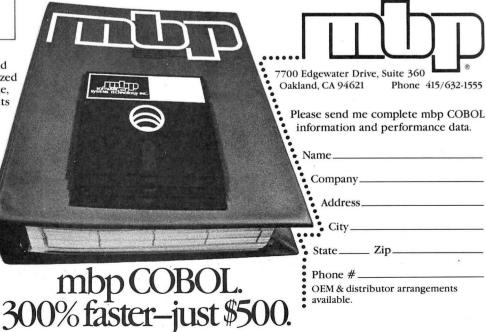
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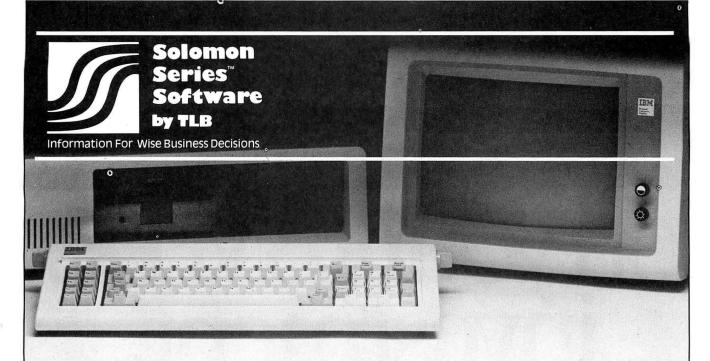
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How the PC Thinks

Exploring the insides of your computer can be a challenging and practical experience.

Peter Norton

Hardly an issue of the weekly news magazines appears that doesn't have an article on computers. The message is clear: computer literacy will be important in the coming years. If you understand how computers work, you will be better equipped to survive in the age of computers.

This series of articles is intended to help you understand the insides of the IBM PC. This is your opportunity to learn about *interrupt*, *stack*, *port*, *segment*, and *memory*. We'll look at the basic workings of the Intel 8088 microprocessor, the brains of the PC, and we'll describe the PC's memory—how it is used to store values and how it is addressed. We'll also discuss the notorious hexadecimal number system and memory segments, as well as PC memory organization.

Memory

The computer, like the human brain, depends on memory to store information. Think of computers as electronic office workers: the microprocessor is the worker; disks are the filing cabinets where information is stored; operating systems, such as PC-DOS or CP/M, are like the worker's general education; and applications programs such as *VisiCalc*

or *WordStar* are like specific job training.

A computer's memory is like a desk top for an office worker. In the same way that a desk top may have a telephone or a dictionary sitting on one corner, part of computer's memory is reserved for fixed uses such as holding part of an operating system. The largest part of the computer's memory is allocated for working storage for programs and data being used at the moment. The computer's memory is a temporary holding place for the work being done.

Computer memory is organized into many storage locations. Each location is like a post office box that can hold values such as numbers or letters of the alphabet. Storage locations are identified by their numerical addresses, just as post office boxes are identified by their numbers.

The size of the locations and the kind of values that can be stored in them vary from computer to computer. Some older computers have very large memory locations called *words*. The Cray super computers and Univac computers are word oriented.

The difficulty with a large word size is that the programs running on the computer often need to work with less than a full word of information, which can be clumsy on a word-oriented computer. Most modern computers, including personal computers, use a smaller storage location made up of 8 bits, called a *byte*.

A bit is the smallest unit of information a computer can handle. (*Bit* is a blend of the phrase *binary digit*.) Bits, binary entities, have two values: zero or one. A string of bits looks like this: 10110001010101. A byte is a handy unit of information because it is the right size to hold a single letter of the alphabet or character (*byte* and *character* are sometimes used interchangeably).

The PC uses storage locations of 1 byte, which can hold any value that can be expressed in bits. This allows

for two to the eighth power of possible values, or 256 values. The way those values are interpreted depends upon the way they are used. A byte could be considered to hold the coding for an alphabetic character or a number. As a number, the 256 possible values could be taken as positive numbers ranging from 0 to 255 or as a signed range of numbers from -128 to +127. On the other hand, a single byte could be used as part of a larger amount of data such as a string of characters or as a 2-byte number.

> The computer's memory is a temporary holding place for the work being done.

To manipulate character data, a computer needs to have the characters translated into byte values in a well-organized code. Most computers, including the PC, use the American Standard Code for Information Interchange (ASCII). Most of IBM's large computers use another character coding scheme known as EBCDIC. ASCII and EBCDIC are organized differently, but translating from one to the other is not difficult.

ASCII assigns numeric values to all the conventionally used characters, such as letters of the alphabet (both upper and lowercase), numeric digits, and punctuation symbols. ASCII also reserves a small number of codes for control purposes such as indicating the end of a string of characters. These special control codes appear mostly in the first 32 ASCII characters, which are referred to in BASIC as CHR$(0) to CHR$(31).

ASCII is a 7-bit code with 128 possible code values. ASCII uses the first 128 of the 256 possible byte values, allowing other purposes to be assigned to the remaining 128 code values to make up an extended ASCII

character set. No standards exist for what the extended codes should be used for, and different computer devices apply them differently. For the PC display, IBM uses the extended ASCII character set to represent mathematical symbols, characters used in languages other than English, and shapes used for graphics. The BASIC program given in Listing 1 displays the PC's special symbols.

The standard IBM dot matrix printer, a version of the Epson MX-80, translates the extended ASCII character codes into printed shapes different from the characters the PC display screen shows. If you run the demonstration program and then use the Print Screen operation to print out the display with an Epson printer, you will be able to compare the display and printer versions of the same extended ASCII character codes.

You can find tables of ASCII character codes and the PC extended ASCII character codes in many places. One table is in the back of the IBM BASIC manual (Appendix G). A very useful form of the table is given in the *IBM Technical Reference* manual (Appendix C).

We have considered how the PC's memory may be used 1 byte at a time, but often several bytes are used to represent more complex values. When strings of characters are needed, the characters are stored 1 character per byte in adjacent memory locations. The first, or left-most, character of a string is stored in the lowest address location.

When integers larger than a single byte are needed, they are stored in several bytes in adjacent locations. The most common format uses 2 bytes, or 16 bits, a convenient size for a 16-bit microprocessor like the PC's 8088. In the terminology of the 8088, a 2-byte integer is a *word*. Many of the instructions in the 8088 are made for manipulating 16-bit numbers. Longer formats can be used (3, 4, or more bytes), but they are not

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⬙ Hands On

as common as 2-byte numbers and require special programming.

When numbers of 2 bytes or more are stored in the 8088's memory, they are placed with the least significant byte first, which is the opposite of what many people are accustomed to. If any of your programs operate on individual bytes in memory, you should be aware of this storage convention.

Memory Addresses

Every memory location has an address. Address numbers begin with zero for the first location and extend to the highest location. Since addresses are numbers, the computer uses its arithmetic abilities to calculate and manipulate memory addresses.

Each computer design has its own limitations on how big addresses can be. The highest possible number for an address determines the size of the address space of the computer, which is determined by how much memory it can use. A computer usually has less actual memory attached than the address space allows. A small address space can put a limit on the problem-solving capability of a computer. Ideally, address spaces are made as large as possible.

The PC makes use of the full address space of its microprocessor's design. In the 8088, addresses are 20 bits—the processor has an address space of 2 to the twentieth power, or a little over 1 million byte locations. In the common K notation for memory, in which each K is made of 1,024 bytes of storage, the PC has an address space of 1,024K; the exact amount in decimal-based numbers is 1,048,576. For a personal computer, that's a lot of room.

Creating such a large address space in the PC enabled IBM to be liberal in its use of memory and to dedicate some portions of memory to special

---

Listing 1:

```
1000  REM                                    Listing 1—A program to display all screen characters
1010  REM                                      From the book "Inside the IBM Personal Computer"
1020  REM                                               (C) Copyright 1982, Peter Norton
1030  REM
1040  GOSUB 2000 ' TITLE
1050  GOSUB 3000 ' GET WHICH DISPLAY TYPE, AND SET ADDRESS
1060  GOSUB 2000 ' SET THE TITLE AGAIN
1070  GOSUB 4000 ' BUILD THE SURROUNDING COMMENTS
1080  GOSUB 5000 ' BUILD THE DISPLAY ARRAY
1090  GOSUB 6000 ' FINISH UP AND RETURN TO DOS

2000  REM    Title subroutine
2010  KEY OFF : CLS : WIDTH 80
2020  REM
2030  PRINT "                       Programs for INSIDE THE IBM PERSONAL COMPUTER"
2040  PRINT "                               (C) Copyright 1982 Peter Norton"
2050  PRINT
2060  PRINT "                    Program 1 : Demonstrate all screen characters"
2999  RETURN

3000  REM    Subroutine to inquire about display type
3010  PRINT
3020  PRINT "Before we go any further, is this a color-graphics display? ";
3030  GOTO 3060
3040  PRINT
3050  PRINT "  (answer Y or N)   ";
3060  ANSWER$ = INKEY$
3070  IF LEN(ANSWER$) < 1 THEN 3060
3080  IF LEN(ANSWER$) > 1 THEN 3040
3090  SEGVAL! = 0
```

purposes. Before we go into that subject, we'll look at how a 16-bit computer is able to work with 20-bit addresses, and see how it places limits on your programs.

Internally, computers always work with binary digits, or bits. Looking at numbers in binary notation isn't very illuminating. With many bits, the numbers get long, and they aren't easy to comprehend, even for experienced users. Hexadecimal notation was invented to make binary numbers more manageable. Don't think that hexadecimal numbers (or *hex* as hexadecimal is called) are different from binary digits inside the computer. Hex is just another way of writing binary numbers for human consumption.

In hex notation, 4 binary digits are represented by a single hex digit. If you take 4 bits and consider all the values that they can have, you will find 16 possible values. In numeric order they are 0000, 0001, 0010 and so on, through 1111. Sixteen different hex digits are used to represent each of the 16 4-bit sequences. The first 10 hex digits are the usual decimal digits, 0 through 9. Letters of the alphabet are used for the final six digits: *A* represents 10, *B*, 11, and so on, through *F*, which represents 15 (see Figure 1).

Since there are 8 bits in a byte and each hex digit represents 4 bits, it takes 2 hex digits to represent a byte. (Since hex digits are half of a byte, they are sometimes called *nibbles*, but this term is used infrequently.) Four hex digits represent a 16-bit word and 5 hex digits represent the 10-bit address used by the PC's 8088 microprocessor.

Segmented Addressing

Most of the arithmetic that the 8088 does is limited to manipulating 16-bit words, which range from 0 to 65,535, or 64K. Since complete addresses are 20 bits long, a practical method had to be devised to control

```
3100  IF MID$(ANSWER$,1,1) = "Y" THEN SEGVAL! = &HB800 ' Color segment
3110  IF MID$(ANSWER$,1,1) = "y" THEN SEGVAL! = &HB800 ' Color segment
3120  IF MID$(ANSWER$,1,1) = "N" THEN SEGVAL! = &HB000 ' Monochrome segment
3130  IF MID$(ANSWER$,1,1) = "n" THEN SEGVAL! = &HB000 ' Monochrome segment
3140  IF SEGVAL! = 0 THEN 3040
3150  DEF SEG = SEGVAL!
3999  RETURN

4000  REM    subroutine to build the surrounding messages
4010  FOR HEX.DIGIT% = 0 TO 15
4020      LOCATE 6,HEX.DIGIT% * 3 + 14
4030      PRINT HEX$(HEX.DIGIT%)
4040      LOCATE HEX.DIGIT% + 8,8
4050      PRINT HEX$(HEX.DIGIT%)
4060  NEXT HEX.DIGIT%
4070  LOCATE ,,0
4999  RETURN

5000  REM    subroutine to set the display array
5010  FOR ROW% = 0 TO 15
5020      FOR COL% = 0 TO 15
5030          POKE (ROW% + 7) * 160 + COL% * 6 + 26, COL% + ROW% * 16
5040      NEXT COL%
5050  NEXT ROW%
5999  RETURN

6000  LOCATE 25,1,1
6010  PRINT "Press any key to return to DOS... ";
6020  IF LEN(INKEY$) = 0 THEN 6020 ' wait for a keystroke
6030  CLS
6999  SYSTEM

9999  REM    End of program listing 1
```

● Hands On

20 bits, working 16 bits at a time. The solution was found in segmented addressing.

If you take a 16-bit number and add 4 binary zeros to it, you have a 20-bit number that can be used as a 20-bit address. By adding 4 zeros or shifting the number 4 binary places, you effectively multiply the number

---

Figure 1: A Summary of Hex

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

---

by 16, and its value can then be as high as 1,024K. Unfortunately, with 4 zeros, a 20-bit number can specify only 1 out of every 16 memory locations, the one whose 20-bit address ends in 4 zeros. None of the other locations with addresses ending in any of the other 15 possible combinations of 4 bits can be specified by that kind of addressing.

To complete the solution to the problem of 20-bit addressing, two 16-bit numbers are used. The first is considered to have 4 binary zeros tacked on to the end, which makes it 20 bits long. This number is called the segment part of the address. The second 16-bit number is used as is. This number is called the relative part

of the address. Added together, the two numbers make up a complete 20-bit address that can locate any of the 1,024K bytes in the PC's address space. The segment value specifies a location called a paragraph boundary that is a multiple of 16. The relative value specifies an exact location some relative distance from the paragraph. (Figure 2 shows how a segmented address is put together.)

While the relative part of the address is needed only to specify the last 4 bits of the 20-bit address, it can have any value from 0 to one less than 64K. Most manipulation of memory addresses is done with the relative part. In effect, the segment part of an address becomes a base location for a 64K working area that the relative part can address.

A segmented address is expressed in a conventional way that you can see in the PC-DOS programming tool called DEBUG and in assembler listings such as the one that appears in the *IBM Technical Reference* manual (Appendix A). The segment part of the address is written first, followed by a colon and the relative part of the address. For example, if you had a segment part that was 2222 (in hex) and a relative part that was 3333, the segmented address would be written 2222:3333. The following addition shows the 20-bit address value, 25553 (in hex):

$$
\begin{array}{r}
22220 \\
+\ \ 3333 \\
\hline
25553.
\end{array}
$$

To make use of these segmented addresses, the 8088 microprocessor has special segment registers dedicated to holding the segment part of addresses. With a value loaded in a segment register, any of the 64K memory locations that follow can be addressed by specifying the relative offset. Without changing the segment register, the computer has a temporary working address space of 64K located within its complete 1,024K address space. By changing the segment register, any location can be addressed.

A computer normally uses its memory for several purposes; some of it is used to hold a program and some is used to hold the data that the program is working on. The 8088 has four segment registers, each with a special use, which allows it to operate with more than 64K at a time. The program, or code segment, is located by using the CS register; for the data segment, the DS register is used; for a special use of memory known as the stack segment, the SS register is used; and to provide some extra capacity, an extra segment (ES)

Figure 2: Assembling a Segmented Address in Hex

First take a segment address word:	1234
Then add a zero to its end (4 binary zeros):	12340
Then take a relative address word:	1234
Add them together for a complete address:	13574

The finished address is 5 hex digits, or 20 bits.

---

register is used.

When a program is prepared to be run, the operating system, such as PC-DOS, decides which paragraph locations will be used for the program code, data, and stack. The segment registers, CS, DS, and SS are set to point to those locations. When running, the program makes use of the segment register values to find its way through memory.

The four segment registers don't have to refer to memory sections located far apart. The registers can point anywhere, even at the same segments. If only a few thousand bytes or program and data are needed, the code and data segments will be placed close together. Although the working portions of the code and data segments are distinct, the 64K spaces addressed by their segment registers can overlap.

If a program doesn't change its segment registers, it is limited to using a total of only 64K for both data and program code. On the other hand, if a program manipulates the segment registers, it can work on data of any size up to 1,024K. Either style of operation can be used, but in practice the data segment register is left fixed, and the code segment register is changed as needed. This particular operation is encouraged by the 8088 instruction set, which provides convenient mechanisms for loading the CS register.

The practical result of this operation is that PC-DOS and the programming language processors use coding conventions that allow programs to grow to any size, while their addressable data space is limited to 64K. If you use either IBM Pascal or the BASIC compiler, you will find that programs can become very big, even larger than 64K, but the data that the programs can work with is limited to 64K.

This limitation for Pascal and the BASIC Compiler programs refers to data in the memory. If your programs are reading and writing from disk files, more than 64K of data can move through the memory. But only 64K of data can be in memory at one time, which is a limitation on the combined size of your program's data variables.

For the interpretive BASIC built into the PC, the interpreter is the actual program that runs, and what you think of as your BASIC program is actually part of the interpreter's data. So for interpretive BASIC, your program is limited to the 64K that the data segment register covers at one time, plus another 64K for the program's data.

The practical result of this situation places some limitations on how much memory you can use. If you use interpretive BASIC, no more than 64K of memory can be used for BASIC programs, regardless of how much memory is in your computer.

If you use compiled programs in languages such as BASIC, Pascal, FORTRAN, or COBOL, however,

≜ Hands On

the programs can grow to any size, although the data is still limited to 64K. On the other hand, a program can have a huge data area if it uses the advanced addressing techniques allowed by assembly language and some other languages.

Not many programs make use of advanced addressing methods; they use conventional addressing methods that leave the DS register fixed. This is why some word processing programs can't work with documents that occupy more than 64K.

Memory Organization

With over a million bytes of address space, the PC has a generous supply of memory. This megabyte potential is organized in an interesting way. Designers of the PC reserved several ranges of the highest numbered memory locations for special purposes and kept all the low memory locations free. Figure 3 shows the allocation of PC memory.

The top quarter of memory from location C000 up to the end is informally reserved for use by read-only memory (ROM). (All references to memory addresses are in hexadecimal unless otherwise indicated.) ROM is used to store permanent programs that are always available for the PC to use. They can't be written over, and they stay in place when the computer is turned off. Ordinary memory, called random access memory (RAM), is used on a temporary basis. The contents of RAM changes, depending on the programs you run on the computer. To run programs stored on disks, you must copy them into RAM; when the computer is turned off, the information stored in RAM is lost.

When the computer is turned on, the ROM programs are ready to be used. Some of the ROM programs test the computer and load the operating system. The testing procedure is called Power-On Self-Test (POST), and loading the operating system is called bootstrap loading, or simply booting.

The highest part of memory is occupied by ROM. The first 8K, beginning at segment FE00, is used by the ROM BIOS (BIOS stands for basic input/output system). The ROM BIOS contains all the fundamental service utilities built into the PC, including the test programs executed when the computer is first turned on. Support programs for peripheral devices like the display, the keyboard, and the disk drives are contained in the BIOS.

The next lower 32K, beginning at segment F600, is used to hold the PC's built-in version of BASIC. BASIC goes into operation when the PC is turned on without a disk in the disk drive. This BASIC that works by itself is Cassette BASIC. The disk versions of BASIC are called Disk BASIC and Advanced BASIC, or BASICA. Essentially, the disk versions of BASIC add extra capabilities to the built-in BASIC.

The BIOS and BASIC interpreter are located in five chips, each containing 8K, plugged into the PC's system board. A sixth chip socket has been left free so that extra ROM can be added. The natural memory location for the extra chip is at

---

Figure 3: Allocation of PC Memory

Hex memory paragraph	Size in k-bytes	Use for the area
FE00	8 K	ROM BIOS (contained in one chip)
F600	32 K	ROM BASIC (contained in three chips)
F400	8 K	reserved for extra ROM socket
F000	16 K	reserved (presumably for ROM)
C000	192 K	future use (ROM/RAM/?)
BC00	16 K	possible expansion of color/graphics
B800	16 K	color/graphics display (all used)
B400	16 K	possible expansion of monochrome
B000	16 K	monochrome display (not all used)
A400	48 K	reserved for future displays
A000	16 K	reserved
1000	576 K	RAM (expansion boards)
0000	64 K	RAM (on system board)
Total:	1024 K	

Figure 4: Amount of Active Memory

Active memory begins at	0		
ends at	8FFF	576 K bytes	(589824 bytes)
Active memory begins at	B000		
ends at	B7FF	32 K bytes	(32768 bytes)
Active memory begins at	F600		
ends at	FFFF	40 K bytes	(40960 bytes)

Finished

---

segment F400. Any of the PC memory space can be used for additional ROM, but to follow the general ground rules for PC memory usage, any ROM should be located above segment C000.

Below ROM is a large block of memory space dedicated to the PC display. The display memory is part of the computer's overall memory, although it is physically located on the display expansion board, or adapter. Beginning at segment address B000, the display memory extends for 64K up to segment C000. The display memory is divided into two parts: the lower half, at segment B000, is used by the monochrome adapter, and the upper half, at segment B800, is used by the color/graphics adapter.

Neither of the two display adapters uses the full 32K of space allotted to it. The monochrome adapter uses only 4K, and the color/graphics adapter uses 16K. With the IBM monochrome and color/graphics adapters, the leftover spaces remain unused, but other display adapters may be added for enhanced display formats. Enhanced display formats might include a 132-column screen, high-resolution monochrome graphics, or additional character sets such as italics.

The 64K block below segment B000 extending to C000 is also reserved for display memory. According to IBM documentation, the A000 block is reserved in two ways. The first 16K, from A000 to A400, is reserved with no explanation given for its intended purpose. The remaining 48K of the A000 block, from

> Explore your system, poke around in its dustier corners, and you will gain a world of insight into how the PC works

A400 up to B000, is part of a full 112K area reserved for display memory.

The complete display memory area goes from A400 to C000, 112K of memory. One might speculate that this large area, especially the 48K in the A000 block, is intended for a new higher resolution display adapter that would require more memory than the original monochrome and color/graphics display adapters. An additional 16K is located at the bottom of the A000 block, but it is not reserved as part of the display memory area.

Below segment A000, 640K of address space is available for RAM. The first 64K up to segment 1000 is located on the system board, and additional memory is located on expansion boards. All of the ordinary RAM installed in the PC is located in the low address locations of the memory address space. You can have almost as much memory installed as you want, up to the limits set by the reserved ROM and display memory locations. Whether you have only 48K, or 576K, the RAM on your computer occupies the low memory locations, beginning at zero (segment 0000) up to the highest address of your RAM.

The lowest part of RAM, starting at memory location zero (0000) and extending for about 1500 bytes, is dedicated to fundamental operating information for the computer. The first part of this area holds interrupt vectors. Following the interrupt vectors is data for the BIOS, DOS, and BASIC. After these reserved parts of low memory, the ordinary part of RAM begins, where programs are loaded into memory and where the programs' working storage is placed.

In between RAM and ROM is the special-purpose display memory. There are gaps in the memory between the end of the RAM and the display memory, and between the display memory and the ROM area.

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These gaps are inactive parts of the PC's address space, ready to be used whenever more memory is installed.

Exploring Memory

You can explore the memory in your PC to discover how much is present and where it is located in the address space. One way to test memory is to try to read from each memory location and then check the results. When this test is carried out with DEBUG or Pascal programs, the result is that all the bits are set (or that each bit has the value 1), which is the same as hex FF, or decimal 255. This result isn't too surprising. The most likely result from reading missing memory is all bits off, or all bits on. For some reason, when the test is run with BASIC, the result is usually decimal 233.

We can take advantage of this quirk to check the entire PC address space for active memory. Listing 2 shows a simple BASIC program that reads a few bytes from each 1K of memory and checks them for the decimal 233 value. If you run this program on your system, it will show you how much active memory you have. Figure 4 shows the results from a sample run of this program.

Notice in Figure 4 that three blocks of memory were detected. The first block, RAM, begins at segment 0. In this example, the first block is 576K because the memory consists of the standard 64K on the system board and an expansion board containing 512K.

The second block of active memory begins at segment B000, which is where the monochrome display memory is located. This information shows that the system has the monochrome display. Notice that the program interprets this memory as

---

Listing 2:

```
1000  REM                                    A program to scan for and report active memory
1010  REM                                              (C) Copyright 1982, Peter Norton
1020  REM
1030  GOSUB 2000    '  TITLE
1040  GOSUB 3000    '  SEARCH AND DISPLAY
1050  GOSUB 4000    '  RETURN TO DOS

2000  REM    Title subroutine
2010  KEY OFF : CLS : WIDTH 80
2020  REM
2030  PRINT "                          Programs for INSIDE THE IBM PERSONAL COMPUTER"
2040  PRINT "                                    (C) Copyright 1982 Peter Norton"
2050  PRINT
2060  PRINT "                               Find and Display Active Memory"
2070  PRINT
2080  PRINT "                          Be patient—this program takes 65 seconds"
2090  PRINT "              (Addresses given as segment paragraphs in hexadecimal)"
2100  PRINT
2999  RETURN

3000  REM    Subroutine for the main search and display
3010  TRUE.%  =  -1
3020  FALSE.% =   0
3030  IN.MEMORY.% = FALSE.%
3040  FOR PARAGRAPH.! = 0 TO 65535! STEP 64 ' CHECK EACH 1K OF MEMORY
3050     GOSUB 5000    '   CHECK FOR ACTIVE MEMORY
3060     IF (IN.MEMORY.%=FALSE.%)   AND   (MEMORY.HERE.%=TRUE.%)   THEN GOSUB 6000
3070     IF (IN.MEMORY.%=TRUE.%)    AND   (MEMORY.HERE.%=FALSE.%)  THEN GOSUB 7000
3080     IN.MEMORY.% = FALSE.%
3090     IF MEMORY.HERE.% THEN IN.MEMORY.% = TRUE.%
3100  NEXT PARAGRAPH.!
3110  IF IN.MEMORY.% THEN PARAGRAPH.! = 65536 : GOSUB 7000
3999  RETURN

4000  REM    Subroutine to finish up
```

---

extending for 32K even though the monochrome adapter contains only 4K. The extra 28K detected by the program is probably a side effect of the circuitry that supports the 4K of real memory. Running this program on a system with the color/graphics adapter also shows 32K of memory, although only 16K is present on the color/graphics adapter. After the display adapter memory, the program detects the ROM at the high end of the address space. For this last block, like the first one, the program detected exactly what was present.

While this is a useful program for exploring your system's memory, it is also an example of what you can do to learn about your PC. IBM didn't advertise that BASIC finds the decimal 233 value in missing memory. But with a little exploration, the program shown in Listing 2 was produced. This is the sort of thing you should do on your own. Explore your system, poke around in its dustier corners, and you will gain a world of insight into how the PC works. Be forewarned that some non-IBM memory boards give curious results when this test program is run. That's another way that you can learn more about your system.

The next article in this series will cover four topics: registers, interrupts, stacks, and ports. They are the keys to the way the IBM PC gets its work done.

```
4010  PRINT
4020  PRINT "Finished."
4999  SYSTEM

5000  REM   Check for memory present—sample the first four bytes
5010  DEF SEG = PARAGRAPH.!
5020  BYTE0.% = PEEK (0)
5030  BYTE1.% = PEEK (1)
5040  BYTE2.% = PEEK (2)
5050  BYTE3.% = PEEK (3)
5060  CHECK.COUNT.% = 0
5070  IF BYTE0.% = 233 THEN CHECK.COUNT.% = CHECK.COUNT.% + 1
5080  IF BYTE1.% = 233 THEN CHECK.COUNT.% = CHECK.COUNT.% + 1
5090  IF BYTE2.% = 233 THEN CHECK.COUNT.% = CHECK.COUNT.% + 1
5100  IF BYTE3.% = 233 THEN CHECK.COUNT.% = CHECK.COUNT.% + 1
5110  MEMORY.HERE.% = FALSE.%
5120  IF CHECK.COUNT.% <= 3 THEN MEMORY.HERE.% = TRUE.%
5999  RETURN

6000  REM   Subroutine to start an active block of memory
6010  IN.MEMORY.% = TRUE.%
6020  START.! = PARAGRAPH.!
6999  RETURN

7000  REM   Subroutine to end a block of active memory
7010  SIZE.! = (PARAGRAPH.! − START.!) * 16
7020  IF SIZE.! < 8 * 1024 THEN 7999   '   SUPPRESS SMALL-BLOCK FALSE REPORTS
7030  PRINT "Active memory begins at ",
7040  PRINT HEX$(START.!)
7050  PRINT "                                    ends at ",
7060  PRINT HEX$(PARAGRAPH.! − 1);
7070  PRINT SIZE.! / 1024;"K-bytes";" (";SIZE.!;"bytes   )"
7080  IN.MEMORY.% = FALSE.%
7090  PRINT
7999  RETURN

9999  REM   End of program listing to explore memory
```

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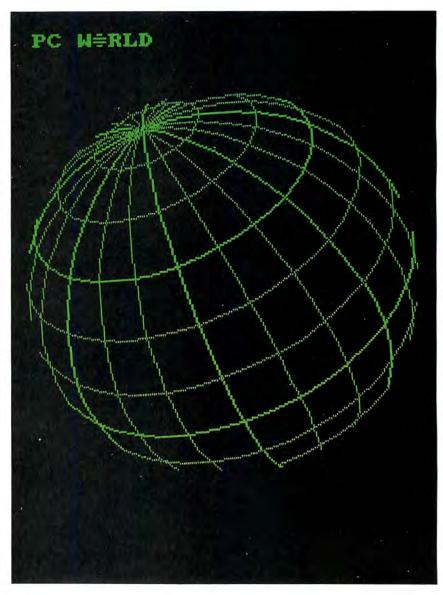
Karl Koessel

Last month an artist at *PC WORLD* asked me if I could create an image of the globe on the graphics monitor of the IBM PC. Although producing continental outlines would be an arduous task, the globular image suggested by the intersection of meridians and parallels, spaced every 15 degrees and drawn in perspective, seemed feasible. As he sketched an example of the globe, he told me he wasn't sure what size, portion, tilt, or screen position would be needed. This ruled out the possibility of drawing a single etch-a-sketch-type image, and I realized that what he needed was a program that would allow him to designate any orientation and then draw the appropriate image. With this type of program he could create and observe any number of different images and use whichever he preferred. A day and a half later I finished the program. I was amazed at how short and simple it turned out (see Listing 1).

Load BASICA and type in the program. As always, reproduce the listing exactly. Many of the lines are very similar; take care.

Where In the World Are You?
The program contains sample data (see Figure 1) so that you can see one of the possible orientations without having to enter workable values (no checks are provided for improper

entries). Run the sample by answering 'Want to see a sample run (Y/N) ?' with 'yes', and study the queries and their sample responses.

The 'screen location of center of globe' values position the image on the screen. For the sample run, the values of XC (160) and YC (100) place the center of the image at the center of the screen. Smaller values of XC move the image to the left, and larger values to the right. Smaller values of YC move the image up, and larger values down.

The 'relative coordinates of observer' position the point of observation relative to the center of the image of the globe. This positioning is analogous to your seat number, floor, and row at a symphony concert: XOBS (seat) is your position to the right of center when positive (or left of center when negative), YOBS (floor) is your position above the stage when positive (or below when negative), and ZOBS (row) is your position away from the stage. ZOBS must be larger than the radius of the globe (you can't see the orchestra if you're sitting in it). In other words, you may use any values for XOBS and YOBS, but ZOBS must be positive and larger than the radius.

The 'parallel, meridian, & image's tilt' values position the globe to a specified orientation. The first and second parameters (XROT and YROT) of this input determine the parallel (positive values are north, negative values are south) and meridian (positive values are east, negative values are west) that will cross at the image's center (assuming XOBS = 0 and YOBS = 0). The third parameter (ZROT) is the number of degrees counterclockwise to turn the screen image around its center.

The 'sphere's radius' may be any positive value, but remember that ZOBS (observer's distance away from the screen) must be larger than the radius. All of these values are entered in terms of the 320 horizontal and 200 vertical pixels of the PC's medium-resolution graphics mode.

The background color on the PC is chosen by a number from 0 to 15. Zero (black), one (blue), eight (gray), and nine (light blue) are the best choices; other values may match the color of some of the longitude/latitude lines, rendering them invisible.

The screen's aspect ratio (see the IBM BASIC manual, 4-37 and 4-72) is the actual length of a number of vertical pixels divided by the actual length of the same number of horizontal pixels. The value you input must be a single number, not a ratio (e.g., 1.21875, not 19.5/16). Different graphics monitors have different aspect ratios. The sample run uses the value 1.21875, but you should normally enter the correct value for your display. If you do not know your monitor's aspect ratio, stop the program (press Ctrl-ScrollLock), and type in this direct command: CLS:DRAW "BM20,OR199D199L199U199" then press ENTER. Get a ruler and measure the lines on the display, and then calculate: aspect ratio = vertical length/horizontal length. Write it down, type CONT, and press ENTER.

He needed a program that would allow him to designate any orientation and then draw the appropriate image.

Enter the screen's calculated aspect ratio, get up, and stretch. Approximately 4 1/2 minutes are required to draw the globe.

Global Notes

If you choose values that keep the globe's image within the screen boundaries, you can cut the program's execution time about 6 to 7 percent by placing an apostrophe in front of 'Q =' on line 820 and in front of 'LX =' on line 840.

If you want the globe drawn in only one color, add the following line:

855 C$ = "3"

You may use a 1 or a 2 instead of the 3 between the double-quotes. See the IBM BASIC manual (4-47) for a list of actual colors drawn for different combinations of color values and palette values.

If you want to see the back side of the globe drawn as well as the front (as if you could see through the globe), place an apostrophe in front of 'IF' on line 810.

I hope this brief example has helped to demonstrate that with a little bit of programming, your PC world is what you make it.

Figure 1: Screen Dump of the Program's Queries As Answered by the Sample Run

Perspective Image of Rotated Globe

Want to see a sample run (Y/N)
? yes

Enter screen location of center of globe
(e.g. 160,100)   ? 160 , 100

Enter relative coordinates of
    observer:
points left(−) / right(+) of X,
below(−) / above(+) Y,
and distance from the screen
(e.g. − 9,0,456)   ? − 9 , 0 , 456

Enter parallel, meridian, & image's tilt
(e.g. 37, − 123,23)   ? 37 , − 123 , 23

Enter sphere's radius
(e.g. 100)   ? 100

Enter background color and palette
(e.g. 1,1)   ? 1 , 1

Enter this screen's aspect ratio
(e.g. 1.21875)   ? 1.21875

Hit Any Key To Continue

Listing 1.

```
10   SCREEN 1                                              'PC WORLD
20   CLS:KEY OFF                                           'Karl Koessel
30   PRINT "                                               Perspective Image of Rotated Globe"
40   DEFINT L,R,X − Z
50   CX = CY:CZ = SX:SY = SZ:I = J:R = A:B = C:A1 = B2:C1 = C2      'Order variables to optimize
60   A3 = B3:X = Y:XC = YC:LX = LY:B$ = C$:RC = PI:LZ = ZS:Q = DR   'speed, about 3% faster
70   DIM RC(11)
80   FOR X = 1 TO 11                                       'Prepare an array holding the
90        RC(X) = (X − 1) MOD 3 + 1                        'colors of parallels; pattern
100       IF X>6 THEN RC(X) = (5 − RC(X)) MOD 3 + 1        'reverses after equator which
110  NEXT                                                  'is brown or white (palette 0 or 1)
120  PI = 3.14159265#
130  CF = PI/180#
140  PRINT
150  INPUT "Want to see a sample run (Y/N) ";S$
160  S$ = LEFT$(S$,1)
170  IF S$ = "y" OR S$ = "Y" THEN GOSUB 880:GOTO 380
180  PRINT
190  PRINT "Enter screen location of center of globe";
200  INPUT "(e.g. 160,100)                ";XC,YC
210  PRINT
220  PRINT "Enter relative coordinates of observer:";
230  PRINT "points left( − )/right( + ) of X, below( − )/";
240  PRINT "above( + ) Y, and distance from the screen";
250  INPUT "(e.g.  − 9,0,456)              ";XOBS,YOBS,ZOBS
260  PRINT
270  PRINT "Enter parallel, meridian, & image's tilt";
280  INPUT "(e.g. 37, − 123,23)            ";XROT,YROT,ZROT
290  PRINT
300  PRINT "Enter sphere's radius"
310  INPUT "(e.g. 100)                     ";R
320  PRINT
330  PRINT "Enter background color and palette"
340  INPUT "(e.g., 1,1)                    ";BCK,PAL
350  PRINT
360  PRINT "Enter this screen's aspect ratio"
370  INPUT "(e.g. 1.21875)                 ";ASP
380  CX = COS(CF*XROT + ATN(YOBS/ZOBS)):SX = SIN(CF*XROT + ATN(YOBS/ZOBS))
390  CY = COS(CF*YROT + ATN(XOBS/ZOBS)):SY = SIN(CF*YROT + ATN(XOBS/ZOBS))
400  CZ = COS(CF*ZROT):SZ = SIN(CF*ZROT)
410  ZOBS = SQR(XOBS^2 + YOBS^2 + ZOBS^2)                  'Observer's distance from globe's center
420  ZS = R^2/ZOBS                                         'Can't see if point's Z coordinate < ZS
430  CLS:COLOR BCK,PAL
440  FOR I = 0 TO 3 STEP PI/12                             '24 lines of longitude around poles
450       RC = (I*12/PI + 2) MOD 3 + 1                     'Prime meridian color = equator color
460       C$ = STR$(RC)
470       FOR J = 0 TO 2.0001*PI STEP PI/24                'Step along the meridian circle
480            A = R*SIN(I)*SIN(J)
490            B = R*COS(J)
500            C = R*COS(I)*SIN(J)
510            GOSUB 710
520            GOSUB 810
530       NEXT
540  NEXT
550  FOR I = PI/12 TO 11*PI/12 STEP PI/12                  '11 lines of latitude between poles
560       RC = RC(I*12/PI)                                 'From array of parallels' colors
570       C$ = STR$(RC)
580       FOR J = 0 TO 2.0001*PI STEP PI/24                'Step along the parallel circle
590            A = R*SIN(I)*SIN(J)
600            B = R*COS(I)
```

```
610              C = R*SIN(I)*COS(J)
620              GOSUB 710
630              GOSUB 810
640       NEXT
650   NEXT
660   LOCATE 1,1:PRINT "PC WORLD"
670   LINE (32,1) − (38,1),0:LINE (32,2) − (38,2),3
680   LINE (32,3) − (38,3),0:LINE (32,4) − (38,4),3
690   LINE (32,5) − (38,5),0
700   GOSUB 1160:GOTO 1190
710   A1 = A*CY − C*SY                             'Turn requested meridian to observer at 0,0,0
720   C1 = A*SY + C*CY                             '(B1 = B, so B is used below for B1)
730   B2 = B*CX − C1*SX                            'Turn requested parallel to observer at 0,0,0
740   C2 = B*SX + C1*CX                            '(A2 = A1, so A1 is used below for A2)
750   A3 = A1*CZ − B2*SZ                           'Turn image on axis perpendicular to screen
760   B3 = A1*SZ + B2*CZ                           '(C3 = C2, so C2 is used below for C3)
770   DR = C2/(ZOBS − C2) + 1                      'Distance ratio for computing perspective
780   X = INT(A3*DR*ASP + XC)                      'Screen's x (with perspective & aspect ratios)
790   Y = INT(B3* − DR + YC)                       'Screen's y (with perspective, direction ratio)
800   RETURN                                       '(Z = C3 = C2, so C2 is used below for Z)
810   IF C2<ZS OR LZ<ZS THEN B$ = "BC":GOTO 840    'Insert ' before IF to draw back
820   Q = (X<0) + (X>319) + (Y<0) + (Y>199) + (LX<0) + (LX>319) +
      (LY <0) + (LY>199)                           'Off screen?
830   IF Q + (J = 0) THEN B$ = "BC" ELSE B$ = "C"  'Draw clear if Q or J = 0 (new circle)
840   LX = X:LY = Y                                'LX,LY,LZ are X,Y,Z of last referenced point
850   LZ = C2
860   DRAW B$ + C$ + "M" + STR$(X) + "," + STR$(Y)
870   RETURN
880   XC = 160:YC = 100                            'Data for sample run
890   XOBS = − 9:YOBS = 0:ZOBS = 456
900   XROT = 37:YROT = − 123:ZROT = 23
910   R = 100
920   BCK = 1:PAL = 1
930   ASP = 1.21875
940   LOCATE 5,1                                   'Screen for sample run
950   PRINT "Enter screen location of center of globe";
960   PRINT "(e.g. 160,100)                        ?";XC","YC
970   PRINT
980   PRINT "Enter relative coordinates of observer:";
990   PRINT "points left( − )/right( + ) of X, below( − )/";
1000  PRINT "above( + ) Y, and distance from the screen";
1010  PRINT "(e.g. − 9,0,456)                  ?";XOBS","YOBS","ZOBS
1020  PRINT
1030  PRINT "Enter parallel, meridian, & image's tilt";
1040  PRINT "(e.g. 37, − 123,23)               ?";XROT","YROT","ZROT
1050  PRINT
1060  PRINT "Enter sphere's radius"
1070  PRINT "(e.g. 100)                 ?";R
1080  PRINT
1090  PRINT "Enter background color and palette"
1100  PRINT "(e.g. 1,1)                 ?";BCK","PAL
1110  PRINT
1120  PRINT "Enter this screen's aspect ratio"
1130  PRINT "(e.g. 1.21875)            ?";ASP
1140  LOCATE 25,1
1150  PRINT "HIT ANY KEY TO CONTINUE";
1160  IF INKEY$>"" THEN 1160
1170  IF INKEY$ = "" THEN 1170
1180  RETURN
1190  SCREEN 0,0,0,0:KEY ON
1200  END
```

Bob Frankston at 30,000 Feet

Lawrence J. Magid

The boarding area for PSA flight 825 was jammed as weary COMDEX attendees waited for the plane that would take them from Las Vegas to Los Angeles and on to San Francisco. The airline hadn't called the flight yet, so most passengers were sprawled out in chairs throughout the waiting area. In this chaotic environment a small group lined up near the boarding gate, prepared to be the first on the plane. I recognized one of them as Bob Frankston.

Frankston knows what it's like to be first in line. Along with partner Dan Bricklin he wrote the first successful microcomputer business program. Four years after entering the software market, _VisiCalc_ continues to be the hottest-selling program ever written except for games.

After four days at COMDEX I was exhausted and hardly in the mood to talk about computers, but I couldn't resist saying hello to one of the people responsible for launching the microcomputer software industry. I joined him in line and sat with him for the 3-hour trip that was to take me home and Frankston on a 2-day visit to Palo Alto, California.

Frankston is still programming, and he and Bricklin now head up Software Arts, a company with almost 100 employees. The company's goal is to develop systems that go beyond applications programs. Just as _VisiCalc_ broke new ground in 1978, Frankston hopes his new products will do the same in the 1980s.

The company's new program, _TK!Solver_, allows you to reduce formulas to simple words and use those words as variables in any equations. The program is simpler than _VisiCalc_ and offers features such as automatic measurement unit conversion, iterative solving (guessing until the program converges on a solution), solving for any element in an equation, and built-in math and business functions. It also has a help facility that provides assistance at the touch of the question mark key. The exclamation mark in _TK!Solver_ stands for the

key you press to solve an equation. This key is the same one used in _VisiCalc_ to calculate a result.

Get Frankston on the subject of computers and it's like talking to a kid on his first encounter with a home video game. He bubbles with the kind of excitement most of us experienced the first time we put our hands on this magic technology, but he is far from being a newcomer. At age 33 he has been programming for more than 20 years.

Somewhere over the San Bernardino mountains, 20 minutes out of Las Vegas, Frankston asked me what I planned to write about COMDEX. I told him that the conversation we were having was the most interesting part of my trip and that I was tempted to turn on my tape recorder and write about him. He said he wouldn't mind, so I pulled out the microcassette recorder from my coat pocket.

Magid: You and Dan [Bricklin] have had a very successful business with VisiCalc, _but you got to the point where you decided to do something new. How did that process happen?_

Frankston: A number of things happened. We haven't stopped working on _VisiCalc_, but we recognize that we can't do one thing forever, especially in this competitive field. I'm pleasantly surprised at how long it took people to copy _VisiCalc_. Even though we knew there would be competition. Many people are trying to stay one step ahead of everybody. They're all going to be at our heels for different reasons.

From the beginning we knew we wanted to become a full company. We're not just programmers hiding in the back room; we're set up to do documentation, support, and marketing. And if you want to get good people, you have to be involved in other areas.

Magid: Like maintaining creativity?

Frankston: Yes. It's one thing to expand in _VisiCalc_, but we need more than that. In fact, _TK!Solver_ in some ways looks a little more like _VisiCalc_ than I would have

liked. We don't want to be locked into our history—that's another reason to branch out. We want to be compatible with *VisiCalc*, but we also want to innovate and get at new markets.

Magid: What are some of those new markets?

Frankston: For one thing, we want to provide *TK!Solver* on different manufacturers' systems. In the past people wrote their own spreadsheets as part of a package along with a word processor, a data base, and a graphics program. Why should they do their own solver? We can supply solvers to their operating system. Besides, our solver has readily available specialized mathematical expertise.

Magid: Are you going to bundle TK!Solver *with some of the multipurpose programs like MBA or 1-2-3?*

'We see ourselves as a consumer product company that is helping to change the image of computers.'

Frankston: It's possible. We're also considering converting to different operating systems.

Magid: Could a software company with a word processor and a spreadsheet insert TK!Solver *into the system?*

Frankston: Yes, but that's no small process. We'd have to work together.

Magid: When I think of Bob Frankston, I think of this guy in a T-shirt and blue jeans sitting at a terminal, happy as a clam and not relating to the outside world. Now you're president of a large corporation, handling a wide range of marketing activities. How do you explain this transformation?

Frankston: While I was at MIT, I created things that were useful. Now my goal is to make them available. Sure, I get a thrill writing algorithms, but I get satisfaction when people use them. Programming is part of that process, but not all of it.

Magid: Do you still program?

Frankston: I do a lot of programming, sometimes to relax. When I wake up in the morning, I often write a program to get myself moving and to do something useful. That's had a good effect; I'm not the only one in the company doing it. As a result, we've developed many in-house tools. We built a text editor as a side project, which DEC [Digital Equipment Corporation] is now selling as their standard screen editor.

Magid: How long did it take you to write that program?

Frankston: I wrote it during evenings over a couple of months, working at home and at the office.

Magid: What computer do you use at home?

Frankston: I have an Apple and an IBM PC at home, and I've got a terminal in the office. I spend a lot of my time on the mainframe. We have an environment on the mainframe that lets us develop tools and then convert them to use with micros. The issue is not the size of the machine, but how willing you are to provide availability and interaction.

Magid: You and Dan must have millions of dollars invested in this system. Do you have outside capital?

Frankston: No, it's all from *VisiCalc*.

Magid: So you're taking a large calculated risk?

Frankston: Yes, we are. Much of the capital is invested in building the company. *TK!Solver* is a two-part investment: *TK!Solver* itself and the development of languages and programming tools for *TK!Solver* and other products. We're also developing marketing channels.

Magid: How do you see Software Arts fitting in with the other software companies?

Frankston: We see ourselves as a consumer product company that is helping to change the image of computers. We see the computer becoming more invisible, as it already is in devices like microwave ovens and television sets.

Magid: What do you know about the international software market?

Frankston: We're just getting into that area. Americans are very provincial. When gas stations went to litres, they had to revert to gallons because people didn't want to adapt to a foreign concept. There are obvious exceptions. Commodore, at least, recognizes an international market.

Magid: How does that tie in with the software business?

Frankston: I think software has to be an international business at some point. I want to learn more so we can offer useful products in all countries.

Magid: It would seem to me that TK!Solver *and* VisiCalc *aren't that restricted by language or national differences.*

Frankston: There are some problems. One thing we have in our favor is that English is, in some ways, an international language, but that makes it too easy to be provincial. We need to make sure that a program's introductory manual, at least, is written in the native language. We also have to deal with different standards of money and measurement.

We plan to support our programs internationally and make the appropriate translations. As to which languages and when, that is a question that involves the allocation of resources, as in any other business decision.

Magid: Many companies in the computer industry don't practice what they preach. I know one company that makes a word processing program, but they still use typewriters for most correspondence.

Frankston: I know, it's silly. I'm trying to create an environment at the office that is more advanced and to get people used to the fact that everyone has a terminal.

Magid: Everyone?

Frankston: Everyone. No exceptions. If you want to get something fixed by the janitor, you send electronic mail—that's how we get our messages. Everyone logs into the system, and the system knows who you are and what you have access to.

Magid: How does the IBM PC tie in with your office communications network?

Frankston: Currently we're using RS-232 interfaces. We've written our own terminal program for the PC that serves to exchange files with our Prime mainframe. We have a mixture of terminals connected to the mainframe via our Ethernet, and the PCs are connected via this network. We can move files between the systems and ship programs to the micros so we can run them there. By having everything connected, we can use electronic mail to coordinate the systems.

We can also access common files so that people can work together on projects. It's fine for personal computers to speak to each other, but if you're going to speak to other computers, you need a system that everyone is hooked into.

Magid: So it really doesn't matter what you're using as a terminal?

Frankston: Right. Typically, it's the program of both the terminal and the micro. That's how we can use the mainframe to write programs that will work on a variety of micros. We have an editor that allows you to look at listings. The editor translates the locations in the listings and shows the corresponding values for the micro. This

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'I'm amazed when people force things into the spreadsheet model; it might not be appropriate, but it's accessible.'

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allows us to do symbolic debugging even with simple debuggers on the micros.

Magid: You guys are very good when it comes to computers, but what if you were in a different business? Would you still be using them?

Frankston: That would depend on how accessible the tools were. Businesses have been using word processors for years. Then we made spreadsheets accessible. How you make computers accessible and usable is becoming a common theme.

Magid: When I first got VisiCalc, I used it to determine what kind of car to buy. I wanted to control for all the costs associated with owning and driving a car. I had to enter new data for each possibility, though I eventually got the results I needed. Could I have done that with TK!Solver?

Frankston: Yes. Your calculations would have been easier and more accurate with *TK!Solver*. What you had were formulas that you kept applying to different numbers. *TK!Solver* would have allowed you to run all the options in one operation.

Magid: So I wouldn't have had to play the "what if" game manually for each possibility?

Frankston: Right. The program iterates. It settles on a solution. You've hit upon the whole problem we're going to have. You did a mathematical model because *VisiCalc* was accessible to you. *VisiCalc* helped you solve the problem, but *TK!Solver* sounds like the more appropriate tool.

Magid: It was easier than writing a program in BASIC.

Frankston: You could have used pencil and paper or a slide rule. The point is, people applied other methods before *VisiCalc*, so it's not that *VisiCalc* made it all suddenly possible. The difference is that people didn't have the spreadsheet. You would have still made a decision on which car to buy, but you might not have made the same decision. People win and lose on the stock market with or without *VisiCalc*. I'm amazed when people force things into the spreadsheet model; it might not be appropriate, but it's accessible.

Magid: They use it for everything. I once saw someone using VisiCalc *as a word processor on the Apple.*

Frankston: Yes, that's another lesson. People will gravitate toward the lamp post.

Magid: What do you mean, lamp post?

Frankston: Picture a drunk under a lamp post looking for a key. Someone offers to help and asks where he lost the key. The drunk says, "Down the street," but he is searching under the lamp.

Magid: What is the conceptual difference between VisiCalc *and* TK!Solver?

Frankston: *TK!Solver* allows you to do different things, such as playing with relationships. In your car buying model, for example, you made so much effort putting your equations into *VisiCalc*. What if you wanted to change the rules? If you wanted to look at the problem a different way, you'd be playing with the model. You're placing constraints on the model, such as the number of years you want for the payments.

Magid: In other words, I limited my problem and solution by the tools that I had. I suppose I could have developed a broader problem, such as how much I'm going to have to spend on transportation over the next ten years.

Frankston: Exactly. *TK!Solver* can also run the years through. It will produce tables and plot them.

Magid: How long would that calculation take with TK!Solver?

Frankston: A few minutes.

Magid: With VisiCalc *it would have taken me a few hours.*

Frankston: With *TK!Solver*, once you know the formulas, you just type them in and the program applies them to the problem.

Magid: Do you think VisiCalc *and* TK!Solver *encourage creativity?*

Frankston: I think, in some ways, *TK!Solver* is much more interesting for exploring and playing with ideas. The problem with spreadsheets is that you put in the idea and project it out, but you're still limited by your model.

Magid: It's interesting when you talk about changing your rules. In graduate school you're taught to defend your models. The data can be garbage, but the model is sacred. People write dissertations based on models. I wonder if we're going to be seeing a different concept of what knowledge is.

Frankston: Universities will no longer approve a dissertation because someone spent 90 percent of his time on a Monroe calculator. You can spend 5 minutes with your numbers and the rest of your time interpreting them.

Magid: Does that mean we're going to have to be smarter to get Ph.D.'s, or that we're already smart and will have time to produce something more creative?

Frankston: We'll accomplish something for a change.

Magid: That is true. When I did my dissertation, I spent most of my time collecting and analyzing data. My thesis had nothing to do with computers, but the process forced me to learn to use a mainframe, and that led me to buy an Apple and learn BASIC. In the end I learned more about computers than I did about social research.

Frankston: That's why this phenomenon is happening. If you'd known about computers when you were an undergraduate, you might have gone in that direction.

Magid: I might have, but when I went to Berkeley in the sixties, computer jocks were looked on as boring. Maybe they weren't, but that was my impression.

Frankston: Many people were saying that the arts are more significant than engineering or the sciences. What's the difference between engineering and art? It's one thing for people to argue whether art is ugly or not. You can argue whether a design is elegant, but you can also say "this works" or "this doesn't." You have to refine your sense of aesthetics and realize that there is an aesthetic sense with things you might not be able to quantify.

I see an analogy between engineering and other aesthetic pursuits. If you understand music, for example, you'll see nuances that a casual listener will miss. There

is a lot of excitement in engineering also. Much of it comes from accomplishments and an aesthetic appreciation. Engineering and other sciences can be a social refuge for the nerd or the computer jock; you can get involved without having to overcome social reticence. But this doesn't mean that the field is dull. In fact, many of these areas are very exciting, and the nerd has the advantage in getting involved earlier in life and getting an opportunity to build on the knowledge.

You can look at a set of numbers and just see numbers, or you can see beyond them to the knowledge they represent, and then build on that knowledge.

Magid: How has your life changed since VisiCalc *became a best-seller?*

Frankston: I've got Software Arts to play at, I don't get as much time to go folk dancing, and I did buy a house and become middle class. I have a kid now, but I can't blame Software Arts for that.

Magid: You and Dan impress me as being the least pretentious of all the computer entrepreneurs I've met. You hardly seem like the folk hero that some magazines make you out to be.

Frankston: Some people are intimidated by me, and that is a problem because I want to sit down and work on technical matters or spend some time working with people on projects. I want to be able to give suggestions and participate in the work; at times I might say something stupid, and I'd like someone to point that out to me.

Magid: Tell me a little about your education.

Frankston: I grew up in Brooklyn and went to Stuyvesant High School.

Magid: And college?

Frankston: MIT. I took a year at Stony Brook because I couldn't get into MIT at first.

'We're not just programmers hiding in the back room; we're set up to do documentation, support, and marketing.'

Magid: You couldn't get into MIT?

Frankston: I was on the waiting list. Many students at Stuyvesant apply there. I was a B student; no matter how difficult or easy a class, I'll be a B student unless I'm really interested. I got my B.S. from MIT in electrical engineering—at that time the field wasn't called computer science.

When I applied to grad school, I didn't get in the

first time. I applied a second time with a recommendation from my bachelor's thesis adviser, who was head of the graduate portion of my department at MIT.

Then I got the master's in computer science and an engineering degree. The advanced electrical engineer degree is beyond the master's, essentially a Ph.D. without the dissertation. I had difficulty finding a dissertation topic because I have trouble keeping concepts theoretical without thinking of a solution or implementation.

I wanted to take advanced placement physics when I was a senior in high school, but that brought me up to seven classes of majors, and the New York Board of Education has a limit of five classes. The school cheated for me by calling advanced placement physics a shop. The reason was that we had to learn calculus in order to do the physics problems. While I think that calculus is useful and necessary, my ability to learn physics and experiment with ideas shouldn't have to wait for me to learn calculus. Even having learned it, you get involved in the details of doing the math, not the physics.

Magid: You went to school before they had VisiCalc *and* TK!Solver.

Frankston: Before they had a lot of things. I was asked to take a computer course in high school so I could help the teacher out.

Magid: I'm surprised they taught computers when you went to high school. Most high schools still don't have them.

Frankston: I graduated in 1966. Stuyvesant was getting delivery on an IBM 1130 at that point. Bronx Science and some other schools already had the IBM 1620.

Magid: How were you in math when you were a kid?

Frankston: Reasonable. I don't know what I would have done if it weren't for computers. I never became a ham radio operator and I was never on the math team. I took the clarinet but was more interested in music theory than actually sitting down to practice. I never practiced, so my parents eventually stopped my clarinet lessons. I really would have loved to continue the theory, and I would have loved to perfect my voice because, to some extent, I have perfect pitch. It's a B-flat perfect pitch because I think back to my clarinet sound.

Magid: I was a poor student in mathematics in high school, and I went through most of college thinking I was a dumbbell when it came to mathematics. Then a company called Texas Instruments came along and produced a calculator I could afford. As a result, I discovered that I'm a decent mathematician and just poor at arithmetic.

Frankston: If you get the right kind of tools and models, you'll learn; if you don't, you won't. If you have the wrong kind of model of math and you assume the arithmetic is important, you can't do anything without it; you'll think you're dumb and can't do math. But it's teachable. It's like the nonsense of someone having a talent for languages. If you grow up in China, you speak Chinese. It's a matter of how you are taught and the kind of motivation you have—the same is true of learning math.

Another analogy is typing. I read that if you teach kids to type before you teach them handwriting, their handwriting will improve.

Magid: Do you do your own typing?

Frankston: Yes, it's more efficient. I have been typing for 20 years and have been using interactive terminals for 16. The model 33 Teletype is a good workout for your fingers.

Magid: I wouldn't be much of a writer if I couldn't type. How about you as a programmer?

Frankston: I would be a systems analyst and would have my programmer dictate to the coder, and the coder dictate to the keypunch operator. This wouldn't work for

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'The computer causes us to reexamine many concepts. It gives us a vehicle that provides a way to think at a conceptual level where ideas become meaningful.'

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me. When I compose letters, I have to do it myself. If somebody writes a draft for me, I'll edit it directly. I often mark up text on line, depending on the tools. The tools aren't always up to my expectations, though we're trying to get there. It's like the irony of building word processors to produce pieces of paper. There's something wrong there.

Magid: You should be producing electronic transfer of mail.

Frankston: Yes. You should be able to read it on a presentation device.

Magid: I find that when I write, I need hard copy at some point.

Frankston: Why?

Magid: Because I catch errors that I don't catch on the screen.

Frankston: Why?

Magid: I thought I was asking the questions. Maybe I'm trained to read on paper.

Frankston: What if you had a flat screen that looks like a piece of paper?

Magid: I wouldn't be able to run my pen against it. Maybe I could with a stylus.

Frankston: You can; it's a matter of design. I keep asking why—why you use a piece of paper. I often print out text and read it because it's easier to skim. I don't want to be a fanatic and say we have to use the

computer because it's there, but I try to understand why we do things a certain way. It's important to find out how we can accomplish tasks with the computer.

When people ask me about bits and bytes, I point out that it's like hi-fi. Do you look at harmonic distortion when you buy hi-fi equipment? You might decide that if the distortion level is lower, the product is better. But that's about the extent of the evaluation.

A lot of conceptualization is involved with computers. Some people confuse programming with computers. The reason the computer is catching on so fast is not only because we have this device that computes; the

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'Think of the effect of artificial intelligence on psychology. I think it's going to have much more of an impact than Freud.'

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computer causes us to reexamine many concepts. It gives us a vehicle that provides a way to think at a conceptual level where ideas become meaningful.

People will often ask a designer to set up a computer system. So he'll come in and analyze what's happening and get 90 percent improvement without even using the computer. This is because they had to sit back and understand what they were trying to do. They've got new metaphors.

Think of the effect of artificial intelligence on psychology. I think it's going to have much more of an impact than Freud. Artificial intelligence gives you an understanding of what is, in effect, a model of thinking and how you can describe complexity. Those are the basic concepts. The impetus comes from trying to program the computer, but the effect goes well beyond that.

Magid: What I get from your remarks is a sense that computers are more important than the other tools or devices in our lives. I have lots of machines, but none of them are as compelling or addicting as my computer. What is it about that device that makes it unlike anything else in our environment?

Frankston: Some people really get into modeling, sculpting, building, or music. There's a lot to explore, but computers are more accessible. To program you need a lot of background, but you can sometimes hack around and produce something useful without much effort.

Magid: Do you use VisiCalc?

Frankston: Why do I need to use a spreadsheet?

Magid: Bob Frankston doesn't use a spreadsheet? This I want to quote.

Frankston: Well, I have several spreadsheets. I

suppose our financial people use them. What about you, do you ever use a spreadsheet?

Magid: Yes, occasionally. I use one when I do a price comparison, but I don't understand how you could write a spreadsheet program if you don't use them.

Frankston: If I had just sat down to write one, I would have designed a clunky thing. Dan's the one who knew all about spreadsheets. I was the programmer.

But I'm being unfair. I have used *VisiCalc* to do my taxes. One of the reasons I don't use it at the office is that we're trying to go beyond it and do other things, so I've got a data base system for my checkbooks and things like that.

Magid: Is it worth using a computer for your personal checkbook?

Frankston: Well not just my checkbook but all my credit card stuff; I actually once caught a ten dollar error using it.

Magid: Did you learn anything from using VisiCalc for your taxes?

Frankston: That's how we created the "look up" feature. We learned what you need for those kinds of problems. We also learned from outside people using the program.

Magid: Where do you think we ought to be going with communications?

Frankston: I think we should assume that we're going to have what I call the ad hoc interconnection. Two machines that talk to each other might be on the same network or on different nets, so you need to be able to give a path from one to another. Initially, that would have to be visible, like giving a postal address. You say it's down the street from Joe and five blocks over, and then you develop phone books. You say, "Get me Joe," and your little phone book knows who Joe is, but it might say, "Which Joe do you want?" That's sugaring on top of the protocol level, but both need to be available because your mail program needs to be able to communicate with the next mail program and pass it on.

Magid: Shouldn't the system also be integrated with a word processor and other programs?

Frankston: Of course. When I want to send mail in our office, I just say send mail—it's integrated.

Magid: While you're editing?

Frankston: Yes, I could take any text and mail it back and forth.

Magid: If I'm writing an article and in the middle of my article I want to send you a message, I shouldn't have to leave the editor.

Frankston: I don't leave mine. As a matter of fact, you want to compose the message in the same editor.

Magid: Exactly.

Frankston: That's what we have on our Prime.

Magid: Can you block move what you're typing into your mail message?

Frankston: If you want, you can move it into your

mail message or send a different message—you can split the screen. If you want a reply, the system will show you the other half of the screen. You have the letter; you can pick it up and put it back in the system.

Magid: Could you write that kind of program for the PC?

Frankston: It takes about a million bytes of one code, but it's getting to the point where, yes, we can put that kind of program on the PC. But again, is that a good product? You see, this is the problem with commercial versus in-house software.

Magid: You have experience programming on mainframes. What do you see as an essential difference between mainframe and micro software?

Frankston: The bigger the machine, the lower my standards are for the quality of the software. People on big machines are willing to put up with such awful stuff. I'm getting cynical, but there's a truth to this. The mainframe software market is smaller, and no one is going to eat the cost of the millions of dollars it takes to do a good job. If I'm going to sell only 100 copies of a piece of software even at $10,000 a copy, there's not much room for doing a good job. And that's one of the exciting things about the PC market—it allows you to do that. It not only allows you, but it forces you to do a good job.

Magid: That's not always the case. You should see some of the programs people send us for review.

Frankston: I bet you get a lot of shlock software. I want to set a standard that the shlock software has to meet.

Magid: Do you ever long for the old days when you had full control over what you were doing?

Frankston: Yes. In fact, I want to return to those days, not by having to do all the development myself, but by providing the leverage to programmers and other

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'The bigger the machine, the lower my standards are for the quality of the software.'

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people. I want to concentrate on the creative aspects.

Magid: How much of your time is administrative?

Frankston: It varies. It's increasing, but it also involves training people to delegate work to.

Magid: Is that something you had to learn to do?

Frankston: It's hard for me to compromise on quality. If I feel somebody can't do a job as well as I can, that's difficult. I have no problem with delegating if things go smoothly. Of course, there is little that I view as smooth, so in reality I don't always delegate as much as I should. I wind up delegating anyway because there are so many things that demand my attention; if an area is working smoothly at all, I will deal with other issues.

Magid: Would it be easier to do the work yourself than to teach someone else to do it?

Frankston: In many cases. Sometimes I do things myself when I should be teaching. But I also like to teach and explain things to people.

Magid: By the way, how long have you and Dan been working together?

Frankston: I've known him since 1970, but we didn't really work together until Software Arts and *VisiCalc*.

Magid: Are you good friends?

Frankston: Yes. When he was at DEC, he'd drop by my apartment at 3 a.m. to discuss DEC word processors. I introduced him to his wife through folk dancing.

Magid: Is your wife involved with computers?

Frankston: There's a terminal in the house that she uses to contact me while I'm traveling.

Magid: How do you communicate from the road?

Frankston: I'll open my briefcase and show you.

Magid: Your briefcase looks like a miniature electronics store. What do you have in there?

Frankston: In addition to the *Wall Street Journal* and some papers I'm reading, I have a camera, a terminal, a modem, and a 20-column printer. The terminal can't be used as a stand-alone system, but I can log into my office's computer from any phone. I can hook up the printer and get output on the spot. The system can be plugged in directly, or I can use the acoustical modem with pay phones.

Magid: Do you use it often?

Frankston: All the time.

It was nearly midnight when Frankston and I finally touched ground. After the long walk to the baggage area, Frankston excused himself to call his wife.

"But it's 3 a.m. in Boston," I exclaimed. "Oh, I'm not going to talk with her. I'll just check my electronic mail and send her a note that she'll read when she wakes up."

Frankston walked to a nearby pay phone, opened his briefcase, and pulled out his portable modem and terminal. He dialed his office's computer and placed the pay phone's handset in the cradle of his modem. After entering his account number and password, he displayed a note from his wife. After responding, he invited me to peer over his shoulder as he checked his routine mail. "Oops, I have a personnel memo. I'll have to ask you to give me some privacy while I handle this one."

The plane may have touched down, but Bob Frankston was still flying.

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Memory Madness

*Tall Trees Systems founder John Henderson, who
started the megamemory sweepstakes,
lives in an electronic environment all his own.*
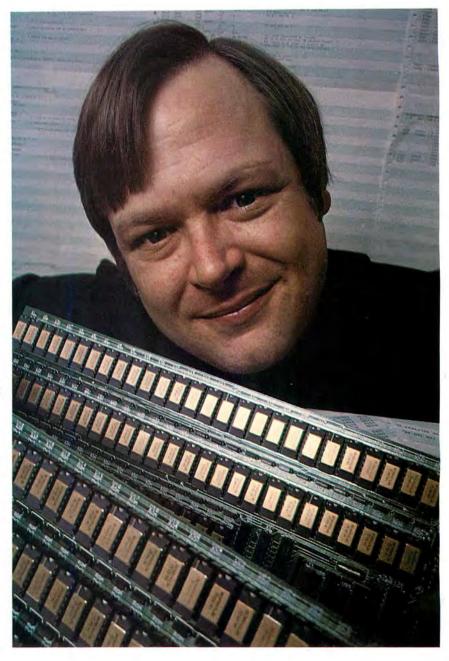
Jeremy Joan Hewes

John Henderson belongs to the first
generation of computer whiz kids,
those entrepreneurs who grew up in
the fifties with soldering guns on
their belts and algorithms in their
heads. Although Henderson's name is
not as familiar as some—Frankston,
Bricklin, Gates, Wozniak, Jobs—and
he has not achieved the millionaire
status of the exalted few, he has been
there with the home brew tinkerers
and the Pentagon masterminds, and
he too is leaving an imprint on the
industry.

Like many of his wealthier com-
patriots, he has created a business
that is literally and figuratively close
to home. His company, Tall Trees
Systems, is headquartered in his Los
Altos, California, garage with a satel-
lite office in his house. And the
products reflect his personality and
interests, even to the point of his
naming the company after a towering
redwood in his yard and beginning
each product's name with his first
initial.

Finding His Niche

The first products Henderson man-
ufactured were for the IBM Personal
Computer. Previously, Tall Trees Sys-
tems was simply the name of his
consulting business. His perspective
as a computer consultant, in fact, is
what led him to join the crowd
making add-ins and add-ons for the
PC.

"I saw how Corvus and a lot of other companies caught on with the Apple wave and were really successful," he observes, "and I realized that there was going to be another wave for the IBM. So I decided that I had to make some product for the IBM."

After working on designs for a hard disk controller board and a multifunction board, John discovered the real source of his interest in the PC. "I was trying to make my design for a multifunction board fit onto a printed circuit, and it was nearly impossible," he recalls. "And then—bingo—all of a sudden I thought, 'If I could just get rid of all these functions, I could put all the RAM I want on here.'

"I've had enough experience with systems software to know that people are going to want to go beyond the memory that's given," he continues. "I realized I'd been sitting on this memory curve all the way, and I knew how cheap it was going to get. So I decided that more memory would be a better product than an interface such as a multifunction board or hard disk controller."

After making the decision to sell memory, John went about creating his product line in the way he does most things—with a quiet vengeance. Early last year when firms like Tecmar, Quadram, and AST Research were announcing memory boards with anywhere from 64K to 256K, Henderson topped them all with a stunning 512K on a single board. Now, a year later, the Tall Trees Systems memory board is one of a precious few that incorporate the full 512K on one board; several of the widely advertised boards hold only 256K on the main board and require an add-on 256K unit that piggybacks on the main board to achieve the full 512K.

The Electronic Environment
Not content to offer twice as much memory as his competitors (and twice the RAM the PC was then reputed to utilize), John designed the Tall Trees Systems board, JRAM, so that memory could be addressed in 64K blocks and so that a PC could utilize a megabyte or more of RAM. He also wrote equally important software to make the memory do tricks.

Henderson was the first to enter the PC marketplace with software that treated all or part of the JRAM's memory as an electronic disk. Although relatively common today, this use of memory caused a minor revolution among PC owners when he introduced it. Essentially, the electronic disk provides an environment that operates many times faster than the standard floppy disk or even a hard disk.

By treating RAM as if it were a disk, a PC user can load one or more entire programs into the memory and then create or edit potentially huge files without dividing them into segments to be stored on the regular

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> Henderson was the first to enter the PC marketplace with software that treated all or part of the JRAM's memory as an electronic disk.

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disk. Thus all parts of a file as well as all help messages and functions of a program are available instantly on the disk created from the expanded RAM. With 512K or even 256K, for example, you could load in a word processing program, write a long chapter or article, load in a spell-checking program, a hefty dictionary file, and a grammar program, and then check your work for spelling and grammar—all without leaving the electronic environment.

John distributes his own program, *JEL*, which addresses memory as an electronic disk. The program works with other manufacturers' RAM boards as well as with his own. He

has recently added another enhancement to this electronic environment: the *JET* program, which allows high-speed transfer of large files from a floppy or hard disk to the electronic disk and vice versa.

The prime advantage of working in the electronic environment is that it is speedy. "I find that the most impressive things about what I try to do in the electronic environment are the half-second changes where you go from a 1-second wait—the rrrrh, rrrrh of the floppy disk drive—to bing, it's right there. And you haven't lost the context, you don't lose your concentration, and you aren't interrupted by the whirr of a disk drive."

Lost in the Memory Ozone
For all its speed and convenience, the electronic environment has one big disadvantage: temporary memory. If the power goes off or something goes awry in a program and you haven't saved the contents of the electronic disk to a floppy or hard disk, all of your new work will be sent to electronic oblivion. Of course, this is true for any work stored in the computer's RAM, whether or not you are using it as an electronic disk. The familiar computer users' maxim, Save Often, is just as important for the electronic disk as for RAM and floppies.

Henderson has anticipated the potential loss of data on the electronic disk, however, and he has a solution. As part of the documentation for JRAM, he provides a listing of components (all available from the Sears catalog) for building a 6-hour battery backup for the electronic environment. He cautions that if you aren't knowledgeable about electronics, you should purchase a ready-made battery backup system or hire an expert to build one for you.

John has built the backup for his PC and stores it in the closet near his desk. "I have 1.2 megabytes of RAM in my computer, and it's all backed up with batteries," he states. "The power could go off and the memory would still be here—I keep the whole

computer running." However, he has one minor adjustment to make in the backup system. "The backup changes the frequency of the fan and makes it noisier. I'm working on a fix for that by having the fan run on regualr AC.

Missionary Spirit

Providing customers with the list of parts for a battery backup system is typical of Henderson's business policy. He is highly accessible and often spends an hour or two on the phone with someone who needs help configuring Tall Trees Systems software for special uses. This means that he hears from customers who have problems or who are trying to put together exotic systems.

"I just got a complaint from one of our customers in Alaska," he notes. "He has a 2.5-megabyte system with an expansion chassis. When he tried to add another 64K, the whole thing fell apart. I have a fix for it, but he's the first person to run into that problem."

Henderson's zeal permeates most of his work with computers. In the late 1960s, for example, he was doing computer work for a research company that had military contracts. When he was drafted, he got the firm to request that he be assigned to their military projects because of his computer expertise, so he went straight to the Pentagon from boot camp.

"I thought I could contribute something in a subtle way. I'm definitely against war, so I'd use thousands of dollars of time on the computers, showing how expensive war can be. And I think computers might actually be keeping the plug on things because they keep track of the costs. Some general would say, 'Do this,' and I could come up and say, 'My computer says that's going to cost $3 trillion.' I even won a medal for computer programming."

Besides showing the generals how expensive war could be, John worked both ends of the war, so to speak. "I

used to protest when they had the big marches at the Pentagon," he recalls, "and then walk around the back, go in, turn my job around and look out the window at the riots, and then go back around front and join in."

Taking on DOS

Henderson has recently turned his zeal toward other players in the PC arena. He has become an electronic advocate, urging software designers to create new programs or redesign existing ones for the PC's expanded memory.

"What I talk to people about is that big memory is going to let you do much more," he asserts. "Originally, a program like *VisiCalc* was made for a machine with maybe 32K of memory and was organized around having that much memory and not going out to disk. Now this environment is going to be a half-

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> 'I'm an electronic advocate rather than a RAM advocate.'

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megabyte or 1 megabyte of memory. It hasn't struck the people who write software to use the memory capabilities they have available now. It hasn't hit yet."

John has long-term plans to write some expanded applications programs himself, but the first item on his agenda is to establish the concept of the electronic environment firmly within the PC community. Besides having advocated that programmers write for this environment, he has produced a group of utility programs, collectively called *JFORMAT*, that make use of expanded RAM and pack more data on floppy disks.

The *JFORMAT* programs operate with an altered basic input output system (BIOS), the part of PC-DOS that controls input and output. He has rewritten the IBM BIOS so that *JFORMAT* can manipulate various parts of the computer system. Floppy

disks can be utilized in a ten-sector format, for example, providing 25 percent more storage per disk than the regular format.

Despite the usefulness of more concentrated disk storage and the speed of working in an electronic environment, Henderson's decision to alter the BIOS is controversial, and not ideal for all situations. For example, a disk that holds data in a ten-sector format cannot reliably be read by all drives, and it can't be read at all without using the *JFORMAT* BIOS instead of the standard PC-DOS BIOS. So anyone who routinely takes disks back and forth to two or more PCs or who must share a PC with others probably would not opt for Henderson's alternate disk format.

The electronic disk is also somewhat controversial because of its vulnerability to sudden interruptions in power or even mistakes at the keyboard. John acknowledges the possibility of losing data but asserts that the trade-off in speed and convenience is worth the risk. "People say my program is not user-friendly because it allows you to destroy yourself," he observes. "I think of it as being like a car: you don't stay off the road just because you might crash."

Because his programs operate with an altered BIOS, Henderson has configured *JFORMAT* to support many of the popular peripherals for the PC. Most manufacturers' hard disks will work with the utility programs, for instance, and John will help install any that aren't included in his program. Some companies offer 8-inch floppy disk drives for the PC, and *JFORMAT* is the only software that supports them. This group of programs will also operate with the Tandon double-sided quad-density floppy drives that some owners have installed in their PCs.

John calls *JFORMAT* a "universal BIOS" because he aims to support many more programs and peripherals than the standard BIOS. "*JFORMAT* is the only universal BIOS out there now," he points out, "and it's a supportable BIOS. I'm gearing up for

PC-DOS 2.0. When it comes out, I'm just going to eat it alive. Within a month or two, there's going to be an equivalent operating system out there from Tall Trees Systems."

Once that is accomplished, he'll go on to laserdisks and bubble memory. "I may do a complete operating system that replaces DOS, and I may make the BIOS so that it will run on all those new machines that are like the IBM."

Up to Electronic Speed

Henderson's plans go beyond the megabytes he now sells. "The current little cram package that I'm thinking about," he elaborates, "has eight 256K chips mounted on a ceramic strip, so one strip holds 1/4 megabyte of memory. [A full 256K of memory requires eight chips—one for each bit in the standard 8-bit word. A ninth chip is needed for parity.] And you can easily put 64 of those strips on one board to give yourself a 16-megabyte board."

He believes that then he'll be up to electronic speed. And that's what he aims for—speed and versatility from his computer. "I'm an electronic advocate rather than a RAM advocate. What that means is zero access time, no moving parts, no waiting; it's all just there for you. I'm going for a quicker way of doing things, not only in the electronic disk but also in the processor, because I feel that's the wave of the future." If his performance to date is any indication, Henderson is already riding that wave.

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1036 Los Altos Ave.
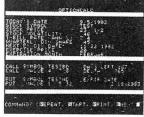*Los Altos, CA 94022*
415/941-5500

It's Computer Season

A doctor explores the growing popularity of personal computers in professional circles and the reasons for his own fascination with the PC.

Stuart R. Schwartz, M.D.

Last week my telephone was constantly ringing. There were more than a dozen "nonprofessional" messages; that's how my answering service labels calls from people not directly seeking medical help.

Most of the callers were professionals, requesting assistance of a different sort. Some were close friends, while others I barely knew. They all had heard that I own an IBM PC and wanted information. How long have you had it? What did it cost? Are you pleased with it? And the perennial question: What do you use it for?

This sudden interest reminded me of my childhood in a tight little New York City neighborhood, when kids would come to the yard to play after school, each carrying exactly the right piece of equipment. One week it was marbles; the next week it was yo-yos or baseball cards. Somehow, everyone instinctively knew when marble season was approaching and when only marbles would do.

Social psychologists are well acquainted with this phenomenon. People of the same general background tend to become interested in things at about the same time. Some of these are voguish and pass rapidly; others are more sustained. A few such common interests have a utility that goes well beyond fashion and causes them to become part of our everyday lives.

Advance Men

My callers seemed to be harbingers of such a change. Typically, the person who called was a man in his thirties, earning a good living after having spent many years obtaining an education. He was more or less married and probably had a few children. In the past he had had little or no direct exposure to computers; now, for the first time, he was seriously interested in buying one, but was not sure whether he would keep it at his office or at home.

I have been amazed at how important a place the computer has taken in my life.

As I listened to their questions, I got the sense that almost everyone who called was asking for a rationale. They vaguely wanted a computer but were concerned that this desire might be a bit frivolous.

Although these people shared an intuitive feeling that it was a good idea, they could not be specific about their reasons—like the kids who showed up with marbles or baseball cards. They wanted to have a computer not so much for any single application, but because they had a general notion that it would become useful. In a sense, they were advance men for the inevitable rush into this arena. In comparison to the hobbyists or hackers who had bought computers in the early Apple and TRS-80 era, these users seem somewhat keyboard shy and are not oriented toward hands-on learning; nevertheless, they are interested in knowing about each component so they can fit together an appropriate system. My callers were people who knew how to get and use information in making their decisions. As a group they quickly picked up significant possibilities and problems.

They were attracted to the new, but they required substance— something they could trust. A piece of equipment with a household name like IBM was the ideal vehicle for these people. I noted other elements that the callers had in common. All of them had a desire for practical applications. They all inquired about word processing, for example. Most were interested in spreadsheets, while others expressed interest in complex number crunching or statistical packages to apply to research projects.

By contrast, networking and communications were applications that only a few had considered. Most found this appealing but hadn't grasped the many possibilities.

These men were not specifically interested in the computer for its entertainment value, though most of them wanted a system that supported

game software as one of its functions. Many wanted to know about educational programs for their children. Some found it easier to justify the purchase of a computer for their teenager than for themselves. I gently nudged a few of these callers in the direction of Atari or Apple.

Involvement and Identity

My increased involvement with potential computer owners has led me to consider seriously how I use my PC and to formulate answers to at least some of their questions. Yet I haven't been able to give a short, simple answer to the question, What do you use it for? My computer plays too many roles to be described in 25 words or less.

I continually use the word processing capabilities of the PC for record keeping, report writing, and correspondence. I also do my own billing with it and keep track of investments through a simple *VisiCalc* template. I'm developing my own data base system to manage both professional and personal information. Increasingly, I have used the computer as a vehicle for communication.

More important are the countless hours that I have been spending at the console, familiarizing myself with the computer and its capabilities. This activity is random and not particularly disciplined. One day I may work on learning more about an operating system; another day's activity may be telecommunications or more sophisticated uses of applications programs. I soon realized that even if I did this full-time over the course of several years, I would still feel like a novice because the amount to learn is expanding so rapidly. I have been amazed at how important a place the computer has taken in my life. The time I spend at the keyboard, as well as musing about applications and possibilities, has been far greater than I expected.

My wife has not joined me in this pursuit, and my involvement has turned her into something of a computer widow. Although I have never been a joiner, I have come to identify with others who have PCs.

Tool or Toy?

As I spent more time just using the computer with no specific purpose or application, I began to wonder whether this idle play was justified. I even heard myself make a slip of the tongue in conversation, calling my PC a "useful toy," rather than the intended description of "useful tool." This became a dilemma: was it merely a toy, or was it an important tool?

As I considered this question, I tried to justify the many hours I'd spent at the computer by offering a variety of explanations to myself and others. But my pangs of guilt were ended one day when I awoke with the obvious but useful insight that the computer was both tool and toy and that the two uses were interconnected. To make this machine work, I had to give myself freedom to play.

As psychoanalyst Erik Erikson has so beautifully described, play leads to mastery, and the future benefits it offers are not clearly measurable in the present. Erikson's observation applies equally to the personal computer: it is important to find out what this machine can do, and by spending many hours with one, what it can't do. Having put aside my own doubts about the value of the activity, I try not to proselytize those who seek my advice.

When people ask me what I use it for, I think back to the marbles and that little neighborhood in New York. It's not always possible to assign a value to everything we do, but that was a very important time for me. I don't tell them that, though. Instead, I'm content to supply them with practical reasons for having a personal computer, knowing that they will discover the fun for themselves.

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A Global Exchange of Personal Computer Discoveries

The somewhat cryptic title for this department is, of course, the DOS convention for a global instruction without limitations. Loosely translated, it means "anything goes." In keeping with that open spirit, you are all invited to contribute your personal computer discoveries to these pages.

Perhaps you've written a short program that performs a handy function or bypasses some bizarre system feature. Maybe you've come up with a routine that makes an applications program do its job better. Or you might have gained some insight into how the computer works—or how and why it doesn't work as advertised. Tell us about it, and we'll pass your discovery along. We'll also pay $25 to $100 for each item published.

Incidentally, if you're wondering how to pronounce the title of this department, you can do as the programmers do—call it Star-Dot-Star. By whatever name, I hope you'll enjoy sharing in the serendipity. Please let us hear from you.

DOS to WordStar to DOS

If you receive a text file via telecommunications, it will probably come to you in standard DOS format; that is, with each line terminated by a carriage return/line feed sequence. If you try to edit that file using the *WordStar* word processing program, you'll discover that it's exceedingly difficult to reformat paragraphs after making revisions.

The problem arises because *Word-*

Star uses an end-of-line convention for its document files that is different from DOS files. Lines in a standard DOS file, such as a file created by the DOS 'COPY CON:' command, terminate with two characters. The first of these characters is commonly called a carriage return. The ASCII value for this character is 13 in decimal (OD in hexadecimal). The second end-of-line character is commonly called a line feed. It has an ASCII value of 10 decimal, which is OA in hexadecimal. If you use the DOS DEBUG.COM utility to examine one of your text files, you'll regularly see the two characters, 'OD OA', which signify the end of each line.

WordStar uses a different convention for its text files. Each line terminates with the ASCII characters 141 and 10. (All ASCII codes will subsequently be referred to in decimal notation.) The ASCII 141 represents the same character as the ASCII 13 carriage return, but with a one instead of a zero, as the most significant bit of 8 binary digits that make up the character. MicroPro calls this a high-bit character. The ASCII decimal value of a high-bit character is 128 greater than its low-bit version.

When *WordStar* sees one of these high-bit carriage returns and a line feed (141 10) at the end of a line, it knows that it can reform that line to accommodate revisions or different margins. If *WordStar* sees a line ending with regular carriage return and line feed (13 10), it treats that line as the end of a paragraph and won't reform past it. That is why *WordStar* can't reform a text file that is in standard DOS format.

You could write a program that merely converts all the regular carriage returns to high-bit carriage returns, but then *WordStar* would treat the converted file as one big paragraph. Upon invocation of the reform command, the text would collapse into a solid block. What is needed is a program that decides where paragraph endings should be preserved.

A more complicated problem arises if you want to use a *WordStar*-created document as a standard DOS file. *WordStar* encodes the last character of each word as the high-bit version of that character; for example, a lowercase *e* (ASCII 101) at the end of a word is encoded as ASCII 229. If you view a *WordStar* document file with the DOS TYPE command, you'll see strange characters throughout the file. Once again, the solution is not as simple as converting all the high-bit characters to their low-bit equivalents. *WordStar* document files may contain various print enhancement characters such as Control-S (ASCII 19) for underlining and Control-B (ASCII 2) for boldface. Some lines may contain "dot" commands used for print formatting.

Furthermore, *WordStar* encodes "soft" hyphens as ASCII 31 characters. These must be stripped if they occur in the middle of a line but should appear as regular hyphens if they reside at the end of a line.

The program in Listing 1 handles all these problems. It will convert a DOS text file into *WordStar* text format and convert a *WordStar* document file into a standard DOS file. I've found it very useful in both receiving and sending text files over the phone lines. Copy the program carefully (especially the semicolons)

and run it; it should get the job done.

Most of the program features are documented in the option prompts. If you enter a question mark in response to a file specification prompt, you'll see the files on the default drive. You can follow the question mark with any of the DOS filespec conventions. (Inputting ? b:*.BAS will list all the .BAS files on drive B.) If you want to terminate when asked for a file specification, just press ENTER.

The performance of the program improves considerably if the two files are on different disk drives. For optimum performance, put both files on an electronic drive. Incidentally, the program compiles very nicely using the '/e' option of the BASIC Compiler.

A.F.

VisiCalc and Electronic Disks

Following is a tidbit regarding the use of *VisiCalc* (256K) with the QuadRAM QuadBoard running more than 256K. (It may also apply to other memory expansion boards.)

If *VisiCalc* sees more than 288K of memory, it automatically defaults to the minimum configuration, leaving only 22K of spreadsheet memory. By installing the QuadRAM Drive (or Ramdisk, Flashdisk, etc.) to "consume" enough memory to drop the accessible RAM to 288K, *VisiCalc* will provide its maximum 245K of

Hands On

Listing 1.

```
2 ´ WS-DOS.BAS
4 ´ by Andrew Fluegelman
6 ´ Copyright 1983, The Headlands Press, Inc.
8 ´
10 DEFINT A-Z:ON ERROR GOTO 9000
15 A=0:A$="":L$="":p=0 ´optimize key variables
20 CRLF$=CHR$(13)+CHR$(10):HBLF$=CHR$(141)+CHR$(10)´hard & soft CR/LF
25 SP$=CHR$(32):TB$=CHR$(9)´space & tab
30 SH$=CHR$(31):PB$=CHR$(20)´soft hyphen & placebo
35 DT=19:DIM D$(19):FOR P=1 TO DT:READ D$(P):NEXT´read dot commands
40 EN=4:DIM EN(4),ENO$(4),ENC$(4),MRK(4)´dim & read enhancement symbols
45 FOR P=1 TO EN:READ EN(P),ENO$(P),ENC$(P):MRK(P)=0:NEXT
100 KEY OFF:CLS
105 PRINT"          ==== CONVERT ===="
110 PRINT
115 PRINT"          1 - DOS to WS
120 PRINT"          2 - WS to DOS
900 PRINT"          x - exit
905 PRINT
910 LOCATE ,10:PRINT"Choose:";
915 INPUT"",Q$:IF Q$="X" OR Q$="x" THEN SYSTEM
920 ON VAL(Q$) GOTO 1000,2000
925 BEEP:GOTO 100
930 ´
1000 CLS
1005 PRINT"          === DOS-to-WORDSTAR CONVERTER ==="
1010 PRINT
1015 PRINT"This routine will convert a standard DOS file into the format
1020 PRINT"  required by WordStar for paragraph reforming by converting
1025 PRINT"  ´hard´ carriage returns (ASCII 13) into ´soft´ CRs (ASCII 141).
1030 PRINT"If the file contains blank lines between paragraphs or indented
1035 PRINT"   paragraphs, hard returns will preserved at each paragraph end.
1040 PRINT
1045 GOSUB 8000:IF FL$="" THEN 100
1050 PRINT:PRINT"Conversion in progress...";
1055 IF EOF(1) THEN 8045 ELSE LINE INPUT #1,L$
1060 IF EOF(1) THEN PRINT #2,L$+CRLF$;:GOTO 8045
1065 LINE INPUT #1,A$
1070 IF A$="" THEN 1090 ´test for blank line
1075 IF LEFT$(A$,2)=SP$+SP$ THEN 1090 ´test for indent
1080 IF LEFT$(A$,1)=TB$ THEN 1090 ´also test for tab
1085 PRINT #2,L$+HBLF$;:L$=A$:GOTO 1060 ´write line with soft CR
1090 PRINT #2,L$+CRLF$;:L$=A$:PRINT PB$;:GOTO 1060 ´write line and hard CR
1095 ´
2000 CLS
2005 PRINT"          === WORDSTAR-to-DOS CONVERTER ==="
2010 PRINT
2015 PRINT"This routine converts a WordStar ´document´ file
2020 PRINT"  into standard DOS format.  All ´high-bit´ characters
2025 PRINT"  are converted to their ´low-bit´ equivalents.
2030 PRINT"All ´soft´ hyphens are stripped, except that any hyphens
2035 PRINT"  at the ends of lines are retained.
2040 PRINT
2045 PRINT"You can either strip or retain lines that contain dot commands.
2050 PRINT"As another option, you can either strip all print enhancements
2055 PRINT"  or replace certain enhancement codes as follows:
2060 PRINT
```

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PC W●RLD

Please take the time to fill out our reader questionnaire.

1. Which articles in this issue did you find most informative and/or enjoyable?
   _____
   _____
   _____

2. Would you like the content of this magazine to be more technical, less technical, or maintain the same balance?
   ☐ More technical   ☐ Less technical   ☐ Maintain the same balance
   In which areas would you like to see more coverage?
   _____

   In what areas would you like to see less coverage?
   _____

3. How would you classify your experience with personal computers?
   ☐ Novice _____
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   ☐ Advanced _____

4. Which personal computer do you use?
   ☐ IBM PC   ☐ Other _____   ☐ Don't use one yet

5. Please describe your system.
   Memory _____
   Storage devices _____
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6. Which operating system does your personal computer use?
   ☐ PC-DOS (MS-DOS)   ☐ UCSD p-System
   ☐ CP/M-86   ☐ Other _____

7. Name up to four applications programs that you use most with your personal computer ____
   _____
   _____
   _____

8. Where do you use your personal computer?
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   Name _____
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   City/State/Zip _____
   (Please complete this information to be eligible for the drawing.)

```
2065 PRINT"    underline (^S) becomes   << ... >>
2070 PRINT"     boldface (^B) becomes  <<< ... >>>
2075 PRINT"  superscript (^T) becomes   <^ ... ^>
2080 PRINT"    subscript (^V) becomes   <_ ... _>
2085 PRINT
2090 PRINT:INPUT"Strip or Retain dot commands (s/r):",Q$
2095 IF Q$="S" OR Q$="s" THEN STRIPDOT=-1 ELSE STRIPDOT=0
2100 INPUT"Strip or Replace print enhancements (s/r):",Q$
2105 IF Q$="R" OR Q$="r" THEN ENHANCE=-1 ELSE ENHANCE=0
2110 GOSUB 8000:IF FL$="" THEN 100
2115 PRINT:PRINT"Conversion in progress...";
2120 L$=""
2125 IF EOF(1) THEN 8045 ELSE A$=INPUT$(1,#1):A=ASC(A$):IF A>30 AND A<128 THEN
     L$=L$+A$:GOTO 2125 'soft hyphen or normal ASCII, proceed
2130 IF A>127 THEN A=A-128:A$=CHR$(A) 'convert to low-bit character
2135 IF A>31 THEN L$=L$+A$:GOTO 2125 'now if normal ASCII, proceed
2140 IF A=13 THEN GOSUB 2170:A$=INPUT$(1,#1):GOTO 2120'eol, process & remove LF
2145 IF NOT ENHANCE THEN 2125
2150 ' deal with enhancements
2155 FOR P=1 TO EN:IF A<>EN(P) THEN 2165 'find special characters
2160 IF MRK(P) THEN L$=L$+ENC$(P):MRK(P)=0 ELSE L$=L$+ENO$(P):MRK(P)=-1'convert
2165 NEXT:GOTO 2125
2170 ' subroutine to strip soft hyphens and dot commands
2175 P=INSTR(L$,SH$):IF P=0 OR P>=LEN(L$)-1 THEN 2180 ELSE L$=LEFT$(L$,P-
     1)+RIGHT$(L$,LEN(L$)-P):GOTO 2175 'strip soft hyphens...
2180 IF RIGHT$(L$,1)=SH$ THEN MID$(L$,LEN(L$),1)="-" 'except at eol
2185 '
2190 IF STRIPDOT AND (LEFT$(L$,1)=".") THEN 2200 'possible dot command?
2195 PRINT #2,L$:PRINT PB$;:RETURN 'write line to disk
2200 B$=MID$(L$,2,1):A=ASC(B$):IF A>64 AND A<91 THEN A=A+32:B$=CHR$(A)
2205 C$=MID$(L$,3,1):A=ASC(C$):IF A>64 AND A<91 THEN A=A+32:C$=CHR$(A)
2210 DUMP=0:FOR P=1 TO DT:IF B$+C$=D$(P) THEN DUMP=-1 'search for dot cmds.
2215 NEXT:IF DUMP THEN RETURN ELSE GOTO 2195 'dump line if dot command
2220 '
8000 ' File specs
8005 INPUT"File to convert:",FL$:IF FL$="" THEN RETURN
8010 IF LEFT$(FL$,1)="?" THEN GOSUB 8035:GOTO 8005
8015 OPEN FL$ FOR INPUT AS #1
8020 INPUT"Convert to file:",FL$:IF FL$="" THEN 8005
8025 IF LEFT$(FL$,1)="?" THEN GOSUB 8035:GOTO 8020
8030 OPEN FL$ FOR OUTPUT AS #2:RETURN
8035 IF LEN(FL$)>1 THEN FL$=RIGHT$(FL$,LEN(FL$)-1) ELSE FL$="*.*"
8040 PRINT:FILES FL$:PRINT:RETURN
8045 CLOSE:BEEP:PRINT:PRINT"Done!":GOTO 105
8050 '
9000 ' Error Trapping
9005 IF ERL=8015 THEN CLOSE:BEEP:PRINT"===Filespec Error===":RESUME 8005
9010 IF ERL=8030 THEN CLOSE 2:BEEP:PRINT"===Filespec Error===":RESUME 8020
9015 IF ERL=8040 THEN CLOSE:BEEP:PRINT"===File(s) Not Found===":RESUME 8005
9020 ON ERROR GOTO 0
9025 '
10000 DATA bp,uj,po,cw,ig,cp,fo,fm,he,hm,lh,mb,mt,pa,op,pn,pc,sr,pl
10005 DATA 19,"<<",">>"
10010 DATA 2,"<<<",">>>"
10015 DATA 22,"<_","_>"
10020 DATA 20,"<^","^>"
```

spreadsheet memory. This is easily accomplished with the QuadBoard by adding the following command to the *VisiCalc* AUTOEXEC.BAT file:

QD 1 (for 320K systems)
QD 2 (for 352K systems)
QD 3 (for 384K systems)

The appropriate version of the above command allocates the indicated number 32K blocks of memory to the QuadRAM drive, thus reducing the memory accessible by the system. The QuadRAM drive configuration program QD.EXE must reside on the *VisiCalc* disk.

Ronald M. Egalka
Microcomputer Consultants, Inc.
Framingham, Massachusetts

Bum Key Rescue

Maybe I'm just a malevolent typist, but one of my keys seems to stop working every few weeks. I know I can pull the key off, wiggle the spring, and get the key working again, but temporarily losing use of the key can cause drastic problems. The ultimate disaster occurred when my K key decided to quit. I had just finished typing a valuable file using *WordStar* and had seemingly no way to give a Control-K command and save it.

I was ready to concede defeat when I remembered that any keystroke can be reproduced by holding down the Alt key, typing the ASCII

decimal value of the desired key on the numeric keypad, and then releasing the Alt key. A quick check of an ASCII chart revealed that Control-K is ASCII 11. Sure enough, Alt-(011) S saved the day and my file. This tip might serve you well in an emergency.

Alan Hokes
Lexington, Kentucky

BASIC Print Screen

When BASIC is running on the PC, the DOS Print Screen function (Crtl-PrtSc) isn't available. You can create your own Print Screen function by inserting the following lines at the beginning of your program:

```
10   DEF SEG = 4095
20   POKE 0,205:POKE 1,5:POKE 2,203
30   PRINTSCREEN = 0
```

When you want your program to print the contents of the screen, execute this statement:

```
100   CALL PRINTSCREEN
```

The line can be inserted anywhere in the program as long as the DEF SEG hasn't been changed. You might have your program act on a special keystroke and make the Print Screen call as a subroutine via GOSUB and RETURN statements.

Peter Norton
The Norton Utilities
Venice, California

BASIC Key Lines

A strange fluke in BASIC and BASICA has been discovered. If a program tries to write on the 25th line (the key line) while the key values are displayed there, the program will fail. A program must include a KEY OFF statement for information to be written to line 25. However, the key line will not be displayed if you specify the program to execute from the DOS command line ('BASIC progname'). Try these examples:

```
A>BASIC
OK
10 LOCATE 25,1:PRINT "Look ma, no keyline!"
SAVE"KL
RUN
Illegal function call in 10
OK
system
A>BASIC KL
Look ma, no keyline!
OK
```

Don O. Hoosatt
Ft. Worth, Texas

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User Group Dispatch

User Group News from Around the World

User Group Dispatch is a regular column in *PC WORLD* featuring user group profiles, topics of special interest to group members, and excerpts from groups' newsletters. Each column will include a directory of user groups. We will publish names, addresses, and phone numbers for all groups related to the PC and compatible systems, whether or not the groups publish a newsletter.

Group Support

As the microcomputer industry continues to expand, the need for user education grows. This need is being filled by professional publications, software tutorials, and a new crop of microcomputer books. Computer users are being inundated with educational products.

In the midst of this enormous flow of material, the user group is a welcome support to the overwhelmed user. User groups represent the epitome of education—dialogue—offering an opportunity for users to ask elementary questions or share their technical expertise in an open forum.

According to Paul Cowan of Personna Computer Association, Inc., The International Association for Users of the PC, when IBM first released the PC, the response took company officials by surprise. IBM did not expect the public's response to the PC to be so great.

Cowan points out that IBM does not have time to train end users. "Selling a PC to an end user is different from selling a mainframe to a Ph.D. in electrical engineering," he says. IBM considers dealers the official liason between the company and the user. IBM has more than 600 dealers across the United States, established to provide service and support. In turn, the dealers are

supported by IBM with a dealer hot line and a monthly newsletter that includes user updates, new packages, and common fixes. Even so, it seems that dealers alone have not been able to fill the user need for support.

User groups serve a useful purpose. Members exchange ideas and information by providing the support that dealers and manufacturers are often unable to provide. New user groups dedicated to the IBM PC are appearing across the United States, as well as in Canada. Some international groups are forming as well. In general, these groups have grown quickly. Many members report that their groups are quickly outgrowing the available seating in their regular meeting places. Members flock to meetings even when there is standing room only.

Many user groups have formed special interest groups (SIGs) that focus on such subjects as graphics, assembly language, data base management systems, products, and education. Because SIG members bring their talents together, they create an environment that generates new ideas and innovations.

Most user groups have a software exchange. Members can swap programs they've written or buy member-written programs at low prices. Many user groups purchase software and hardware in bulk and make PC products available for members at discount prices.

If you own a PC or compatible system and don't belong to a user group, check the directory in this column or ask friends or computer dealers about local groups. If you can't find one, start one. A user group is probably one of the few places that has something for everyone.

Profile

James and Cynthia Cookinham started International PC Owners, Inc. (IPCO) in November 1981. Today, a little over a year later, IPCO has more than 1,000 members hailing from the United States, Saudi Arabia, Germany, England, Kuwait, Mexico, and France.

Though IPCO started small and the Cookinhams didn't advertise, the organization got a boost from notices in *BYTE* and *Creative Computing*. PC owners around the world, feeling isolated and excluded from the wealth of knowledge and software available to owners in the United States, latched onto *IPCO*. The Cookinhams report that IPCO has received software requests from Saudi Arabian and German PC owners. The PC enjoys a limited use internationally, and there is still little or no software support for it in most countries.

Unlike locally based user groups, IPCO members cannot hold regular meetings. Their sole means of communication is their bimonthly newsletter, *IPCO INFO*, a 30-page, well-produced, quality publication. According to James Cookinham, reader response has been overwhelmingly positive.

He notes that the two most valuable services IPCO offers are the opportunity for informal discussion via the newsletter and the organization's software exchange. Each issue of *IPCO INFO* contains an extensive list of owner-written software ranging from business/professional, math, and engineering to graphics, games, home applications, and educational programs.

As of December 1982, *IPCO INFO* offered 83 programs to members for $3 each. Members can also

receive four programs of their choice in return for submitting one self-developed program to the software exchange. IPCO purchases commercial products such as *Volkswriter 1.2* and *dBASE II* at a bulk discount and passes the savings along to members.

IPCO is a nonprofit organization; membership dues just cover the cost of the newsletter's publication. At present the Cookinhams produce the newsletter as a labor of love. James Cookinham wants to change professions and get into the microcomputer field. His philosophy is to learn all he can about PCs and to communicate what he learns to other users. *IPCO INFO* serves him well for both these objectives.

When he first bought his PC, he realized that it would be all too easy to put off learning how to use it. Putting out *IPCO INFO* every 2 months, he says, is a great way to get trained. For more information write IPCO, Inc., P.O. Box 10426, Pittsburgh, PA 15234, 412/561-1857.

Newletter News

The following information has been quoted directly from user group newsletters. *PC WORLD* takes no responsiblity for its accuracy. We suggest that you contact specific user groups for further details.

Free Assembler Program

The following item is reprinted from IPCO INFO, *November/December 1982, IPCO, Inc.*

David Whitman (2 N. Park St., Apt. L, Hanover, NH 03755) sent us a program with the following letter:

"The disk contains BASIC code and documentation for an assembler I have written for the PC. The program will run on any IBM PC with 64K and one disk. I wanted to experiment in assembly language programming but couldn't afford the $100 to buy the IBM macro assembler, and this is the result [the program he sent to us].

It occurred to me that other members might be in the same boat—wanting to try assembly language but not wanting to plunk down $100 to find out if they like it. Due to the amount of work that went into this program (intermittently for several months), I'm not offering this for the exchange. I'm distributing the program as was done with *PC-Talk*—unlimited free copying with a $20 donation requested from all satisfied users regardless of how they got their copy.

I will be pleased to copy the program onto any disk I receive, provided that a self-addressed, stamped envelope accompanies the disk. I cannot be responsible for returning disks unaccompanied by a SASE.

It would please me no end if you would copy CHASM (my assembler) onto program exchange disks as you do with *PC-Talk*. The audience for CHASM will be smaller, but I think that the more experienced members would get real use out of this program. A batch file on the disk will automatically transfer the program along with all the documentation and data files. From DOS just type TCHASM. The PC will do all the work."

IPCO Note: We have read the documentation provided with the program and are impressed. If you want to take the big step into assembly language, this is a cheap way to see if it is your bag.

Ribbons for Your Printer

The following item is reprinted from IPCO INFO, *November/December 1982. If you have bought a ribbon for your IBM printer (EPSON MX-80), you were probably shocked by the $16 price tag. After buying several ribbons at that price, we realized that there must be a better buy.*

We found a small ad in the back of *Info World* that offered ribbons for under $4. We sent for them and found that if you don't mind getting your fingers dirty, you can replace the ribbon in 10 to 15 minutes. What you receive is a new ribbon that must be installed in the cartridge in your printer (a wet wipe is even included for your use). We were quite satisfied with the new ribbons, and the instructions provided were quite easy to follow. At a savings of $12 per ribbon, a little black on the fingers never hurt anyone. To order contact C & D Research, P.O. Box 40027, San Francisco, CA 94140, 415/431-5557, Source: TCD935.

Last Meeting

The following item is reprinted from Manhattan Micro News, *The Manhattan IBM Micro Club, 360 Central Park West, New York, NY 10025.*

We spent a fair amount of time discussing the new disk emulation programs—SemiDisk, RAM Drive, etc. The concept behind these is apparently only a couple of years old in the land of mainframes, so it is really quite nice that they have trickled down to us so quickly. The concept behind them is to use extra RAM to emulate a disk drive. This eliminates the wait necessary for the disk drive head to come up to speed to read or write information. It is a drive with a

practically instantaneous read and write ability.

The major drawback to these programs is that if you lose power, you lose your data. There are two ways around this: save your data to the real disk periodically or buy a power supply that will protect you from a loss of power and allow you time to back up your files.

Two companies supply insurance for computers used for business: Personal Computer Insurance (PCI) of San Jose, California (408/723-8107), and The Columbia National General Agency (CNGA) of Columbus, Ohio (800/848-0598).

PCI gives from $7,500 to $15,000 worth of coverage with no deductible and the option of $2,500 insurance against business interruptions for an extra $10. PCI does not offer this policy in New York, however.

CNGA does offer its policy in New York. A policy with a $50 deductible covers equipment from $2,000 to $32,000. CNGA's policy covers travel in the United States and Canada, while PCI's covers travel in the United States only. Both PCI and CNGA offer full replacement-cost policies that cover hardware, purchased programs, and media.

EDLIN

Before using EDLIN, always run CHKDSK to ensure you have enough disk space to store the program twice. If there's not enough space, the edited version disappears when you go back into DOS, the original program left untouched.

Don Withrow
Fairfax, Virginia
A BASIC file must be saved in ASCII (using SAVE "xxx", A) to be edited with EDLIN—Larry Jordan.

The Bit Buyer

The following item is reprinted from Blue Notes, *San Francisco IBM PC Users Group, Software Center, 4720 Geary St., San Francisco, CA 94118.*

My name is Burt Alcantara, and I'll tell you a little bit about buying PC-related products by mail. Mail order can be tricky business. Often you'll see a great bargain in a magazine and call up the vendor only to find that (1) the company moved to Angola, (2) your bargain is not in stock, but "it'll be in within 2 weeks, I swear," and/or (3) the price has been inflated 15 percent.

Always read the fine print in the advertisements. It tells you about shipping charges (0 to 5 percent), credit card charges (average 3 percent), and, if your vendor is in California, sales tax. I propose to set up a national computer cooperative purchasing network. Let me know what you want, and in what quantity. Disks get used up surprisingly fast. Submit an order for your favorite brands and format. The greater the volume, the lower the price. Same goes with paper, ribbons, print wheels, and anything that wears out or needs replacement. You can reach me at 415/922-4018.

We welcome readers' participation and suggestions. We would like to receive subscriptions to groups' news-letters so that we may report on group ideas and activities. Address pertinent information to User Group Dispatch, PC WORLD, 555 DeHaro St., San Francisco, CA 94107.

User Group Directory

PC WORLD will publish a User Group Directory every month. If your group is not in this first index but would like to be, send your name, address, contact, and other information to *User Group Dispatch*, PC WORLD, 555 DeHaro St., San Francisco, CA 94107.

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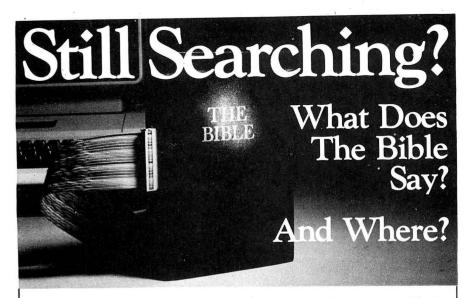13700 Beauwick Ct.
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The Int'l Association for the PC
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The New York IBM PC Users Group
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North American Amateur Computer
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BBS Watch

*Information, friendship, and free programs are just
a bulletin board phone call away.*

Gene Plantz

IBM Personal Computer users have many questions about computerized bulletin board systems: What are they? How do they work? What benefits do they offer? This department will answer these questions and keep you informed of IBM PC bulletin boards throughout the country.

A bulletin board is a computer with a program (or collection of programs) that allows the computer to automatically answer incoming telephone calls and give the caller access to some of the computer's facilities. These facilities often include electronic mail (message exchange), program transfer (usually public domain, or free software), and sometimes product ordering. Most bulletin boards are single-user systems, which interact with only one caller at a time.

Bulletin board systems have been around for the last 5 or 6 years. Many systems run 24 hours a day, 7 days a week; other systems operate at night only. While most computer bulletin boards are sponsored by clubs and user groups, others are operated by individuals and businesses. These systems turn on their communications equipment after business hours to enable callers to exchange messages or order store items through the bulletin board. The person who monitors the day-to-day operation of the bulletin board is called the system operator, or the SYSOP.

Modems

To access a bulletin board you need a modem. A modem is a device that connects a computer to the telephone line. It translates the digital data you send to another computer into signals that can be transmitted over a telephone line. The computer on the other end also has a modem to return the data to its original digital format. Modems cost from $90 to $700. The higher priced models offer faster transmission speed and special features such as automatic dialing and answering. Most modems allow for data transmission at speeds of 300 baud (approximately 30 characters per second) or 1200 baud (approximately 120 characters per second). While most bulletin board systems operate at 300 baud, some operate at both speeds. If you want to call a bulletin board and are not sure what speed to use, try 300 baud.

Software

In addition to the hardware required for communications, you need software to control the computer and the modem. This software can vary from a simple set of BASIC statements that allow your microcomputer to act like a dumb terminal (a terminal with no independent processing capabilities) to sophisticated programs that automatically dial and redial a phone number until a connection is made. One important thing the program should do is allow you to save on disk the data you receive from the bulletin board system.

My Chicago Area BBS

I operate an IBM PC bulletin board system in a northwest Chicago suburb (312/259-8086). It runs 24 hours a day, 7 days a week and allows either the 300-baud or 1200-baud transfer rate. The system provides a message exchange facility that pro-vides an opportunity to meet other users, learn about computer topics, and ask for hands-on information about products.

Users can leave messages for one specific person or direct a message to everyone who uses the system. Some bulletin board regulars pick up useful information by following messages passed among other callers. The system displays messages containing technical information on applications software such as word processing, spreadsheet, data management, and communications programs. One such message explains how to patch *Word-Star* so that the IBM 80 cps Matrix printer can do super- and subscript printing.

My bulletin board system also offers more than 100 public domain programs for transfer to your system.

Gene Plantz runs a computer consulting firm. He is the author of PCMODEM *and the systems operator of a Chicago-area bulletin board.*

In upcoming issues, BBS Watch *will feature specific bulletin boards and cover topics such as how to connect with a system, file transfer techniques, and reviews of bulletin board software.*

If you are the system operater of an IBM PC bulletin board, we would like to hear about your system. We welcome readers' questions and suggestions. Please send correspondence to Gene Plantz, P.O. Box 95638, Hoffman Estates, IL 60915.

IBM PC
Bulletin Boards

Following is a partial listing of the IBM PC bulletin boards on line in the United States. Most operate 24 hours a day. Some are very popular and have many callers, so don't be discouraged by a busy signal. Keep trying to get through; it will be worth the effort.

201/678-6670
New York, New York
SYSOP: Donald David
(TC7057)
24 hrs

213/390-3239
Santa Monica, California
SYSOP: Marc Schoenber
24 hrs, download & upload,
10 MB disk, 300/1200

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)

301/937-4339
Beltsville, Maryland
Small People Software
SYSOP: Chet Rhodes
24 hrs, games, messages

312/376-7598
Chicago, Illinois
SYSOP: Pete Coniceak
24 hrs, download & upload,
messages, 300

312/259-8086
Chicago, Illinois
SYSOP: Gene Plantz
(PCMODEM)
24 hrs, download & upload,
messages, 300/1200

404/252-9438
Atlanta, Georgia
SYSOP: Rod Roark
24 hrs, messages, download
& upload, tips, news

406/656-9624
Billings, Montana
SYSOP: George Peck
9a.m. to 5p.m.; 11p.m. to
7a.m./Mountain Time

608/262-4939
Madison, Wisconsin
PC Users Group
SYSOP: Read Gilgen
24 hrs, 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

913/842-5749
Lawrence, Kansas
24 hrs, download & upload,
messages

Directory

Accessories/Computer Covers

Quilted Computer Covers
Attractive, washable dust-covers available in 5 colors; evergreen, claypot, chocolate, navy or cream. Order in sets of 3 or 4 (one or two piece monitor & system unit, keyboard and printer cover). Specify wide or narrow printer. $66 per set. CA residents add 6%. Allow 6 weeks for delivery. Covers A Lot, P.O. Box 369, La Honda, CA 94020, 415/747-0352 (M-Th, 10am - 4 pm)

IBM PC Protection
KEYBOARD COVER (#KC210) $12. A custom design dustcover to protect keyboard. Rigid smoked bronze low silhouette. DISK DRIVE COVER (#DC310) $10. Contemporary black plastic design with vinyl foam perimeter seal to lock out harmful elements. Nat Hellman III, Inc., Microcomputer Accessories, 400 S. Beverly Dr. Ste.# 312, Beverly Hills, CA 90212, 213/273-0133

Accessories/ Furniture

Printer Pedestals
Stands feature an opening for bottom feed as well as rear feed and allow paper storage under the printer. They are available for 80-column and 132-column printer. List price for 80-column printer $29.95,

for 132-column printer $49.95. We invite dealer inquiries on our complete line of products. RGB Designs, 3375 Woodward Ave., Santa Clara, CA 95050, 408/748-0400

Accessories/Jewelry

Computer Jewelry
Signifying professional involvement in the microcomputer industry. Unique designer pieces are perfect for gifts, awards, or premiums. Lapel pins, tie tacks, and stick pins in 18K gold vermeil ($12) or sterling silver ($10). Satisfaction is guaranteed, or your money back. (See display ad this issue.) MC/N, Computer Jewelry, Simms Center / Box 9393, San Rafael, CA 94912, 415/453-7033

MC/N, Inc.
COMPUTER JEWELRY

Consultants/Alaska

Construction/Computer Mgmt.
Computer consultant specializing in contruction management, hardware/software selection, custom programming and software such as Estimating, Job costing, and Critical Path Scheduling for MS-DOS applications are ready and only a phone call away. Rambow Enterprises, 7-480 A "I" St., Elmendorf, AK 99506, 907/ 753-2291

Consultants/ California

PC Accounting Applications
CPA firm specializing in computerized accounting. We have tested and evaluated all major accounting software packages (12) through actual use. Experienced engineering and accounting professionals will help you select and implement your system. General business consultations. Sherry Knight, Certified Public Accountant, 6644 Heartwood Dr., Oakland, CA 94611, 415/339-9036

Sherry Knight
Certified Public Accountant

Advice, Assistance & Software
Experienced engineers offering assistance & "plain English" advice to business and the professions. Programming services include troubleshooting, maintenance, customization & development. Other services include equipment & program selection, user orientation, program & data conversion. Computer Tamers, 1514 Manhattan Beach Blvd., Los Angeles, CA 90266, 213/379-1276

PC and Mainframe Consulting
•PC system configuration
•Mainframe interface
•Audits and Controls
•Networking
•Applications Development
•Support for non op users
•System evaluation and selection MIS Consultants, Inc., 1065 E. Hillsdale Blvd. Ste.# 114, Foster City, CA 94404, 415/345-6000

The PC Software Experts
Experienced specialists in all areas of PC software. We can help you with hard disk drivers, spollers, ram-disks, diagnostics, communications, data bases, and business application. Let us handle the entire job for you - design - implementation - documentation - training. PCX, 21941 Cayuga, Lake Forest, CA 92630, 714/951-8320

Consultants/ Massachusetts

Business Consulting
Systems development, programming, and in-house training on the IBM-PC. Our background in IBM mainframes will be helpful to data processing installations trying to cope with the PC invasion! Proficient in BASIC, COBOL, PL1, dBASE. Springfield Associates, 37 Parker St., Newton Centre, MA 02159, 617/969-5183

Diskettes

No-Flop Floppy
100% certified AND guaranteed diskettes. Box of 10 soft sector, 5 1/4 inch, reinforced hub. To keep cost down, mail order only.
MEMOREX SSDD $27.00 DSDD $37.00
MAXELL   SSDD $29.00 DSDD $40.00
No EXTRA CHARGE! CA residents add 6.5% sales tax. Please send check or M.O. to: Ramsys, 225 W. Broadway, Ste.# 500, Glendale, CA 91204, 213/240-9521

Premium Diskettes in Color!
CenTech is first to offer red, blue, green, yellow and orange diskettes for color coding. If locally unavailable then factory direct. 5 1/4" single side, double density $19.95 a box. Double side, double density $28.95 + $2.50 freight. 30 day moneyback guarantee. 5 yr. warranty. Dealer inquiries welcome. Cenna Technology, 183 Cottage Ave., Sandy, UT 84070, 801/261-1600

Elephant Memory Systems
Quality diskettes are available in all popular 5 1/4" and 8" models and custom formats. They're guaranteed to meet or beat every industry standard for quality. They come standard with reinforced hub rings and they sell at some of the lowest prices in the business. Leading Edge Products, 225 Turnpike St., Canton, MA 02021, 800/ 343-6833, 617/828-8150

Diskette Copy Service

Superior Diskette Copying
Lifetime guaranteed duplicating for most systems and formats using sophisticated reliable equipment. Serialization, copy protection (encryption), and packaging available. Double boot for Apple and TRS. Supplied on OEM Allenbach diskettes. Rapid delivery for 100 to 100K copies. Allenbach Industries, Inc., 2101 Las

Palmas, Ste. A, Carlsbad, CA 92008, 619/438-2258 800/854-1515

Hardware/Add-On Boards

Quality Boards at Low Prices
RAM CARD 64K Expandable - 256K w/parity, price $149. 64K expansion kit $79. EPROM PROGRAMMER for most 4K to 64K 24 P10 EPROMS $129. COMBO CARD w/parallel printer asychronous communications (RS232C) & clock calendar, price $199. PROTO CARD holds 85 14 pin chips, ground plane design 3.5 X 8" $29.95. Apparat, Inc., 4401 S. Tamarac Pkwy., Denver, CO 80237, 303/ 741-1778

Lab Master
A sophisticated system that includes 16 channels of 12-bit A/D with 30 KHz conversion rate, 2 channels of 12-bit D/A, 5 timer/counters and 3 8-bit parallel ports. Options: programmable gain up to 1000, 14 and 16 bit accuracy, 40 and 100 KHz conversion, up to 256 channels. (List price $995.) Tecmar, Inc., 23600 Mercantile Rd., Cleveland, OH 44122, 216/ 464-7410

Three-In-One-Board
A hardware and software replacement for three IBM cards: two serial cards and one game adapter card. List price: $289. We invite dealer inquiries on our complete line

of products. RGB Designs, 3375 Woodward Ave., Santa Clara, CA 95050, 408/ 748-0400

M-192 Memory Expansion Board
192K byte memory board for only $259. It is compatible to all IBM PC softwares. Easy to install by users. Requires PC system with 64K memory. Offer one-year warranty. Chintronics also offer 9 RAM chips (64K) for only $59. Fully tested and burned-in. Chintronics Co., 19 Longmeadow Rd., Chelmsford, MA 01824, 617/ 256-7862

Graphics Master
A multifunction board that interfaces to the monochrome or color display and does high-resolution graphics. External sync allow you to display IBM characters over a video image with an external mixer. Ideal for adding legends, arrows, bar graphs, etc. on a screen. (List price $595.) Tecmar, Inc., 23600 Mercantile Rd., Cleveland, OH 44122, 216/ 464-7410

Circuit Boards
Circuit board transforms PC into CP/M 2.2 system, giving user access to abundant software. 64K RAM expansion card is plug compatible and couples Z-80 microprocessor to IBM 8088 microprocessor, speeding memory access 30 times with complete buffering. Requires 48K, 1dd. Byad, Inc., 101 Lions Dr., Barrington, IL 60010, 312/381-2330

Z-80, 8086, & 68000 Microcards
512K VersaCard for IBM PC. Sritek brings ultimate price/ performance to IBM PC with Z-80, 8086, 68000 MicroCards and UNIX/XENIX operating system. The user can start with 256K bytes of VersaCard expansion memory for the IBM PC and upgrade it to 512K bytes by mounting a RAM Module. Sritek, 3637 S. Green Rd., Cleveland, OH 44122, 216/292-0011

Quadboards & Quadram Products
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Coda, Inc. has all QUADRAM Products at mail order prices. All products carry the QUADRAM warrantees and can be used for any special offers from QUADRAM. We will meet or beat any advertised prices. Call or write for a complete price list. Coda, Inc., P.O. Box 1054, Lilburn, GA 30247, 404/925-0640

IEEE 488 Interface
Complete implementation of industry-standard IEEE 488 interface lets the PC operate as Controller, Talker or Listener on the IEEE 488 bus; DMA and interrupt capabilities set this IEEE 488 boards apart. IEEE 488 Software is available. Tecmar, Inc., 23600 Mercantile Rd., Cleveland, OH 44122, 216/ 464-7410

Error Correcting RAM
A memory card that corrects a single-bit error in any byte and detects a dual-bit error. It is designed for applications where memory must be non-stop. Any RAM chip in a row can be removed and the memory will continue to function perfectly at full system speed. List price: $775. RGB Designs, 3375 Woodward Ave., Santa Clara, CA 95050, 408/ 748-0400

IBM PC Products to Remember
*Dual I/O PCB, 2 IBM Printer port 2 Async RS232 I/O, clock with battery backup $192.40. *Multifunction PCB, Mem expandable 256KB with Parity check, 1 IBM Printer port, 1 Async RS232 port, clock with battery backup, 64KB at $495. *Others include Mem PCB expandable 512KB, Mem with Async I/O, Mem with parallel I/O. Computer Peripherals, Inc., 1117 Venice Blvd., Los Angelels, CA 90015, 213/298-1297 Telex: 194561 LSA

Hardware/Cables

Printer Cables
Our printer cables connect the IBM PC with MX-80, Prowriter, NEC and other parallel printers. Connectors are high quality with gold plated contacts. Our price is only $35, including shipping. Master-Card/VISA accepted, COD add $2. Quantity Discounts, Custom Lengths Avail. Austin Computer Technologies, P.O. Box 26595, Austin, TX 78755, 512/835-6136

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Looking for the right connection?
MNM offers a complete line of cables to connect your IBM-PC to any peripheral. All MNM products carry a lifetime guarantee & are available at Authorized MNM Cable Dealers. Call toll free for the name of your nearest MNM dealer. Milford Null Modem, Phoenixville Pike & Charelstown Rd., Malvern, PA l9355, 800/345-2121

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milford null modem

Video Extension Cable
A 3-meter-long combined power and D-9 video extension cable set for locating the video display remotely from the processor unit. List price: $75. We invite dealer inquiries on our complete line of products. RGB Designs, 3375 Woodward Ave., Santa Clara, CA 95050, 408/748-0400

IBM Cables
Mail order only. Cable to connect IBM PC CPU to the keyboard, non-accordian. Can be used stand-alone or as an extender. 10 ft. length $25. Clark Systems, 389 Pheasant Run, Batesville, IN 47006, 812/934-3817

Hardware/Computer Graphics

High Resolution Color Graphics
Introducing the RA-640 color board with 640 X 480 resolution, 16 colors selectable from a palate of 4096. Complete

software support for all MS DOS languages including multiple fonts, pattern fills, etc. Complete presentation graphics package available. Media Cybernetics, Inc., 36 Columbia Ave., Tacoma Park, MD 20912, 301/270-2272

Hardware/Computer Graphics Camera

Videoslide35
A computer graphics camera that records video images onto 35mm color film & is compatible with microcomputers & most color graphics terminals. Inputs accepted include RS-170 RGB, TTLRGB and NTSC. The price is $2799 complete with camera cables & IBM PC interface. Lang Systems, Inc., 1010 O'Brien Dr., Menlo Park, CA 94025, 415/328-5555

LANG
SYSTEMS, INC.

Hardware/Disk Drives

Versatile Space Saver
2 TEAC Disk Drives fits in space of 1 standard unit. 40 Tr DS & 80 Tr available. DOS 1.1 compatible on 80 Tr w/JFORMAT program. Capacity to 800KB. Available w/mounting brackets. Price 40 Tr DS $299 - 80 Tr DS $435. Winchester Hard Disk System w/capacities to 20MB are available. Apparat, Inc., 4401 S. Tamarac Pkwy., Denver CO 80237, 303/741-1778

5 1/4-inch Disk Drives
Single-sided single-density, single-sided double-density, double-sided single-density, double-sided double-density, 5 1/4-inch disk drives available for IBM PC. We invite dealer inquiries on our complete line of products. RGB Designs, 3375 Woodward Ave., Santa Clara, CA 95050, 408/ 748-0400

Hard Disk III
Leading Edge® hard disk III is a 5 1/4" Winchester disk subsystem. Features a (Z80A) microprocessor which provides 18 high level commands TRS-80 model III & I and IBM PC compatibility. Provides power for 2 Winchester disk drives full sector buffer 256-512 bytes. Leading Edge Products, 225 Turnpike St., Canton, MA 02021, 800/ 343-6833 617/828-8150

Disk Drives for PC
Save on Tandon Disk Drives. TM100-1, SS, 40T: $195 TM100-2, DS, 40T: $259 TM100-4, DS, 80T: $349 All drives are new. VISA/MC or checks. NJ residents add tax. Shipping extra. VLM Computer Electronics, 10 Park Pl., Morristown, NJ 07960, 201/267-3268

Cartridge Winchester in PC
Package includes Removable-Cartridge Winchester, cartridge, new 'superspeed' controller, software, and kit for installation into PC. Additional power supply optional. (List price $1795) Tecmar, Inc., 23600 Mercantile Rd., Cleveland, OH 44122, 216/ 464-7410

Hardware/General

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Sell or buy used PC compatible products!
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Hardware/Monitors

Displays
13" medium-res display with 420 pixels x 625 lines res. Display all 16 colors, plugs directly DB-9 socket with 8' cable. 19" display is high-res and is adequate for full 320 X 200 matrix of color graphic display board. List: 13" $639, 19" display $745. Requires: Color/graphics adapter. RGB Designs, 3375 Woodward Ave., Santa Clara, CA 95050, 408/748-0400

RGB Monitors & Mods. for 80NY
RGB conversion kit, SONY 19" & 25" PROFEEL: 16 color display, 8' cable, complete instructions, $99. RGB interface for 12" SONY KX1211HG, 16 color display, no mod. req., just plug in, $139. Modified SONY 19" & 25" PROFEEL, 16 colors, 19" $825. 25" $1375, Comp. with 8' cable. 23" CONRAC B W,

record. $225. Telemax, Inc., Video Marketing Division, 780 Lorraine Dr. Box 339, Warrington, PA 18976, 215/343-3000

Hardware/Power Protection

Ramlok
Standby power supply/line voltage conditioner. Automatically switches to standby power if incorrect line voltage is reaching equipment. Contents in memory are saved. Requires auto battery. Included 10 amp battery charger, overcharge and reverse-polarity protection. Ladco Development Co., P.O Box 464, Olean, NY 14760, 716/372-0168

Hardware/Printers

Starwriter F-10
This 40 CPS daisy wheel includes low profile design, industry standard ribbons and print wheels, standard centronics parallel or RS 232C, and extensive built-in word processing functions. The Starwriter F-10 printer is supported by a full year warranty and national authorized Leading Edge service centers. Leading Edge Products, 225 Turnpike St., Canton, MA 02021, 800/ 343-6833 617/828-8150

Sprint II Plus™
QUME is the largest daisywheel printer manufacturer in the world. Our new SPRINT II PLUS™ is the one low-cost premium quality printer that is plug-compatible with virtually any microcomputer. It prints at 40 cps, boasts the latest in sophisticated features, and the best reliability record in the industry. Qume Corporation, 2350 Qume Dr., San Jose, CA 95131, 408/942-4000

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Printmaster F-10
The 55 CPS model with all the same features as the Starwriter F-10 plus faster print speed and carriage return time, accept data transmission up to 0.600 baud, dual-color ribbons, and original plus 4 copies. The Printmaster F-10 is supported by a year warranty and national authorized Leading Edge service centers. Leading Edge Products, 225 Turnpike St., Canton, MA 02021, 800/ 343-6833 617/828-8150

Prowriter
Offers a printing speed of 120 CPS, bidirectional printing, 8 character sizes, and 5 alphabets. Prowriter's NX9 matrix produces correspondence quality print and high resolution graphics. The Prowriter 85 IOA provides a 10" carriage Prowriter. 1550 provides a 15" carriage. Leading Edge Products, 225 Turnpike St., Canton, MA 02021, 800/ 343-6833 617/828-8150

Hardware/Storage Devices

Versatile Print Buffer
SPOOL/64 increases operator throughput by letting printer operate from 64K buffer while operator uses PC for other tasks. Program control space compression & copies parallel version $319. Optional serial board for serial/serial & parallel/serial conversion. Option price $99. Cables available. Apparat, Inc., 4401 S. Tamarac Pkwy., Denver, CO 303/741-1778

Apparat, Inc.

Cyberdrive™
Ultra-high speed hard disk using swingarm positioner for fastest average seek times (33 milliseconds!!) Speed up performance and use the integrated backup device. 13.5, 27, or 40 Mbytes per cabinet. Over 100 Mbytes supported with additional cabinets. Quantity discounts. Cybernetics, Inc., 8041 Newman Ave. #208, Huntington Beach, CA 92647, 714/848-1922

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Tallgrass Technologies offers a family of high performance, high capacity HardFiles with formatted capacities from 6.25 Mb to 70.7 Mb. With integral streaming tape cartridge backup, the Tallgrass

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IBM/PC Survivors Manual
New, short introduction to the IBM Personal Computer for the complete novice. Easy step-by-step "how to" for every IBM PC buyer or prospective buyer. Ideal for secretary, spouse, friend. Immediate delivery. Price: $11.95 + $2 shipping/handling. Mayer Associates International, 6009 Walnut St., Pittsburgh, PA 15206, 412/362-1290, Source no. STO910

Retailers/ California

Large Group Hardware Buys
Cost-effective multiple PC buys. CTI expertise in IBM-PC and PC Workalike machines, peripherals and sources enables us to assist you make the most cost-effective total systems buy and helps you get the most out of it after purchase. See our ad this issue! CTI - Computer Technology Innovations, 1037 North Fair Oaks Ave., Sunnyvale, CA 94086, 408/745-0180

Retailers/Florida

Sales - Support - Training
Specializing in IBM PC, hardware, peripherals, software, and books. Individual training and training seminars provided. Second store in South Miami at 12105 S. Dixie Hwy. 305/238-7238. Exclusive software shop at 1625 NE 163rd St., Miami Beach, 305/945-1015. Computer Scene, 1641 NE 163rd St., Miami Beach, FL 33162, 305/945-1014

Retailers/Texas

IBM PC-Compatible
A dealer of PC compatible hardware, software, supplies and furniture oriented for business users. Manufacturers include Okidata, NEC, PGS, VisiCorp, MicroPro, Quadran and much more. IBM trained personnel with strong busi-

ness orientations are available for follow-up support after sales. Las Colinas Computer Co., 125 E. John Carpenter Fwy. Ste.# 660, Irving, TX 75062, 214/556-2424

LCC
Las Colinas Computer Company

Retailers/New York

IBM, Columbia Systems
PGS, Amdek, Electrohome, Pi-Tech, USI, Taxan, BMC monitors. EPSON, IDS, NEC, SCM, Okidata, C.ITOH, Diablo printers. Tallgrass, Corvus, Tecmar, Davong hard disks. Xedex, Quadram, AST, Hayes, Maynard, Hercules, Seattle peripherals. A full range of software, including lots of games. Greenwich Village Computers, 687 Broadway, New York, NY 10012 212/254-9191

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IBM Software Afficionados
You'd like free software, we'd like reviews. The Book Company seeks additional reviewers for the Book of IBM software. For details write: The Book Company, Attn: The Editor, 11223 S. Hindry Ave., Los Angeles, CA 90045

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STONE

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We are ready to demonstrate and support your hardware/software products in Zurich on our IBM PC's and would be interested to distribute/represent/adapt your products or services for the local market. We have a new store in Zurich for IBM and other related products. Contact Hans Roduner. 31 Corporation, Bernerstr 169, CH-8048, Zurich, Switzerland (01) 62-22-30

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files can be sorted by location, franchise, or type of computer. The list will be added to monthly. Computer Intelligence, 3344 N. Torrey Pines Ct., La Jolla, CA 92037, 800/854-2010, 619/450-1667

☐ COMPUTER INTELLIGENCE

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Personal Financial Assistant
Accounting system for personal or small-business users. Double entry accounting. Complete financial reports: Balance Sheet/Income Statement, Trial Balance, General Ledger. Up to 5 check journals automatically integrated into ledger. Complete system $100. Documentation only, $25. L.C. Systems, P.O. Box 5360, Coralville, IA 52241, 319/354-2630

LC Systems

Inventory/ Accounting

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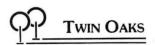Mis Consultants, Inc., 1065 E. Hillsdale Blvd. Ste.# 114, Foster City, CA 94404, 415/345-6000

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Software/Program Compression

BASIC Variable Renamer
Reduces long variables to short, unique names like AA, ZZ9$. Can also discard comments and extra spaces. Fully supports CHAINING and shared variables. Will restore old names. Leaves program source disguised, but modifiable. Reduce file size up to 30%. Tiny-Namer $40. Writering, 5050 Garford, #160, Long Beach, CA 90815, 213/498-6496

Software/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

Software/Religious

The WORD processor
The entire KJV Bible Text on floppy disc with capabilities to search on any word, character, phrase; to display or print

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BIBLE RESEARCH SYSTEMS

Software/Sort

Optimum-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. Optimum Data Processing, P.O. Box 2167, Humble, TX 77347, 713/454-7428

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Scientific Subroutines
Fortran stats. Subroutines covering data screening, correlation & regression, design, discriminant, factor, time, freq. analysis. Non-parametric stats, generation & distribution functions, matrix & storage operation, eigenanalysis, mat. & polynomial solutions & misc. Linear equations, Sources $295. Alpha Computer Service, P.O. Box 2517, Cypress, CA. 90630, 714/894-6808

Multistat
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Software/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, Ste.# 179, Denver, CO 80231, 303/793-0145

Software/ Typesetting

Typenet
Provides powerful typesetting and printing services to local and remote PC subscribers. Ideal for booklets, directories, etc. Fully supported by a company with in-depth experience in typography and computing. Call Ken Abbott. Manhattan Graphics Corporation, 163 Varick St., New York, NY 10013, 212/924-3110

Software/Utilities

Funkey
Program the function keys to suit your own needs. Funkey makes using word processing, spreadsheet and other applications programs easier and faster. Uses are limited only by the imagination. See display ad. Bourbaki Inc., 431 Main St., Boise, ID 83702, 208/342-5849

Compress/Decompress
Removes all comments from BASIC programs and places as many statements on one line as possible. Can cut program size by 50%. Decompress performs opposite function. Requires 64K, 1 dd, $50. Call Andy Needle. Byte-One, 5252 Thorntree, Irvine, CA 92715, 714/551-9191

PC Toolbox
EDIR-formatted information about files and used/free space. List-file printing with total printer control, heading and forms options. Clock-continuous time on screen with alarm. File Utility-assign/remove "hidden" status, recovers deleted files. Monitor-dynamic switch between color/BW CRT's $37. Alta Systems, Inc., P.O. Box 9802 #181, Austin, TX 78766, 512/836-7351

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binary/ASCII strings, offset no., forward/backward scrolling. Other function: file/sector printing, DIR lift, sector saving, customization $47. Alta Systems, Inc., P.O. Box 9802 Ste.# 181, Austin, TX 78766 512/836-7351

Softpool™
Parallel/Serial print spooling 128K capacity. Program execution no longer linked to printer speed - $$$ SALE PRICED $$$ Keyswap™ IBM PC keyboard conversion program, audible feedback on toggle keys, $69.95. See display ad this issue. Rickerdata, P.O. Box 288, Burlington, MA 01803, 617/662-0856

The Norton Utilities
Your data is in danger...if you don't have UnErase and FileFix for file recovery—part of the Norton Utilities, over a dozen essential utilities to supplement PC-DOS. "An industry standard; no PC should be without them." — DC User's Group. $80. Peter Norton, 1716 Main St., Venice, CA 90291

Peeks 'N Pokes For The IBM PC
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 Pokes. Over 30 programs plus manual. $30 plus $2.50 shipping. MC/VISA. Data Base Decisions, 14 Bonnie Ln., Atlanta, GA 30328, 404/256-3860

Directory

Diskette Catalog
DC keeps track of all your files on all your disks. Functions include add, alphabetize, delete, list, rename, and search. All functions work with a single disk or your whole catalog. If you own more than one disk, you need DC. For PC DOS with one drive and 64K. $20. Creative Programs Unlimited, 16533 37th Avenue NE, Seattle, WA 98155, 206/364-3196

Quickguide - IBM PC
The best of the tutorial/command reference guides with DOS, Edlin, BASIC, "batch files", etc. to take the user from day one to confidence on the PC. A must for you, your office help and others suffering from "manual shock". More practical than disk tutors. Get up and running fast! $12.95. Public Data Corporation, Dept. PC-3, 420 S. Beverly Drive, Ste.# 207, Beverly Hills, CA 90212

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Helps you write professional programs!
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Variable string search & replace
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PC DOS BASIC source code diskette $25.00. Tulsa Computer Consortium, P.O. Box 14097, Tulsa, OK 74104, 918/747-0151

Ultimenu For DOS
DOS is even easier when you use the original full screen menu system. Eliminates the need to memorize utilities or type lengthy character strings. Fast. Easy to customize. $24.95. (Similar system for BASIC add $19.95). Mastercard/VISA accepted. DB/DC Software ASSOCIATES, P.O. Box 4695, Manchester, NH 03108, 617/682-6629

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Dr. Pig's BASIC Prettyprinter
Are your BASIC programs over 100 lines long? Then you need Dr. Pig's BASIC Prettyprinter - just $24.95. It prints BASIC programs so you can read them: indented, block structured, keywords in lowercase, remarks highlighted, cross reference. $24.95 or write for details. Personal Computer Things, Inc., P.O. Box 207 - PCW, Centreville, MD 21617

Software/Word Processing

Versatext
Word Processing & Data base $199.95
Thinker-Spreadsheet, color

opt. EZ use $75
PC File-Electronic filing cabinet $75
All three can be used as one-read files from Thinker and PCFile into VersaText. Combination package $335 - can use on 64K. Best all purpose business pack available. Texasoft, Inc., 3415 Westminster Ave. Ste.# 100, Dallas, TX 75205 214/369-0795

Readiwriter
An extremely powerful word formatter; handles footnotes and table of contents automatically. There is no size limit for documents. Complete with 100 + page user manual and tutorial. See display adv. and ordering info in this issue. Readiware Systems, Inc., P.O. Box 680-B, West Redding, CT 06896 203/431-3521

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 100 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

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Rickerdata	Keyswap *(transforms PC keyboard into typewriter style keyboard)*	69.95
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Solution Software	PCModem 1.3 *for Smartmodem 300*	49.95
	PCModem 1.4 *for Smartmodem 1200*	79.95
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HARDWARE

AST Research	ComboPlus 64k *with SuperDrive and SuperSpooler, clock calendar, and serial and parallel ports, with one year warranty, upgradable to 256k*	389.00
	MegaPlus	*(see above special)*
Amdek	*We supply cable to IBM-PC for all Amdek monitors*	
	Color II RGB Hi Res Monitor	697.00
	Video 300 Green *(use with color graphics card)*	159.00
	Video 300 Amber *(use with color graphics card)*	169.00
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	Amplot Digital XY Plotter	727.00
CompuCable	Parallel printer cable for IBM-PC *specify make of printer*	32.00
Curtis	PC Pedestal *for IBM Display*	65.00
	Extension Cables for IBM Display	44.00
	Keyboard Extension Cable *(3 to 9 ft.)*	36.00
Epson	MX-80 F/T with GRAFTRAX-Plus	497.00
	MX-100 F/T with GRAFTRAX-Plus	697.00
FTG Data	Light Pen (Push Tip)	159.95
	Demo Diskette Set for Light Pen	39.95
Hayes	Smartmodem 300	227.00
	Smartmodem 1200	557.00
	PCModem Software 1.3 for Smartmodem 300	49.95
	PCModem Software 1.4 for Smartmodem 1200	79.95
	Smartmodem-to-IBM Cable	30.00
IDS	Prism 80 with all 4 options	1297.00
	Prism 132 with all 4 options	1578.00
Kraft	Joystick	51.00
	Paddle	37.00
Microsoft	RAMCard *(with RAMDrive & Utility)* 64k upgradable	257.00
Princeton Graphics	PGS Hi Res RGB Monitor *with cable*	597.00
Quadram	Quadboard *with QuadRAM-Drive, serial and parallel ports, and clock/calendar, 64k upgradable to 256k*	418.00
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	ME 8 (8k) upgradable to 64k	127.00
	ME 64 (64k)	181.00
	Microfazer Printer buffers (parallel) with copy feature	
	MP 8 (8k) upgradable to 512k	134.00
	MP 64 (64k) upgradable to 512k	188.00
Symtec	Light Pen (Touch Ring) *with demo diskette*	126.00
	Light Pen (Push Tip) *with demo diskette*	138.00
TG	Joystick	51.00
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	"Y" Cable for 2 Joysticks	39.00
Tandon	TM 100-2 (5¼") Drive (DS, DD) *configured as Drive A or Drive B for your PC; comes with complete step by step installation instructions*	278.00

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United States:
For monitors, printers, drives and furniture, add 2% to all orders. For all other items, add $2 per order for UPS surface; $3 per order for UPS Blue Label.

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PC'83

ANNOUNCING PC '83, THE INTERNATIONAL CONFERENCE AND EXPOSITION FOR PC USERS.

In the last few months, *thousands* of exciting new products have become available to make your IBM Personal Computer work in hundreds of innovative, landmark applications. By adding the right software, plug-in cards, peripherals and accessories, you can make your PC more productive and useful than you ever dreamed possible.

And now there's finally a way to learn about and try out all of these products: PC '83, the first international event *exclusively* for PC users.

THE LARGEST EVER

The exposition portion of PC '83 is the largest gathering of PC-compatible products ever held. You'll find, under one roof, more than 400 exhibits of software for business, professional, home, personal and education applications; plug-in cards for memory expansion, telecommunications, speech and many other functions; hundreds of peripherals, including printers, networking systems and innovative new storage devices; plus dozens of publications, books and invaluable support services. PC '83 brings together the *entire* PC world.

RELIABLE AND COST-EFFECTIVE

Think about the different vehicles available for buying software and add-ons for your PC. You can shop at local computer stores, but they usually have a very limited selection of products and a less-than-expert staff. You can buy through mail order—and take some big risks if you get products that don't work or don't do what you expected.

At PC '83 you have the best of all worlds. You can see *all* the different PC-compatible products in one location at one time. You can talk with factory experts rather than just local salespeople. You can 'test drive' each product and decide if it's right for you. And when you find what you're looking for, you can buy it right on the spot.

Best of all, you'll save hundreds—even thousands—of dollars at PC '83. Most of the products shown at PC '83 are sold at special show prices, so you won't have to look hard to find incredible values. And because PC '83 will help you make more informed purchase decisions, you'll end up with products that are better suited to your applications.

A REMARKABLE CONFERENCE PROGRAM

The conference program at PC '83 isn't just a warmed-over, pared-down version of other computer conferences. The seminars, workshops and forums at PC '83 are the result of months of research and planning targeted toward one specific goal: helping you get absolutely the most out of your IBM Personal Computer.

The program features world-renowned PC authorities speaking at over 100 educational sessions. Seminars provide an in-depth, understandable look at a broad range of PC uses in business, home and education. Seminars emphasize 'how to,' telling you specifically what you need to know—in non-technical language—to use the PC in dozens of different applications.

Forums present an inside look at what's happening in the PC-compatible industry and what new developments you can expect in the next few years.

Software and Hardware Spotlights are a PC '83 exclusive. These workshops address one of the biggest problems that virtually all computer users face: how to decide which software and hardware packages are best for your applications. Each Spotlight provides a detailed discussion and demonstration (with large-screen television) of a group of products, covering their features, capabilities *and* limitations. Experts are on hand at each of these sessions to answer all your questions.

EASY ON YOUR FEET

We've thought of a lot of details to make your visit to PC '83 just a little more pleasant. As with all of our events, the show is fully carpeted, so your feet won't give out before you've seen all the exhibits.

Our unique Conference and Exhibits Guide helps you quickly find the exhibits and educational sessions you want to attend—even if you can't remember their names. And the Guide is provided free of charge to all attendees.

If you're traveling some distance to attend PC '83, we'll arrange a discounted hotel room near the show site through the PC '83 Housing Bureau. On request, we will also provide information on things to do, places to visit and where to eat in San Francisco and Boston—to make your stay in these grand cities a memorable and relaxing one.

A TOTAL SUPPORT SERVICE

Let's face it, getting support for your PC is tough. The PC magazines, newsletters, user groups and retailers are certainly helpful. But there are so many different products, services and things to learn about for your PC, what you really need is *one* event that brings everything together in one place in a well-organized format.

PC '83 does it all. It showcases all the PC-compatibles under one roof. It has a complete and comprehensive program of seminars, forums and product workshops. And it's produced with the quality and professionalism you've come to expect from Northeast Expositions.

So if you do anything with the IBM Personal Computer or if you're considering buying one, be sure to put PC '83 in your calendar right away. Your PC will certainly appreciate it.

PC'83

SAN FRANCISCO:
Friday-Sunday, June 17-19, 1983, Brooks Hall/Civic Center, 10:30 AM-5:30 PM daily

BOSTON:
Saturday-Monday, October 8-10, 1983, (Columbus Day weekend), Bayside Exposition Center, 10:30 AM-5:30 PM daily

Just Announced

The Wide World of PC Products

Hardware

Boards

RAM Card

A memory expansion board that provides an additional 64K RAM for a system that already has 64K. The card is expandable to 256K in 64K increments. List price: $149; additional 64K increments, $79 each. Apparat, Inc., 4401 S. Tamarac Pkwy., Denver, CO 80237, 800/525-7674, 303/741-1778.

QuadColor

A color/graphics board that comes in three versions. QuadColor I is hardware and software compatible with the IBM Color/Graphics Adapter. QuadColor II has a bit-mapped resolution of 640 by 200 and displays up to 16 colors simultaneously. Quad-Color III has a bit-mapped resolution of 640 by 400 and displays up to 16 colors at once. List price: QuadColor I, $350; QuadColor II, $575; Quad-Color III, $850. Quadram Corporation, 4357 Park Dr., Norcross, GA 30093, 404/923- 6666, TWX: 810-766-4915.

IRMA

A board that enables users to attach the IBM PC via coaxial cable to most IBM 3270 controllers to emulate an IBM 3278 display terminal. IRMA requires 64K and one disk drive. Either MS-DOS or CP-M/86 may be used. Designed for business use, the board allows the PC to access common or central mainframe data bases through the coaxial cable while maintaining full PC capabilities in a local mode. List price: $1,195. Technical Analysis Corporation, 120 W. Wieuca Rd. NE, Atlanta, GA 30042, 404/252-1045, Telex: 54-9600.

Hercules Graphics Card

A replacement for IBM's Display Printer Adapter that enables users to plot high-resolution (720 by 348), bit-mapped graphics on the IBM PC monochrome display. The card includes text and graphics modes. The graphics mode includes two graphics pages that can be displayed alternately. A parallel port interface, 64K RAM, and a light pen interface are provided. Software supplied with the card allows the use of Advanced BASIC statements. List price: $649. Hercules Computer Technology, 160 Beechnut Dr., Hercules, CA 94547, 415/799-9354.

PC VersaCard

A memory expansion board that also provides the ability to add a variety of microprocessors. The board comes with 256K, and an additional 256K can be piggybacked with the RAM Module. In addition to the RAM Module, another piggyback board, called a MicroCard can be attached. A MicroCard contains an alternate microprocessor.

There are three MicroCards, each with a different microprocessor: the Z-80, the 8086, and the 68000. MicroCards for the iAPX-286 and 16032 microprocessors are planned as soon as these chips become commercially available. The Z-80 MicroCard gives the PC access to the large number of programs that run under CP/M-80. The 8086 MicroCard improves performance by 300 to 400 percent and retains software compatibility with programs that run under the 8088 microprocessor. The 68000 Micro-Card increases IBM PC throughput by an order of magnitude and provides a multiuser environment that can take advantage of the UNIX/XENIX System III operating system. List price: VersaCard, $995; RAM Module, $595; Z-80 MicroCard, $195; 8086 MicroCard, $595; 68000 MicroCard, $795. Sritek, 3637 S. Green Rd., Cleveland, OH 44122, 216/292- 0011.

Supertalker II

A speech digitizer that enables the IBM PC to store and reproduce words and sounds. The board comes with a loudspeaker and microphone and requires 64K and one disk drive. The board's 32K can be used for other programs when it is not needed for voice applications. Supertalker software is available, but the digitizer will run on user-developed BASIC programs. Supertalker II enables up to 2 minutes of words or sounds to be entered via the microphone, digitized, and stored on disk for playback. The speech digitizer reproduces the actual human voice including voice inflection. List price: $565. Mountain Computer, Inc., 300 El Pueblo Rd., Scotts Valley, CA 95066, 408/438-6650.

Storage Devices

The Toaster

A hard disk subsystem that uses two removable 3.9-inch cartridge drives. Like floppy disks, the 5MB cartridges are removable, interchangeable, and transportable, yet they provide the large storage capability and speed associated with hard disks. Two cartridges are included that provide 10MB of storage. The advantage of two cartridge drives is that one cartridge can back the other one up. List price: $2,795; additional cartridges, $75 each. XCOMP, 7566 Trade St., San Diego, CA 92121, 619/271-8730, Telex: 182-786.

Display

QuadScreen

A monitor that displays a great amount of information at a glance. The screen shows 160 characters by 64 lines using a 5-by-7-character matrix. The bit-mapped graphics mode allows addressable resolution of 960 by 512. An interesting feature is the split-screen mode, which permits two 80-character by 64-line screens to be pictured side by side. Information can be edited from one screen to another. Other features include inverse video and forward and backward smooth scroll. Monitor, cable, software, and display controller board are included. List price: $1,950. Quadram Corporation, 4357 Park Dr., Norcross, GA 30093, 404/923-6666, TWX: 810-766-4915.

QuadScreen, Quadram

IBM 581

A large-capacity plasma display panel for original equipment manufacturers (OEMs). The 581 is filled with neon/argon gas that is excited by a grid of conductors to create a high-resolution, 737,000-pixel image in orange and black. An interface kit is available for OEMs that includes a power supply, a 5 1/4-inch floppy disk, a card that plugs into the PC, and documentation on compatibility. The 581's screen is 17 1/4 inches diagonally and has the ability to display 69 lines of 160 characters each—as much information as can be displayed on four standard 1,920-character screens. The all-points-addressable screen can display any mixture of alphanumeric information, graphs, and pictures. Full or partial images can be added, deleted, moved, or altered anywhere on the screen. No external refresh is required; images remain stable and flicker free unless erased or altered. List price: $4,500. IBM, OEM Products, 44 W. Brokaw Rd., San Jose, CA 95110, 408/224-4622.
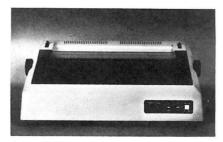
Printers

Microline 92 and 93

Dot matrix printers that have four printing modes: bidirectional data processing at 160 cps, correspondence quality at 40 cps, enhanced and emphasized at 80 cps, and standard dot addressable. The printers support a parallel interface, and an RS-232C interface is optional. Both feature ASCII 96 character sets, subscripting and superscripting, and underlining. Both accept down-line loadable character sets. The printers vary in size and paper feed: the ML 92 is an 80-column printer, while the ML 93 is a 136-column printer. The ML 92 uses pin and friction paper feed, but an optional tractor feed is available. The ML 93 uses either friction or tractor feed. List price: ML 92, $699; ML 93, $1,249. Okidata Corporation, 111 Gaither Dr., Mt. Laurel, NJ 08054, 609/235-2600, TWX: 710-897- 0792.

C.Itoh A-10

A low-speed daisy wheel printer that requires a parallel or serial interface and a cable. It has an 18 cps printing speed and a 100-character print wheel. The word is that it will be available by the end of March. List price: $995. C. Itoh Electronics, Inc., 5301 Beethoven St., Los Angeles, CA 90066, 213/306-6700.

A-10 daisey wheel printer, C.Itoh

Pacemark 2410

A dot matrix printer that has four print modes: data processing quality printing at 350 cps, draft quality at 175 cps, correspondence quality at 85 cps, and dot addressable graphics. The Pacemark 2410 supports parallel or serial interface. It features red or black print, double-wide characters, underlining, subscripting and superscripting, and proportional character spacing. Carriage size varies from 136 columns at 10 cpi to 232 columns at 17.1 cpi. Both friction and tractor paper feed are offered with an optional cut sheet feeder that accepts up to 200 sheets. Character sets include an ASCII 96-character set and extension set, a down-line loadable character set, and an optional correspondence quality character set. List price: parallel interface version; $2,995; serial interface, $3,145. Okidata Corporation, 111 Gaither Dr., Mt. Laurel, NJ 08054, 609/235-2600, TWX: 710/897-0792.

Just Announced

Infoscribe 1100

A dot matrix printer than can operate in draft/data processing (200 cps), correspondence (100 cps), business letter (40 cps), and graphics modes. The printer requires a parallel or serial interface and cable, one disk drive, and a program written in BASIC. It has a one-piece structural foam chassis that reduces noise. List price: $2,295. Infoscribe, 2720 S. Croddy Way, Santa Ana, CA 92704, 714/641- 8595, Telex: 692-422.

Infoscribe 1100 dot matrix printer, Infoscribe

Modems
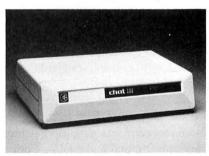
PC Modem Plus

A communications package that offers everything the PC needs for telecommunications: a card-type modem, a serial port, communications software, and a cable. The full duplex, 300-baud modem has auto-answer and auto-dial capability and a 2K buffer. It expands to 1200 baud with the addition of a piggyback card called the PC Modem Speed Adapter, which operates at full- or half-duplex. The software is menu-driven and has capturing ability, electronic mail, and single-keystroke dialing for use with independent information services. The modem is compatible in all modes with other communications software such as *PC-Talk*, *Micro-Com*, *Crosstalk*, and *E-Mail*. List price: $389. Ven-Tel, Inc., 2342 Walsh Ave., Santa Clara, CA 95051, 408/727-5721.

Chat II

A communications interface that is both a modem and a message processor. It requires an RS-232C interface and communications software to access Telex, TWX, or the Bell System networks. Users choose two of the three when selecting the network cards that come with Chat II. The device comes with a cable.

Chat II will interconnect up to three dissimilar types of office equipment such as word processors, terminals, and personal computers. The device allows up to 16K of messages to be prepared off line and sent out at a future time to take advantage of after-hours rates. Likewise, the device can receive and store up to 16K of incoming messages for retrieval at a later time. List price: $1,645. Chat Communications, 2462 Wyandotte, Mountain View, CA 94043, 415/962-9670, Telex: 172385.

Chat II modem and message processor, Chat Communications

Network Devices

ShareNet

A local network for 1 to 24 microcomputers that connects the PC to a Motorola MC68000-based Network Manager and File Server. ShareNet requires a network interface card for each standard configuration IBM PC on the network. (Both 8-bit and 16-bit microcomputers can share the network.) The network allows the linked microcomputers to share the same directory areas and data files concurrently. List price: Network processor and peripherals, $7,263; interface card, $250. Novell Data Systems, Inc., 1170 N. Industrial Park Dr., Orem, UT 84057, 800/453-1267, Telex: 669 401.

Miscellaneous

VX Series

Voice technology devices that provide interactive voice recognition, storage, and response. Each device requires an RS-232 interface and driver protocol, which the manufacturer provides at additional cost. The V1000 offers the Speaker Dependent Recognition system that recognizes individual words or phrases. It operates by comparing the spoken word to a vocabulary entered by the user. The V4000 combines a Voice Response feature with the Voice Store and Forward feature. Voice Response enables spoken words to be digitized, compressed, stored, and played back, either immediately or later. Voice Store and Forward technology permits spoken words to be digitized, compressed, buffered, and transmitted to a storage device or a node in a communications network device. The V5000 combines the features of the V1000 and V4000. List price: V1000A, $4,200; V4000A, 4,200; V5000A, $5,000; IBM Driver Package, $500. Votan, 26046 Eden Landing Rd. #3, Hayward, CA 94545, 415/785-8060.

P2402-19

A keyboard for the IBM PC that has an alternative key layout. The left Shift key and right RETURN key have traditional typewriter locations. Key legends for several keys use recognizable spellings rather than the symbols

used on the IBM keyboard. An ENTER key has been added for use with the numeric keypad. LED indicators on lock keys show on/off status. List price: $235 including cable. Key Tronic Corporation, P.O. Box 14687, Spokane, WA 99214.

Software

Applications

Bottom Line Strategist
A financial forecasting tool that considers the business assumptions of users before creating its predictions. It requires 128K, one disk drive, and an 80-column monitor. The program requests information about the user's assumptions in eight categories: growth, marketing and advertising, costs, pricing, productivity, inflation, depreciation, and cost of capital. It then analyzes the viability and profitability of the project. If desired, the program will graphically display 11 types of financial and marketing forecasts. List price: $400. Ashton-Tate, 10150 W. Jefferson Blvd., Culver City, CA 90230, 213/204-5570.
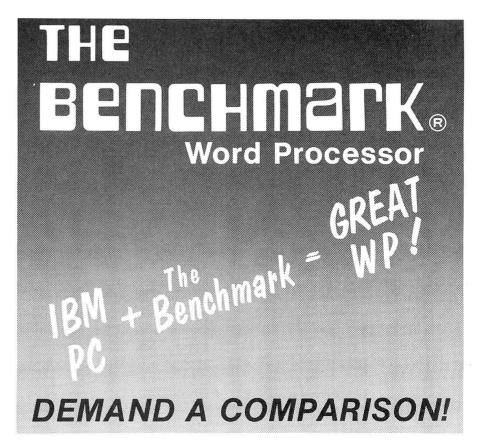
Lotus 1-2-3
A business program that integrates spreadsheet, graphing, and information management. It requires 128K and two double-sided, double-density disk drives. For graphic production the program supports three combinations: 1) a monochrome monitor, which allows the user to print graphs even though they cannot be viewed on the board; 2) a color monitor, which enables the user to view the graphs as well as print them out; 3) a combination of the color monitor and the monochrome monitor, which enables the user to view the spreadsheet and

the graphs simultaneously. For hard copy, the program supports Hewlett-Packard's HP 7470 A Plotter, the Epson MX-80 and MX-100, the IDS Prism Color Printer, and IDS 560 and 460 printers.

By combining spreadsheet, graphing, and information management into one program, *Lotus 1-2-3* allows the user greater speed and improves individual functions. *1-2-3*'s spreadsheet contains 2048 rows by 256 columns with a half-megabyte-model capacity, making 30-year projections a possibility. *1-2-3* interfaces with a number of other products through *VisiCalc*, *dBASE*, and DIF converters. List price: $495. Lotus Development Corporation, 55 Wheeler St., Cambridge, MA 02138, 617/492-7171.

The Financial Planner

A forecasting program aimed at users who have relied on mainframes. It requires 128K and two disk drives. The program uses a financial planning language that implements a standard programming language and uses terms familiar to financial analysts. The user builds command files for specific applications. The program handles simultaneous equations, internal rate of return calculations, and net present value calculations. List price: $700. Ashton-Tate, 10150 West Jefferson Blvd., Culver City, CA 90230, 213/204-5770.

The Business Library

An accounting/management information system that offers seven data base programs written in Compiled BASIC that can be run independently or as an integrated system. The general accounting system consists of four programs: General Ledger, Accounts Receivable, Accounts Payable, and Payroll. Three additional programs are designed specifically for manufacturers and distributors: Inventory Control, Order Entry/Sales Analysis, and Purchase Order Tracking.

The Business Library also offers a management report writer that allows users to create an unlimited number of unique formats for income statements, balance sheets, and reports. Audit trails account for every transaction on all programs, which allows for fast and accurate audits. Each program automatically collects data from the others so that redundant operations are unnecessary. *The Business Library* is designed to operate in a multiuser capacity in the event of system expansion. List price: $595 per program. Software Libraries, Inc., P.O. Box 844, Pasadena, CA 91102, 213/793-1700.

Systems

Cache/Q

A data buffer and a printer buffer combined. *Cache/Q* transfers data from mass storage into RAM, minimizing the number of disk I/Os and speeding up *WordStar, SuperCalc, VisiCalc,* or whatever software is in use. The printer buffer allows simultaneous use of the printer and keyboard. *Cache/Q* has no RAM requirements but the more RAM the system has the larger the buffer size will be. *Cache/Q* will run on either floppy or hard disk drives. It features automatic write-thru; all data written into the buffer area automatically copies over into mass storage.

Cache/Q also features a Least Recently Used algorithm, which determines buffer usage and returns any sector of data not in heavy use back to mass storage. *Cache/Q* allows the user to decide which sectors should be buffered. It can be configured in the Single-Bank Mode if the system has only one bank of memory, or the Multi-Bank Mode if more than one bank of memory is available. *Cache/Q* can utilize up to 800K of data buffers. List price: $225. Techne Software Corporation, 3685 Mt. Diablo Blvd. #130, Lafayette, CA 94549, 415/283-6824.

PC-DocuMate

A keyboard overlay template that provides accessible visual identification of commands and formats. The template documents all commands and formats for DOS 1.10, EDLIN, and DEBUG. Also included are over 100 BASIC commands and statements, function key and control key symbols, and brief descriptions of their use. The plastic overlay conforms to the keyboard flange areas and has black print on a background color that matches the IBM keyboard. List price: $12.95. Systems Management Associates, P.O. Box 20025, Raleigh, NC 27619, 919/787-7703.

PC-Documate keyboard overlay, Systems Management Associates

Quickcode

A utility program that generates programs for *dBASE II*. It requires 48K and one disk drive. Two modes of operation are provided. The Autopilot mode generates programs to run most of *dBASE II* automatically for users who wish to avoid programming. The Quickscreen mode permits users to organize data fields, entry items, field limits, and other specifications by creating drawings on screen. List price: $295. Fox & Geller Associates, P.O. Box 1053, Teaneck, NJ 07666, 201/837-0142.

Just Announced *uses information provided by manufacturers; it does not evaluate products or corroborate manufacturers' claims. Send a description and photograph of your new product to* Just Announced, PC WORLD, *555 DeHaro St., San Francisco, CA 94107.*

Up and Coming

PC WORLD *peeks through Visi/ON's window.*

Roundup review of electronic disks: A comparative look at the current market of disk emulating programs.

Reviews of Multiplan, *a popular calc program from Microsoft, and* Final-Word, *a text editor written in C from Mark of the Unicorn.*

Mouse Technology: Anatomy, behaviour, and varieties of mice.

The World Class PC: Nominate your favorite PC products. Rules, prizes, and entry form in the next issue.

The World According To Jeff P. Garbers: An exclusive talk with the voice behind the midnight express bulletin board service.

Product Report: On the road with the Compaq Computer.

Radical Disk Fixes: Sometimes surgery is the only method for recovering data from damaged disks.

Advertisers

(About Our Gatefold)

The illustration inside our gatefold cover was created by *PC WORLD* Art Director Mick Wiggins using an IBM Personal Computer with the Plantronics Color + card and software.

Mick tells us that this was his first experience using a computer. He is obviously a talented artist, and this image is proof of the creative aspect of personal computing. Mick found it exciting to work with a medium that allowed him to make endless variations without laboring over each change. He found himself taking risks that he would not have taken using traditional media.

Mick reports that learning to use the system was fairly easy, although he had to remind himself to save images as he went along. He discovered that having more RAM memory would have enabled him to make more complex images without having to go back and forth between RAM and the disk.

The Plantronics gatefold will be a regular feature of *PC WORLD*. Each issue we will ask a different artist, architect, or designer to experiment with this system and create an image for our gatefold. 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 COLOR-PLUS. If you have any suggestions, or if you have a COLORPLUS board and would like to be considered for our contest, please contact our Editorial Department.

YOUR IBM PC HAS HELPED YOU, TAUGHT YOU AND ENTERTAINED YOU.

NOW LET IT DAZZLE YOU.

JUST TURN THE PAGE TO SEE WHAT COLORPLUS CAN DO FOR YOU!

PC+™ PRODUCTS

PLANTRONICS™
Frederick Electronics