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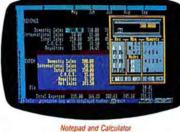Lotus's Manuscript—
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The Sound-Alike list of the Turbo Lightning Proofreader

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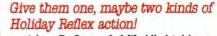
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BI-1076B

PC WØRLD

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PC W●RLD

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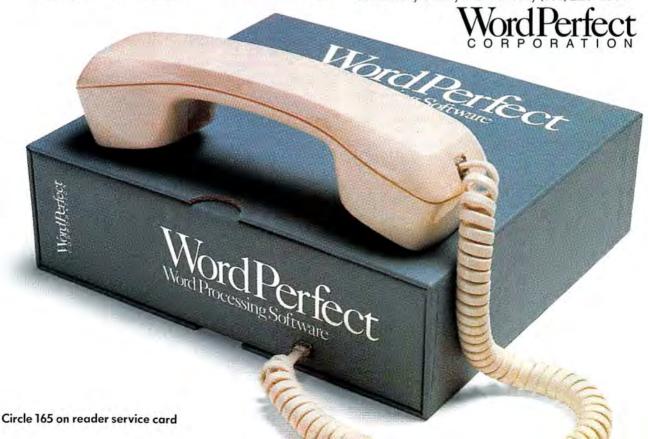
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Planning Assistant makes number

The Assistant Series from IBM.

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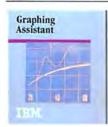
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Fighting PC Protectionism

David Bunnell

Memory is going to cost a lot more now that U.S. chip protectionists have had their day in court against the Japanese. Are we just going to remember the good old days, or can we do something about it?

Recently, two events occurred in the personal computer world that made American semiconductor manufacturers, particularly Intel Corporation, feel positively euphoric.

In the first instance a secret trade agreement about semiconductors was reached by the United States and Japan. In the second instance a U.S. federal judge ruled in Intel's favor against the Japanese chip giant NEC Corporation, upholding Intel's copyright of microchip codes.

On the surface these developments appear to be a great victory for U.S. integrated circuit manufacturers over the Japanese.

But guess who'll be the loser. The consumer. Why? Because the consumer is bound to end up paying higher prices for personal computers in this newly realigned marketplace.

And who speaks for the consumer in these negotiations between the United States and Japan?

No one.
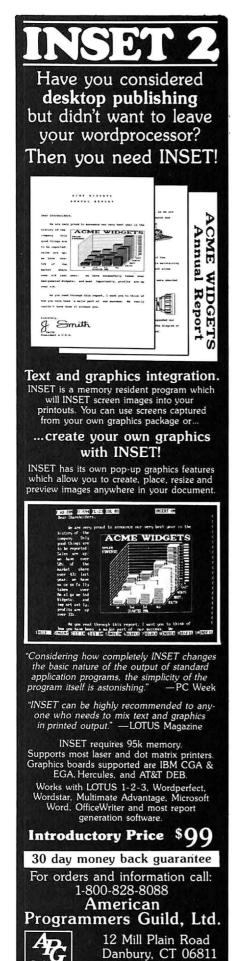
Let's take a look at the trade agreement and what it has wrought. The issue presented to the public and touted to the industry is that the Japanese have been dumping chips on the U.S. market to gain market share. This in turn has put a great strain on our national semiconductor industry.

But that's not the real problem.

What's really at issue here is the enormous oversupply of chips. Worldwide production capacity has far exceeded the demand. Microchip manufacturers came up with some pretty wild estimates of how big the market—and their share of it—would be.

So they went overboard and produced a glut of chips. Once that happened, they were forced to sell their chips at whatever price the market was willing to pay.

When American companies sell their products in a world market at a price the market will bear, we call it "free enterprise." But when the Japanese do the same thing, we call it "predatory pricing" and accuse them of "anticompetitive trade practices."

(continues)

David Bunnell

At any rate, U.S. chip manufacturers went running to the Department of Commerce with their skinned knees and got some administration economists to come up with a "fair market value" for chips, as a salve for their wounds.

So the pie-chart wizards conferred and actually arrived at an estimate—a troubling development, as I see it.

Since when do Washington bureaucrats decide what constitutes a "fair" price? That's something the market is supposed to determine, isn't it?

Will Zachmann, vice president of International Data Corporation, compares the semiconductor industry's action to the creation of the oil cartel. He calls it the "OPEC of high tech."

I believe he's essentially right, because the real aim of the semiconductor agreement with Japan is to raise the price of chips. The implication of the agreement is that a 256K-bit DRAM (dynamic random access memory) chip will sell for $5.79—almost three times its current street value.

When a 256K-bit chip costs the manufacturer $2, a megabyte of memory comes to about $65. But by the time it's put on a circuit board, marked up, marketed, and sold to the consumer, a megabyte of memory at today's prices sells for between $250 and $300.

By inflating the chip price, our semiconductor manufacturers will be driving up the cost to the consumer of a megabyte of memory to over $500—back to where we were in the early stages of the personal computer's development.

This could have an extremely dampening effect on the proliferation of personal computers, because so much new technology depends on having more memory.

Remember when we first faced the 64K barrier and broke through it, a long time ago? Then we bravely confronted the 512K barrier and pushed through that. Next, we crashed through the 640K barrier. Now we foresee having personal computers with several megabytes of internal memory. We also have a great many peripheral devices that are memory-intensive—such as a laser printer that stores PostScript.

Like the big cars we used to drive, back in the days before the oil crisis in the seventies, these systems are the memory-guzzlers of our information technology.

If we allow memory prices to be inflated, we'll be taking a major step backward.

It will mean that the really capable systems we've all been dreaming about, with their terrific graphics and megamemory, are going to cost a lot more than we expected. This will hurt not only consumers but also the smaller computer companies and makers of peripherals. It will also adversely affect people who produce add-on boards, local area networks, laser printers, and other memory-intensive systems.

Who derives the greatest advantage from all this price hiking? The semiconductor manufacturers

(continues)

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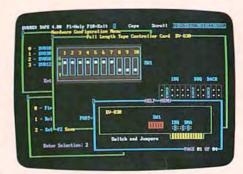
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David Bunnell

and the large computer manufacturers who make their own chips —because they can still make a chip for $2 or less while smaller companies are paying $5.79.

Although most of the press coverage promotes the trade agreement as the next best thing to paid vacations, it's actually nothing to celebrate. In fact, this may be your last holiday season to find genuine bargains.

In the long run, the coming price hike will even hurt the semiconductor companies themselves, by slowing down the overall growth of the personal computer and its market.

The other recent decision in the chip area—the case of Intel versus NEC Corporation—may also adversely affect the consumer.

The U.S. federal court ruled that the microcode embedded in a chip can be copyrighted. Therefore, NEC can no longer sell chips that are copies of Intel's family of 8088, 8086, and 286 chips, which power all IBM-standard PCs. Now, any company that wants to be a secondary source for another manufacturer's microprocessor chip has to go to the time and expense of re-creating the functional equivalent of Intel's chip without using Intel's original microcode.

While I acknowledge that the microcode judgment has considerable merit because it involves the protection of a creative property, I'm still troubled by the possible consequences.

For one thing, the decision could have a serious impact on the availability of PC clones. And as with the higher cost of memory,

(continues)

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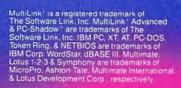
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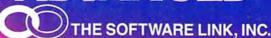
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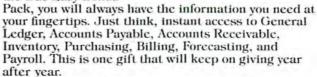
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Circle 33 on reader service card

David Bunnell

we're also likely to see higher personal computer prices. But perhaps most worrisome is the possibility that IBM will buy Intel outright—now that it knows the 386 chips can be protected. IBM would then be able to control via license the distribution of the 386 chip and thus prevent the development of clones in the 386 market. IBM could decisively checkmate any clones and prevent what happened with the cloning of the 286- and 8088-based machines.

Perhaps there should be a consumers' computer association. Consumers' voices weren't heard in the courtroom during the Intel-NEC deliberations. They weren't in the smoke-filled rooms where the negotiators for the Department of Commerce and the U.S. and Japanese semiconductor companies got together and hammered out their secret trade agreement.

Incidentally, why were the details of the agreement kept secret? Could it be, as IDC's Will Zachmann suggests, that knowledge is being withheld from American consumers about what amounts to a conspiracy (actively encouraged by the United States government) between U.S. and Japanese semiconductor vendors to drive up worldwide chip prices?

Once again, the consumer is consumed by big-business interests. What can be done about all this? Protectionism doesn't work. ⊜

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Here at PCSG we sell our IBM PC disk access speedup software by the thousands. But software doesn't do anything about speeding up the microprocessor (or CPU) speed. As you know the microprocessor is the brain of the computer that controls all the operations like screen updates and calculations like a spreadsheet makes.

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We wanted to offer a speedup card that would be the compliment to our disk speedup software, (incidentally included at no extra charge.) We wanted it to be literally the most advanced, fastest, most feature rich board available today. We could only be satisfied with a board that was the finest example of the engineering art.

There is no question we have met our every objective by developing and manufacturing the *BREAKTHRU 286* card. This is the best designed and most functional speed up card available today. We guarantee it.

HERE IS WHAT MAKES IT SO SPECIAL.

First, it installs so easily. It is a half slot card, only five inches in length. You don't even have to give up a full slot. What's more, unlike competing products it works in the Compaq and most clones. The instructions are so simple we considered showing a picture of a child putting it in. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, it is advanced. The *BREAKTHRU 286* replaces the CPU of the PC or XT with an 80286 microprocessor that

is faster than the one found in the AT. A 16K cache memory provides zero-wait-access to the most recently used code and data. In benchmark tests the card accelerated software programs—both custom and off-the-shelf anywhere from 200% to as much as 700%. Wow!

Third, you have full compatibility. All existing system RAM, hardware, and peripheral cards can be used without software modification. It operates with LAN and mainframe communication products and conforms to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Fourth, it is the best there is. There are several other boards on the market. Some are priced about the same as the *BREAKTHRU 286* and some are cheaper. We at PCSG have compared them all, but there simply was no comparison. What we discovered is that many cards being sold offer only a marginal speed up in spite of their claims. We found some to be merely versions of the obsolete 8088 or 8086, and others to be just poorly engineered. The 8MHz *BREAKTHRU 286* is unequivocally the best executed and most completely reliable speedup board manufactured today.

PCSG has since early 1983 dominated the lap portable market with ROM software such a Lucid spreadsheet and Write ROM that reviewers rated as excellent. We were proud to successfully enter the IBM PC market last year with disk access speedup software. Now we are so pleased with the *BREAKTHRU* speedup card. We use them on our own PC's to make them faster than AT's. We are really excited about this product.

PCSG makes the unabashed statement that the *BREAKTHRU 286* card represents more advanced technology than boards by Orchid, Quadram, Victor, Mountain, P.C. Technologies, Phoenix . . . we could go on.

But an ad can't let you experience it for yourself. That's why we sell the *BREAKTHRU 286* on a 60 day trial. If you aren't completely satisfied return it within 60 days for a full refund. It is priced at $395. Call today with your MasterCard, Visa, American Express or COD instructions and we will ship your card the very next day.

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Letters

Reactions and responses from the PC World community

Design Flaws

Planning to purchase a CAD system? You may be interested in my experience.

I bought a Houston Instrument (HI) DMP 42 plotter and a PC's Limited AT for my yacht-designing business. When I set them up, they checked out fine.

The next day, however, the plotter blew a fuse; indeed, it blew every fuse I put into it. After two calls to HI tech support, I returned the DMP 42 for repair. Three weeks later I received someone else's DMP 52 in return. Not wanting to benefit from another's misfortune, I sent it back.

One day after I had returned my malfunctioning DMP 42, the PC's Limited AT lost its extended memory. Thoroughly disgusted, I sent the machine back to PC's Limited for a full refund under their "30-day money-back" guarantee. Two weeks later it arrived back on my doorstep, delivery refused.

In the meantime, I bought a Tandy 3000. Unfortunately, I discovered, it requires a special cable to hook the monochrome monitor up to the Tandy Deluxe Graphics Adapter necessary for CAD. The local Radio Shack said it would take 10 to 14 days to order one, but another store 45 miles away assured me the cable was in stock. Naturally, I drove there—to find out it wasn't. No one at any of the other four Radio Shack stores I contacted even knew about the special cable.

I'd spent $7372, not counting long-distance phone calls, for nothing—no plotter and no working computer.

There's a happy ending to this horror story. PC's Limited eventually refunded my money, and I've successfully hammered the Tandy 3000 and the HI plotter into a satisfactory CAD system. But manufacturers should be warned that professionals less tolerant than I will not put up with this kind of treatment. They've been successful without CAD for years and can easily prosper without it.

Ted Brewer
Anacortes, Washington

One for the Road

I don't know if Paul Freiberger actually took the IBM PC Convertible on a plane trip, but his article left me out in the cold ["IBM's Road Machine," *PCW*, August 1986].

If Mr. Freiberger had run the Application Selector with other software, he would have discovered that the Convertible, with its standard 256K RAM, doesn't have enough memory to run some programs. Granted, the Application Selector only uses 88K of RAM, but apparently that's enough to preclude its use with, for instance, *Microsoft Word*.

On the other hand, while it seems to be in vogue to criticize IBM keyboards, I find this one quite good. I'm dumbfounded by Mr. Freiberger's dislike for the placement of the <CapsLock> key. It's in a perfect position for the left hand's little finger, while the <Ctrl> key, which isn't used nearly as often, is also easily accessible. The only feature the keyboard lacks is a <NumLock> indicator light.

Furthermore, the Convertible's LCD has an excellent range of contrasts. When it's on a table,

(continues)

Letters

shining a light on it helps, but for
an LCD, it's good.

Overall, I'm happy with my PC
Convertible, and I feel it's a solid
entry in the laptop market. In the
future I hope *PC World* will offer
more than the usual data and give
the consumer a little something
extra.

Michael Speight
Santa Barbara, California
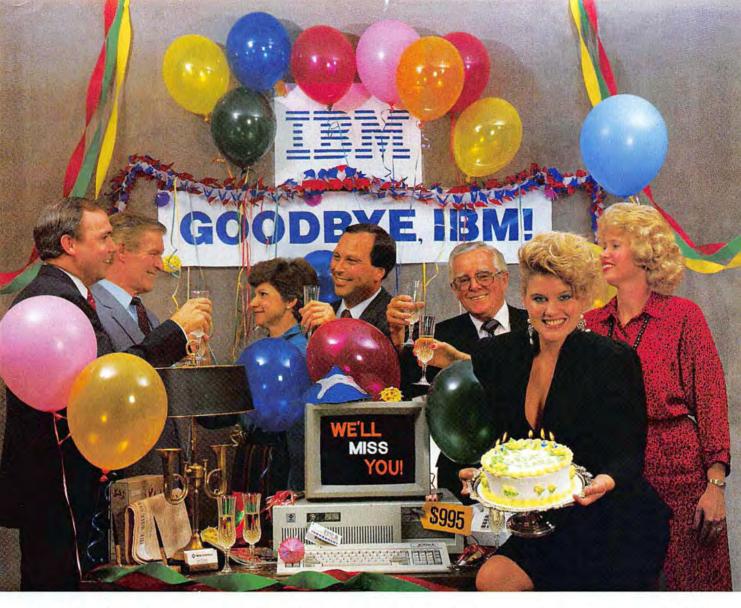
20/20 Revision

Although the overall tone of
"20/20 Storage" by Donald Triv-
ette [*PCW*, August 1986] is pro
Bernoulli Box, your readers will
get the wrong impression of sev-
eral of its important features. As
an authorized Iomega repair tech-
nician, I'd like to submit a few
corrections.

The article states that the Ber-
noulli Box uses a stepper motor to
position the read/write head, when
in fact it uses a voice-coil actuator.
Voice-coil technology is superior
to the stepper motor in high-speed
head positioning applications.
Since it's so essential to the speed
and reliability of the Bernoulli
Box 20 + 20, it's unfair to con-
fuse the two.

Also, suggesting that a power
failure will cause the read/write
head to "land" on the spinning
storage-disk media will strike fear
into the heart of even the most
stalwart hard disk user. Although
it's true that the head is constantly
repositioned to prevent excessive
wear, it moves only in a horizontal
plane. The Bernoulli effect draws

(continues)

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the flexible storage media close to the head, which is what makes the Bernoulli Box unique.

David Hotin
Marlow, New Hampshire

More On-Line Success

Henry Kisor's experiences were enlightening and uplifting ["On Line to Success," *PC World View*, *PCW*, September 1986]. My friend is also a deaf computer user who uses a telecommunications device for the deaf (TDD). I know deaf users would like to know more about Mr. Kisor's bulletin board and the Novation TDD board.

Guy Wise
Berkeley, California

Henry Kisor will gladly answer queries sent to him care of the Chicago Sun-Times, 401 N. Wabash, Chicago, IL 60611. –Ed.

Keep It Simple

David Bunnell has his finger on the pulse of user dilemmas in "On the PC Fault Line" [*PCW*, July 1986]. I thought I was slow, but when I read the problems other people have, I feel at least average.

I agree with David's gripes, but I'd like to add my own suggestions for PC product manufacturers. If you've got something to sell, just tell me (a) what it costs, (b) what it's compatible with, (c) what other hardware or software it needs to work, and (d) how I can find out more about it.

(continues)

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Then, take the documentation to an absolute novice and ask him to use the product following your instructions. How he fares will probably teach you more about the average computer user than you'd ever want to know.

Paul Tempke
Doylestown, Pennsylvania

Dealers Beware

It's difficult for me to feel sympathy for "battered PC dealers" like Martin Cherry [*Letters, PCW,* August 1986]. From Boston to San Francisco, growing numbers of users are fed up with arrogant dealers who readily take our

money and expect matters to end there. We want follow-up, support, and help from knowledgeable people with practical, real-world business experience.

It took years for consumers to get angry enough with car dealers to push legislation like the "lemon law," but it won't take nearly that long for PC users to show computer dealers that we mean business. For one thing, modems give us near-instantaneous communications with a vast network of dissatisfied software and hardware owners. More important, we now know how to get action from the legislative and the judicial branches of local, state, and national governments. If dealers don't start to police themselves,

they may find someone else doing it for them.

Marcia Blake
Paradise, California

Basic BASIC

As much as I enjoyed reading "Fast and BASIC" by Greg Perry [*PCW,* September 1986], he made a statement that is not applicable to IBM BASIC. In the section titled "Jockeying for Position" he states that "when a program reaches a GOSUB, the BASIC interpreter goes to the beginning of the program and reads line numbers until it hits the subroutine's

(continues)

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line number. BASIC simply isn't capable of proceeding directly to the line of code called."

The IBM BASIC 2.0 user manual under "Tips and Techniques" states that "In IBM Personal Computer BASIC, the search is only performed once, and thereafter the branch is direct. So placing frequently used subroutines at the beginning of the program will not make your program run faster." (Appendix I-12).

I realize that Mr. Perry's article was about BASIC in general, but I wanted to point out that one difference for IBM BASIC programmers. Consequently, I put all subroutines at the bottom of the

program for easy reference, without sacrificing performance.

Rusty Brown
Irving, Texas

AST's EGA F.Y.I.
My compliments to Eric Knorr and Karl Koessel for their comprehensive article "Seven Up on EGA" [*PCW*, August 1986].

However, the AST-3G Model 1 is actually an older version of the product currently on the market, the AST-3G. While the specifications are basically the same for both models, only the AST-3G can be upgraded to include compatibility with the IBM Color/ Graphics Adapter, the Hercules Graphics Card, and the IBM

Monochrome Display and Printer Adapter.

Bret Berg
Graphics Product Specialist
AST Research, Inc.
Irvine, California

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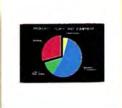
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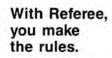
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Circle 142 on reader service card

REMark:
Exit Entry Systems

Brian Jeffery

Those inspired early days at IBM's Entry Systems Division are long gone. In their place is a new era of hard-nosed marketing, streamlined manufacturing, and systems integration for PCs.

It seems like ages since Don Estridge was promoted out of Entry Systems to a corporate staff post. During that turning point in 1985, debates raged over whether Entry Systems would lose its character and whether IBM's strategy for marketing PCs would change.

Nowadays, these speculations seem academic. IBM's maverick division hasn't changed so much as it has disappeared.

Most of the original staff has gone. Don Estridge died tragically in a plane crash, many staffers have been reassigned to other units, and some have left IBM altogether. IBM now conducts product development in a variety of new locales, such as its Kingston, New York, facility, where work on PCs has merged with research and development for IBM 3270 workstations. Efforts to integrate the PC with other systems are under way at the big new complex in Raleigh, North Carolina, where the lion's share of IBM's communications and office systems research takes place, while disk storage products are being handled at the company's Rochester, Minnesota, location. In short, PCs have disappeared into the maw of the IBM organization.

Entry Systems' real estate has also shrunk; its headquarters, formerly in Boca Raton, Florida, has shifted to a new IBM complex in Montvale, New Jersey. There Entry Systems shares building space with the National Distribution Division (which took over all responsibility for third-party distribution this year), a move designed to encourage close cooperation between the two units. Not surprisingly, the faces at National Distribution have also changed; ex-mainframer Ned Lautenbach now heads third-party distribution, the old VAR management team has been largely dissolved, and the Entry Systems managers who first put IBM in the retail PC business have for the most part been sidelined or reassigned. Few of the old guard have stuck it out. Dick Koon, former head of Entry Systems' dealer operations and an

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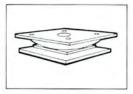
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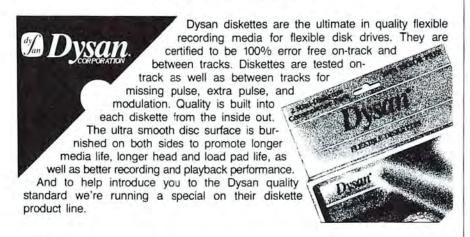
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Circle 931 on reader service card

inveterate mover and shaker, now leads National Distribution's marketing support for all of IBM's resellers.

Entry Systems once had responsibility for IBM's large PC assembly plant in Austin, Texas. This facility has now been handed over to the little-known Systems Technology Division, the unit that handles IBM's circuit packaging operations. Austin's new state-of-the-art facility for turning out PC Convertibles symbolizes this shift in IBM's overall approach to PCs. Austin is where IBM's plans to counterattack the clones are currently being laid, not by some variation on the Estridge team, but by engineers who talk about flush component mounting, automated tape bonding, and other nuts-and-bolts manufacturing issues. [For more on the automated production of IBM's PC Convertible, see "The Self-Made PC" in this issue.] Foremost among these manufacturing engineers' design achievements is a plant in Kentucky that produces electric motors used in IBM typewriters at a cost lower than any Southeast Asian manufacturer has managed. Purportedly, IBM is committed to bringing PC hardware costs down by at least 40 percent and perhaps by 60 percent over the next few years. This, and not open architecture, is what they talk about in Austin.

Times have also changed for long-standing IBM collaborators. Intel has seen its business from IBM decline, and it has suffered the indignity of watching IBM go to a new supplier, Harris Corporation, for components used in the PC Convertible. And in case anyone missed the point, IBM also

PC Mouse

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Several reasons. No moving parts. No problems.

Their mechanical mouse has a rolling ball, potentiometers, little teeny bearings and shafts, and plastic housings housing who-knows what. All of which makes it less reliable. Less accurate. And so dirty it actually needs to be cleaned now and then. (Ever clean a mouse? You don't want to.)

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PC Mouse in either a serial version or the new BusPlus model, and both versions include our PC Paint Plus and Designer™ Pop-up Menus, FREE.

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sold off a chunk of its Intel stock.
Sytek, once the proud supplier of
PC Network, struggled to recover
when IBM canceled its remaining
orders this year, and Computer
Memories came close to bank-
ruptcy when IBM stopped order-
ing that supplier's 20MB Win-
chester drives for the AT. And
what's behind Microsoft's gloomy
equivocations about the future of
DOS? Could it be that IBM is
shunning DOS 5.00, 6.00, or
whatever the multitasking succes-
sor is to MS-DOS as we know it?

The fact is, for IBM, PCs have
come and gone. The primary
growth in the market has ended—
now the main issue for IBM is
converting its installed base to in-
telligent terminals that interface
with the broader, more complex
IBM network environment. Even
the terminology is changing. IBM
has taken to using the terms *per-
sonal computer* and *workstation*
interchangeably, and the talk is all
about 3270 emulation, SNA inter-
faces, and systems integration.

IBM seems to feel that the pi-
oneering work has been done, and
now the whole PC juggernaut can
be turned over to communications
people, manufacturing specialists,
and other solid, experienced man-
agers accustomed to doing busi-
ness in stable and established mar-
kets. Like it or not, the innovators
have gone, and the old excitement
is a thing of the past. The Entry
Systems era was an exception.
Now, it's back to business as
usual. ●

*Brian Jeffery is the managing
director of the International
Technology Group in Los Altos,
California.*

PROBLEM: The more experience your hard disk has, the harder it has to work.

THE SOFTLOGIC SOLUTION: Disk Optimizer™

Your hard disk will run faster when it's not chasing around after files.

Remember the old days when your hard drive was new? Remember that smooth, fast, slick performance? Those quick retrievals, rapid saves, lightning-like database sorts?

Well ever since, DOS has been doing its best to slow your hard drive down. Not by slowing down the motor, but by breaking your files up into pieces. Storing different chunks in different places. Data files, programs, overlays and batches that started out in one seamless piece are now scattered all over.

Loading is slower. Sorting is slower. Retrieving, backing-up. Everything takes longer because your disk has to work harder.

Problem is, it's something that happens so gradually you may not notice the difference. At least, not until you see the dramatic improvement after using Disk Optimizer.

File fragmentation—It's a problem you can see.

Watch your hard drive the next time it reads or writes a file. Each "blip" of the LED means the drive-head is moving to another place on the disk—either to pick up or lay down another chunk of data.

And the truth is, head movement takes time. Far more time than actual reading and writing. What's worse, all this head movement causes extra wear and tear that can shorten the life of your drive.

Disk Optimizer—Tunes up your disk by cleaning up your files.

Disk Optimizer works by finding all the scattered pieces of your files and putting them

PERCENT FRAGMENTATION
The more fragmented your files get, the longer they take to retrieve.

back together where they belong. Next time your drive reads it, there's just one place to look.

And the results are often dramatic. Reading and writing times may be cut by as much as two thirds. Database sorts that used to take hundreds of head moves now proceed quickly and efficiently. And since head movement is now at an absolute minimum, your disk drive will lead a longer, more productive life.

Analyze, scrutinize, optimize.

Before you optimize, you'll probably want to analyze. So Disk Optimizer shows you, in percentages, how much fragmentation has taken place—on the entire disk, in individual directories, or for groups of files you specify using global or wildcard names.

Plus, there's built-in data security that lets you assign passwords to as many files or file groups as you want.

And the File Peeker gives you an inside look at the structure of files. It's a great way for non-programmers to learn more about computers, and a powerful tool for professionals who want to analyze the contents of their disks.

Get your hard drive back in shape—at a special low price.

When you think about it, it's simple. The longer you

own your hard drive, the more you come to depend on it. But the longer you wait to get Disk Optimizer, the less performance you'll have.

Special holiday offer— free* SoftLogic software.

Now, as a special holiday bonus, you can get another SoftLogic Solutions product free when you buy Disk Optimizer and Software Carousel—the software that lets you keep up to ten programs loaded and ready to run.

Take your choice of either Cubit or DoubleDOS.

See the coupon below for details. But don't wait. This offer expires December 31, 1986. SoftLogic Solutions products are available at your software dealer. Or by calling SoftLogic Solutions at 800-272-9900 (603-627-9900 in New Hampshire).

Circle 559 on reader service card

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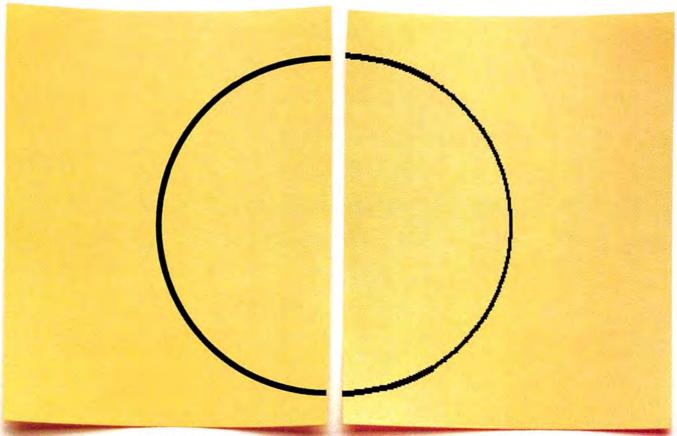
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.ctual unretouched photo of the monochrome display produced by Lotus 1-2-3 on a leading color graphics card.

Actual unretouched photo of the 16-shade monochrome display produced by Lotus 1-2-3 on the Paradise Modular Graphics Card.

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The Supercharged XT: Another Small Blue Step

IBM blurs the line between XT and AT, while the industry awaits more dramatic moves.

When the IBM Personal Computer XT burst on the scene in March 1983, its proudest boast was a 10MB hard disk drive. Since then the XT has been extended up, down, and sideways—up with boosted memory and disk storage, sideways into models tailored for mainframe access or industrial work, and down into versions that have become IBM's standard floppy disk offerings.

Now the XT has taken its wildest leap—all the way up into AT

PC World View *reports on new developments in computer technology, items of interest to computer enthusiasts, and the most significant and enticing insights about industry trends and personalities. —Eric Bender*

territory. IBM's new Personal Computer XT Model 286 sports an Intel 80286 processor just like Big Blue's high-end PCs. But it carries a modest price tag, starting at $3995 with 640K of internal memory on the motherboard, a 5¼-inch 1.2MB floppy disk drive, a 20MB hard disk drive, and a serial/parallel adapter.

Calling this hybrid machine an XT raised some eyebrows among analysts—it seemed rather like General Motors marketing a Cadillac under the Chevy brand. After all, when the AT was first unveiled, IBM said that the "Advanced Technology" in its name referred mainly to the 80286 chip.

The XT 286 is "a machine that's kind of in the middle," acknowledges IBM spokesman Cary Ziter. "But we're calling it an XT because it *is* an XT." Running at 6 MHz with no wait states, the PC XT 286's processor can't quite match an AT's 8-MHz CPU, he pointed out. Additionally, the AT can support one or two 30MB drives, with 40-millisecond (ms) average access times, compared to 85 ms for the XT 286. The XT 286 also looks like a garden-variety XT, with an identical

footprint. The system runs under PC-DOS 3.20 or PC Xenix 2.0. IBM offers freedom of choice among floppy disk options: a $190 720K 3½-inch drive, a $225 360K 5¼-inch drive, or another 1.2MB floppy drive for $275. And the XT line claimed another first: Five of its eight expansion slots are 16-bit, like an AT's. A 157-watt power supply is standard.

At the same time IBM dropped one 6-MHz AT model and quietly lowered dealer pricing for other AT models. However, Ziter cautions against reading these moves as divorce proceedings for the 8088 chip that powers basic PCs and XTs. "We have not abandoned 8088 technology," he insists.

* * * * * * * * * * * * * * * * * * * *

In fact, in recent months the computer giant has put a lot of marketing emphasis on its first-generation PCs—most visibly during the fifth anniversary celebration of the PC last August. IBM splurged on a massive advertising campaign and sent each of its authorized dealers a chocolate layer cake decorated with the number 5 on top.

But IBM's Entry Systems Division (ESD) enjoyed few celebrations in 1986. Its share of the IBM-compatible PC market was plummeting to below half the total by year's end, according to industry analysts at International Data Corporation, and the Gartner Group estimated that Tandy was selling more PCs to small business than Big Blue itself.

The industry kept waiting for the empire to strike back with blockbuster products. Quick-spreading rumors suggested that the new Blue boxes would beat off the attack of low-priced clones, or carry off the high-performance honors, or carve out a proprietary path that no one but software developers and eager customers could follow.

Last April, while launching the PC Convertible, ESD chief William Lowe strongly underscored IBM's intentions to leverage its technology and manufacturing might. "Compatible manufacturers will now have to move quickly to remain compatible," Lowe warned.

But after this uncharacteristic bit of saber-rattling, IBM retreated to its tent. Well into fall, the manufacturer showed no signs of a massive counterattack, taking no significant action other than cutting prices a notch every month or two.

(continues)

The PC XT 286 (right) plugs the AT's powerful 80286 processor into the familiar XT box.

John Greenleigh

The $3 Million Classroom

In which the University of Texas reinvents the classroom

When it came time to envision the classroom for the next millenium, the University of Texas at Austin began with a large, striking glass enclosure suspended from the ceiling of its business school. The eventual result was even glitzier: Classroom 2000, a high-tech educational theater stocked with the world's largest collection of AT/370s and an astonishing array of audiovisual aids.

"I wanted to employ information systems technology in the teaching of that subject," recalls Darwin Klingman, director of an MBA program specializing in information systems. Klingman's students began learning and working in Classroom 2000 last winter.

Built under an IBM grant that totaled almost $3 million in cash and computers, the classroom is also designed to help company executives and others outside of UT become comfortable with information technology.

Hanging directly above a turn-of-the-century New York Stock Exchange booth ("containing a million little boxes for three-by-five cards," Klingman says), the classroom holds 48 fully loaded AT/370s. The machines are linked by an IBM Token-Ring network—

the only beta-test site in a U.S. university.

In addition, Classroom 2000 workstations reach out to an Ethernet network and a campus-wide broadband net. Students doing course work can access the university's two IBM mainframes, its several DEC VAX minicomputers, and a remote supercomputer.
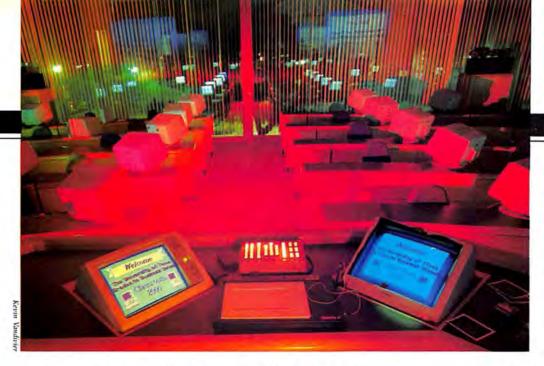
Instructors enjoy a wealth of opportunities for creating and displaying material via two large overhead video projectors. One device converts each 35mm slide in a carousel to RGB video signals; another device, a combination PC/writing tablet, permits annotation of PC output. Also in the hardware bag of tricks are a VideoShow presentation graphics system, a video camera, and other

---

The Supercharged XT ...
(continued)

While analysts generally comment favorably on the XT 286, they describe it as another incremental, defensive move. It took only a day after the IBM announcement for Compaq and Sperry to roll out similar systems with similar prices, touting similar performance.

And the following week Compaq, which for more than two years has claimed that the PC standard no longer belongs to

IBM, put its money where its mouth was. At the glittery New York debut of its Deskpro 386 (see "Compaq Spawns a New Generation," *PC World View, PCW,* November 1986), Compaq president Rod Canion ticked off all the reasons for waiting for IBM, concluding that these were simply outweighed by the chance to get ahead with the powerful new 80386 technology. "Whatever IBM is doing, a big factor is when they do it," he added.

At Compaq's Manhattan nightclub extravaganza, disco music blasted away, laser light flickered, smoke rose from the stage, and a

30-foot-high model of the Deskpro 386 descended from the ceiling. But more important than the show were the enthusiastic endorsements delivered by major executives in the microcomputer-software industry. "This is a machine that will be very hard to obsolete," said Lotus chairman Jim Manzi. "It gives us the power we need *today.*" To make sure nobody missed the point, Compaq took out an eight-page advertising insert in the *Wall Street Journal* later that week.

The view from the podium at Classroom 2000, where instructors command an army of high-end PCs and presentation devices

goodies. If all else fails, 12 large digital speakers embedded in the ceiling ensure that students get the message.

This term, an experiment in video networking has enabled instructors to project any PC screen image overhead. The setup also permits the instructor to check student screens and tap in suggestions with a few keystrokes.

"One-button control is what really makes the room work," Klingman says. Instructors can use the room without spending hours in training. It's no surprise that before the control system was implemented, the classroom tended to intimidate instructors.

Curiously enough, the first crop of students took some time to

fully exploit the hardware. While they typically possessed computer science backgrounds and had substantial experience on larger systems, "Only 1 in 22 was really familiar with PCs," Klingman says. "That was wild."

Last summer's internships, at companies ranging from Exxon to Apple Computer, seemed to validate the program's worth. Most students are on a career track that culminates in the "chief information officer" slot—an emerging top-rank position within many U.S. firms.

Klingman emphasizes that achieving the CIO goal will require not only computing and business smarts but also people-smarts. For Klingman, interest in Classroom 2000 outside UT has underlined the sluggish growth of information technology within most schools. "Nationwide, it's amazing how few faculty members have even taken a PC into the classroom and displayed the output on a big screen."

While IBM apparently relinquished 80386 leadership and watched its market share for PC- and AT-class machines dwindle, its competitors began taking potshots. "Big Blue is making agonizing noises," Tandy president John Roach declared. "While all that debate's going on, it appears to me that nobody really cares.... The technical state of the art is being driven by other manufacturers."

Roach compared IBM's decision-making process to a drawn out game of chess, remarking that it was complicated by ESD's return north to near IBM headquarters, where any move it makes can

be checked by other IBM divisions with different mandates. "Chess is a slow game, and you can imagine how difficult it can get with five people trying to play at once," Roach said.

Most people were not so quick to write off the world's dominant computer supplier—particularly in its bastion of large corporate customers. The most popular speculation suggested that IBM is not readying a "clone-killer" but will launch a completely revamped line, with built-in graphics and high-end pricing, early in 1987.

Follow That Story!
* *

Information Centers: Moody Views

Information centers (ICs) are booming wildly. Or they might be on the road to extinction.

"The watchword for information centers is growth," proclaims the latest report on ICs from the American Management Association (AMA). Statistically, 1986 was another banner year for these end-user assistance groups, with 44 percent growth in PC usage, a 21 percent increase in clients, and 24 percent more requests for assistance per month than in 1985. On average, ICs added one more staff person to cope with the onslaught (see "The Information Center Holds," *PCW*, August 1986).

But at the third annual Information Center Conference, held recently in Anaheim, California, the mood was decidedly downbeat: IC managers depicted a struggle for survival rather than unspoiled vistas and expanding staff.

The dichotomy may seem puzzling, particularly because many conference speakers contributed to the AMA report. The plight of the IC is nonetheless increasingly schizophrenic, the result of the very technological changes that called it into being.

Any institution experiencing 20-percent-plus growth would seem a raging success, and some estimates place the number of ICs at more than 5000. The birthrate for ICs has slowed in the nation's largest corporations, but only because more than 80 percent already have ICs in place. In companies with annual sales between $50 and $500 million, ICs are still being installed at an impressive clip: Two-thirds have been formed since 1984. IC purchasing power among those surveyed is approaching the $500 million mark, and PC-related acquisitions are up by about 20 percent this year.

Perhaps the clearest indication of change is that this year, for the first time, more IC clients are sitting at PCs than at mainframe and minicomputer terminals combined. Ironically, that's because of a huge increase in the number of PCs acting as terminals.

ICs are also wielding ever-greater authority. Some 70 percent of ICs can authorize PC purchases, and 60 percent can approve access to data residing on corporate mainframes. The demand for training is relentless, and more than 85 percent of ICs are busily evaluating PC hardware and software.

Despite the apparent good news, however, ICs don't seem to be leading the technological parade. Rather, they appear to be following along and tidying up the mess. In theory, ICs supply only

technology and training, while those they assist bring glory—and profit—to the company. Yet ICs are often blamed for the inability of companies to cost-justify huge expenditures for PCs and training.

There's also an element of "parental conflict" tugging at the IC, according to the AMA report. MIS (management information systems) departments originally begat the IC as a mediator between MIS and corporate end-users, and IC managers report to MIS. As the PC entered the scene, costs rose dramatically, and control passed from MIS to end-users—aided and abetted by the IC.

Today, the IC's MIS overseers are in the awkward position of supervising a group that seems to be encouraging an expensive form of rebellion. And even as its workload increases, the IC itself may be contemplating its own obsolescence—in the guise of near-universal computer literacy.

While IC managers are split between optimism and pessimism over the IC's future, unanimity does exist on at least one point, neatly summarized in the AMA report: "Information centers must prove themselves again and again." —*Phillip Gordon*

You Can Never TeleCompaq Everything

Suppose someone tied your telephone to your computer, and in so doing managed to improve both. An inspired idea, perhaps, but in the real world, all too few customers have bought it. In the battle for desktop real estate, armies of "integrated workstations"— hoisting the flags ranging from AmbiSet to Zaisan—have mutely surrendered.

Against this grim backdrop, Compaq Computer, the fastest-growing computer concern in history, decided to try its hand. The idea first cropped up at a Christmas party three years ago. Moving quickly, the Houston manufacturer spun off the Compaq Telecommunications Corporation and set it down in Dallas. The subsidiary grafted a telephone on to a modified version of its basic Deskpro, added desktop and telephone management utilities in ROM, and sold the machine—or tried to sell it—as the TeleCompaq. After a year and a half of effort, the divi-sion (which had grown to 50 people) has been "consolidated" back into the company proper. And the TeleCompaq itself isn't making many connections.

The problem, the company and observers agree, is that the market has not developed as anticipated. "We never expected to establish a market by ourselves," says a Compaq spokesperson. "In the absence of a developing market, the Tele-Compaq hasn't sold as well as we would have liked."

Compaq has promoted the Tele-Compaq more as a phone than a computer. The device is offered primarily through telecommunications suppliers, including Bell Atlantic, Pacific Telesis, and telephone giant GTE. Most slap their own label on the unit.

Jan Lewis, president of the Palo Alto Research Group, believes the TeleCompaq has flopped because the desk top may be the wrong place to integrate voice and data. "At some point you need that integration," she says. That point may be in the telephone company's central office or in a PBX, "but it may be a handicap on the user's desk," where convenience and space are paramount.

Compaq continues to hone the design, hoping that enough competitors and customers will join the party and give credibility to the market for integrated workstations—much as IBM did for personal computers. And in the long run, Lewis points out, Compaq's alliances with major telecommunications suppliers might pay dividends.

Compaq promises to be ready for the world when the world is ready for its communications hybrid. The phones may yet begin to ring. —*Daniel J. Rosenbaum*

The PC Turns VAX Consultant

Five years after American business discovered personal computers, Digital Equipment has joined the revolution.

This was the year Digital Equipment Corporation dropped to third place among computer giants, behind IBM and the new Burroughs/Sperry monolith. And, gritting its teeth slightly, DEC finally entered the IBM-compatible PC parade.

But Kenneth Olsen, the outspoken engineer who founded DEC, regards those two disappointments as about as disturbing as ants at a picnic. Despite the slump that scarred the rest of the industry, 1986 proved a memorable year for Olsen's firm. DEC has been on the march, swiping business from IBM and just about everybody else.
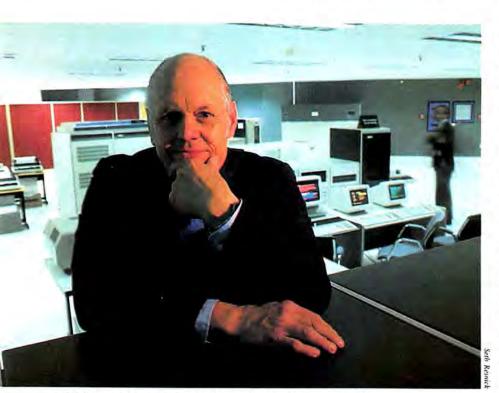
The numbers back up his buoyancy; for the first half of this year, DEC's income more than doubled that for the same period in 1985, outshining even the earnings performance of star PC-supplier Compaq Computer. Sales climbed by one-sixth—dramatic indeed for an $8 billion heavyweight whose R&D budget alone is half again the amount of Compaq's total sales.

DEC pulled off that feat with a negligible contribution from its moribund lines of PC-incompatibles. Instead, the heroes were members of the VAX family—a powerful 32-bit architecture that extends from the deskbound MicroVAX II to clustered superminicomputers that can replace mainframes—and a common networking scheme that enables any VAX to talk to any other.

Given the barest opening, Olsen extols the blessings of networking entire organizations—a task accomplished within DEC years ago. Despite the tremendous breadth of product development at DEC, he declares that "no company project exists that isn't directly in line with our goals for networking"—and he loves to demonstrate how VAXs large and small can be plugged in to the same Ethernet jack. With the recent introduction of the VAXmate, DEC now has an AT-compatible system that plays in this scenario.

DEC describes the $4300 VAXmate as the first PC built from the ground up for networking, with integrated Ethernet hardware and network software that sneaks by the 640K DOS limit. Measuring roughly 16 inches square, VAXmate comes standard with an 8-MHz 80286 processor, DOS 3.10, *Microsoft Windows*, 1MB of RAM, a mouse, serial and parallel

DEC president Kenneth Olsen finally bows to IBM PC compatibility: "We'll follow it as long as it's a standard."

DEC's new AT-class Vaxmate, designed from the ground up for networking, runs Microsoft Windows.

ports, and a hybrid Digital/IBM keyboard. A 1.2MB 5¼-inch floppy disk drive fits next to the unit's 14-inch monitor, which supports DEC video modes or the IBM Color/Graphics Adapter. Convection cooled, the system doesn't need a fan.

Options include a $1945 expansion box with a 20MB hard drive and two 16-bit AT-compatible slots, a 2MB expansion board for $1245, and a Hayes-compatible 2400-bps modem for $895. As these prices indicate, DEC isn't much better than IBM at creating bargain-basement buys.

While industry analysts have generally had nice things to say about the VAXmate, most agree it's more important that DEC has begun to spin a network web around the millions of PCs already planted on desk tops. Acknowledging the point, DEC emphasizes

new micro-to-VAX products that accept PCs and compatibles as well as the VAXmate.

The grandest of these is the PC All-in-One, an $81,000 collection that packages a MicroVAX II network server with networking and office automation software and ties together up to 30 PCs. DEC is taking a less ambitious tack with *VAX/VMS Services*, micro-to-mini software that can cost anywhere from $650 to $19,500. The critical advantage in both offerings is a "seamless environment" in which, DEC says, a VAX looks like a natural extension of the PC.

Among services to its "client" PCs, the VAX server can store and deliver PC applications. DEC has signed agreements with Microsoft and a handful of other software

vendors to create suitable versions of their applications. Lotus Development's name has also been bandied about, but no deals have been disclosed yet.

Software support for DEC's new line doesn't figure to be as tardy as it was for the company's ill-fated Rainbow. "Back then, we picked MS-DOS, the world standard for software; it just didn't stay that way," Olsen shrugs. And is DEC now fully embracing the IBM standard? "For this application, yes," he replies. And sounding like Compaq's Rod Canion, he suggests, "It's gotten bigger than IBM. We'll follow it as long as it's the standard."

But What Has He Done Lately?

Chess-playing computers now can trounce all but the top grand masters. One program at AT&T Bell Laboratories recently went a step further and changed the game itself, chewing through every last possibility in endgames with five or fewer pieces left on the board.

AT&T researcher Kenneth Thompson built what he describes as an "un-move generator" that moves backward a step at a time from every possible checkmate. The computer simulation examined all 121,110,528 possible positions, overturning some hoary bits of chess wisdom in the process. It showed, for example, that a king and a queen can indeed force a win over a king and two bishops.

That finding was far from the first big triumph for Thompson, whose work continues to pay off, whatever the venue. A previous Thompson experiment was the starting point for AT&T's UNIX operating system.

Michael McLaughlin

Daily Breadth

The all-in-one integrated package may be poised for a quiet comeback, albeit modestly. It recently garnered endorsements from two major players who had spent years cheerfully sniping at the concept.

Software Publishing has recast its million-selling *pfs:* series into *pfs: first choice*, a $149 package with a graphics interface. *first choice* combines word processing, file management, spreadsheet, and communications functions. Its name pinpoints its target audience.

Microsoft, whose Macintosh offerings sometimes hint at future PC applications, may have indicated that something is up with *Microsoft Works*. In this case, asking for the *Works* gets Mac enthusiasts a word processor, a data manager (with report generator), a

spreadsheet (with graphics), and a communications program.

Granted, *Microsoft Works* is intended for those who can't bear to face an A> unaided. More interestingly, Microsoft has discovered something it calls the "breadth user"—and has gone to great lengths to distinguish that sort of individual from its traditional "depth user" constituency.

Among breadth users, Microsoft reports, "Jobs do not revolve around computing. They want software they can learn over a lunch hour and then use quickly whenever they want." If you think that sounds like computer novices, Microsoft would agree.

Indeed, neophytes may yet be behind the salvation of the much-

maligned integrated package as we know it. Even Lotus's *Symphony*, the M-1 tank of PC software (huge firepower, but not for friendly drives in the country), occasionally addresses these needs, says Lotus product manager Paula Berman. Berman notes that all-in-one packages continue to appeal to corporate micro managers because the software needs only one round of installation and training.

Meanwhile, Alpha Software's *Electric Desk*, one low-profile all-in-one package, keeps chugging away. "When the PCjr was flying, we sold tons of *Electric Desk*," says company president Richard Rabins. When the Jr was grounded, *Electric Desk* sales slid. Now, with a gaggle of dirt-cheap PC clones flooding the market, sales curves are pointing upward again.

Getting to The Point

MBA programs began outfitting students with PCs about two years ago, equipping tomorrow's managers with today's high-tech tools, the better to wage business skirmishes and competitive battles. But at one institution of higher learning, the battleground isn't just a metaphor.

PCs are now standard issue for budding Army officers at West Point. Each of the more than 1200 members of the academy's class of 1990 received a PC for this fall's courses. PCs "will add a new dimension to cadet education," declares Lt. Col. Lanse Leach, director of West Point's personal computer project.

"We have reviewed a number of courses that will permit us to integrate personal computers into the curriculum," Leach says. As befits a military purchase, the product is from Zenith Data Systems, which shipped its Z-248, an AT-compatible with dual floppy disk drives.

This one isn't on Uncle Sam, however. Each cadet must cough up the $1300 purchase price over a two-year period.

"The marketplace has changed dramatically," Rabins points out. "Now you're paying for a real PC about what you paid two years ago for a Jr on promotion. A whole class of people feel that they can't afford not to buy." Just to keep interest in the product high (among an audience Rabins says overlaps that of *first choice*), Alpha has slashed the price from $345 to $129 and pumped up the package with an add-on spelling checker and thesaurus.

Five years after the PC made its entrance, new buyers hardly possess the zeal of the early adopters, Rabins points out. But they still want solid, flexible software. Says Rabins, "Most people are smart. Even the laggards want as much power as you can give them."

A Few Minutes With . . .

Morton Rosenthal, chairman of Corporate Software: "The problem in PC software is not power, it's design. The 80386 will make it easier to write terrible products."

John Roach, CEO of Tandy Corporation: "CD ROMs are great, but how often do you go home at night and look something up in a book?"

Raymond Noorda, chairman of Novell: "Very soon you'll see the cost of a diskless PC terminal with a network interface at $600. That will come from several major vendors—to get it down to $600, several must be competing."

Edward Esber, chairman of Ashton-Tate: "Sometimes pioneers are the guys with the big success. Sometimes pioneers are the guys who are dead."

Phillip Gordon consults on information centers in San Francisco, and Daniel J. Rosenbaum writes about computers and communications from the marshes of northern New Jersey. ◉

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1901 Landings Dr.
P.O. Box 7210
Mountain View, CA 94039
415/962-8910
List price: $149
Requirements: 256K, two disk drives, DOS 2.00 or later version

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Alpha Software
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Burlington, MA 01803
617/229-2924
List price: $129
Requirements: 256K, two disk drives

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And if you want full EGA color, take a look at the new TeleCAT-286 EGA. With its

high-resolution 13-inch EGA color monitor, you get a full spectrum of brilliant displays. Its low-glare, high-contrast dark screen makes it easy on the eyes, too. You can even change this screen to green monochrome, with the flick of a switch.

What's more, the new TeleCAT-286 EGA comes with an EGA card that's fully IBM compatible, so you can run any full-color AT graphics software packages. And they'll never look better. Because this EGA card features 256KB of display RAM, and 640 X 350

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Circle 701 on reader service card

From the Hardware Shelf

PC World offers first impressions of recent hardware releases

Toshiba unveils a definitive 80286 portable, NEC hawks a monster AT-compatible (and those little chips that won't go away), Paradise bests the EGA and its compatibles, and two companies provide data insurance policies.

Edited by Eric Knorr

Toshiba T3100

Like the wiry result of a radical new diet, Toshiba's svelte new T3100 shows it's possible to shave off unwanted bulk and still pack Olympic-class muscle. This mobile AT compatible tips the scales at a mere 15 pounds—more than 40 percent lighter than the Compaq Portable II. With a 10MB hard disk, an 80286-2 CPU that you can toggle between 6 MHz and 8 MHz, and a gas plasma display that approaches CRT quality, the T3100 makes hotel-room computing a whole new ball game.

At 12⅕ by 3 by 14⅕ inches, the T3100 is a shade larger than the 8088-based Data General/One Model 2 laptop (see *From the Hardware Shelf, PCW,* August 1986). Sleek, gray body and fold-out display notwithstanding, the T3100 is no laptop, eschewing batteries in favor of desktop-like power. Yet if you've ever suffered through sluggish laptop performance, you'll be enthralled to find so much power in such a tiny box.

Even with 640K RAM, a 720K 3½-inch floppy drive, and a hard disk (the same model used in the Compaq Portable II) as standard equipment, the T3100 is no lightweight in terms of price. When you compare this machine with a cut-rate AT clone, $4499 seems a bit much to ask for portability (see "An AT by Any Other Name" in this issue). But when you measure Toshiba's entry against similarly configured models from Data General or Compaq, the T3100 is faster than the former, more luggable than the latter, and a bit less expensive than either.

On the showroom floor, the T3100's 5¾-by-7⅝-inch gas plasma display should attract the multitudes. Although gas plasma can't quite match the contrast of electroluminescence, the machine's bright orange, 25-line-by-80-column display is remarkably readable, even under harsh lighting. The T3100 is compatible with IBM's Color/Graphics Adapter, although it doubles the number of lines to 400. And for those requiring more than different shades of orange, an external RGB output connector comes standard.

The machine has two proprietary option slots, one for a 2MB memory-expansion board and another for a Hayes-compatible 1200/300-bps internal modem. Toshiba also offers a $999 expansion chassis that holds up to five 8-bit, IBM-compatible boards; this add-on unit requires an additional $199 interface board in order to function. An external 5¼-inch floppy disk drive is available for $499, and another option, PC Floppy Link, enables the T3100 to commandeer one of your PC's floppy drives.

The T3100's keyboard combines a sensible layout with 81 solid-feeling keys. The 10 function keys are lined across the top edge, while the cursor keys sit in an inverted T formation in the lower right corner. Pressing <NumLock> turns 13 of the letter keys into a numeric keypad; unfortunately, these keys are poorly labeled and difficult to read in low light. LEDs for <NumLock>, <CapsLock>, and <ScrollLock> are located on the bottom of the foldout display.

Other standard features include a Centronics parallel port (switchable for accessing the external floppy drive), a 9-pin RS-232C serial port, a 61-watt internal power supply, and a clock/calendar with battery backup. Externally located DIP switches make configuration changes a breeze, and a well-designed carrying case helps transport the little guy and all his cables from home to office and back.

Watching this small miracle perform at speeds that would have raised eyebrows for a desk-bound machine just over a year ago is a humbling experience. The T3100 ably displayed compatibility by whizzing through *WordPerfect*, *VP-Planner*, *1-2-3*, *SideKick*, and *SuperKey* without a glitch. And if you run into problems, Toshiba claims it will replace failed units overnight.

No doubt about it, Toshiba has built a whale of a computer into the T3100's trim, stylish body. With back orders stretching well into 1987, you can bet a few other technophiles think so too. *–Paul Meyers*

T3100
Toshiba America, Inc.
Information Systems Division
2441 Michelle Dr.
Tustin, CA 92680
714/730-5000
List price: $4499, external 5¼-inch disk drive $499, 2MB memory-expansion board (price to be announced), 1200/300-bps modem $399, PC-Floppy Link $199, expansion chassis $999, interface board for expansion chassis $199

■

NEC APC IV

Its name sounds like it's straight out of NASA's acronym generator, but NEC's APC IV is neither a robot arm nor a food dispenser for weightless diners. *APC* stands for Advanced Personal Computer, and *IV* marks the evolution of the APC series. The first NEC PC to bear the APC moniker was an MS-DOS machine with 8-inch floppy drives, an impressive custom graphics chip, and virtually no PC compatibility. Next came the still-manufactured APC

John Greenleigh

Offering an eye-popping gas plasma display, Toshiba's 14-pound T3100 gives you the freedom to take 80286 power almost anywhere. And with 640K RAM, a 10MB hard disk, and an 8-MHz switchable clock, you won't have to swap performance for mobility.

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Take a look at the screen on the right and you'll see what we mean.
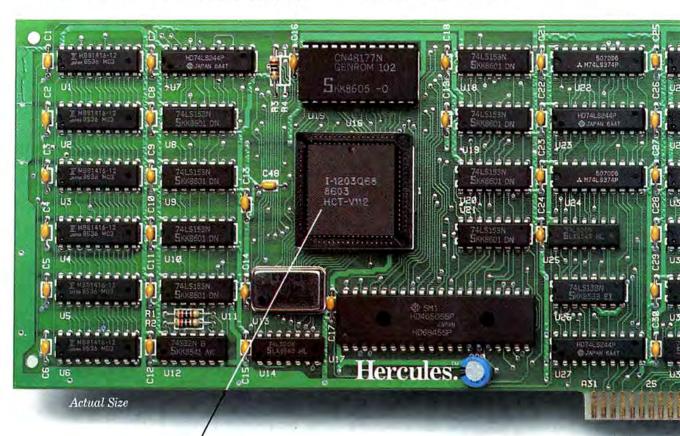
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Now, what was the first thing that caught your eye? The cute little graphics window, of course.

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Actual Size

Hercules.™

The heart of the Graphics Card Plus: the V112 microchip, Hercules' next generation video processor that makes the RamFont mode possible.

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RamFont is a radical new hardware mode that combines the speed of text with the flexibility of graphics.

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RamFont also makes it possible to mix true text and graphics on a single screen.

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The New Hercules Graphics Card Plus.

Circle 77 on reader service card

From the Hardware Shelf

III, which features 5¼-inch drives but continues to stray from the compatibility trail, needing a special utility to run most PC programs.

But with the APC IV, NEC finally got it right. The APC IV is an AT-compatible, 80286-based screamer with a swift 40MB hard disk, a 1.2MB floppy, 640K of RAM, a built-in clock/calendar, and the best clone keyboard I've ever used. *PC World*'s review system also included NEC's EGA-compatible graphics board and advanced color display—a combination that makes *Microsoft Windows* explode with the kind of vivid colors and razor-edged text that make Mac users jealous. Best of all, the whole shebang goes for considerably less than a comparably equipped IBM AT or XT-286.

On a desktop, the APC IV has the same colossal presence as an AT. The left side of the unit's front panel sports a key lock (which also doubles as a reset switch), plus power and hard disk indicator lights. Beneath the lock is a switch for toggling between the machine's 6-MHz and 8-MHz clock rates—an arrangement I find preferable to some clones' <Ctrl>-<Alt>-\ toggle, which is too easily confused with commands that call up RAM-resident utilities. The right side of the front panel has room for up to four externally accessible half-height storage devices, versus the AT's limit of two.

The APC IV's keyboard is an identical twin of IBM's original AT model and has a similar feel. Most clones' keyboards feel mushy

(continues)

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- Color or monochrome graphics card.
- Serial/parallel interface card.
- 33 Mb (formatted) fixed disk drive with 40 ms access time.
- 20 Mb tape backup.
- American Mouse with free Compu-Brush graphics program.
- FCC approved; class 15J, part B.

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Dealers Circle 771 on reader service card
End users Circle 770 on reader service card

to me, but the APC IV's is crisp and responsive; it even produces the same telegraph-key clacking as IBM's clavier. The APC IV also matches the AT's slot count, offering six 16-bit and two 8-bit slots. The APC IV has one-upped the AT, however, by building a parallel printer port and two serial communications ports into the motherboard, thereby eliminating a need for extra I/O boards.

On the playing field, the APC IV performed beautifully. Its Phoenix BIOS enabled it to run all the programs I fed it, including *1-2-3*, *Framework II*, *Microsoft Word*, *Access*, *WordStar 3.3*, *SideKick*, *SuperKey*, *ProKey*, and more. And its performance was as good as or better than another AT imitator in its class, the Tandy 3000 (see Table 1).

The APC IV's speed, display, and EGA-compatible graphics board (which sports a full 256K of video RAM) team up to make *Microsoft Windows* and other

Table 1: The NEC APC IV and the Tandy 3000 face off (all times in seconds)·

| | APC IV | | Tandy 3000 |
	6 MHz	8 MHz	
Run compiled BASIC prime number generator (1651 primes)	12.0	9.0	9.0
Search and replace 38K WordStar document	46.0	33.0	34.0
Recalculate 1-2-3 worksheet	5.0	3.5	3.6

graphics applications downright stunning. If you have other PCs, you can use the tilt-and-swivel display with them, too. Automatically adjusting to scan rates between 15.5 and 35 kHz, the monitor can accept either TTL or RGB signals.

Of course, you can find a cheaper AT clone via mail order. Even with NEC's recently announced price cuts, the APC IV isn't intended to be the cheapest AT compatible. This is quality computer hardware that can take a beating and keep on booting, and with a 40MB hard disk of-

fered as part of the default configuration, it's obvious that NEC is targeting the machine for high-end applications. If you're looking for an AT compatible—and especially if you have graphics applications in mind—the APC IV deserves a close look. *—Jim Heid*

NEC APC IV
NEC Information Systems
1414 Massachusetts Ave.
Boxborough, MA 01719
617/264-8000
List price: APC IV with 640K

RAM, 1.2MB floppy disk drive, 40MB hard disk $3995; with 20MB hard disk $3495; without a hard disk $2995; 512K memory expansion option $395; advanced color display and advanced graphics board $1425; color graphics board $225; 80287-3 math coprocessor $450

■

Paradise AutoSwitch EGA

Next to the IBM PC, the IBM Enhanced Graphics Adapter (EGA) is the most imitated computer product on the market today. In a quest to win ever-larger shares of the video graphics market, manufacturers of EGA compatibles are stuffing their video duplicates with added features such as expanded Color/Graphics Adapter (CGA) support, Hercules graphics emulation, and other perks. Among these third-party entrants, no board has been as successful at

improving IBM's original idea as Paradise Systems' AutoSwitch EGA.

The AutoSwitch is fully EGA compatible, displaying enhanced graphics in 16 colors from a palette of 64, with 640-by-350-pixel resolution. As with a number of its counterparts, this half-slot board also runs software written for IBM's CGA and Monochrome Display Adapter (MDA) and the Hercules Graphics Card. Pulling ahead of the pack, the AutoSwitch rounds out its repertoire by emulating Plantronics' Color/Plus board. What really sets the Auto-Switch apart, however, is its ability to automatically select the appropriate video mode from its extensive built-in assortment.

Using a proprietary BIOS routine, the AutoSwitch monitors port calls made by graphics software to access a given video mode. Once the board deciphers a request, it automatically configures itself for the appropriate emu-

lation. Because the AutoSwitch's video modes are implemented in hardware—not in software, as in other EGA work-alikes—hardware calls can't circumvent the BIOS and cause mischief. Paradise has developed its own VLSI EGA simulation chip, which incorporates all of the hardware attributes (including registers) of the Motorola 6845—the video graphics chip used by IBM's Monochrome Display and Color/Graphics adapters. Consequently, any software designed to operate with either the MDA or CGA is 100 percent compatible with the AutoSwitch board.

Some programs, however, don't give the AutoSwitch enough information to work with. IBM's *PC Storyboard*, for example, requires the CGA mode but doesn't seem to access the video mode in the standard manner. This confuses the AutoSwitch board, which blanks the screen and forces you

(continues)

Was your word processor designed to write like this?

to restart your system. Other programs, such as Omation's *Schema* and American Small Business Computers' *Pro Design II*, can also befuddle the BIOS's switching capabilities.

Paradise has anticipated situations like this and provides two methods of escape. First, you can flip a switch, located on the board's rear bracket, that disables automatic switches and forces the board into EGA mode. The second solution employs a software utility that enables you to perform this same function from the keyboard. The software tack has the added advantage of permitting manual switching to MDA or CGA mode.

For the most part, however, the AutoSwitch performs flawlessly—even toughies like *Flight Simulator* come off without a hitch. In fact, it's interesting to view *Flight Simulator* in different modes by manually switching the board before starting the program. You can even force the board to operate *Flight Simulator* in the Hercules

graphics mode using a CGA-compatible graphics monitor, although the performance is a bit slow and terribly choppy.

Like IBM's EGA, the Auto-Switch has a light-pen interface, along with IBM's mysterious and as yet unimplemented "feature connector." A particularly nice touch is the external toggle switch that allows you to use either a monochrome monitor or standard CGA monitor in one switch position or an EGA monitor in the other. Unlike some other EGA compatibles, the AutoSwitch offers no parallel or serial ports.

The AutoSwitch documentation is excellent. A 23-page booklet details everything you need to know; even the klutziest novice should have the board up and running in less than 10 minutes. Couple this ease of installation with hardware-based emulation and transparent mode switching, and you have the most versatile EGA board on the market today. —*TJ Byers*

Paradise AutoSwitch EGA Card
Paradise Systems, Inc.
217 E. Grand Ave.
San Francisco, CA 94080
415/588-6000
List price: $599

■
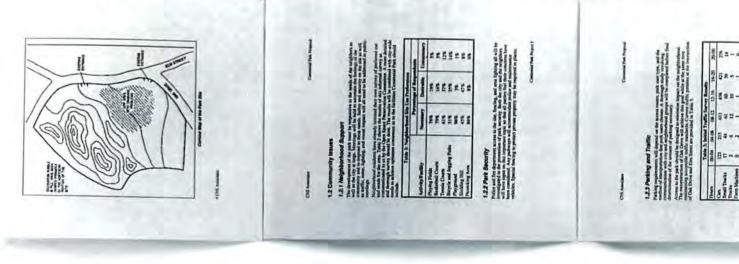
NEC V20 and V30

If you're still using a PC or an XT, you've heard the admonition by now: Pop out that poky old 8088 or 8086 and pop in a NEC V20 or V30. Varying reports circulate about the chips' performance, but one thing is certain—there's no cheaper way to speed up your PC or XT.

At first glance the speed gains may seem insignificant. Overall, the V20 and V30 (which replace the 8088 and 8086, respectively) are rated by NEC as about 6 percent faster than their Intel counter-

---

parts. But if you recalculate long spreadsheets or perform other processing-intensive operations, you may find that your pace picks up by as much as 25 percent.
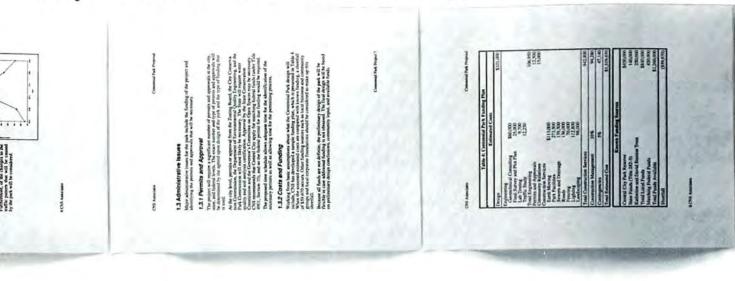
The main difference between the V20 and V30 is the same as the distinction between the 8088 and the 8086: The V30 is a 16-bit processor, while the V20 is the same as the V30 but surrounded by an 8-bit shell. And not only are the V20 and V30 fully pin-compatible with their Intel progenitors, they're software compatible as well.

If you look hard, you may be able to find some older software that won't work properly with the V20, but I've only encountered one recently released program that bombs: *SmartNotes*, a RAM-resident utility for posting small, windowlike overlays on applications. *Microsoft Word*, *XyWrite*, *1-2-3*, *Pop-Up DeskSet Plus*, *Side-Kick*, *Turbo Lightning*, and even the finicky *Jet* make themselves right at home.

With an enhanced color display and adapter, NEC's APC IV makes any graphics application shine. NEC is targeting high-end applications by including a 40MB hard disk as part of the APC's $3995 selling price.

very technical document, mixing text and graphics?

What makes the NEC chips faster than Intel processors? Simply put, the V chips have roughly double the number of transistors of their Intel equivalents and two internal buses instead of one. These assets, plus streamlined microcode, enable the V chips to process the same number of instructions in fewer clock cycles.

The practical result for PC users is a modest but noticeable increase in speed. Using the V20, recalculating a 2821-cell *1-2-3* spreadsheet took 20 seconds compared to 23 seconds with an 8088 chip. A DOS SORT command on a 60K text file produced output on screen within 8 seconds, while the 8088 chip lagged behind at 16 seconds. Batch-file execution also accelerated: A 14-line batch file that executed in 25 seconds with the 8088 took the V20 just 21 seconds to complete.

The V20 and V30 come in 5-MHz, 8-MHz, and 10-MHz versions. Just determine the clock speed your machine is set to run at and match it with the appropriate V chip. If you have a turbo PC that runs at various speeds, buy the V chip that matches your highest clock speed—it'll work fine at lower speeds as well.

To install the V chip, first locate your 8088 or 8086 CPU, a 40-pin chip usually located at the center rear of the motherboard. Before you remove the original, note the location of the semicircular groove cut into the side of the processor. You'll want to install the V chip with its semicircle in the same orientation to make certain you're not putting it in backwards.
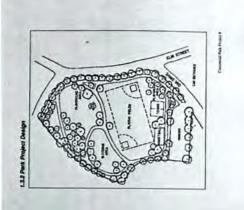
If you don't have a chip-puller, you can extract the Intel chip with a screwdriver; gently pry up the processor from each end and take care not to bend the tines. Before you remove the V chip from its packaging, touch grounded metal to discharge any static electricity you may have acquired. Then align the legs of the processor with the holes in the socket and press slowly but firmly until the chip is fully seated.

Once your V chip is installed, don't hold your breath waiting for a sudden rush of acceleration. If you're a bit disappointed, entertain yourself with the notion that your PC's brain is just about its cheapest replaceable part. The increase in speed will definitely be perceptible. And for the same price as a silk tie or cab fare across town, that's nothing to sneeze at. —*Patrick Marshall*

V20 and V30
NEC Electronics, Inc.
P.O. Box 7241
Mountain View, CA 94039
415/965-6048
List prices: V20 5 MHz $12.25,
8 MHz $14.50, 10 MHz $18;
V30 5 MHz $14.50, 8 MHz
$16.75, 10 MHz $20

Was it designed to write a highly-structured document,

Excel Stream 60

Hard disks may have removed the floppy clutter from your office, but they've also added something for you to carry home—namely, the nagging question, What happens if my hard disk self-destructs? The only way to quell that fear is to make weekly or even daily backups a ritual. And rather than grow old using DOS's sluggish BACKUP command, an increasing number of users are turning to fast, reliable streaming tape backups.

A reasonably priced archival unit that employs standard ¼-inch QIC DC600A 60MB tape cartridges, the Excel Stream 60 from Everex provides high-performance tape backup with enough flexibility to accommodate a wide range of needs. This sophisticated product offers extensive file selection

Everex's Stream 60 offers high performance and a wide variety of file selection capabilities for both backup and restore operations.

with many revisions, as easily as it knocks out a memo?

facilities for both backup and restore operations. The unit's greatest flaw is that its software's overabundance of options and jargon-filled menus may intimidate new users.

The Excel Stream 60 is available in two versions, which use identical software and the same reliable Wangtek drive mechanism. The only difference between the two lies in the size of their controller boards: One uses a short board and costs $1645, while the other uses a full-size board and goes for $50 less. But if you're going to back up more than one machine (a likely prospect, surely), pick up the short-board version. Additional half-size boards run only $159 apiece, compared to the long board's $459 tariff.

Although the Excel 60 lacks a carrying handle, its 8½-by-11¼-inch size shouldn't prohibit departmental shuttling. The manufacturer claims that at 90 kilobits per second, the Excel 60 performs a 20MB image backup in 5 minutes. Even for most file-by-file operations, this speed seems to suffer little degradation.

Installing the Excel Stream 60 is routine; after settling the board and cables into place, the menu-driven software creates a subdirectory and copies all programs onto the tape. The Everex system, like most current tape drives, uses a DMA (direct memory access) channel 1 to shuttle data from your PC's hard disk to the tape unit. However, if this setup causes a hardware conflict in your system (say between an internal modem using COM2: and the Everex controller card), the manual provides instructions on altering the DMA value, as well as the port address and interrupt levels.

The Excel Stream 60 performs almost any backup and restore operation you can imagine. By using context-sensitive help, Everex hopes to make many of these functions available to novices as well as experienced users. Unfortunately, this intent is thwarted by unnecessarily technical jargon in menus, the manual, and even some help screens.

Experienced users, however, will quickly discover a wealth of power and flexibility. A sophisticated windowing system enables you to back up and restore any combination of files from all available drives, paths, and subdirectories. This means you can perform selective file-by-file restorations of image backups and thereby transfer an image backup from one type of drive to a dissimilar one—such as from a 20MB drive to a 30MB drive. A window in the main menu displays current operation and tape position—reading, writing, beginning of tape, or end of tape. Ongoing progress is represented by a moving bar using a percentage scale and by a sector counter.

Everex refers to data backed up in one operation as a data set, and you can give each data set a label

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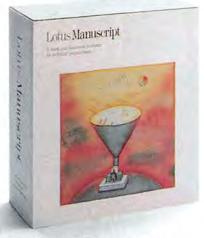
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Another feature designed specifically for the writer of technical documents is Manuscript's integrated Outliner. When you collapse the document you're able to navigate the outline much easier than wading through

Manuscript allows you to mix text and graphics on the same page.

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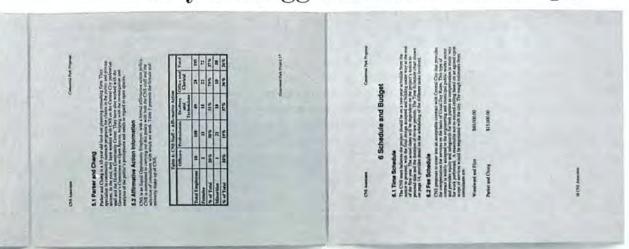
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May we suggest Lotus Manuscript.

and number for tracking purposes. You can restrict a backed-up data set to modified files or to files from a specified time period. In addition, you can define a data set and then exclude specific file groups or even single files.

The Excel Stream 60 uses the standard read-after-write verification method to maintain data integrity during backups. For more thorough data checking during image-restore operations, the tape can also scan the disk for bad sectors that eluded detection by DOS; it then relocates those sectors so that DOS will flag them properly. A data-comparison program (similar to DOS's DISKCOMP) can check all data bit by bit and display any errors—an option especially recommended the first time you back up an entire hard disk.

Compared to the competition, the new Excel Stream 60 offers a healthy chunk of power and performance at an equitable price, and few products can offer a comparable array of file-selection capabilities. As an added bonus, Everex includes a utility for unattended backup, which leaves you free to pursue less pedestrian diversions. Such comprehensive features make this security device worth the training time for beginner and expert alike. —*Art Wilcox*

Excel Stream 60
Everex Systems, Inc.
48431 Milmont Dr.
Fremont, CA 94538
415/498-1111
List price: with QIC-36 (long) controller board $1595, with QIC-02 (short) controller board $1645; additional QIC-36 controllers $495, additional QIC-02 controllers $159 Requirements: 256K

Watchman I

In a market increasingly dominated by intricate add-ons, the unabashed simplicity of the $299 Watchman I Standby Power System (SPS) from RTE Deltec is almost shocking. As deep and as tall as an IBM PC chassis, with a face 7½ inches wide, this 29-pound watchdog has a single task: to supply power to your system if the AC current fails.

The amount of time the Watchman I's sealed lead-acid battery and DC-to-AC inverter can sustain power depends on how much juice your equipment draws. The maximum rated power output is 200 watts. At that rate, your system will last approximately 20 minutes, more than enough time to save what you've done and shut down the computer. If your system draws, say, 100 watts, you'll have twice as long to wind up loose ends.

Built into the Watchman I's homely front panel are a mode-indicator light, an alarm reset button, and a system reset switch. When power fails and the battery takes over, the indicator light turns from green to flashing red and an intermittent beep sounds;

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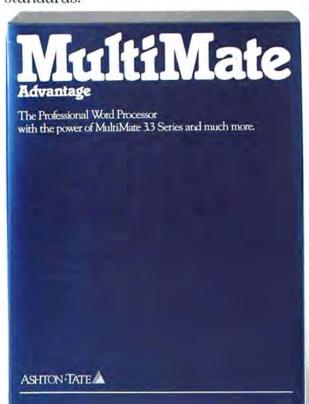
It also supports a new 40,000-word thesaurus. As well as a 110,000-word dictionary (complete with medical and legal jargon), which you can easily customize to include your own frequently used words.

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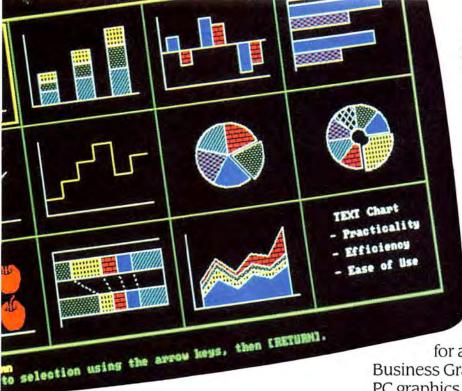
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Your first Chart in five minutes.

1

Boot your PC. Type SBG. When the menu screen appears, use the cursor to select any of 12 formats for your graph. Then press (RTN).

pressing the alarm reset button cancels both beeping and flashing. When power is restored, the indicator light should turn green again. If it doesn't, just flick the system reset switch.

Because the line current does not run continuously through the battery to the computer, the Watchman I cannot technically be considered an uninterruptible power system. There is an instant, however brief, between the moment the line current is cut and the moment the battery comes alive. If your PC's power supply is particularly sensitive to electrical failure, the computer could shut down during that instant, destroying your data. The Watchman I does have surge suppression built in.
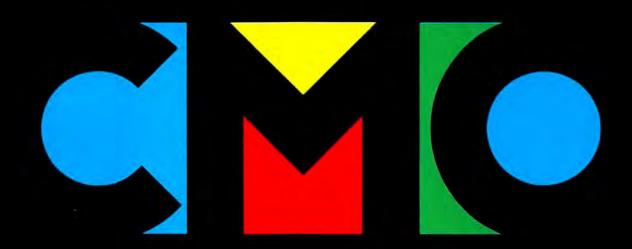
To determine if the Watchman I performs as claimed, the following test was performed: Two computers were plugged into the backup power system, one holding an accelerator board and the other a modem. While both PCs formatted floppy disks, the Watchman I wall plug was yanked from its socket. A noticeable change in the whine of the computers' cooling fans indicated that a serious load was being placed on the batteries. The disk drives of both machines continued to function without a hitch, however, properly formatting the disks.

After tripping circuit breakers, kicking out power cords, and generally wreaking electrical havoc on

(continues)

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—Robert Nusbaum

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RTE Deltec Corp.
2727 Kurtz St.
San Diego, CA 92110
619/291-4211
List Price: $299

Paul Meyers is an independent San Francisco television producer who specializes in science and technology. Jim Heid is a Contributing Editor for PC World. *TJ Byers is a freelance writer and the author of* Inside the IBM PC AT *(McGraw-Hill, Inc., New York, 1985). Patrick Marshall edits the Commentary Page of the* Oakland Tribune. *Art Wilcox is a Contributing Editor for* PC World. *Robert Nusbaum is a freelance writer and programmer living in Los Angeles.* ●

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PC World offers first impressions of recent software releases

This month: intricate desktop publishing, a jack-of-all-trades presentation program, more memory-resident management, a top-notch investment package, simple surveys, and Infocom strikes again

Edited by Robert Luhn and Reed McManus

■

SCLaser Plus

As a one-time newspaper editor accustomed to long hours hovering over a light table with an Exacto knife and pica rule in my sometimes shaky hands, I marvel at the advent of personal computer publishing. For all but the most exacting publications, desktop publishing systems eliminate laborious manual layout and typesetting—along with the page designer's nemesis, wax under the fingernails.

Unfortunately, desktop publishing on the IBM PC is a frustrating affair. While the graphics-oriented Apple Macintosh, with its strict data compatibility requirements, mouse, and superb LaserWriter printer, took to publishing like a duck to water, the PC is saddled with a relatively slow microprocessor, an operating system never intended for extensive graphics manipulation, and legions of unruly nonstandard peripherals.

Powerful graphics-oriented PC publishing programs that provide true-to-life on-screen formatting are on their way (among them

PageMaker and *Ventura Publisher*), but these systems may require an AT, an Enhanced Graphics Adapter, and possibly a LaserWriter. Those with humbler setups (namely the PC and the Hewlett-Packard LaserJet) generally must rely on code-based programs derived from traditional typesetting systems.
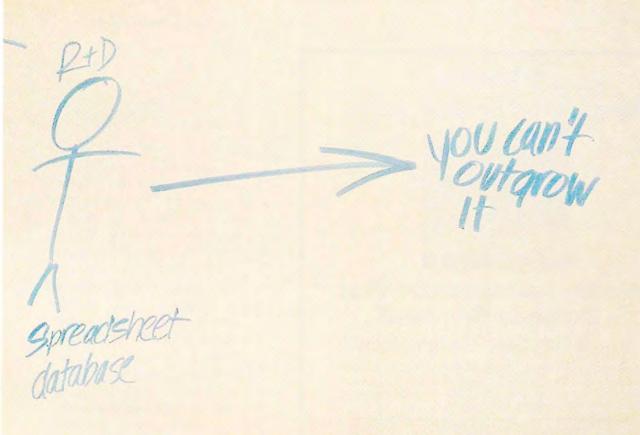
One such example is Software Channels' *SCLaser Plus*. This is no intuitive, interactive, what-you-see-is-what-you-get publishing program but a typesetting-like system that relies on an intricate set of embedded formatting codes. As a result, an *SCLaser Plus* document in the raw closely resembles source code. It takes a keen eye to correctly insert the necessary codes in a document and an active imagination to envision its final look. Although *SCLaser Plus* warns you about command syntax errors, most users, I'm afraid, will probably find themselves printing out many drafts before settling on a final version.

In the right hands *SCLaser Plus* can be an efficient (though hardly

Anthony Russo

revolutionary) aid in harnessing the typographic powers of the LaserJet. *SCLaser Plus* can help you turn out crisp-looking documents combining a variety of fonts, graphs, and tables. The program consists of a text formatter, a word processor, and several handy commands and utilities that can incorporate graphics created with other applications and spiff up documents with icons, boxes, italics, and shadow text. The program allows you to kern text (adjust the spacing between characters), alter leading (the spacing between lines), and set hyphenation and justification. *SCLaser Plus* works with the LaserJet's internal, cartridge, and downloadable disk fonts.
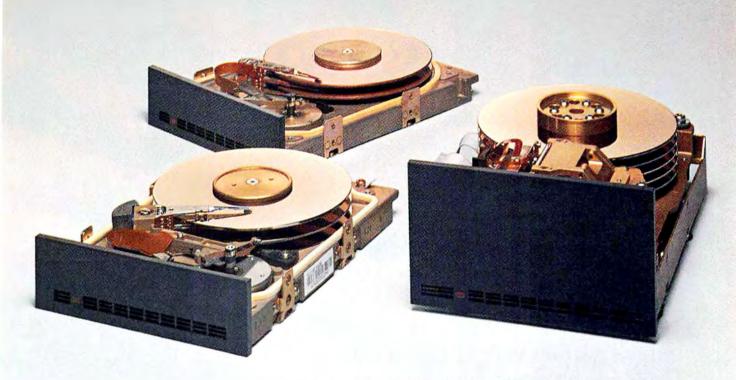
However, to master *SCLaser Plus*, you had better be a very dedicated person willing to crawl up a monumental learning curve. Although *SCLaser Plus*'s formatting language uses English-like dot commands, its complexity all but requires a healthy understanding of programming concepts and organization.

Defining a document format from scratch is an arduous task. For example, a simple memo template supplied with *SCLaser Plus* that defines margins, typeface, headings, and salutations fills up an entire page with code; 13 lines alone are needed to create a macro that inserts names in the memo after 'From:' (see Figure 1).

Once a format is created, however, it can be merged with separate text files relatively easily. With the program's macro capability,

(continues)

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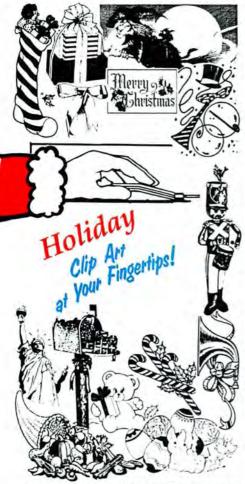
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```
.include funicons

.margin top=2in bottom=2in left=2in right=2in
.paraspacing 11n
.begin center
 .inboth 1in
 .paraspacing 3pt
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 .line thick 3
 .line thick 3
.end center

.begin nofill
(bo TO:)_____All Group A Employees
                   All Group B Employees with Seniority
(bo FROM:)_____T.R. Henpecked, Vice President
(bo DATE:)_____December 24, 1986
(bo SUBJECT:)_Christmas, Possible Celebration of
.end nofill
.sp +11n

All employees expecting a Christmas bonus should meet in the
coffee room at (ul 5:30 a.m.) tomorrow. Our employer, Avarice G.
Shallowpockets, would like to meet with each of you individually
for a good laugh at your expense.

In addition, Mr. Shallowpockets extends his best wishes to you
and your family during this festive season and is happy to
provide (it one (1) plump roasting hen to every seven (7)
employees.)

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★ M E M O R A N D U M ★

TO: All Group A Employees
          All Group B Employees with Seniority
FROM: T.R. Henpecked, Vice President
DATE: December 24, 1986
SUBJECT: Christmas, Possible Celebration of

All employees expecting a Christmas bonus should meet in the coffee room at 5:30 a.m. tomorrow. Our employer, Avarice G. Shallowpockets, would like to meet with each of you individually for a good laugh at your expense.

In addition, Mr. Shallowpockets extends his best wishes to you and your family during this festive season and is happy to provide *one (1) plump roasting hen to every seven (7) employees.*

↑↑↑↑ Happy holidays! ↑↑↑↑

Figure 1: SCLaser Plus's formatting language relies on a mélange of dot commands, in-line commands (which make requests on particular words or phrases rather than blocks of text), and text variables (for creating macros). The program includes a template file that lets you create a plain memo without redefining the format each time.

advanced users can reduce long sequences of keystrokes to a few simple commands; these are especially helpful when formats are handed over to users with only a rudimentary knowledge of the *SCLaser Plus* system. You can avoid programming headaches entirely by sticking to *SCLaser Plus's* six canned templates for memos, letters, reports, and document merges. Most users, however, will quickly tire of these precooked formats and be tempted into the programming abyss.

To prepare a document, you create the text with a word processor, stud the document with the appropriate format commands, and save it as an ASCII text file. (This last step is automatic if you use *SCWriter Plus*.) Format the document and send it to the LaserJet or a disk file.

Although *SCLaser Plus* can digest ASCII output from most word processors, there are exceptions. The program cannot handle lines of text longer than 255 characters. Unfortunately, ASCII files generated by *Microsoft Word* place a carriage return only at the end of a paragraph. Thus *SCLaser Plus* recognizes only the first 255 characters of a *Word* paragraph and discards the rest. Luckily, ASCII files from *WordPerfect*, *MultiMate*, *WordStar*, and *Word-Star 2000* are compatible with *SCLaser Plus*.

If you must resort to *SCWriter Plus*, you may rightly balk at learning a program that takes a giant step backwards from most contemporary word processors.

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For even the simplest formatting—margins, tabs, paragraph indentation, and line spacing—you must embed commands in the text and view the results at print time. In its favor, *SCWriter Plus* offers automatic word wrap, search-and-replace functions, two text windows, password file encryption, and a 50,000-word spelling checker.

Although the *SCLaser Plus* formatting language is difficult to master, you don't necessarily gain unbridled power for your efforts. For example, you cannot set the right margin without simultaneously setting the left margin for the same value. More maddening is the inability to specify the actual point size of type. Instead, you use the relative modifiers "large" for the next increment in type size and "large large" for an even bigger font. It's up to you to keep track of what these descriptors mean.

The program's saving graces are its icon editor, graphics commands, and screen-capture utility. A conscientious document designer can enhance an otherwise drab letter or brochure with special symbols, boxes, lines, italics, shadowtext, and graphics imported from other applications. You can create your own library of original icons for letterheads, logos, and graphs, or edit and use the 48 icons provided with the program. Among these are bullets, typographic quotation marks, and Keyicons—a character set representing the PC's keyboard.

(continues)

From the Software Shelf

Screen 1: The icon editor allows you to create reverse images, insert and delete rows and columns, and fill in specified regions. It automatically draws lines, circles, and boxes.

The icon editor enables you to alter existing icons or build icons as large as 3 inches square (at 75 dpi) from scratch. Unfortunately, the program does not support a mouse, so you must create a symbol by moving the pointer with the cursor keys and turning each dot on or off with the space bar. Commands that jump the crosshair to the next filled dot, move it eight dots at a time, and slide it diagonally across the grid help relieve the tedium of this operation (see Screen 1).

Other shortcut commands will fill in an outlined area and set print resolution to 75, 100, 150, and 300 dpi. From the icon editor's menu you can save, abort, and set margins and baselines, and undo errant commands. Incorporating icons is easy: Once an icon library is referenced with a dot command at the beginning of a document, you simply enter the icon name in the appropriate position on the page.

SCLaser Plus's graphics commands are hit or miss. For instance, there are commands for easily generating bar codes, address labels, and vertical and horizontal bar graphs from within the program but none for generating vertical lines or easily changing horizontal lines' start and end points. (In the latter case, you must change your margins, create the line, then reset margins.) In addition, you can't vary the size of the box in which *SCLaser Plus* can automatically enclose a paragraph.

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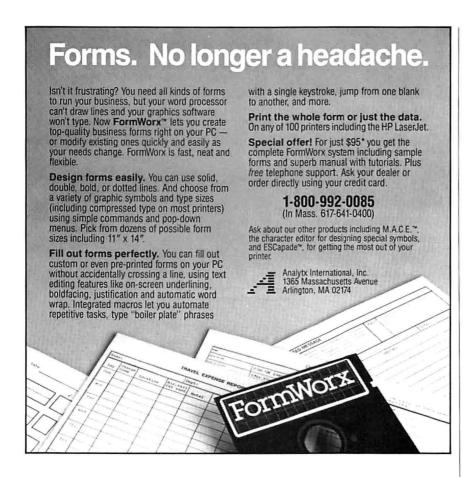
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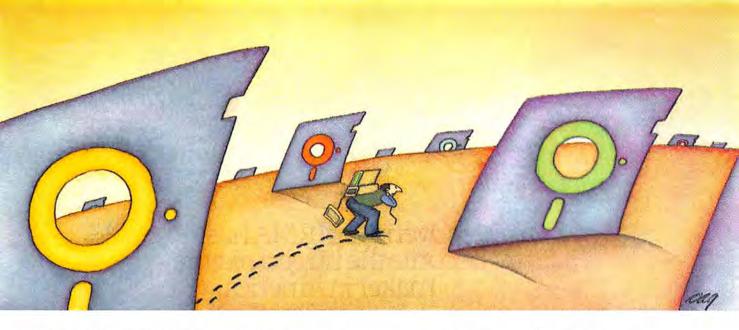
SCLaser Plus's memory-resident screen-snapshot utility can grab images displayed by almost any application. Pressing <Shift>-<PrtSc> stores an image to a special buffer; you can then save the snapshot to disk and give it a file name. To insert the picture in a document, place the file name next to the *.picture* command embedded in the document. You can't, however, crop a captured image like an icon. Instead, you must add parameters to the *.picture* command specifying the picture's distance from the top, bottom, left, and right margins.

An experienced, patient user can put the LaserJet through its paces with *SCLaser Plus*. But even seasoned corporate publishing managers will think twice before taking the leap. *SCLaser Plus* demands as much as it delivers.
—*Jason Durbin*

SCLaser Plus
Software Channels, Inc.
212 King St. W
Toronto, Ontario
M5H 1K5 Canada
416/591-9131
List price: $495
Requirements: 256K, one disk drive (hard disk recommended), DOS 2.00 or later version, Hewlett-Packard LaserJet or LaserJet Plus, graphics display board (required for icon editor only)
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From the Software Shelf

Screen 2: Graphics in a flash. Tools, colors, and effects are close at hand.

Harvard Presentation Graphics

Life is full of momentous deadlines: finish college, get a job (and a haircut!), find a spouse, file income taxes. But these cosmic concerns are better left to caterers, accountants, and other *demipenseurs*, for more immediate deadlines await. If pulling together a business presentation in half an hour is the current monkey on your back, consider the merits of *Harvard Presentation Graphics* from the folks at Software Publishing.

Like its *pfs* step-siblings, *Harvard Presentation Graphics* won't dazzle you—but it gets the job done quickly and with a minimum of fuss. *Harvard Presentation Graphics* provides a complete smorgasbord of presentation graphics features that are plucked from the program as easily as canapés from a tray. Generating text and organizational charts and bar, scatter, line, area, exploded pie, or high/low/close graphs means filling out a few on-screen forms. Do you need to dress up a dowdy *1-2-3* graph in something au courant? Vacuum up the worksheet data, drop it into the program's built-in 60-row-by-8-column spreadsheet, generate the chart of your choice, and add captions, labels, arrows, boxes, and

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shadows in a flash (see Screen 2). Numbers can be directly entered into *Harvard Presentation Graphics'* spreadsheet; *Symphony*, *pfs:graph*, and ASCII files are also importable.

Like any self-respecting graphics program, *Harvard Presentation Graphics* can run a PC-based slide show that displays charts at set intervals. Images can also be sent to slide-making devices such as the Polaroid Palette and CalComp Color Master Printer; the program's graph files can be typeset by the MAGICorp slide service. Hard copy is not confined to plotters, either; a chart can just as easily be printed on a variety of dot matrix graphics printers, the HP LaserJet, or the Apple Laser-Writer. Draft, standard, and high-resolution output are available in full-, half-, and quarter-page formats.

With *Harvard Presentation Graphics*, functions follow forms. Once data is captured in the program's spreadsheet, you can flip through option forms and select chart type, label formats (value, percent, dollars, none), fill styles (colors and patterns), three-dimensional effects (for bar, pie, and combination graphs), and type in titles and footnotes. After completing the forms, press <F2> to instantly preview the chart; to see the result on paper, select the print option from the main menu and specify the desired resolution, page size, and output device.

On the graphics side, you have a choice of horizontal and vertical

(continues)

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From the Software Shelf

Figure 2: Harvard Presentation Graphics can spit out workaday charts in short order. Stacked bars, pie charts, and special effects are available just by filling out an on-screen form.

bar graphs with clustered, overlapped, or stacked bars (see Figure 2). Line graphs can employ straight or curved lines, trend lines, or unconnected points. Bar and line graphs can show running totals in steplike fashion and incorporate grids. You can slice a pie 12 ways, explode slices, and sort slices according to size. However, only one slice can be exploded when 3-D effects are employed.

Although the program's graphics are mostly standard fare, text charts go beyond the ordinary and can include titles, footnotes, bulleted lists, two- or three-column tables, and some free-form arrangements. Organization charts can incorporate as many as 32

names, titles, and comments, and up to eight levels (see Figure 3). After text is entered, you specify placement (centered, flush left, or flush right); point size; filled, outlined, bold, or italic style; and other attributes. Although *Harvard Presentation Graphics* offers five fonts (the most useful of which is the Helvetica-like Executive), only one can be used per chart.

Breadth, of course, doesn't necessarily imply depth. *Harvard Presentation Graphics* limits any chart to two graphs, and all elements (with the exception of some accompanying text) are pasted down in set locations. When it comes to adding some extra punch to an image, *Harvard Presentation Graphics* likewise falls short. Although the program furnishes a comely drafting table, capable drawing and editing tools are not on hand.

(continues)

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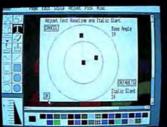
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1950 Spectrum Circle, Suite A495, Marietta, Georgia 30067, (404) 980-1950

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Figure 3: Need the corporate power structure for quick reference? Harvard Presentation Graphics can include 8 levels and 32 different titles.

In short, *Harvard Presentation Graphics* is for those who need a quick, balanced snack instead of a seven-course meal. It can't match the comprehensiveness of *Graphstation*, but if you're in a hurry for reliable presentation graphics, this could be your dish. –*Richard Jantz*

Harvard Presentation Graphics
  version A.01
Software Publishing Corp.
P.O. Box 7210
1901 Landings Dr.
Mountain View, CA 94039-7210
415/962-8910
List price: $395
Requirements: 256K (384K for slide output devices); two disk drives (hard disk required with slide devices); DOS 2.00 or later version; IBM Enhanced Color Adapter, IBM Color/Graphics Adapter, Hercules Graphics Card, or compatible graphics board
Not copy protected

Referee

It's fourth and forty with one minute left in the game. Your team is down by three points. You decide to go for the gusto. The ball is snapped, you fake a lateral and fire off a bomb downfield to your ace receiver. Touchdown!

(continues)

But wait. The ref dropped a flag. Your team had too many men on the field. No touchdown. The game is over and it's back to the USFL. If you'd only been warned ...

You can eliminate such bush-league antics—at least on the PC gridiron—with the help of *Referee* from Persoft. While the program won't exactly blow the whistle on errant memory-resident programs, it will help you put pugnacious players on the bench or assemble winning lineups.

As you may have guessed, *Referee* can activate or deactivate memory-resident programs (but not remove them from memory) and thus prevent conflicts from wreaking havoc. You can also create "RAM Teams"—sets of memory-resident programs that are automatically activated or deactivated whenever a given application is run.

Referee consists of three modules: Refwatch, Referee, and Sideline Referee. Refwatch (which must always be loaded) stakes out 25K for itself and keeps track of memory-resident players. Type *Referee* at the DOS prompt and up pops the program's main menu; select the first option and *Referee* lists resident programs, notes which are active with a check mark, and supplies total memory used and memory remaining. Activating or deactivating a program is a matter of highlighting the program name and pressing the spacebar. Press <Enter> and the program's memory use is provided (see Screen 3).

(continues)

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> Kathryn H. Wilson, Raychem Corporation

"Javelin was selected for its ease of use in entering and importing data, performing consolidations, defining reports, producing graphs, and automatically debugging models."

> Timothy J. Lee, Price Waterhouse

"I must confess to finding Javelin vastly superior for much of what I want to do. I'm doing my income tax on it this year and it is fantastic."

> William F. Zachman, International Data Corporation

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Javelin Software Corporation
One Kendall Square
Cambridge, Massachusetts 02139

Technical Specifications:
Minimum configuration—IBM PC Dual Floppy 512K. Supports Hard Disk, Mono, Regular & Enhanced Graphics, 8Mb Expanded Memory, Math Co-Processor. Features: Not Copy Protected. 16,382 line item data capacity. 175 year calendar built-in, complete audit-trail and notes filing system, 7 graph types (printing & plotting built-in), Import/Export from Javelin, .WKS, ASCII, and .DIF, complete macro language including custom pull-down menus.

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Worksheet/Chart Views:
Any product can draw a graph. Only Javelin lets you use graphics to enter data. The numbers appear instantly in your worksheets. You can have as many worksheets as you want, all dynamically linked.
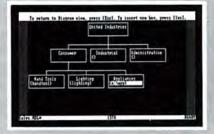
Diagram View:
Only Javelin offers a Diagram View that helps you trace the logic of your model—in both directions.

Formulas View:
Only Javelin has a complete audit-trail facility and notes filing system built-in.

Org Chart:
Javelin's unique Rollup Building Block does hours of multi-department consolidation work in minutes. This chart defines your consolidation hierarchy. Javelin does the rest!

From the Software Shelf

Screen 3: Memory madness quelled. Referee can manage TSRs, activate and deactivate them with a single keystroke, and assemble teams geared for your primary application.

The remaining menu options enable you to designate RAM teams. Essentially, you list all the applications and memory-resident programs you plan to use, then with the RAM team option, pick resident programs to be activated for each application.

Once you've determined your rosters, you never have to call on *Referee* again. Just slip the command Refwatch into your system's AUTOEXEC.BAT file and the specified RAM teams will come into play. If you expect to deactivate a program from within an application, load the Sideline Referee module and press <Alt>-<GrayPlus> to set it into motion.

Referee is simple to use and handy indeed, but it doesn't free up memory or eliminate the hassle of writing batch files. The program can completely remove a TSR from memory, but because of DOS's quirky nature, you can only extract programs in "last one in, first one out" fashion.

Referee mixes well with most programs, but there are some notable exceptions. *SideKick* users may discover that *Referee* prevents this desktop manager from working with some programs. If you use an operating environment such as *Microsoft Windows* or *Desqview*, keep in mind that you can assign a RAM team to the environment as a whole, but that *Referee* will not perceive applications loaded within it. *Referee* also

(continues)

won't recognize, much less manage, RAM disks and other programs loaded via CONFIG.SYS.

Referee won't cut memory use—in fact, it may even tempt you to expand your PC's allotment if you frequently switch among applications. With RAM chips going for a double sawbuck a dozen, this is no big deal, but controlling a mob of squabbling memory-resident programs is, and Referee is just the ticket. —Patrick Marshall

Referee 1.0
Persoft, Inc.
465 Science Dr.
Madison, WI 53711
608/273-6000

List price: $69.95
Requirements: 128K, one disk drive, DOS 2.00 or later version
Not copy protected

■

The Active Investor Series

If you wrote a spreadsheet program that was only as good as 1-2-3, odds are no one would buy it. The name of the game in the crowded software marketplace is "added value"—an appellation particularly apt in the realm of securities analysis software. With the flood of programs that tackle portfolio, fundamental, and technical analysis, a package has to be very special to stand out from the crowd.

The Active Investor Series from Interactive Data Corporation is such a program. It's easy to use, offers all three methods of analysis, produces outstanding reports, and its built-in telecommunications program gives you entrée into one of the most extensive financial data bases commercially available. Put it all together and you have a premier securities analysis program in the under-$500 bracket.

Active Investor offers all the analytical capacities the marketplace demands. The portfolio

Infocom introduces four new gan

Infocom,™ the crazy people who brought you "Zork"® and "The Hitchhiker's Guide to the Galaxy,"™ has a habit of coming up with games that add a new dimension to interactive fiction. And the best keeps getting better. Case in point: "Leather Goddesses of Phobos."™ It has a scratch n' sniff card and a 3-d comic book to excite all your senses. Once your interest is piqued, you'll embark on a rowdy romp through the solar system. This hilarious spoof of 1930's pulp science fiction has 3 "naughtiness levels," for the prude to the lewd. "Leather Goddesses" is sure to amuse members of either sex.

One's really warped.

Then there's "Trinity."™ It answers the question of whether a game can be both light-hearted and profound. You journey through a time warp into a mischievous fantasy world where all atomic explosions are mysteriously connected. "Trinity" takes you back to the dawn of the atomic age and puts the course of history in your hands.

One's a real circus.

It has been said that the circus is the only really mysterious thing left in civilization. One thing's for sure, there is plenty of mystery in "Ballyhoo."™ While trying to locate the circus owner's kidnapped daughter, you are somersaulted into a three-ring world of deception and crime. To solve the crime

manager will track your current holdings, calculating totals for cost, profit or loss, and yield. Positions that have been closed are memorialized with date, price, commissions, dividends, and profit/loss calculated. This information in turn is integrated into a tax report of long- and short-term capital gains and losses. The manager also provides cash account reports of current balances, credit limits, and interest rates. The program has the capacity to generate monthly income reports and, most interestingly, custom reports of your own design.

The fundamental analysis module searches the on-line data base and links you with either the Fundamental or the Ratings data

package; both follow the 1600 companies listed in the *Value Line Investment Survey*. The Fundamental data package provides current stock prices and detailed company-specific financial data, which you can then analyze, order, and rank on your own. The Ratings package uses its own algorithms, which rank stocks according to safety, appreciation potential, and prospects for future gain, graphically displaying the results. Subscribing to both data packages lets you test your analysis against that of the experts, or at least the programmer.

The technical analysis module creates the gaggle of charts that research department gnomes cannot live without. Just about everything is here: moving averages, oscillators, price/volume comparisons, trend lines, volume histograms, and even 30 different price, volume, and related studies.

All this talent doesn't come cheap. You must buy the software and pay a fixed monthly rate for the data that you use. For example, *Value Line* Fundamental and Ratings data cost $25 and $40 a month, respectively, while technical charting quotes are 3 cents each. But at least you can look at the costs up front and determine whether your portfolio justifies the

---

expense. If you're antsy about dropping five bills for the program, $30 will coax a fully operational demo of *The Active Investor* from Interactive Data. (Keep in mind that your existing investment in the Hercules Color Graphics Card or compatible board is for naught: *The Active Investor* works only with CGA and EGA devices.)

As with most sophisticated packages in this genre, *The Active Investor* won't teach you the whys and wherefores of securities analysis. You must know how to use the information the program provides. If you're serious about your investments and can afford to pay the

freight, stop looking for the right piece of analytical software. This one does it all, and does it right.
—Stephen A. Blumenthal

The Active Investor Series
Interactive Data Corp.
Jeffers Corp. (distributor)
2570 San Ramon Valley Rd.
*   #203*
San Ramon, CA 94583
415/830-2700
List price: $495; $25 a month
*   for Fundamental data package,*
* $40 a month for Ratings data*
*   package (1 year minimum*
*   subscription required)*
Requirements: 192K, two disk
*   drives, DOS 2.10 or later*
*   version, IBM Color/Graphics*
*   Adapter or Enhanced Graphics*

Adapter or compatible boards,
Hayes-compatible 300- or 1200-
bps modem
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PeopleFacts: The Opinion Processor

First there were word processors, then outline processors, and now, at last, opinion processors. Opinion processors? Well, yes and no. *PeopleFacts*, the first entrant in this as-yet-to-be-established field,

(continues)

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isn't Lou Harris on a disk, but it will help you develop and analyze simple questionnaires.

Having earned a few dollars as a survey research consultant, my first reaction was that *PeopleFacts* might be useful in my work. My second reaction was fear. Could *PeopleFacts* take away business? Could it turn serious research into a do-it-yourself proposition for amateurs?

A quick stroll through the program allayed my apprehensions: *PeopleFacts* is no high-powered statistical package—it's designed for novice pollsters who need to conduct small-scale, informal surveys but haven't the foggiest notion of where to begin.

PeopleFacts keeps things simple by limiting your horizons. Pick the appropriate option from the main menu, and you can select question types (multiple choice, numeric, or fill-in-the-blank), enter and rearrange questions and response options, print out precast questionnaires and accompanying answer sheets, and enter response data. Moving from module to module takes but a few keystrokes; unacceptable entries are adroitly flagged; and you're even reminded to save your work before quitting the program. The 120-page user manual is a good introduction to the art of conduct-

ing surveys and walks you through the steps, from defining your population to writing a report.
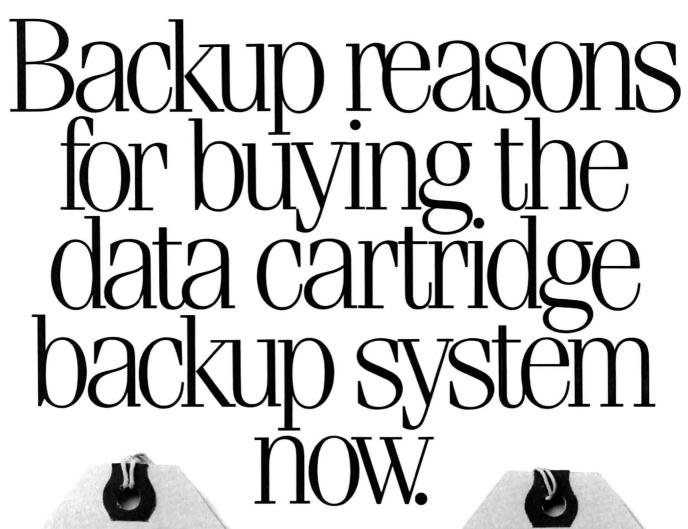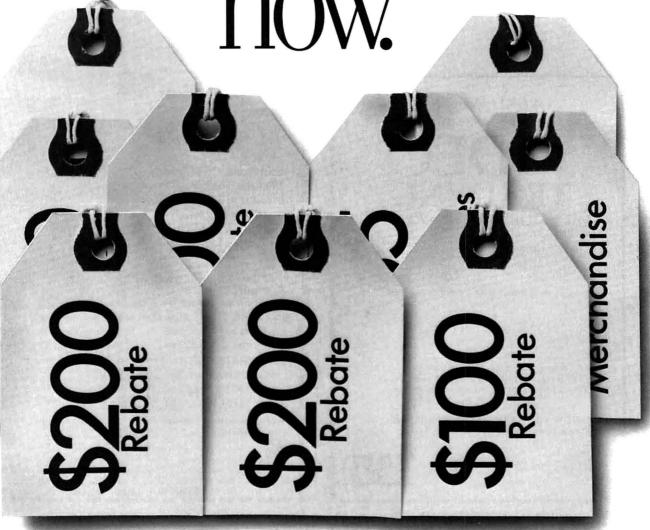
When completed surveys start rolling in, select the data input mode to store the responses in a disk file. A *PeopleFacts* report can supply frequency counts (the number of responses to each item), percentages, medians, and standard deviations. For more details, you can request cross-tabulations that break down each item's responses by some other variable, such as sex or age. You even have the option of limiting your analyses to a specific subgroup of respondents—everyone between the ages of 40 and 60, for example.

(continues)

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You may or may not know the primary, basic reasons for choosing data cartridge technology for your backup.

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It costs less per formatted megabyte of storage than any other removable mass storage for the PC user.

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The tough plastic cover protects the tape from problems that can occur with floppies.

A metal plate prevents tape alignment problems that can cause slipping and jamming. A problem that can cause data loss in cassettes.

But if you act before December 31, 1986, there are some other, alternative reasons for joining the data cartridge club:

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For a free 16-page buyers guide detailing these offers, you can call (800) 835-2246 ext. 260. (In Kansas call (800) 362-2421 ext. 260.)

Or better still, just amble on down to your computer products retailer to see who's offering what.

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The process is so simple and straightforward that even computer novices can master it in short order.

But simplicity has its price. If the survey you envision includes thousands of samples and numerous complex variables, *PeopleFacts* probably won't cut the mustard. Managing smaller, more straightforward projects may be frustrating as well. Each survey response must be followed by a carriage return, making data entry slow and tedious, yet you can't import data gathered with another application. And questionnaire and answer sheet formatting is fixed, so you will probably have to resort to formatting more complex questionnaires with a word processor.

A survey can include as many as 200 items, and the number of respondents is limited only by disk storage. But be forewarned: *PeopleFacts* won't win any prizes for speedy processing. It was written in interpreted BASIC and should be run on an IBM machine, since the company won't guarantee that the program works with versions of disk BASIC supplied with compatible systems.

Remember, too, that a little knowledge can be dangerous. There's a tendency to view survey results as gospel, particularly when they are laid out in a nicely formatted report. *PeopleFacts* is a structural tool—it can't weed out erroneous responses, much less offer sage advice on how to conduct an accurate, truly representative survey.

PeopleFacts' strong point is ease of use. It's suitable for canvassing

(continues)

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800-992-2882 (Outside CA)

employees about that upcoming Christmas party or informally measuring customer satisfaction. But if you need serious market research information you can rely on, seek out a professional. —John Walkenbach

PeopleFacts
Shamrock Press
1277 Garnet Ave.
San Diego, CA 92109
619/272-3880
List price: $395; demo disk $25
Requirements: 128K, one disk
drive, DOS 2.10 or later
version, IBM BASIC
Not copy protected

Trinity
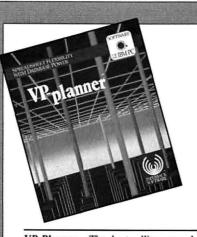
Atoms or systems into ruin hurled,
And now a bubble burst, and now
a world. —Alexander Pope

The world squirms in the nuclear hot seat as the superpowers face off for World War III. But you're determined not to let anything—including a stray ICBM—ruin your $599 London vacation special. Sound like just another day on the High Frontier? It's also the opening scene of *Trinity*, the latest interactive fiction game from Infocom.

The object of the game is to journey back through time to Alamogordo, New Mexico, on the morning of July 16, 1945—to "Trinity," the site of the first atomic explosion. Prevent the blast and you save tomorrow from certain nuclear Armageddon. Fail in your mission or falter at any point along the way, and you face a ride down the River with the Grim Ferryman to begin the game anew.

Science (and science fiction) fans, professional and armchair historians, and those up for a bit of fourth-dimension adventuring

(continues)

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will find *Trinity* a riveting experience. You crisscross time and space to gather a bizarre array of clues, tools, and booty in your quest to save the earth from the ultimate vaporware. Some objects are hidden in a multidimensional Grand Central Station filled with puzzles and booby traps; others lie inconspicuously at the sites of famous atomic blasts of the past.

Like all Infocom text adventures, this one eschews graphics in favor of your imagination. And *Trinity* is Infocom's most ambitious brain bender yet. The program understands 2100 words and features over 600 objects and locations. (Typical Infocom games such as *Suspect* recognize only about 700 words.) Even an un-

deleted expletive (that I angrily typed in after confronting a particularly frustrating enigma) prompted the response: "Yes, this story does recognize crudity." Communicating with the program is the least of your worries.
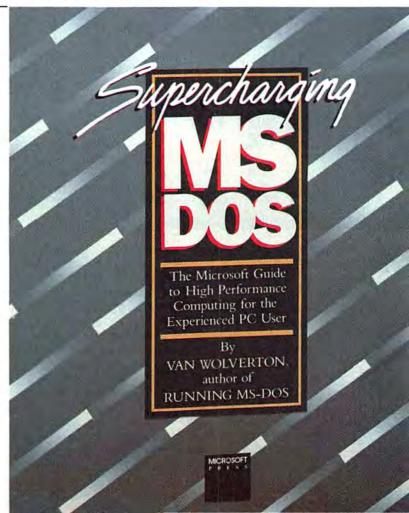
Although Infocom rates *Trinity's* level of difficulty as "standard," the program's cerebral challenges and digitized dangers are demanding and abundant. For instance, how do you survive in outer space without a spacecraft? Who was Felix Klein and why is he famous? To answer these questions—and to avoid *Trinity's* stygian detours—the package includes a detailed map of the Trinity site, an intricately decorated sundial, instructions for folding a Japanese origami paper crane, and

a tongue-in-cheek Classics Illustrated-style comic book depicting a pro-nuke history of the Bomb. *Trinity* even offers moral support (and a clue or two) via an occasional help screen filled with quotes from the works of artists as diverse as Henry David Thoreau and David Byrne of Talking Heads.

Hard-core gamesters may look askance at such assistance, but sooner or later even the most dogged journeyman will welcome help from any quarter. I suggest you heed Infocom's advice and sketch out maps of the real and fanciful destinations you visit courtesy of *Trinity.* If you really get stuck, the company sells a hint book with maps for $7.95.

Supercharging MS-DOS by Van Wolverton. If you're hungry for the power of DOS, this book is filled with tidbits. From the bestselling author of *Running MS-DOS.* $18.95. 352 pages. Softcover.

Trinity forces you to think the unthinkable in the name of good clean fun, and there are times when this game ceases to be entertaining. For example, the adventure begins in London's Kensington Gardens, described with a precision that would make Fodor proud. Linger too long, however, and you wade through a mass of screaming, terrorized citizens fleeing the aftermath of an H-bomb explosion. You also visit Nagasaki during World War II, minutes before it's obliterated by the "Fat Man." Here you must persuade a child to help you make a narrow escape—alone.

Trinity is challenging, top-of-the-line interactive fiction in the classic Infocom tradition and a precursor of equally sophisticated games to come. Just the same, when I finally unravel the final solution, I hope I find something hopeful. *—Wes Nihei*

|| *Trinity*
|| *Infocom*
|| *125 Cambridge Park Dr.*
|| *Cambridge, MA 02140*
|| *617/492-6000*
|| *List price: $39.95*
|| *Requirements: 128K, one disk drive, DOS 2.00 or later version*
|| *Copy protected*

|| *Jason Durbin is editor of a corporate newspaper and a frequent* *contributor on desktop publishing. Richard Jantz, a freelance writer and editor based in Berkeley, California, is principal author of* Creating the Best Impression: All About Business Graphics Software *(Hayden Book Company, Hasbrouck Heights, NJ, 1986). Patrick Marshall edits the Commentary Page of the* Oakland Tribune. *Stephen A. Blumenthal is a PC World Contributing Editor and vice president of regulatory relations for the Securities Industry Association in Washington, D.C. John Walkenbach is a freelance writer and consultant in Manhattan Beach, California. Wes Nihei is the Editorial Assistant at PC World.* ⊜

Once upon a midday dreary,

While I pondered, weak and teary,
How to find some missing theory,
For my micro to restore;

✔ denotes IBM-AT compatibility.
★ denotes IBM-PCjr compatibility.
(call for specific requirements)

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★✔Turbo Lightning 1.0 . . . . 59.
★✔Word Wizard 1.1 . . . . 41.
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★✔Turbo Prolog 1.0 . . . . 59.
★✔Turbo Family Jumbo Pack . . . . 187.
★✔Sidekick 1.5. 51.
★✔Traveling Sidekick 1.0 . . . . 43.
★✔Traveling Sidekick w/Sidekick. . . . . 73.
★✔Reflex 1.1 . . . . 87.
★✔Reflex Workshop 1.1 . . . . 41.
★✔Superkey 1.1 . . . . 41.
★✔Superkey/Sidekick Package . . . . 69.
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✔Q & A 2.0

Integrated software program that features a database manager and word processor. New version 2.0 has more than 100 enhancements over the previous edition, including LAN support. But why should you buy Q & A? Because it's great, it's easy, and an excellent value!

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✔Dac Accounting Tutor. . . . . 15.
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✔WordStar 2000 Plus Release 2. . . . . 285.
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✔R:base 5000 1.01 . . . . call
✔R:base 5000 1.01 *(runtime version)* . . . . . 237.
✔R:base System V 1.0 . . . . 359.
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★✔Quick Basic 2.0 . . . . 59.
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★✔Fortran Compiler 3.31 . . . . 229.
★✔C Compiler 4.0 . . . . 279.
✔Cobol Compiler 2.1 . . . . 439.

For the IBM-PC (XT & AT) exclusively.

PC CONNECTION ®

While I nodded, nearly napping,

Suddenly there came a tapping,
Mingling with my PC's zapping,
Rapping at my office door.

Microstuf *(not copy-protected)*
✓Infoscope 1.03 . . . . $45.
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✓MultiMate Advantage 3.6. . . . . call
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✓Clipper *(Autumn '86)* . . . . 349.
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✓Wines on Disk . . . . 25.
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★✓VP-Info 1.0 . . . . 57.
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✓DESQView 1.3. 65.
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★✓Prokey 4.0. . . . . 84.
Sierra On-Line
★✓Smart Money 1.0. . . . . 49.
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★✓Newsroom•Pro *(not copy-protected)* . . . . . 79.
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✓Q & A 2.0. . . . . special
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★✓True BASIC 1.0 . . . . 109.
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IBM-PC   BASIC. . . . . each 33.
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WordStar   Displaywrite 3 R:base 5000
MultiMate Advantage
Symphony. . . . . each 43.
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★✓Professor DOS. . . . . 33.
★✓Tutorial Set *(both items above)* . . . . 49.
★✓Typing Instructor II . . . . 26.
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★States and Traits *(ages 9+)* . . . . 25.
Eduware *(reqs. graphics brd.)*
★Algebra 1,2,3, or 4 . . . . 22.
Harcourt Brace Jovanovich
★✓Computer SAT . . . . 49.
Scarborough *(reqs. graphics brd.)*
★✓Build-A-Book About Me *(create personalized adventure stories)* . . . . 19.
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★✓Early Games for Young Children . . . . 22.
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★✓Easy as ABC . . . . 24.
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★✓Memory Master *(ages 2 to 6)* . . . . 27.
★✓My Letters,Numbers,Words *(ages 1 to 5)* . . 27.
★✓Kids Stuff *(ages 3 to 8)*. . . . . 27.
The Learning Company *(reqs. graphics brd.)*
★✓Magic Spells *(ages 6-12)* . . . . 23.
★✓Word Spinner *(ages 6-10)* . . . . 23.
★✓Moptown Parade *(ages 6-10)*. . . . . 26.
★✓Reader Rabbit *(ages 5 to 7)* . . . . 26.
★✓Rocky's Boots *(ages 9 and up)* . . . . 32.
★✓Robot Odyssey *(ages 12 and up)* . . . . 32.
True Basic, Inc. *(not copy-protected)*
★✓Calculus *(reqs. True Basic package)* . . . . . 32.
★✓PreCalculus *(reqs. True Basic package)* . . . 32.
★✓Probability *(reqs. True Basic package)* . . . . 32.
★✓Trigonometry *(reqs. True Basic package)*. . . 32.
★✓Algebra *(reqs. True Basic package)* . . . . . . 32.

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Realistic financial simulations.
★✓American Dream . . . . 36.
★✓Baron . . . . 36.
★✓Millionaire . . . . 36.
★✓Squire . . . . 36.
★✓Tycoon. . . . . 36.

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⇐ PC CONNECTION ®

Could it be some help from nearby,

Entering my frantic sphere by
Shoving right before my clear eye,
Basics of computer lore?

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★ Championship Lode Runner . . . . 22.
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★ Murder by the Dozen . . . . 17.
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★ Music Construction Set . . . . 17.
★ Dr J/Larry Bird One-on-One . . . . 17.
★ ↵ Starflight . . . . 32.
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★ ↵ PC Arcade *(10 games)* . . . . 35.
Funtastic *(reqs. graphics brd.)*
Great arcade style games
★ ↵ Big Top . . . . 27.
★ ↵ Cosmic Crusader . . . . 27.
★ ↵ Master Miner . . . . 27.
★ ↵ Snack Attack II . . . . 27.
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Difficulty levels shown in italics
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★ Cutthroat ★ Wishbringer ★ Zork I
★ Ballyhoo Fooblitzky
★ Hitchhiker's Guide . . . . *each* 24.
★ ↵ *ADVANCED*
Zork II Zork III Sorcerer
A Mind Forever Voyaging . . . . *each* 27.
★ ↵ *EXPERT*
Spellbreaker . . . . 29.
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★ ↵ Microleague Baseball . . . . 25.
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★ ↵ Silent Service *(WWII submarine in the South
Pacific)* . . . . 22.
★ ↵ Hellcat Ace . . . . 22.
★ ↵ Spitfire Ace . . . . 22.
★ ↵ Solo Flight . . . . 22.
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★ ↵ Flight Simulator 2.12 . . . . 32.
Mindscape *(reqs. graphics brd.)*
↵ Balance of Power *(avoid nuclear war)* . . . . . . 30.
1Step Software *(reqs. graphics brd.)*
★ ↵ Golf's Best *(Pinehurst)* . . . . 19.
★ ↵ Golf's Best *(St. Andrew's)* . . . . 19.
Origin Systems *(reqs. graphics brd.)*
★ ↵ Ultima 3 . . . . 39.
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★ ↵ Championship Boxing . . . . 24.
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Sir-Tech
★ Wizardry . . . . 36.
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★ ↵ Orbiter *(Shuttle simulation)* . . . . 27.
★ ↵ GATO . . . . 27.
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★ ↵ Package of all 6 Western Airports 69
XOR *(not copy-protected)*
↵ NFL Challenge *(be the coach)* 79

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AST Research … 2 years
I/O Plus II C/S 119
Second serial, parallel or game port 35
SixPakPlus 64k C/S/P *includes Sidekick vers.
1.5 not copy-protected & DESQView* 169
SixPakPlus 384k *(fully populated)* 209
SixPakPremium 256k C/S/P
*upgrades to 1 Meg on board, 2 Meg w/ opt.
piggyback board; EEMS compatible, includes
DESQView* 319
SixPakPremium Piggyback Board 512k . . . 189
Flashpak *(accelerator board)* 369
↵ Advantage 128k *upgradeable to 1.5 Meg
includes Sidekick version 1.5 not
copy-protected and DESQView* 369
↵ Advantage Premium 512k S/P
*upgrades to 1 Meg on board, 2 Meg w/ opt.
piggyback board; EEMS compatible, includes
DESQView* 449
↵ Advantage Premium Piggyback Board 512k 289
↵ 3780 579
↵ 5251-11 . . . . 579.
↵ 5251-11 Plus 639
↵ RAMpage! 256k *upgrades to 2Mb* . . . . . . cal
↵ RAMpage! AT 512k *upgrades to 2Mb* . . . . . cal
*Both RAMpage boards support EMS and fully
support EEMS, and include DESQView.*
Amdek … 2 years
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↵ Color 722 - EGA compatible 519
Compucable … lifetime
Plastic Keyboard & Drive Cover Set . . . . . . 15.
↵ IBM Mono Screen Enhancement . . . . 17.
↵ 9-to-25 Pin Serial Converter cable 19
↵ AT-to-Smartmodem cable 19
↵ 15-foot Parallel cable 27
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★ ↵ 3-Position 65
★ ↵ 4-Position 79
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★ Datasaver 200 Watt . . . . cal
↵ Datasaver 400 Watt . . . . cal
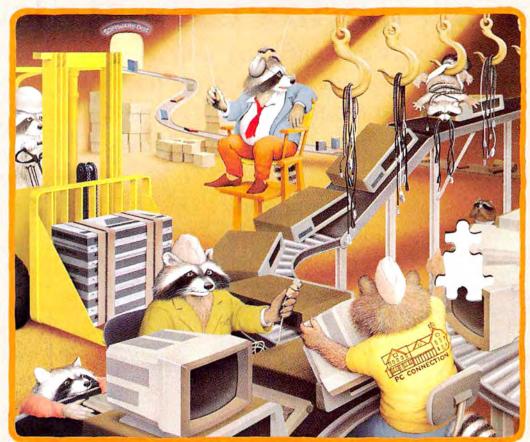
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PC CONNECTION ®

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PCs may not be down in the boiler room shoveling coal, but they are donning factory overalls–and helping managers keep a watchful eye on manufacturing processes.
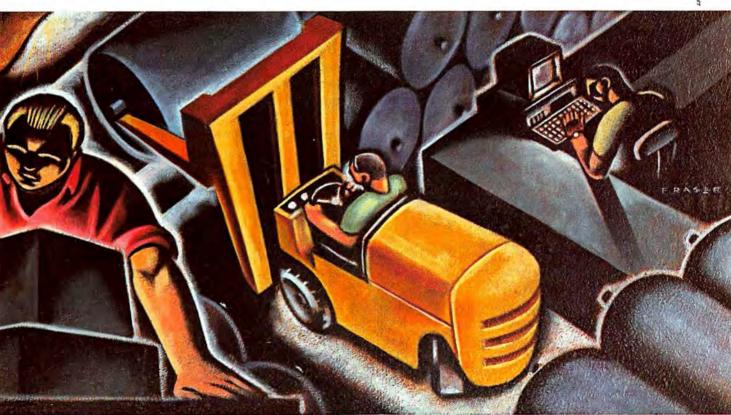
James C. Finucane

In the early 1980s, one office automation specialist predicted that PCs would become as common in corporate America as yellow legal pads. She wasn't far wrong. Today, the PC and its compatibles are among the hottest commodities in the business marketplace. Although such periodicals as *Fortune* and the *Wall Street Journal* regularly speculate about whether the PC has truly boosted productivity, discouraging words are seldom heard from users in large and small businesses. The things may not always work right, but they've earned a respected position in the white-collar world.

Of course, American business isn't confined to service organizations, stock brokerages, and purveyors of information. In manufacturing centers across the nation, where cars, shoes, and aluminum siding roll off assembly lines, the PC is making surprising inroads (see "MAPping the Islands of Automation" and "Of MISys and Management" in this issue.) PCs aren't actually running the mills or replacing dedicated machines on factory floors, but they are assuming more blue-collar tasks, moving into the realm of manufacturing control, where supermicros and minicomputers have traditionally held sway.

One compelling reason for the PC's popularity is cost: PCs are a cheap means of programming some industrial computers and, in many cases, they offer an efficient way of tapping into data captured by the computers running the show. And while a minicomputer may outmuscle the PC when it comes to processing power, few of the big boxes offer the PC's comprehensive library of data analysis and reporting software.

Doug Fraser

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Standards, Standards

IBM has never been a major player in process control systems—which may explain the perplexing array of solutions available to the manufacturer seeking control over processes and machines. It seems that every vendor offers proprietary workstations, networks, minicomputer hosts, and software. This state of affairs suits the vendor, but for the manufacturer, incompatibility runs rampant. A Modcomp system can't link up to a DEC network; software developed for system A can't be used on system B. Worse still, a manufacturer that needs a custom data analysis package or even a general-purpose analytical tool might have to pay an arm and a leg for program development.

Thus the lure of the PC. There's no wrangling over hardware or operating system standards; better still, a wealth of commercial software can easily fill

> *A manufacturer that needs a custom data analysis package or even a general-purpose analytical tool might have to pay an arm and a leg for program development.*

the bill for any manufacturer wanting to analyze the inner workings of a plant. Purveyors of computers for manufacturing have seen the light and are offering PCs to their customers. If nothing else, they've learned that you don't have to sell a manufacturer on the hardware's merits—the IBM logo carries clout. The PC's role in managing manufacturing processes, however, is still limited.

Gathering Data

In most American factories, dedicated control computers gather two kinds of information about any process. The first is production data: What products and how many were made during a particular hour, shift, or week; and how many products were ac-

cepted and rejected? This information is used in production and inventory control, accounting, and costing.

The second kind of information is more subtle, answering the question: How do changes in the settings of control actuators (valves, pumps, heaters, dedicated controllers) affect the quality (weight, color, strength, thickness, hardness) of the product? A dedicated control computer measures the product and takes actions based on deviations from the "ideal." With this information in hand (and in the PC), the process engineer who is intimate with the quirks of a company's products and processes can fine-tune production, getting the most out of a plant's machinery and materials.

Making Products

Of course, not all factories are the same. A paper mill and an auto plant use different methods to manufacture distinctly different products. Different kinds of data must be gathered and acted upon by control computers on the shop floor. A factory is seldom run by one gargantuan mainframe but by a collection of computers, some no bigger than a PC's expansion board. In paper mills, where process control is key, computers manage continuous processes. Paper is made in continuous sheets, often hundreds of miles long. It's essentially an analog process—the physical properties of the product vary continuously. Typically, the various processes all take place within one large machine—so the computers must gather information and act on it immediately, for one malfunction could wreak havoc on the entire apparatus.

Machine control, on the other hand, involves managing a number of individual machines in a production line. Production starts with discrete parts (such as screws and sheet metal), which are formed, machined, and assembled into objects, such as automobiles or beer cans. Products are made by a sequence of machines, each carrying out a series of repetitive steps before passing the part on. Measuring the physical properties of the product in real time is not necessary.

A Process Control Primer

To understand the PC's role in process control, consider the operation of a paper-making machine. The machine, which turns out 25-foot-wide paper at 2000 feet per minute, is as long as a city block. It contains dozens of drums full of steam that dry the pulp, one or two coating stations that apply latex to the surface of the sheet, and perhaps a calendering station where the sheet is forced through a set of rollers for final pressings. All these components are driven by a number of hundred-plus-horsepower motors. Furthermore, such variables as weight, moisture content, color, coating weight, and paper thickness must be measured at various points along the machine. Information on these variables, gathered by sensors and passed along to computers on the floor, can feed back manufacturing instructions on the spot. This information can also be analyzed on a PC and used to alter computerized models of how the paper machine works. Thus you can fine-tune the model and anticipate what effect producing different paper stocks, changing drum speeds, and so on, would have on the machine.

Naturally, the hardware and software controlling such a complicated process must be extremely reliable. Computer breakdowns or control loss could result in damaged equipment, lost manufacturing time, even injured personnel. To minimize risks, process control systems offered by such vendors as Honeywell or Bailey Controls divide control among a number of networked computers. These systems operate in a manner similar to distributed processing setups. The fabrication of a product is separated into functional areas, and each area is managed by a dedicated microcomputer.

A Computer Pecking Order

In the case of the paper machine, such a distributed control system usually incorporates several levels of computers. On the lowest rung are rack-mounted expansion boards that control the paper-measuring instruments. The boards—which pack software in ROM and a microprocessor—activate instruments, gather relevant data, and convert it into inches, pounds, or other units.

These modest devices report their findings to a dedicated microcomputer responsible for controlling a specific section of the machine, such as its dryers. Based on the information it receives, the computer may open and close valves, change motor speeds, and exert influence on other actuators that directly affect the weight, color, thickness, ash content, and other properties of the paper. The computer also acts as a local operator workstation and is typically equipped with a color graphics monitor, which displays the current status of both measured and controlled variables. Such workstations are an operator's window into the manufacturing process.

At the apex of the pyramid sits a super-minicomputer, perhaps from DEC or Honeywell. Tucked away in a climate-controlled room removed from the sound and fury of manufacturing, this machine may be backed up by another minicomputer. The minicomputer not only is the hub of the network that links all the computers in the factory, it also maintains the central data base for the manufacturing

> *Most process control vendors allow PCs to plug in to their proprietary networks and tap the process data being collected by the control system.*

process. The system stores the essential software recipes for making various grades of paper, tools for developing interactive graphics displays, and most important, the software model of the overall process that guides the computers running the paper machine.

This multiprocessing setup has multiple advantages, but the most compelling is simply time saving. If one computer goes on the blink, the factory doesn't shut down. By the same token, dedicating a microprocessor (such as an 8086 that measures paper thickness) to just one type of measurement allows millisecond-by-millisecond observation of an important variable in the manufacturing process. When things go wrong, the control computer can respond immediately, rather than precious seconds or minutes later.

Process Control

Although the PC was not designed with manufacturing control in mind—it can't react to an incipient power failure, and it lacks a fast, real-time operating system—analyzing process information is right up the PC's alley. Most process control vendors allow PCs to plug in to their proprietary networks and tap the process data being collected by the control system. In the case of the paper machine, you might cull data on pulp moisture, graph the effect of variations on paper thickness, and develop a statistical profile of that variable.

In the old days, a manufacturer had to settle for data management and reporting packages offered by the vendor. Getting a custom report—that is, a different view of the process data—meant paying the vendor thousands of dollars to write a special program. Having the PC perform this chore solves problems for both the manufacturer and the process control vendor. Vendors aren't pestered for custom software, and process engineers can easily siphon data from the network and use such programs as *1-2-3* and *dBASE* for data logging, tabulation, analysis, and reporting.

> *The rush to apply IBM PCs to manufacturing has become so pronounced over the last two years that most vendors are scrambling to open their networks to the machine.*

AccuRay, for example, offers a utility that will import files from a Honeywell minicomputer to a PC in *1-2-3*'s .WKS format. All you have to do is install the utility, connect the PC to the AccuRay network with a serial cable, and start downloading data. This may seem elementary, but to plant managers accustomed to relying on canned minicomputer programs, such a utility is revolutionary.

The rush to apply IBM PCs to manufacturing has become so pronounced over the last two years that many booths at manufacturing trade shows, such as Control Expo and Midcon, feature them—and most vendors are scrambling to open their networks

to the machine. Leading the way is Bailey Controls, which not only offers software for accessing the company's Network 90 distributed control system but also supplies IBM XTs to do the job. Similarly, AccuRay plans to supply Honeywell-made PC compatibles to customers who want to use PCs in process analysis.

PC to PLC

What of the PC in machine control? If you recall, an individual machine (such as a drill press) in a factory carries out a repetitive, preprogrammed series of tasks rather like a washing machine does. Extending that analogy, the next machine in line would be an automatic clothes dryer. The success of the entire process would depend on both machines functioning, yet they would not be mutually dependent. In a factory measurements of the product being fabricated aren't constantly monitored, so the control system acts only if the machine is turned off, or jammed, or has run out of components.

Before the advent of integrated circuits, factory machines were controlled by enormous banks of electromechanical relays, counters, and timers that formed a sequential program of ANDs and ORs. Unfortunately, electromechanical devices are extremely unreliable. Reprogramming a relay—which required a mammoth screwdriver, a roll of 10-gauge wire, a drill, and the patience of Job—was a nightmare.

Relay panels have largely been supplanted with programmable logic controllers, or PLCs—proprietary microcomputers that can be programmed to perform a number of discrete tasks, such as turning lights on and off or actuating solenoids to move mechanical devices according to a programmed sequence.

If you want a PLC to control another machine, such as a spot welder, you simply slip in an expansion board, connect it directly to the welder on the floor, and program the PLC for the appropriate task. However, programming a PLC is an expensive proposition.

PLCs are traditionally programmed with special microcomputers that cost $5000 or more. But these machines can't even print out a copy of the pro-

gram you create. Not surprisingly, the PC's price tag and programming talents have not gone unnoticed by manufacturers, and 1986 has seen an explosion of PCs in the machine-control marketplace. Allen-Bradley, the number one supplier of PLCs, offers industrial IBM XTs and ATs (complete with an extra fan, dust filters, and beefier power supply), as well as the necessary software for programming any of the company's PLCs.

With the proper software, control engineers can access a controller's memory holding the production information and analyze it with statistical and

> *More and more manufacturers are turning to the PC when they need an inexpensive engineering workstation tied into manufacturing control systems—and software and hardware vendors are sitting up and taking notice.*

graphics programs. This capability gives engineers and plant managers a view of the manufacturing process never before available.

Major vendors are taking the hint: General Electric's Workmaster, an industrial version of the Portable PC, includes software for programming GE's PLCs and displaying and logging crucial manufacturing data.

Market leader Allen-Bradley offers *A-B/CAMM*, a menu-driven package that helps plant operators analyze data in real time on a PC. To use the program, you need an Allen-Bradley interface board for each PLC that you want to hook up to the company's Data Highway manufacturing control network. The software includes *Logger*, a specially designed data base that accumulates process information. If you were in charge of a tire plant, for example, *Logger* could gather information from each press about the number of tires made, record a spectrum of physical measurements (thickness, weight, and so on),

and tell you how many tires passed or failed various quality-control tests. In addition, you could log downtime and its cause for each press.
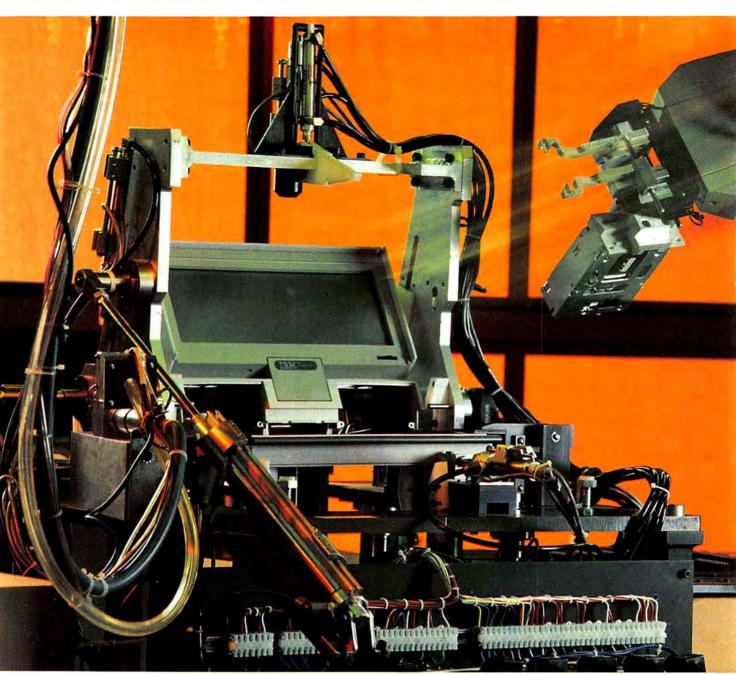
The *A-B/CAMM*'s spreadsheet module is a classic, in the tradition of *1-2-3*. Better still is its graphics module, which allows you to plot data as it is captured on the line. For instance, you could generate a bar graph depicting the number of tires ordered by grade versus the number produced for a given time period. The module's trend graphs illustrate how various properties of the product and the machinery vary over time. For example, you could graph variations in maximum tire press temperature for each machine over the last 24 hours, or for the last 30 minutes. Like any good graphics package, the module also includes a drawing program equipped with the right tools for creating a model of the process being scrutinized. In the tire example, you could create a schematic showing overall press operations, with icons representing individual presses. Each icon could open, close, or change color based on the status (running, down, or standby) of the press. This is a potent feature for the plant operator, manager, or process engineer trying to get a handle on operations.

Slippin' on the Overalls

As it stands, the PC isn't turning manufacturing into a desktop discipline. Dedicated computers that were on the job long before the PC was conceived still do most of the hard work. But the PC is coming on line. More and more manufacturers are turning to the PC when they need an inexpensive engineering workstation tied into manufacturing control systems—and software and hardware vendors are sitting up and taking notice. With the rise of minicomputer-like 80386 PCs, enthusiasm for the PC family may turn into a bonanza for IBM—and its compatible competitors. ◉

James C. Finucane is a freelance writer and a national sales manager for Divelbiss Corporation of Fredricktown, Ohio.

The Self-Made PC

Manipulated by a robot arm, a PC Convertible
LCD assembly snaps to attention.

The process of building IBM's PC Convertible is every bit as intriguing as the product itself. Assuming all goes well in Austin, the first human hands to touch a Convertible may be your own.

Ken Greenberg

▌▌▌▌ Amid the rambling campus that hugs the gently rolling hills of Austin, Texas, IBM has embarked on a manufacturing enterprise that far exceeds Henry Ford's wildest imaginings.

For some, form follows function; for IBM, product design follows automation. That's another way of saying the medium is the message, and the medium here is ALPS—Automated Logistics and Production System. More than just another pretty acronym, ALPS is an intricate fusion of robotics, communications, artificial intelligence, machine vision, materials-handling, and exacting vendor specifications. To produce the PC Convertible, IBM has joined islands of automation into a manufacturing landmass that extends from receiving dock to shipping dock.

ALPS automation isn't limited to robots building laptop computers. IBM PCs are involved in product testing, process control, materials distribution, inventory management, and more. Says Manny Chavez, manager of ALPS manufacturing operations, "What we think is unique is the integration of the total process. Robotic cellular operations have existed for years, but the real advancement—and the significant cost savings for us—is in the integration of several systems."

In a real sense, personal computers are helping to clone themselves. Watching over the ALPS are dozens of off-the-shelf PCs, ATs, portable PCs, and

rack-mounted XTs, some of which converse with Series/1s while others merely talk among themselves. The most revealing sign may be a PC Convertible itself, equipped with monochrome monitor, perched on a forklift, conveying parts-delivery information to one of the few human beings in the building.

According to IBM, the Convertible and the line that manufactures it were developed in tandem. Subassembly has been kept to a minimum; the machine's components are packaged as "robot-ready." Without question, IBM is putting its manufacturing dollars where the technology is. Press accounts of operating snags notwithstanding, ALPS appears to be humming; the line can chug along for 21 hours a day, taking a three-hour maintenance break.
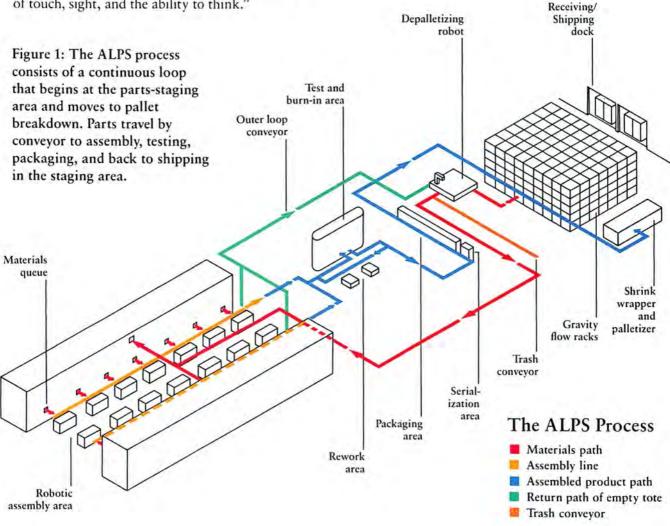
As complicated as the automation process is, every effort has been made to purge ALPS of extraneous complexities; the operation is minimalist, bordering on generic. The model is obvious enough; says Clark Preston, manager of manufacturing technical services, "We want the process to include emulation of touch, sight, and the ability to think."

Climbing the ALPS

In the world according to ALPS, 13 robots take components from the loading dock, turn them into functioning computers, package them, and ready them for shipment (see Figure 1). As an IBM position paper notes, "No manual activity is required from the time pallets of parts are removed from trucks to the time pallets of completed products are loaded onto delivery trucks."

Human intervention is confined to breaking the shrink-wrap on pallets, stepping in when a machine flags trouble it can't fix, and scrubbing scuffed units during the test phase.

ALPS can be boiled down to nine steps: receiving, parts staging, removal of materials from pallets, materials distribution, robotic assembly, test and burn-in, serial-number imprinting, packaging, and finished-goods storage. The key is the way in which each step meshes with every other.

Figure 1: The ALPS process consists of a continuous loop that begins at the parts-staging area and moves to pallet breakdown. Parts travel by conveyor to assembly, testing, packaging, and back to shipping in the staging area.

The ALPS Process

🟥 Materials path
🟧 Assembly line
🟦 Assembled product path
🟩 Return path of empty tote
🟧 Trash conveyor
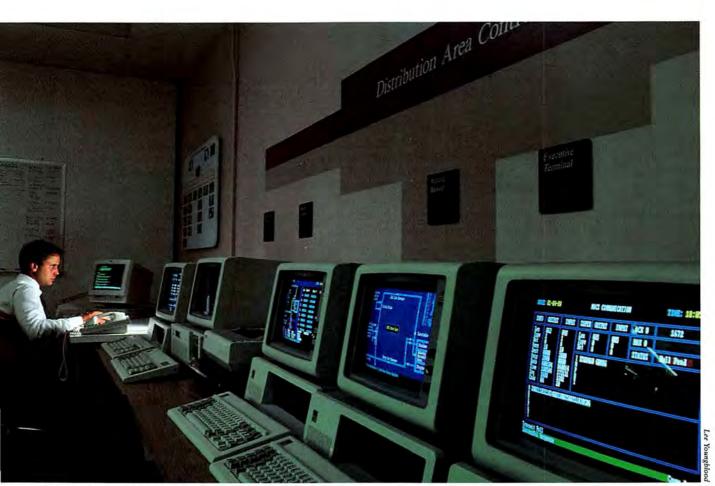
Machine vision dictates specific lighting conditions, as this robotic assembly module indicates. The Portable PC at right collects parts inventory data and passes build instructions between robot controllers and the control room.

In the ALPS facility, "just in time" is an article of faith. The parts staging area—a massive wall of containers 20 feet high—comprises the entire PC Convertible inventory; there is no other parts warehouse. Pallets are standardized, and pallet size, in turn, is based on the standard footprint of the endlessly recirculating yellow carriers called totes, whose sole purpose is to ferry the Convertible from initial assembly to completion. Everything is similarly standardized, modular, flexible, expandable, and/or reusable.

The journey begins at gravity-fed racks that adjoin the parts staging area; that's also where the line eventually ends. Cartons move along an expressway-like conveyor from the racks to where the robots live.

Each step is an arc in a circle. Production cannot start unless a pallet of parts is ready, and a new pallet load will not be moved along until the system can handle it. There's never more than one pallet or container waiting at any given time.

A special robot breaks each pallet down, sends containers of parts on their way, and restacks the pallet methodically. A scanner reads the bar code on the parts container, and a record of the box and its carrier is thereby created. The box is weighed and sized for uniformity; unacceptable containers or parts are diverted to reject spurs without clogging the line.

On two identical assembly lines, consisting of three ungainly robots each, large-frame robots insert planar boards in Convertible bases, then deliver those bases to intelligent IBM cantilever-type robots. Equipped with vision, these robots handle normal assembly-line aberrations in stride and locate parts in

The lineup of XTs in the ALPS control room underscores the pivotal role of off-the-shelf PC hardware in the materials handling process. Each PC monitors a specific stage in the scheme.
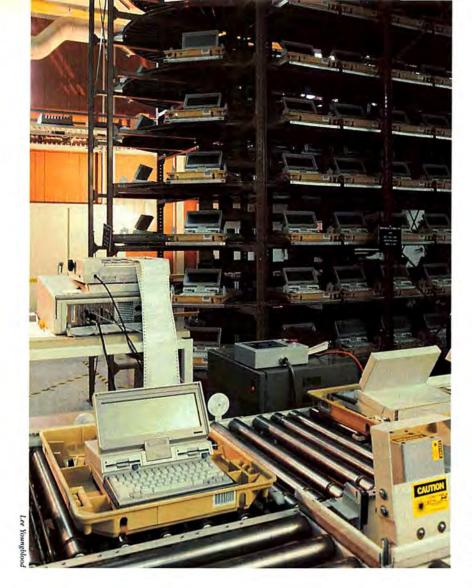
open boxes, even if those parts aren't exactly where vendors originally put them.

Outfitted with grippers, the smarter robots are able to move in seven planes, squeeze two 128K memory boards into a single unit, use registration guides to wiggle memory boards onto the base, mount the drives, attach keyboards, pop in LCDs, and mount and screw in power supplies (see the sidebar "Putting It All Together"). Delicate movement is directed by Series/1 minicomputers; the grand scheme is orchestrated by PCs.

Completed assemblies move via an express conveyor onto two vertical lifts, which deposit units for burn-in at an oblong test center eight tiers high. Yet another robot, an IBM 7545 Manufacturing System,

tests each Convertible by adjusting the display, tickling the keyboard, and visually confirming the results. If something is amiss, a human being intervenes. If everything checks out, the completed Convertible rides the conveyor back to the staging area, where it's enveloped in plastic, styrofoam, and cardboard; cushioned by documentation; and shipped out.

The entire assembly process takes about six minutes; the two ALPS lines turn out Convertibles at the rate of roughly one per minute. Streamlining the process has meant increased manufacturing capacity, improved reliability, and 75 percent fewer workers. Much of the efficiency flows from a drastic reduction in the number of parts. Where one IBM Selectric typewriter consists of 3000 ingredients, the Convertible's part count has been pared to 20, including subassemblies like the keyboard and the LCD (but not

The fully assembled Convertible prepares to ride a tote up to the ALPS robotic test racks. Note the Portable PC in the background.

counting screws). Peripherals for the Convertible are manufactured for IBM by third parties; parts are shipped directly to distribution centers, along with printers and monitors.

Present at the Creation

ALPS evolved fairly rapidly from an IBM manufacturing brain trust. Designed by the Austin Automation Application Engineering Group, ALPS capped a 15-month research and planning effort.

In retrospect, IBM appears to have been moving toward ALPS for most of the decade. The "flexible automation" concept took root at IBM in 1980. In June of that year, the company put its DisplayWriter into production on a manual, business-as-usual basis. Gradually, however, an increasing number of automated tasks—driving screws, stamping, mounting power supplies—were passed on to three robots. People and robots were beachheads in IBM's first islands of automation.

IBM found that adding workers to a shift increased output, but not decisively; moreover, costs didn't decrease accordingly. The planning team began to compile a wish list of preconditions to full automation: no logos, no paint, no cables, an ability to self-test, a facility for custom upgrades. The team also recognized that, in most factories, the number of people moving parts and communicating with the order-entry system greatly exceeded those engaged in assembly. The wish list grew to include the integration of materials-handling into the robotics repertoire.

During the next few years, manufacturing in Austin progressed from batch assembly to islands of automation to a semiautomated factory that encompassed materials-handling, and finally, to dock-to-dock automation.

Putting It All Together

While personal computers ensure that PC Convertibles get assembled, the most visible actors in the ALPS show are the half-dozen robots that actually put the pieces together at the rate of one laptop a minute.

Robotic assembly lines typically adhere to either serial or parallel design parameters. In a parallel line, one robot builds the entire widget; on a serial line, that robot might add only a part or two.

Both designs offer distinct advantages. Serial assembly is most appropriate when there's an overriding need to limit the number of parts per station, avoid duplicate tooling, minimize the complexity of each station, and restrict the number of parts that must be fed to the robot. Parallel assembly is desirable because it increases production on demand while minimizing such factors as capital outlay, downtime, and overall number of stations.

ALPS is a happy compromise between the two approaches. The exact number of robots on an assembly line (or module, in ALPS parlance) varies according to product, number of direct-feed parts per station, tool cost, and total assembly time.

PC Convertible assembly occurs at two types of work cells: simple and complex. The latter require machine intelligence, intricate gripper movements, and vision. The Austin facility consists of six robots arranged in two miniassembly lines. Four of these are so-called cantilever-type robots engaged in complex assembly. Two large-frame robots without vision, both equipped with two IBM selective compliance assembly robot arms

(SCARA), are dedicated to handling materials and partially assembling bases that are supplied to the complex robot cells.

Complex assembly requires a larger work envelope than simple assembly, and the cantilever-type robots include tactile and optical sensors, the latter augmented by special lighting. Robots can avail themselves of several discrete end-of-arm tools, although the Convertible is put together with just a single tool change.

To endow its robotic systems with intellect and sight, IBM developed a high-level language called A Manufacturing Language with Vision (AML/V). AML/V, which could pass for a hybrid of APL, Pascal, and LISP, includes image-processing and multitasking capabilities. AML/V, in turn, serves as the basis for an accessible menu-driven programming scheme called RAPID (Robot Application Programming Interactive Dialog).

Any vision system must discern the position and orientation of objects imprecisely presented to the robot. With ALPS, parts are delivered in matrix containers that may reside anywhere within the work envelope. Machine vision with a resolution of 256 gray levels makes it possible for robots to locate, grasp, and install parts accurately. According to one IBM description, "Machine vision adds the 'missing link' for total automation by making it unnecessary to remove parts from shipping containers." Machine vision also enables the robot to inspect parts and, via the

use of tactile sensors, make adjustments in the event of error.

Vision-equipped robots require slightly less than 2 seconds to record and process an image. A great deal occurs during that time, as the procedure of connecting the keyboard clearly demonstrates. In perhaps the most vision-intensive operation on the ALPS line, the keyboard ribbon cable is plugged in to a partially obstructed connector on the Convertible base. To do that, the robot's eye (a General Electric camera) peers inside the assembly and computes the location of the base connector. As the robot does so, it identifies and retrieves the keyboard and finds the connector, which must be resting face up in the box. Assisted by vision, it feels for the correct position within the Convertible chassis, matching cable to connector. Vision is nearly as critical in assembly of 128K memory boards, as the robot checks the product for flaws, verifies serial numbers, and gives the LCD a once-over during the test phase.

The ALPS vision system consists of several hardware subsystems, most of which IBM built from commercially available components. Although ALPS robots are sighted, they suffer from an acute case of tunnel vision: Their field is a bare 128-by-128 pixels. The constricted viewing cone is another element of IBM's design for automation. As hardware engineer David Leigh indicates in an ALPS position paper, "The key is to design products, packaging, and materials-handling hardware that make it possible to keep the camera field of view small." –K. G.

Well before ALPS lines were drawn, engineers enlisted portable PCs to simulate likely interfaces between materials-handling and robotics applications. Planners then modeled the automation process using Lockheed's *CADAM*. Senior engineer David Leigh says that in preparation for moving from mock-up to manufacturing, "IBM relied on *CADAM* drawings of parts, the robot work area, and the materials distribution scheme."

Designing for Automation

While the question of which came first, ALPS or the PC Convertible, mirrors the chicken-or-the-egg conundrum, in this instance the chicken has the edge. An IBM ALPS position paper contains this revealing edict: "Important in attaining total automation is designing the product to be manufacturable." That, indeed, is why large portions of ALPS were installed before design of the Convertible was complete.

Equipped with vision, cantilever robots handle normal assembly-line aberrations in stride and locate parts in open boxes.

Production-line specifications shape product size and precisely determine pallet size, tote size, and bar-code location. These parameters create what's known as a "product envelope"–the maximum work space that product size and robotic movements permit. According to IBM's Manny Chavez, material can automatically be taken from a pallet, and any product can be built as long as it measures 24 inches wide by 24 inches deep by 14 inches high. A product cannot have more than 66 different parts. So versatile is the process that the ALPS position paper neglects to mention a specific product for ALPS to produce.

The way vendors prepare parts for automated assembly is just as critical as the shape of the product. For suppliers, robot-ready packaging can mean excruciating attention to detail. Although machine vision can tolerate minor deviations, the size, weight,

and orientation of parts within each container (as well as of the containers themselves) must be uniform and comply meticulously with IBM specs. "We discussed with vendors just how we wanted the parts packaged, where we wanted bar codes, and what the codes had to look like," says Chavez. This dialogue with suppliers occurred even as IBM was developing end-of-arm tooling for the ALPS robots.
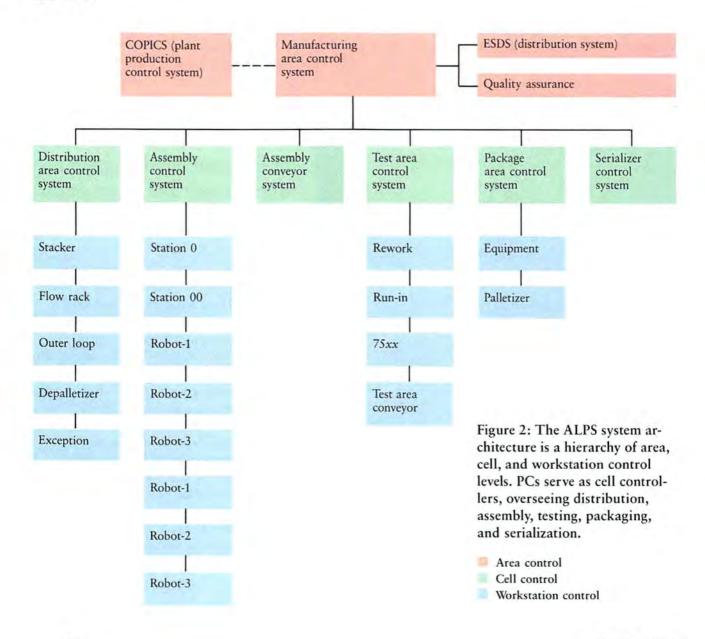
"From a computer-integrated-manufacturing point of view, ALPS offers excellent benefits that have nothing to do with this product," Chavez observes. "The whole concept of CIM is that it allows you to pick up a module–for instance, a test module–and use it for something else. The architecture is complete, the software's written, and the module's totally functional."

Precocious PCs and Talking Robots

Without belittling the role of the seven Series/1s and the few System/36 and System/38 minis, ALPS is every bit a PC show. Some 36 of the system's 49 computers are members of the PC family; they communicate with, oversee, and cajole minis and other micros. In the robotics area alone live 25 PCs, most of them portables or rack-mounted XTs.

The ALPS complement of small systems is organized according to function. On the assembly line, PCs issue marching orders to Series/1s, which direct actual robotic movement. In the ALPS control center, half a dozen PCs talk with the storage system, the

Figure 2: The ALPS system architecture is a hierarchy of area, cell, and workstation control levels. PCs serve as cell controllers, overseeing distribution, assembly, testing, packaging, and serialization.

- Area control
- Cell control
- Workstation control

flow-rack controller near the staging area, the robot that breaks apart pallets, and the conveyor and packaging systems. They communicate with minis and with each other asynchronously via RS-232C connections and IBM's PC Cluster local area network. (The ALPS facility has not implemented General Motors' Manufacturing Automation Protocol; see "MAPping the Islands of Automation" in this issue.)

The PC-as-watchdog role enables ALPS to enforce its modular, three-level hierarchy: area control,

> *'Important in attaining total automation is designing the product to be manufacturable.' That, indeed, is why large portions of ALPS were installed before design of the Convertible was complete.*

module (or cell) control, and machine (or workstation) control. The latter is the smallest unit of control and the one in which the most action occurs (see Figure 2). The ALPS control room, nerve center of the Manufacturing Area Control System (MACS), is home to five XTs and an AT that acts as the master control. One XT is dedicated to archiving backups; another feeds quality-assurance, order-entry, and manufacturing-requirement data into a System/38; still another provides a MACS interface to a Series/1 in the control room. In this way, the PC-based control system can, for example, automatically identify a need for additional parts and have those parts delivered.

At the assembly area, continuous data collection by PCs and endless conversation with the conveyor system keep the line moving. As new parts arrive at the line, a PC takes note and advises the appropriate robot to prepare to build. As parts data is gathered, it travels over the Cluster network to the Series/1. The robot, in turn, tells the Series/1 when one

shift's allotment of machines has been assembled. Similarly, it tells the PC, which in turn informs the Series/1 that no additional Convertibles need be built.

PCs are equally adept at hectoring robots. Robot pit bosses pass performance information up the line to the PC that serves as cell controller—statistics like quantity of products built, number of operator interventions, and how many attempts it takes to accomplish a specific task are tallied. The controller can talk up or down the line, evaluating data based on exceptions to the norm. If performing a task requires more attempts than it should, the controller alerts the control system of a problem meriting corrective action.

Will Build to Suit

ALPS output is tethered to estimates of product demand. For the PC Convertible, IBM is sticking to plans hammered out with suppliers, yet those agreements won't stop the company from doubling initial production projections.

The virtue of ALPS is that output can be quickly adjusted to market fluctuations. Stepping up production only involves expanding the number of lines or the hours of operation—not the actual speed of assembly. IBM's Austin facility includes two modules in an area that can easily house four. And an adjacent space under the same roof could double any four-module line.
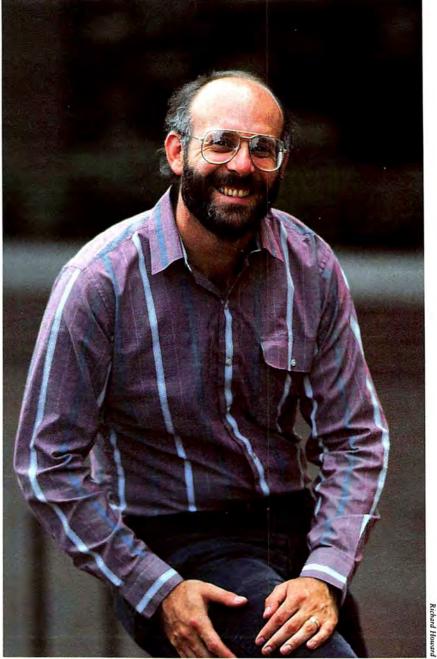
But then, IBM will do well even if the PC Convertible doesn't tear up the market. ALPS technology, while partially covered by patents, is for sale. ⬡

Ken Greenberg is the Southwest Editor of PC World.

Jonathan Sachs
After 1-2-3

The master programmer
who wrote *1-2-3* talks
about applications
design and his newest
brainchild

Eric Bender

The software juggernaut known as *1-2-3* began one day in 1981 as Mitchell Kapor struggled in exasperation to graph some *VisiCalc* figures. A similar moment of frustration two years ago prompted Jonathan Sachs, the man who actually wrote the code for *1-2-3*, to create a new style of high-powered word processor.

"I had an agenda," Sachs recalls. "I had some document I was trying to write, and I was tired of fighting the software I was using. In effect, because I am a technical professional, this became a word processor for technical professionals."

Lotus's *Manuscript* started with Sachs trying to document some of his own work. The document was long, "it seemed like it was highly structured, and people were talking about outliners, so I decided to use an outliner.

"I was really impressed with the synergy between outlining and word processing," he says. "At the same time, I was extremely frustrated by the weaknesses of outliners as word processors. You couldn't put in a title page on the document, so I had a separate title page to keep in sync. You didn't have any control over the format of the output. It didn't page break properly; I couldn't make it start chapters on a new page.

"I just said, 'Gee, it couldn't be too hard to write one of these'," he adds, chuckling. (For more on *Manuscript*, see the sidebar "Manuscript Writing.")

Building on the Prototype
The 39-year-old Sachs worked in software development at the Massachusetts Institute of Technology, Data General, and Concentric Data Systems before founding Lotus with Kapor. He became a millionaire many times over when Lotus went public in the fall of 1983. Slightly more than a year later, he quit his job as vice president of research and development.

The word processor "was the only idea I had at the time I left Lotus that had any commercial value," Sachs notes. "I tossed together a prototype in a couple of months."

He took the prototype back and showed it to Kapor. They agreed that Sachs would pursue the idea, working as an independent consultant under contract to Lotus, and that they would iron out many early design issues together. Lotus duly issued a public announcement to that effect in April 1985, provoking much speculation.

The original project (dubbed SOL, for Sachs Outliner) didn't seem all that ambitious. But it soon expanded, mostly due to all the bells and whistles that accompany today's word processors. "It would be nice to think that you don't need all of them, but sooner or later you need every single thing that's in there," according to Sachs. "So they were added, one at a time."

After the marathon programming sessions that produced both *1-2-3* and a severe case of burnout, the last thing Sachs wanted to do was to rack up the hours again. So he subcontracted out more and more work. "But we're still talking about a small number—about four people at the most were working on the product at any one time."

Defining the Computing Environment

SOL's target machine was the IBM PC XT. "This product is larger than we could have gotten away with when *1-2-3* came out, because 512K and a hard disk would have been unrealistic requirements back then," Sachs points out. "*Visi On* was the first product I know of that required so much memory and storage, and it was heavily criticized for that. These days, anybody creating a document of substantial size will need that kind of machine.

"For almost anything normal, like cutting and pasting a chapter, the program is pretty much instantaneous," he says. "Part of that has to do with the data structure. Cutting a chapter from one place in the document and pasting it to another is changing a few pointers, not shuffling information around as it would be with other products."

The package is mostly written in C, with the rest done in assembly language. "That leaves us with some flexibility to port it to other machines and environments if that becomes important."

Another key design criterion was to allow modular extensions from Lotus and other software firms. "We want to really encourage a third-party developer community, more along the lines of what Ashton-Tate was able to do with *dBASE* than what was done with *1-2-3*. The formats will be published; the hooks are in there for adding other applications in a clean way."

Focusing the Design

But who would buy this specialized, large-document word processor? While technical professionals and their secretarial support always looked like the prime potential customers, "we were thinking more in terms of business products originally," Sachs says. "There certainly is a segment of the business market that writes big sales reports or market surveys and has the same type of problems."

The design did not, however, target desktop publishing, which was barely a gleam in Apple's eye when the SOL search began. "For every person in a typical company who's doing a newsletter, there are ten doing the kinds of documents we're geared to do," the designer comments. "And you wouldn't want to use *PageMaker* or a similar product to create one of these documents. You wouldn't want to redo every page every time you

added a paragraph at the beginning of the document."

As SOL matured, the developers began looking for a home within Lotus. At the same time Lotus's newly formed Engineering and Scientific Products Division (ESPD) "had completely independently worked up a set of requirements for a technical word processor," Sachs says. "We just ran into each other.

"We didn't actually have to change the software that much for ESPD. Equations and formulas were the only major features that were added to bring it into line for an engineering and scientific word processor."

With SOL gradually becoming *Manuscript* under ESPD's wing, Sachs continued as project architect. "For relatively small things, I'd make decisions. For things that

'The instant you're no longer responsible for the implementation, the blinders come off.'

would affect the user interface and the external world, we'd bring more people in."

Additionally, the software circulated within Lotus. "There was a quasi-democratic process where enough people would get together and say, 'Hey, we need XYZ,'" according to Sachs. "Or someone would come up and say, 'You know, if it has *this*, we can get this extra market'.... It's been a pretty cooperative venture. We

don't argue about whether things should be in or out, more about what gets done first.
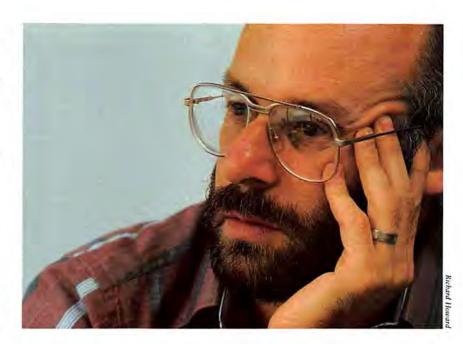
"As time goes on, we'll build on it," Sachs adds. "Software is like fruit, you pick it when it's a bit green. This product is aimed at coming into its full power about a year and a half out."

▇ Lessons From 1-2-3

Not surprisingly, *Manuscript*'s menu structure bears a family resemblance to that of *1-2-3* (see Screen 1). "We did investigate pull-down menus, but in the end we were unable to demonstrate substantial benefits," Sachs comments.

He says he learned a great deal from *1-2-3*, with much of that coming from Kapor. "If there's a meeting where eight people are arguing over something that really doesn't matter that much, he'll refocus everyone on what's important. And he just won't get hung up on minor technical issues, which is a real problem with programmers. I was like that a lot more when I started than I am now.

"As you get further away from the actual coding, you get more and more into the user's frame of mind," he emphasizes. "All of a sudden you get sensitized to issues that you would have liked to ignore.

"There's a subconscious tendency to rationalize things that are bad in the product, just because it would be hard to change them," he explains. "But the instant you're no longer responsible for the implementation, the blinders come off.

Richard Howard

▇ 'Software is like fruit, you pick it when it's a bit green.'

"On the other hand, Mitch can be effective as a designer because he also has enough implementation experience to give him a good feel for what really *is* hard.

"You can't just say, 'We need all these features', and you can't just say, 'Let's implement what's easy'," he sums up. "You wind your way through literally tens of thousands of little decisions."

▇ Changing the Guard

PC software development is changing at Lotus, reflecting not just Kapor's recent departure but more general industry trends, according to Sachs. "Now Lotus is in the acquisition market as well as the development market. It may be cheaper and less risky to find some other entrepreneur who actually has a viable product, and

help him or her sell that, than to try to hire the talent and keep them motivated."

More fundamentally, "as products get more complicated, it takes longer and longer just to get back to where you were, before you can start to make an incremental enhancement. To make a step that's as far ahead as the last step isn't just two times as much work, it's more like five times as much work.

"You need an army of people; it's a different kind of product development project. And when it's all over, it's still a crapshoot whether the product will fly or not."

Screen 1: Manuscript features horizontal menus on top, like 1-2-3. Built-in outlining functions simplify document management; here the Sort command allows document subsections to be listed alphabetically.

| File Global Edit Print Window **Sort** Quit | MENU |

Alphabetize the subsections of the current section

1.2 Community Issues◄

1.2.1 Neighborhood Support◄
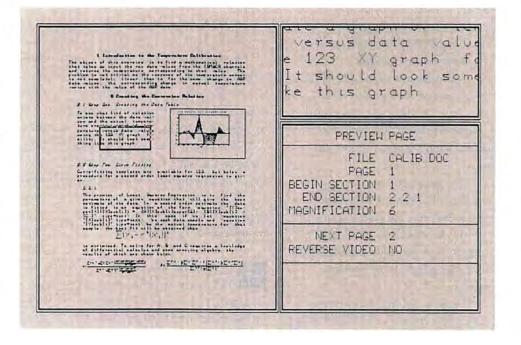
The development of the park must be responsive to the needs of the neighbors as well as the city at large. Meetings will be held to ascertain the feelings of the community and to respond to these needs. Safety and security on the site as well as traffic, noise, lighting, and visual impact will all need to be addressed in public meetings.◄

Neighborhood residents have already initiated their own survey of preferred use and needs for the area. Table 2 shows the results of this informal survey as communicated to us by the Open Space Preservation Committee. A more detailed and thorough survey should be done. The results will be combined with city-wide needs to achieve optimum consensus as to the facilities Centennial Park should include.◄

Table 2: Neighborhood Site Use Preferences◄			
◄	Percentage of Respondents◄		
Activity/Facility◄	Necessary◄	Desirable◄	Unnecessary◄

Screen 2: Manuscript's document previewer approaches what-you-see-is-what-you-get performance. On the left, a page layout combines text, a graph, and formulas. Top right shows a close-up view of the page. The bottom right window lists information about the page.

Looking Back on 1-2-3

1-2-3's elevation to a financial analysis standard took everyone by surprise, and highlighted what otherwise might have seemed only minor design drawbacks.

"At the very beginning, we never even knew if the product would sell," Sachs remembers. "Then when it looked like it would sell, everyone was just concentrating on the spreadsheet, and we were trying to bring it out on more machines. The product probably had been out for a year when the real need for customizing it and having specific application modules became clear."

At that point, the drawbacks to *1-2-3*'s macro language began to loom large. Macros were an afterthought, tacked on in two weeks at the very end of development, Sachs says. "It was a case of creating a monster that really got out of hand."

In the software author's opinion, *1-2-3*'s macro facility has been pushed beyond its limits. "We went into macros with our eyes open, we knew there were going to be problems. It just seemed like it was too useful to leave out, but a lot of the compatibility issues with future versions are very nasty.

"I feel sorry for the people who still have to maintain the product," Sachs says ruefully. "I answered a few questions for *1-2-3* release 2, but it's all been taken over by other people."

> '*You need an army of people; it's a different kind of product development project. And when it's all over, it's still a crapshoot whether the product will fly or not.*'

Surprisingly, the man who wrote what is arguably the most successful software package in history doesn't have any projects in the pipeline after *Manuscript*. Instead, Sachs plans to take some time off, working part-time on a conservation foundation he formed a year ago.

And he himself is far from a spreadsheet buff. "I use *1-2-3* a few times a year to gather my tax records and do a few other things," he acknowledges.

He hasn't looked hard at advances in spreadsheet technology such as Lotus's *HAL* interface or Microsoft's *Excel*. He notes, however, that "*Manuscript*'s page preview is in a sense a copy of what's in *Excel*, although I think we did it slightly better." (See Screen 2.)

Adding some spin on the ball for page preview demonstrates what he does best, Sachs comments. "I'm not a real creative designer, but, for example, I'll read manuals of other products and pick ideas out of them, and then turn them around and try to make them into something that incorporates the best of everything."

In fact, when *1-2-3* started out, the third part was going to be a word processor instead of a data base. "I spent about two weeks prototyping a word processor, and realized it was a lot harder than I thought," he says, grinning. Meanwhile, *Context MBA* appeared, and with it the concept of combining a spreadsheet with a data base. Sachs decided that not only would a data base be easier to design, but it would fit more naturally with a spreadsheet than would a word processor.

"Innovators play a role," he concludes. "It takes a few of everyone's different skills to make the thing come together." ◓

Eric Bender is the East Coast Editor for PC World.

Manuscript
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
617/577-8500
List price: $495
Requirements: 512K, hard disk,
* DOS 2.00 or later version*

Manuscript Writing

Technical professionals often face some intimidating obstacles when they write up their work. Scientific, engineering, or training documents can run to *War and Peace* lengths, and they must stay up-to-date during a long shelf life. When multiple authors find themselves working together, frequent revisions are likely, and the documents tend to be stuffed with complex contents like formulas and graphics.

Lotus's *Manuscript*, a $495 specialized word processor, attacks all these problems, with strong outlining features and the ability to incorporate equations, formulas, and other graphics.

Seen in its prerelease form, *Manuscript* gives the general impression of a conventional word processor that favors power over flash. Some features, notably the document preview, resemble those found in desktop publishing packages, but *Manuscript* has a different target. "This is clearly geared to the person who is concentrating on the content of the document, who wants it to look nice when it's all done, but doesn't want to pay attention to every page break," says developer Jonathan Sachs.

Manuscript opens with a Document Manager, which is similar to *1-2-3*'s Access. Options on the Document Manager's main menu include editing, printing, document previewing in graphics mode, a spelling checker, and a function that enables you to compare document versions.

Although the word processor looks vaguely like *Symphony*'s and provides many similar features, it was designed from scratch, Sachs says. It works in text mode, which has some benefits as well as drawbacks compared to strict what-you-see-is-what-you-get approaches. Performance is quicker in text mode editing, but different type styles and sizes, line breaks, and page breaks can't be displayed on the screen as they'll appear on the printed page, Sachs explains. *Manuscript* circumvents some of the resulting problems with special mechanisms to intelligently break lines and pages, handle positioning of text on a page, and format columnar text.

Outlining is integral to the *Manuscript* design, offering functions such as automatic restructuring and renumbering by section or subsection (see Screen 1 in main article). Users can move swiftly between sections anywhere in the document, helping them find their way through a long opus.

Unlike most outliners, which require users to toggle back and forth between headline and text mode, *Manuscript* operates in a single mode.

Outlining also provides a common framework when several authors are collaborating. A master document can import each author's sections and impose a single format, ensuring consistent treatment.

Manuscript's print formatter supports global style sheets, handles multiple fonts, and can include graphs, spreadsheet ranges, tables, equations, and formulas.

The developers went to a great deal of trouble to optimize printed output, not only on high-end laser printers but also on dot matrix devices. According to Sachs, "We have an order of magnitude more information about the printer than printer drivers usually have; we try to use almost everything. We dis-covered a lot of bugs in printer microcode, especially in simultaneous text and graphics."

The document previewer runs in graphics mode, displaying all characters in correct proportion, along with superscripts (see Screen 2 in main article). The program can handle any document up to the 8MB virtual-memory limit—which translates into about 800 pages. (Much of that storage can be held in internal memory through the Lotus/Intel/Microsoft expanded memory specification.)

Manuscript's spelling checker is a faster version of *Symphony*'s. Lotus also plans to offer specialized dictionaries, exploiting the package's built-in hooks for add-on modules.

The document comparison function shows where text has been de-leted, moved, or inserted for the first time. "It's a big feature with lawyers, although we're not really marketing *Manuscript* for them," Sachs remarks.

Aside from offering the ability to import worksheet files from *1-2-3* and *Symphony*, *Manuscript* can also import and export revisable IBM document content architecture (DCA) files, and import ASCII and *ThinkTank* files. On the graphics side, Lotus plans to add support for its newly acquired *Freelance* package, along with *AutoCAD*. The word processor works with standard IBM graphics adapters, as well as with the Hercules Graphics Card and Graphics Card Plus.
—*E. B.*

Thinking About Thinking PCs

The Center for the Study of Language and Information seeks to unravel the mysteries of language and meaning—an effort that goes hand in hand with the progress of artificial intelligence.
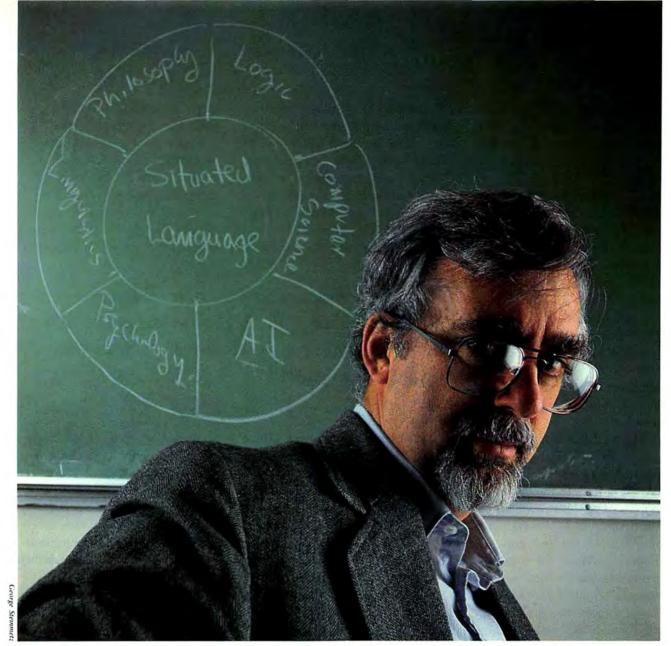
Howard Rheingold

▐▐▐ How much longer will we have to wait before we can engage in witty repartee with our computers—the kinds of conversations that space jockeys in the movies have with their silicon companions? ("HAL, get me the Jackson file, set the course for Andromeda, move my rook to your queen's pawn four, and wake me when the coffee's ready.")

Granted, many of the thorniest technical problems involved in converting voice signals into computer-readable form have already been solved (see "The PC Hear and Now," *PCW,* November, 1986). Today, with proper peripherals, you can talk to your computer and expect it to recognize a few dozen words. You can even tell it to execute a program, but you have to tell it in exactly the same words every time. And if you

tell it that Mary had a little lamb, your computer has no way of "knowing" whether you are talking about a nursery rhyme, a veterinary case history, or an extraordinary obstetrical event.

The gap between speech recognition (the ability to detect specific sound patterns and match them with entries in a stored dictionary) and true understanding (the ability to perform actions based on what the speaker means) has stymied artificial intelligence (AI) researchers for three decades. Desperation has reached such a fever pitch that computer scientists have called in philosophers, and philosophers have summoned linguists.

The chalkboard shows a circular diagram with "Situated Language" at the center, surrounded by Philosophy, Logic, Computer Science, AI, Psychology, and Linguistics.

John Perry, founding director of the Center for the Study of Language and Information, takes an eclectic approach to the study of artificial intelligence.

This odd marriage of electronics and epistemology is exemplified by the Center for the Study of Language and Information (CSLI, pronounced *sizzlee*), a Stanford-based think tank consisting of computer scientists from PARC (Xerox's Palo Alto Research Center) and AI researchers from SRI, plus philosophers, logicians, and various other specialists from around the world. CSLI was founded in 1983 with a $20-million grant from the Systems Development Foundation (a Rand Corporation spin-off), with a mandate to break out of the semantic trap AI theorists first stumbled into years ago.

CSLI researchers claim that computer interpretation of natural language isn't a matter of accumulating technical expertise or amassing computing power. It requires solving fundamental theoretical problems about the nature of meaning, information, and communication. Before you can build a natural language interface

with better chips and more complex software, you have to know what a language is and how it works.

Roots of the Dilemma

When John McCarthy proposed the term "artificial intelligence" at the 1956 Dartmouth conference that inaugurated AI research, pioneer computer scientists and their eager sponsors in government and industry assumed that a computerized translation machine would come along just as soon as they could incorporate grammar into algorithms and load a stack of dictionaries into memory.

The infamous first try at English-Russian translation sent the natural-language computer researchers back to the drawing board. "The spirit is willing but the flesh is weak" was translated into Russian and back into English, yielding "the vodka is agreeable, but the meat has spoiled." Another computer translation transformed the slogan, "Coke adds life" into the Chinese sentence "Coke brings your ancestors back from the grave."

"That attempt," notes John Perry, founding Director of CSLI and former chairman of the philosophy department at Stanford, "was the beginning of the end of the age of hubris, the era when AI people said, 'Well, there are all these problems around that people can't solve because they don't have artificial intelligence software and computers. You want the nature of

knowledge? Give us six months, $13 million, no problem.'

"After the age of hubris," explains Perry, "was the age of interdisciplinary appreciation, where some of the hubris disappeared and people said, 'Maybe all those things philosophers said about knowledge actually have some

How much would a program have to 'know' in order to choose one of the two meanings for the sentence: 'He saw that gas can explode'?

computationally redeeming value and aren't just unadulterated crap.'"

The conclusion that researchers arrived at was that the meaning of language cannot usefully be explored as an abstraction. The context of speech and the knowledge speakers have about one another and about their world swarm invisibly around every word. Until computers can digest the contextual meanings of words, instead of just swallowing the contents of dictionaries, a thinking machine can't be built.

From Word Games to Logic

Created in the mid-1960s by MIT's Joseph Weizenbaum, *Eliza* was a modest program intended to mimic human conversation. The goal was not to capture the meanings of words, but to mirror certain patterns of words. In collaboration with Stanford psychiatrist Kenneth Colby, Weizenbaum designed *Eliza* so that it would re-

peat the words of anyone who tried to communicate with it. "I'm mad at my wife," the subject would type, and *Eliza* would play back the sentence like a practitioner of nondirective psychotherapy: "You're mad at your wife? Tell me about your family." *Eliza* didn't "know" that the sub-

ject's wife was part of his family—the programmer had simply connected canned responses to a list of key words and phrases. To Weizenbaum's horror, people sometimes spilled out their innermost thoughts to a machine that did little more than spit back their words.

Racter, today's surprisingly witty PC-based composer of nonsense and not-so-nonsensical prose, is a clever descendant of *Eliza*: a trickster, a Houdini, a creator of plausible word-salads. Although *Racter* is more grammatical than its predecessor, it still has no more understanding of its own conversation than a talking teddy bear. (For more on *Racter's* verbal skills, see *PC World View*, *PCW*, August 1985.)

In the late 1960s, MIT graduate student Terry Winograd went be-

yond mere word games with a program called *Shrdlu*. This innovative software took natural language research one step closer to the realm of *situated language*—that is, language in context. Winograd based his work on the assumption that computer programs must have knowledge about the world if they are ever to understand the meaning of word patterns. He restricted *Shrdlu*'s environment to a simulated robot arm operating on a tabletop covered with colored blocks and boxes. *Shrdlu* exhibited primitive logic and the ability to pose and answer sensible questions. If you commanded *Shrdlu* to pick up a blue triangle and put it in a red box, and later asked what the red box held, the program would remember. Even more intriguing was *Shrdlu*'s ability to understand slightly ambiguous references:

Q: Have you touched any pyramid before you put the green one on the little cube?

A: Yes, the green one.

Q: Where did you pick it up?

A: While I was stacking up the red cube, a large red block, and a large green cube.

Q: Why?

A: To get rid of it.

Rather than turning sentences around and passing them off as responses, *Shrdlu* was able to connect the word *it* in the human question with its antecedents in previous sentences and make basic assumptions about the structure of conversation. *Shrdlu* was indeed a promising start, but a truly con-

versational program that "understands" words in context still seems a long way off. How much would a program have to "know" in order to choose one of the two meanings for the sentence: "He saw that gas can explode?"

■ In Search of Cabbages and Kings

A language-understanding agent, whether human or silicon, must have knowledge of shoes and ships and sealing wax, of cabbages and kings, before it can converse with a walrus or anything else. But before researchers tackle the task of encoding knowledge in a data base, they must first address basic questions about human intelligence. How do humans reason their way through such mundane

activities as ordering a pizza, taking a bus trip, or following a recipe? One group, led by Yale researcher Roger Schank, promotes the script hypothesis. Schank asserts that humans and programs arrange knowledge about how to act in the world in the form of "scripts" that are modified according to existing circumstances.

CSLI was in fact born in reaction to the script hypothesis, because philosophers and linguists regarded scripts as powerful but shallow extensions of *Eliza*.

Scripts might lead to the creation of clever answering machines, reasoned the Stanford clan, but they couldn't possibly result in computers that had a real understanding of natural language. In any case, CSLI's immediate goal is not to build a "conversation machine."

To illustrate for this interviewer exactly what the organization intends to do with its grant money and mandate, Perry drew four squares, slightly separated from one another, with the following labels: logic, linguistics, computer science, and philosophy. In the negative space between the corners of the four squares was a smaller, amorphous blob labeled 'situated language'. "We are after a rigorous theory of meaning," he explained, pointing to the top two

'The spirit is willing but the flesh is weak' was translated into Russian and back into English, yielding 'the vodka is agreeable, but the meat has spoiled.'

squares. "Logic gives us a precise theory of meaning for a constrained, artificial language; linguistics provides a lot of syntactical theories about the form of natural language." Pointing to the bottom squares, he continued: "Computer scientists study whether a problem can be solved within the structure of a programming language, and can tell us

something about building useful artificial languages. Philosophers have been talking about knowledge and meaning for a long time and even now have valuable contributions. But the big gap between the disciplines is in the area of situated language."

When we talk to each other, our words often have an implicit meaning that is not apparent in the strict dictionary definition. As an example, Perry offered the sentence: "Can you reach the salt?" Everybody knows that you don't want an answer—you want the salt. Intelligible conversation depends on our ability to understand the ambiguous references people use all the time. For example, *Shrdlu*'s ability to determine what a pronoun like *it* refers to declines as the distance between the pronoun and its antecedent increases.

Barbara Grosz, an SRI-based CSLI affiliate, describes a typical conversation between two people, one of whom is teaching the other how to assemble an air compressor. Half an hour after they begin, the teacher says, "Let's plug it in." The air compressor has not been mentioned since the beginning of their conversation.

"Imagine a computer dealing with that," Perry says, "grinding backward through its careful records of everything that was said, looking for a word match—the screwdriver? The toolbox? The pliers?" And as the computer scientists who designed the first chess-playing programs discovered, searching through every possible option quickly exhausts the

capacity of even the most powerful computer.

Perry is unsure whether a mathematically rigorous definition of natural language is possible, given its complexity. He is confident, however, that the knowledge

gained by CSLI's research will significantly influence the design of new computer languages and user interfaces. Says Perry, "Computer language designers have a lot to learn from natural language, which is actually a successful programming language. You and I are programming each other as we speak because we are affecting each other's behavior using natural language."

◼ Toward a Conversational Computer
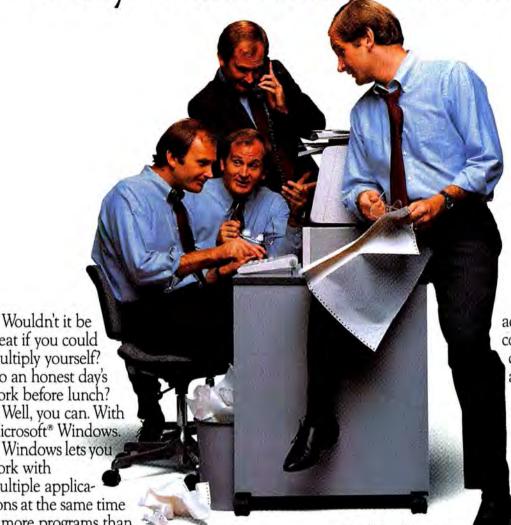
Creating a useful version of even a limited natural language program is no mean feat. However, English-like command syntaxes, such as the one offered by *Q&A*, are already being used successfully. In addition, expert systems using many of the AI principles employed to sort out natural language are gradually making their way to PCs (see "A Prolog to the Future" in this issue). As mainframe processing capacity is downsized into PC CPUs, resource-hungry programs that mimic human conversation may become commonplace desktop

companions. Ironically, the natural language front end that drives a spreadsheet or a data management program may require far more processing power than the application itself. ("We can perform your calculations right away,

> *Ironically, the natural language front end that drives a spreadsheet or a data management program may require far more processing power than the application itself.*

but finding out what you want to calculate and telling you the results will take a little longer. ... ")

It's still premature to speculate about the specific features of a conversation machine. Whether or not the personal computer of 2001 will understand as much English as the average 6-year-old child, much less have the conversational fluency of a HAL, depends on how quickly the eclectic group of specialists at CSLI and their colleagues around the world can generate some answers. In a very real sense, the shape of the next century's computer technology is in the hands of the philosophers. ◉

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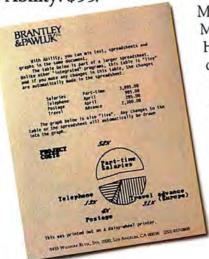
You get full-featured wordprocessing with no exotic codes to learn, and what-you-see-is-what-you-get formatting.

Spreadsheets larger than Symphony, with all the powerful math and business functions you need and the ability to import Lotus 1-2-3 files (and formulas where possible).

A forms-oriented database that's easier to use than pfs:file.

Professional business graphics from your spreadsheets and databases with just a few keystrokes.
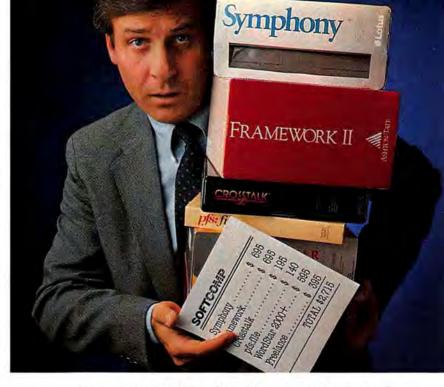
Ability: $99.

Menu-driven, Migent Pocket Modem™ and Hayes-compatible communications. Even "slide shows" with sound on your PC!

And smooth, seamless integration like nothing you've ever seen before.

Because with Ability, the table and graph you see in the letter aren't just copies pasted in—they're live.

So if you change the table in the letter, the changes are made in the linked spreadsheet or database that contains the underlying data. Or change the spreadsheet and the letter is updated at the same time. And the graph is automatically redrawn to reflect the changes, either way. (Perfect for those weekly and monthly reports.)

And anybody can do it with no programming at all, because Ability is menu-driven and uses the same instructions in all six applications.

At just $99, Ability could even pay for your PC if you don't already have one.

Check it out at your local computer store or contact: Migent, Inc., P.O. Box 6062, Incline Village, NV 89450. (702) 832-3700.
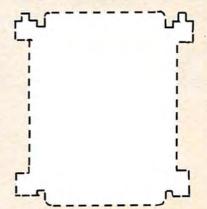
MIGENT™

WE PULLED THE PLUG ON ♪ v1.1

CLARION v1.0 $295.
(former actuator shown at something other than actual size)

CLARION v1.1 $395.
(artist's conception of no actuator at any size)

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We're also dedicated to making applications programmers' professional lives more rewarding.

CLARION, and now v1.1 delivers on that promise.

WHY YOU NEED v1.1

You're losing money every minute you spend programming in something *other* than CLARION 1.1.

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You get all of this power, no copy protection, no Actuator, and *free run-times* for only $395 plus a nominal fee for shipping and handling.

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1-800/354-5444

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from BARRINGTON SYSTEMS, INC.
The Applications Programmers' Advocate

150 EAST SAMPLE ROAD   POMPANO BEACH, FLORIDA 33064   305/785-4555

An AT by Any Other Name

For experienced users willing to tolerate a rough edge here and there, one of the six price-busting AT clones reviewed here may be well worth the mail-order shuffle.
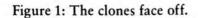
Edited by Eric Knorr
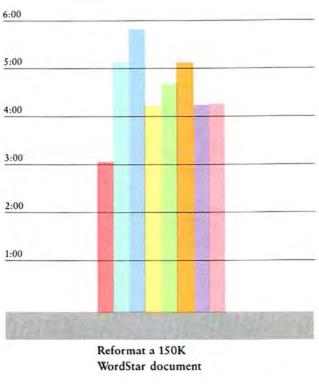
▌▌▌▌ Whether or not you buy one of the latest, cheapest AT clones, you owe their vendors a vote of appreciation. Thanks to these small, ambitious companies, hardware prices will never be the same. Compaq, AT&T, Zenith, and the like may add innovative features to the basic AT design, but no major corporation can match the low overhead of a budding mail-order mogul tightening the belt for an assault on a PC periodical's back pages.

As the personal computer establishment likes to point out, many mail-order companies keep costs down by acquiring most of their components and even fully assembled machines from Taiwan. That's often true, although some concerns—such as PC's Limited—are doing their own manufacturing in the United States. In any case, anyone who's noticed the international origins of the chips inside an IBM AT will find the "buy American" injunction tough to swallow.

And that's who this new generation of mail-order clones is best suited for—sophisticated users who know their way around the inside of a system unit. If you're new to PCs, you're likely to go with an established company. But if you've been around the

Figure 1: The clones face off.
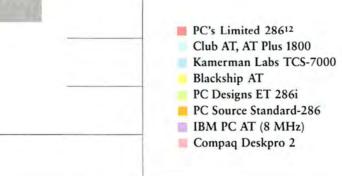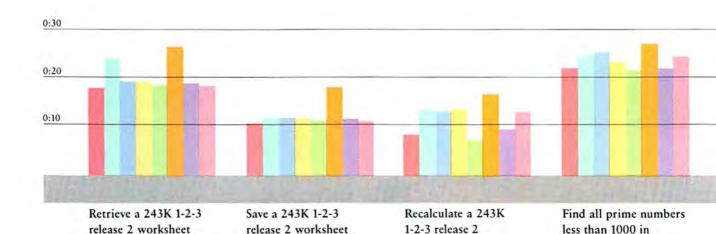
block a few times, you know that hardware is hardware, specs are specs, and a chip that doesn't falter after a few days of heavy use is not likely to fail for a very long time, no matter who makes it.

The high speed of some of these clones should also attract PC veterans. The performance of most of the machines hovers near that of IBM's latest 8-MHz AT incarnation and Compaq's Deskpro 286, although test results vary from task to task (see Figure 1). Unlike IBM's AT, all the clones (except one) can easily downshift to 6 MHz for speed-sensitive software or hardware, a trick accomplished by moving a jumper, flicking an external switch, or executing a keyboard command.

Reformat a 150K
WordStar document

- ■ PC's Limited 286^{12}
- ■ Club AT, AT Plus 1800
- ■ Kamerman Labs TCS-7000
- ■ Blackship AT
- ■ PC Designs ET 286i
- ■ PC Source Standard-286
- ■ IBM PC AT (8 MHz)
- ■ Compaq Deskpro 2

Retrieve a 243K 1-2-3
release 2 worksheet

Save a 243K 1-2-3
release 2 worksheet

Recalculate a 243K
1-2-3 release 2
worksheet
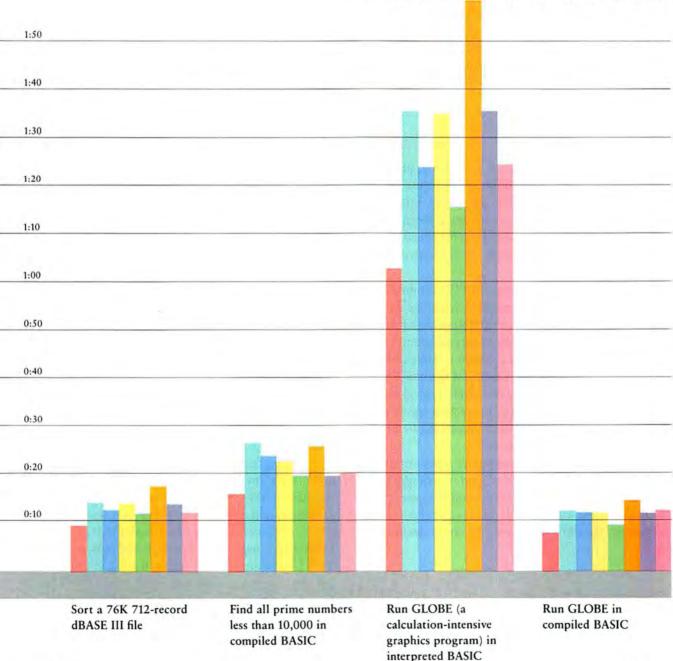
Find all prime numbers
less than 1000 in
interpreted BASIC

Moreover, for most clones, compatibility is no longer a hot issue. This is especially true for the majority of mail-order machines, which—unlike compatibles from companies like AT&T or Texas Instruments—are designed to carry IBM's tune, rather than improve on it. Our informal IBM compatibility tests included running *Jet, TenKey, SuperKey, Microsoft Word* version 3.00, *WordStar* version 3.00, and *1-2-3* releases 1A and 2. In addition, the machines were subjected to IBM's VDISK, PC-DOS 3.10 and 3.20, and even AT Diagnostics. Whether their BIOS originated with Phoenix Software or an obscure Taiwan-

ese manufacturer, nearly all the clones reviewed here ran their IBM-compatible test software flawlessly. The only exception was the PC's Limited 286[12], which loaded but failed to run *Framework I.*

Not that mail-order shopping is without its risks. Judging by the lackluster documentation accompanying most of the clones, experienced users will frequently need their know-how to decipher sketchy, cryptic, and sometimes inaccurate instructions. And while a number of vendors offer generous warranties and support programs, how well they can fulfill those promises is another question. Small mail-order companies have been known to disappear without a trace, while others become successful so quick-

| Sort a 76K 712-record dBASE III file | Find all prime numbers less than 10,000 in compiled BASIC | Run GLOBE (a calculation-intensive graphics program) in interpreted BASIC | Run GLOBE in compiled BASIC |

ly that they can't provide end users with adequate sales support, let alone after-sale assistance. All in all, it's best to have either in-house or third-party support available.

One way to minimize the unknowns associated with mail-order purchase is to outfit your machine with well-known, quality components. Many vendors offer monitors from familiar companies like Princeton and Amdek, hard disks from Seagate or Tandon, floppy drives from Fuji or TEAC, and so on. If you purchase peripherals from the same vendor that sells the basic system unit, you're likely to duck the retail price by about 30 percent.

Cost saving, after all, is what mail-order clones are all about. The new crop may offer few advances over basic AT technology, but they put 80286 boxes within the reach of businesses and individuals previously unable to pay the price. Judging by the latest round of price cuts, the downward pressure is felt even by IBM.

PC's Limited 286¹²

"If speed be the music of computing, play on." That unfortunate parody could well describe the current state of affairs in the PC community. But unlike love according to the Bard, no excess of megahertz can extinguish the public's appetite for speed. If your desire for speed is inexhaustible, PC's Limited has the machine for you.

As this is being written, the PC's Limited 286¹² is the only 12-MHz AT compatible available. As with all increases in clock rate, computation-dependent operations—such as graphing or spreadsheet recalculations—display the most acceleration, while disk-bound activities (data base sorts and the like) show less improvement. And yet, the psychological effect of the 286¹² cannot be ignored; it's reassuring when a computer completes some operations even before your fingers leave the keyboard.

Speed isn't the only impressive aspect of this computer. The construction is solid, the design clean, the components high quality, the connections secure … in short, the machine has an air of permanence. Moreover, the 286¹² is covered by an unconditional,

30-day money-back guarantee and a one-year limited warranty. (The company will replace or repair the equipment at their discretion; in either case, you ship the computer prepaid and insured.) PC's Limited avers that it will set up regional service centers in the near future, an indication of the company's shift from mail-order marketing to designing and manufacturing its own high-performance PCs.

The standard 286¹², priced at $2695, sports a hefty Fortron 192-watt power supply, a 1.2MB floppy disk drive, a PC's Limited BIOS, and 1MB of RAM installed on the motherboard. The system I reviewed added a Mitsubishi 360K floppy drive, a Seagate 4026 full-size 20MB hard disk driven by a Western Digital disk controller, and a half-length PC's Limited Universal Graphics II Card with Hercules, CGA, and Plantronics modes. The review system used the PC's

The PC's Limited 286¹²

Limited Mono-2 monitor, a $129 amber model with a flat picture tube mounted on a tilt-and-swivel stand. Without DOS or BASIC, this configuration runs a fairly hefty $3711.

Setting up the 286¹² was a breeze. PC's Limited installs any of the hardware you opt for, so all you have to do is plug in the machine, format the hard disk, and install DOS. When you start the 286¹², the cutest feature of all comes to life: a tiny LED display next to the key lock and indicator lights. This 1-by-¼-inch display tracks the RAM check in progress and even spells out 'boot' immediately before the DOS prompt appears. It also flashes error

messages in plain English and shows CPU speed, current disk drive designation, disk track being accessed, and other useful information. The error messages are listed and explained in the documentation.

Of all the clones in the roundup, the 286¹² offers the clearest, most accurate, and most comprehensive documentation. In addition, a unique ROM-resident utility lets you perform such tasks as parking

■ *If your desire for speed is inexhaustible, the PC's Limited 286¹² is the machine for you.*

your hard disk and enabling/disabling RAM parity. This utility also gives you access to a setup routine, which you can even summon from within an application.

Although the 286¹² had no trouble with any of the compatibility test software, the manual warns of potential problems regarding memory expansion cards and internal modems that can't keep up with the machine's whiz-bang performance. Such incompatibility becomes more of a risk at higher clock speeds, so the machine's keyboard-selectable 6-MHz mode may well come in handy. Nonetheless, the company's own modem boards—as well as Hayes's—are certified to work at 12 MHz, and PC's Limited is also developing compatible high-speed memory expansion products.

The Maxi-Switch keyboard common to three of the compatibles in this roundup has a light but sure feel. It's such a pleasure to use that I was reluctant to give it up for my Compaq Deskpro 286's keyboard. The layout is AT-style, but two DIP switches on the underside enable you to configure the board for either a PC or an AT, as well as swap the positions of the <Esc> and tilde keys. I still think IBM keyboards have the best response, but I wouldn't hesitate to recommend the Maxi-Switch product.

The 286¹² uses the Chips and Technologies AT chip set with a proprietary PC's Limited BIOS ROM. Like most of the other clones, the machine features six 16-bit expansion card slots; unlike the AT and most of its imitators, however, the 286¹² lines up its

two 8-bit slots adjacent to each other. A particularly nice touch is that many of the DIP switch settings are printed right on the motherboard. On the downside, the socket for the 80287 coprocessor is barely accessible due to its proximity to the hard disk. And although the five half-height drive compartments offer plenty of flexibility, only four power connectors are provided, and the front cover allows access to only two half-height devices. In addition, instead of building ports into the system unit, PC's Limited has merely included five punchouts on the backplane.

True, the PC's Limited 286¹² costs more than the other machines reviewed here, but its sturdy construction and cutting-edge technology make it a solid deal. Unless you're utterly jaded, you'll find the speed very impressive, even if it pushes some software and expansion boards beyond their limits. Once you get past name brand appeal, you crave more power per dollar, and in that category, the PC's Limited 286¹² is hard to beat. —*Harry Miller*

286¹²
PC's Limited
1611 Headway Cir., Bldg. 3
Austin, TX 78754
512/339-6800
List price: 1MB RAM and 1.2MB floppy disk drive $2695, 360K floppy disk drive $109, Seagate 4026 full-size 20MB hard disk $579, additional 1.2MB floppy disk drive $149, Universal Graphics II Card $199, amber monitor $129, Mini I/O Card $99, DOS 3.10 $85, GW Basic $95

■ **Club AT Plus 1800**
If imitation is the sincerest form of flattery, the AT Plus 1800 from Club AT pays the IBM AT a heartfelt compliment. On the outside, the AT Plus's system unit has the same face, size, shape, color, key lock, and indicator lights as the IBM AT—an identical twin save the logo.

Inside, the emulation continues, from an AT-size, 192-watt switchable power supply to an AT-style motherboard bearing eight full-length expansion

slots. Like IBM's workhorse, the first and seventh slots are 8-bit, the remaining six are 16-bit, and one 16-bit slot is dedicated to the combination floppy/hard disk controller.

In the AT Plus's case, it's an Everex AT-compatible controller, which can support up to four floppy and two hard drives. Actually, close inspection of the machine's innards reveals so many Exerex logos, you might be prompted to ask, "Is it Club AT,

Club AT's AT Plus 1800

or is it Everex?" The video adapter is an Everex Evergraphics Plus, a Hercules-compatible board that you can transform into an EGA compatible with Everex's Piggyback Enhanced Graphics Adapter. Everex even makes the AT Plus's motherboard. When you learn that Club AT is located a few doors down the street from Everex Systems—an old hand at quality PC and AT expansion products—you begin to get the picture (although there's no formal affiliation between the two companies).

The biggest difference between the AT Plus and IBM's unit is the price: With 512K RAM, an Award Software BIOS, a TEAC half-height 1.2MB floppy drive, and a keyboard that appears identical to the excellent Maxi-Switch model included with the PC's Limited 286[12], Club AT's entry will set you back a mere $1125. Adding a half-height TEAC 360K drive tacks on $89; you can knock $25 off the selling price if you opt for the 360K model instead of the 1.2MB unit. Also available are Seagate 10MB, 20MB, 30MB,

40MB, and 85MB hard disks; the system reviewed here is equipped with a $549 20MB Seagate drive sporting a 39-ms average access time. This brings t total price of the reviewed system (with monochror graphics adapter and monitor) to precisely $2000.

All told, the machine harbors one full-height and three half-height storage devices, although only two are externally accessible. This means that if you want to install a half-height tape backup, you'll hav to sacrifice one of your floppy drives. No serial or parallel ports are built into the system unit, althoug Club AT does provide three punchouts on the back-plane for 25-pin connectors.

Naturally, the motherboard holds an 80286, a socket for an 80287 coprocessor, and 64 bytes of CMOS RAM in a real-time clock/calendar chip powered by batteries mounted in a case on the side the power supply. Like the AT and every clone, the CMOS RAM holds the date, time, and system confi uration, all of which are set by running the supplied setup program. The AT Plus runs at 8 MHz like the

> *If imitation is the sincerest form of flattery, the AT Plus 1800 from Club AT pays the IBM AT a heartfelt compliment.*

new AT, and although you can scale back to 6 MHz doing so requires that you exchange the mother-board's crystal for one provided in a little plastic bag—an unlikely prospect.

While the AT motherboard has only one DIP switch block, the AT Plus has three, instead of the hard-to-reach jumpers found on some clones. The AT-style single switch indicates whether the primary display is monochrome or color, a four-switch box i dicates whether the ROM BIOS comes in 128K-bit o 256K-bit chips, and a dual switch indicates whether the motherboard RAM totals 256K, 512K, 640K, o 1MB. With 1MB on board, you'll have 640K for con ventional memory and 384K of extended memory (not to be confused with Lotus/Intel/Microsoft ex-panded memory), which can be used by DOS as a RAM disk. (If you use Xenix or have other extende memory applications, up to 15MB more of extended memory can be installed in the expansion slots.)

The Tatung amber text monitor accompanying the AT Plus is an able emulator of IBM's monochrome display. The contrast, brightness, and on/off knobs are mounted out of sight but within easy reach below the front edge of the screen. Rather than mimic IBM's perverse preference for sealing vertical-hold, vertical-size, and horizontal-hold controls inside the plastic shell, Tatung makes these controls easily accessible on the back of the monitor.

Documentation is succinctly presented in a black-and-white, typeset manual. Like most cheaply produced clone manuals, it contains a number of minor errors, but the information presented is enough to get the machine up and running. The AT Plus's DOS must be purchased separately, and DOS 3.10 is recommended. Club AT warrants the machine to the original purchaser for one year for parts and six months for labor. The company's representatives are pleasant and helpful—not surprising, considering that the AT Plus is probably doing both the company's ego and its pocketbook proud.

The only failing of the AT Plus 1800 is that it imitates IBM's machine too accurately; common clone features such as a reset button, a switchable clock, and built-in serial or parallel ports are all absent. But make no mistake: For $2000, Club AT will set you up with a top-quality AT clone, chock-full of reliable Everex components and complete with a monochrome graphics display and a 20MB hard disk. And you can't beat that—not in this roundup, anyway. —*Karl Koessel*

AT Plus 1800
Club AT, Inc.
46707 Fremont Blvd.
Fremont, CA 94539
415/490-2201
List price: 512K RAM and 1.2MB floppy disk drive $1125, additional 128K RAM $18, additional 512K RAM $54; 360K floppy drive $89, additional 1.2MB floppy drive $128; 20MB half-height hard

disk $355, 20MB hard disk $549, 30MB hard disk $648, 40MB hard disk $699, 85MB hard disk $1395; serial/parallel port $89, second serial port $25; Tatung green or amber monitor $138, Tatung Color Monitor $345, Tatung Enhanced Color Display $480; Everex Evergraphics Plus $99, Everex Color Adapter (with parallel port) $99; NEC MultiSync $599; DOS 3.10 $85

Kamerman Labs TCS-7000

Among budget clone vendors, Kamerman Labs clearly has the edge in at least one respect—its name. The vaguely Middle-European ring to it, plus the designation "Labs," conjures images of bespectacled technicians surface-mounting chips in some faraway clean-room. Add to the evocative moniker a bargain-pricing policy and a slickly designed product line, and it's easy to see why the company has had considerable success as a hard disk vendor.

When you take a look at Kamerman's TCS-7000 AT clone, you'll find the Kamerman logo up front all right, but the backplane reveals a different parentage—Tatung, one of the largest Taiwanese PC manufacturers. The machine's chassis matches the IBM AT's imposing footprint, but thanks to the fang-like air vents at the base of the front panel, it looks, well, meaner. Above these chops runs a narrow gutter containing power-on and hard-disk-access indicator lights, flanked on either side by a reset button and an AT-like key lock. Overall, this machine gives the impression that it's built to take far more abuse than it would normally encounter in an office environment.

The TCS-7000's base price of $1599 includes 1MB RAM, a Kamerman BIOS, a TEAC 1.2MB floppy drive, DOS 3.10, a socket for an 80287, a battery-powered clock/calendar, and the ubiquitous 80286 CPU with keyboard-selectable clock rates of 6 MHz and 8 MHz. A Seagate 20MB hard disk with an average access time of 40 ms will run you another $399, and a second 360K floppy disk drive tips the

register at $109. Given that hard disks are Kamerman's specialty, it's somewhat surprising that *Prepare,* a floppy full of hard disk setup and maintenance utilities, is offered as an option for an extra $40. Including the display adapter and a green version of the Tatung monitor discussed in the Club AT Plus 1800 review, this configuration would come to $2215.

Kamerman Labs' TCS-7000

The slot arrangement provides five 16-bit and three 8-bit slots, one less of the former and one more of the latter than the IBM AT. No punchouts or built-in ports grace the TCS-7000's backside, leaving the video board's parallel port as your only avenue to the outside world—unless you buy an I/O board. One full-height device can be mounted internally, and you can install three externally accessible half-height devices, thanks to the removable plastic trim below the two half-height floppy drives.

Generally, the TCS-7000 acted like an able-bodied AT clone, with an overall performance slightly behind that of the new 8-MHz IBM AT. The one exception to this smooth operation was the Behavior Tech keyboard, a Maxi-Switch look-alike without the DIP switches. Granted, I'm picky about keyboards, but to me Behavior Tech's little monster is anathema. Not only do the keys feel loose, but striking them

with less than lightning speed results in multiple characters. In exasperation I filched a spare Maxi-Switch.

Using the *Prepare* disk, initializing and formatting the hard disk proved effortless. In fact, aside from this procedure and copying DOS, the TCS-7000 required no setup at all. For those who get their options piece by piece, however, be forewarned: The manual you get may not be designed for the machine you've purchased. And because reconfiguring the TCS-7000 requires fiddling with jumpers all over the motherboard, rather than just flicking consolidated DIP switches, mismatched setup documentation can be dangerous. When I installed an enhanced color graphics board, for example, the manual advised me to move jumper J7 to pins 1 and 2. Jumper J7 wasn't even close to where it was supposed to be, leading to a frustrating search of the motherboard that finally required removal of the controller card. Another disappointment was the limited warranty: You get a mere 180 days' parts and labor, and you pay the shipping charges on defective merchandise returns.

If you're an experienced user looking for a deal, however, such drawbacks may not deter you. Aside from the scattered jumpers, the motherboard design looks clean, and high-quality components appear to be the rule. Moreover, this baby goes overboard on the sheet metal; among the machines reviewed, it wins hands down as an impenetrable fortress of computing power. Kamerman would be well advised to jump on the Maxi-Switch bandwagon, but other than that, the company seems to have found solid components on which to drape its banner. —*Eric Knorr*

TCS-7000
Kamerman Labs
7861 W. Cirrus Dr.
Beaverton, OR 97005
503/626-6929
List price: 1MB RAM and 1.2MB
  disk drive $1399; 20MB hard
  disk $399; 360K disk drive
  $109; additional 1.2MB floppy
  drive $159; Tatung amber
  monitor $169; Tatung
  monochrome display board
  $99; Prepare version 9.1 $40

Blackship AT

Thanks to Hewlett and Packard, Jobs and Wozniak, and others, the garage has been transformed from a repository for old junk, camping gear, and kids' bikes into a stamping ground for entrepreneurs. Seven years ago, Bruce Shapiro paid homage to this grand tradition by opening the garage door on Blackship Computer Supply, a mail-order floppy disk supplier. Currently enjoying a profitable affiliation with shareware purveyor PC SIG, Shapiro has moved up to hardware (and out of the garage), assembling no-name compatibles from name brand components.

The Blackship AT is the latest machine to emerge from Shapiro's not-so-small company (Blackship grossed $1.5 million in 1985). In appearance, the machine is modest to a fault: It's your basic big beige box, measuring 21 inches wide by 17 inches deep by 7 inches tall, with a little recess where the nameplate should be. Match the price tag with the quantity and quality of the components, however, and you're likely to forget about the machine's looks.

A mere $2199 nets you 1MB of NEC RAM on the motherboard, a monochrome monitor, a Behavior Tech keyboard, a Seagate ST4026 20MB hard disk, and a Toshiba 1.2MB floppy disk drive. The belly of this beast can hold one full-size and three half-height storage devices, and a total of eight expansion slots are provided, two of which are filled by a Western Digital controller and a Hercules-compatible video adapter. This leaves open one 8-bit and five 16-bit expansion slots, which are backed up by an awesome 220-watt power supply. An externally mounted switch on the machine's backplane enables you to switch between 6-MHz and 8-MHz clock speeds, and an adjacent button resets the box when <Ctrl>-<Alt>-<Del> fails. You also get six shareware programs from the PC SIG library: *Express Calc, File Express, Image Print, PC Deskmate, PC Prompt* (a DOS tutorial), and *PC Write*.

The motherboard includes a battery-powered clock/calendar, plus a socket for an 80287 coprocessor. Although two punchouts are built into the backplane, the only external connector supplied is the video adapter's parallel port. An optional board with one parallel and one serial port goes for $69; another interface board containing one parallel port, two se-

rial ports, and one game port sells for $89 and takes up two slots.

If you're into ergonomics, you should find the Blackship AT's 14-inch Quimax monitor a delight. Mounted on a tilt-and-swivel pedestal, the monitor provides slightly larger characters than IBM's monochrome display, with no perceptible sacrifice in resolution. However, turning off the monitor when your system is still on produces an alarming side effect: Your system crashes.

Setting up the Blackship AT is a matter of unpacking the components and plugging them in. That's fortunate, because the user's guide provides no setup instructions, apart from describing how to install disk drives and expansion boards. Moreover, two of the manual's four chapters are written as

The Blackship AT

though tutorial and diagnostic software come with the package—which they don't. To top it all off, Blackship fails to provide either DOS or BASIC. If you don't already own them, you can purchase DOS 3.20 and GW BASIC from Blackship together for $89.95. Once you've copied DOS onto your hard disk, a setup utility provided by Phoenix Software Systems (makers of the Blackship AT's ROM BIOS) guides you through initializing your system.

Blackship's one-year warranty inspires confidence, especially when compared to IBM's meager 90-day offering. The warranty includes parts and labor through Data Bank, an established computer manufacturer and service company. Should your AT

clone break due to defects in workmanship or design, Blackship offers one of three solutions: Blackship will send you a new part, you can send your machine to Data Bank for repair, or you can take the computer into one of Data Bank's 130 affiliated service shops nationwide. In addition, Blackship will refund your money for any reason within 30 days of purchase. A year's worth of technical support is included in the selling price, and you can obtain an extended service contract for $250 per year, including parts and labor.

> *Blackship's one-year warranty inspires confidence, especially when compared to IBM's meager 90-day offering.*

The Blackship AT has so much to offer, you have to wonder about Shapiro's profit margin. In addition to the brand name goodies, the externally accessible reset and clock switches, and an exceptional monitor, you get a bunch of shareware to play with, plus a warranty that matches the best of 'em. Even though you have to struggle through incomplete documentation (and turn off your monitor only when powering down), the Blackship AT is still a good deal. —*Anita Amirrezvani*

Blackship AT
Blackship Computer Supply
385 Oyster Point Blvd. #10
San Francisco, CA 94080
800/431-6249, 415/942-1996
California
List price: $2199; parallel/serial interface board $69; multi-I/O board $89; color board free in exchange for monochrome board, EGA board $269; NEC MultiSync monitor and EGA board $850; 360K disk drive $110; additional 1.2MB floppy drive $169; Intel 80287 $298; DOS 3.10 and GW BASIC $89.95

PC Designs ET 286i

In the current war among AT compatibles for a piece of IBM's turf, the fighting words are all about who's fastest, cheapest, smallest, most compatible, and most reliable. For serious business users, though, the differences are largely incremental—a slightly faster clock, a slightly smaller footprint, a slightly lower price. All in all, it seems rather a phony war.

Now PC Designs has taken the fight to a new front with the ET 286i, a machine that enters the fray as both a cost-effective multiuser host and a single-user workstation for high-end applications. The 286i integrates three serial and two parallel ports and 4MB of memory directly into the motherboard, leaving expansion slots (and purchase power) free for networking boards, extra memory, coprocessing systems, or additional I/O boards. For scientific, engineering, or high-transaction business environments, a fully configured 286i could wipe the competition off the map.

On specs alone the 286i looks pretty impressive. For $2400 you get 1MB of RAM, a Princeton MAX-12 monochrome monitor, a Maxi-Switch AT/XT switchable keyboard, and a choice of a 360K or 1.2MB Fujitsu floppy drive with a Western Digital controller card. Like IBM's AT, the machine is equipped with a 192-watt power supply and a total of eight expansion slots, two of which are occupied by the controller and a monochrome video display board. In the 286i, the latter board is an Everex Hercules-compatible model that adds an extra parallel port to the system. A NEC MultiSync color monitor is available for $425, and you can obtain an EGA clone for an additional $175.

All told, the 286i can hold a maximum of one full-height and three half-height devices. A variety of name brand hard disk drives, with capacities of up to 72MB, are available from PC Designs, including units manufactured by Seagate, Priam, and Bell Technologies. (The system under review included a $495 20MB Seagate hard disk.) The motherboard is socketed for an 80287 math coprocessor and for 1-megabit RAM chips, as well as to permit users to swap the existing 128K BIOS from Access Methods for one as large as 256K. You can select between 6-MHz and

10-MHz CPU speeds from the keyboard, and the vendors claim that the system will support 12-MHz 80286 chips (toggling between speeds is accomplished using <Ctrl>-<Shift>-<Alt>-<Del>—a bit too close to the reset key-combination for comfort). A battery-powered CMOS RAM chip stores clock, calendar, and system configuration information from the BIOS setup routine.

With this much power and a bevy of name brand components at your fingertips, the 286i looks and feels like a solid, well-built monster machine. In fact, so much power and flexibility reside under the hood that business users who are looking for only a little extra speed and memory should think hard

PC Designs' ET 286i

about the kind of support they'll need to back up their purchase. As big and strong as the 286i is, it's also pretty mean to set up and configure.

Not that the folks at PC Designs aren't trying. The product comes with a 30-day money-back guarantee and an additional one-year warranty on parts and labor. Furthermore, the company runs a toll-free technical support line that's available during business hours without long delays. But until this year, PC Designs sold kits mostly to buyers ambitious enough to assemble their own working units, and the documentation and system design still reflect this approach.

Nothing in the photocopied user guide would inspire a novice's confidence, although most of the information is generally accurate enough to the trained eye. For example, to install an internal modem, the manual instructs you to disconnect pins 1 and 2 on jumper J32 to allow the computer to recognize the modem as COM1:, but it omits to say that you must also disconnect pins 11 and 12 on jumper J17. In other cases the manual is just plain wrong. At one point it states that the BIOS setup data can be re-initialized only by turning off the system, popping off the lid, removing the clock battery for several minutes until the charge in the CMOS RAM chip is depleted, reassembling the unit, and restarting—a drastic procedure just to change the time on the system clock. In actuality, turning the machine off and then on again and pressing the <Del> key at the prompt enables you to edit setup information.

Some design flaws exist in the 286i, although they may not be as serious as they look. One glance at the patch wiring on the motherboard, for example, sends chills down the spine. PC Designs admits that there were serious problems with systems released in early 1986, but once the bugs were worked out, PC Designs sent a letter to all early purchasers offering to replace defective boards. The company now claims smooth sailing with improved boards sold over the last several months. During actual use, the 286i ran at 10 MHz without problems.

For users who need the 286i's power and upgrade potential—and have the technical backup or personal expertise take advantage of it—PC Designs' somewhat quirky offering could be the way to go. Not so for the less technical-minded user, who can't depend on third-party or in-house services to fix problems, make adjustments, or monkey with an overabundance of jumpers. The 286i is a monster clone for the money, but you'd better be prepared for its care and feeding. —*Richard Landry*

ET 286i
PC Designs
11105-B E. 56th St.
Tulsa, OK 74146
918/252-5550
List price: $2400, Seagate 20MB
  hard disk $495; NEC
  MultiSync Monitor $425;
  Toshiba 360K floppy disk drive
  $110, Toshiba 1.25MB floppy
  disk drive $165

PC Source Standard-286

Mail-order computers can be either a boon or a bane: a windfall if you get a genuine deal, a disaster if you're stuck with shoddy workmanship, scant support, and a slippery return policy. As you flip through the back pages of PC tabloids and add up options with your credit-card-size calculator, you know it's going to take guts to call that 800 number, whichever machine you select.

When you first open the PC Source packing crate, all the mail-order horror stories you've ever heard come rushing to mind. Instead of the Standard-286 you ordered, there's something in there called the PC Master. A quick phone call to Austin verifies that the PC Master—manufactured by the

PC Source's Standard-286

CAF Computer Corporation of Taipei, Taiwan—is indeed the Standard-286, and vice versa. They just don't bother to change the labels.

With the machine's identity established, you'll find all the features promised by the unit's $1395 base price—an 8-MHz 80286, 640K RAM, a 1.2MB floppy disk drive, a hard/floppy disk controller, a Behavior Tech keyboard, a battery-powered clock/calendar, diagnostic software, and a copy of MS-DOS 3.1. For the unit reviewed here, the $109 360K floppy disk drive, the $549 20MB Computer Memories hard disk, and the $99 Hercules-compatible graphics

board for the $159 Quadram Amberchrome monochrome monitor bring the price to $2311. Of all the machines in this roundup, the Standard-286 has the greatest number of Taiwanese components, in this case manufactured by the obscure CAF Corporation; only the hard disk is American-made. The BIOS and keyboard are also from Taiwan, made by Electronic Research & Service Organization and Behavior Tech, respectively.

The system unit chassis has a footprint identical to that of the IBM AT. The machine's most distinguishing characteristic—and the best way to recognize it in mail-order ad photos, no matter what the distributor calls it—is the vertically aligned recess containing the keyboard lock and indicator lights. Below this birthmark is a handy reset button, also recessed.

Beneath the box's exterior you'll find enough room for five half-height devices; a removable plastic insert beneath the two half-height floppy drives enables up to three half-height devices to have frontal exposure. An ample power supply tips the scales at 220 watts, and like the Kamerman TCS-7000, the standard-286 offers five 16-bit and three 8-bit expansion slots. There is a socket for an 80287 coprocessor, but no ports are built in to the motherboard. And you won't find punchouts on the backplane, which means any external connections (other than to the video board's parallel port) require an I/O expansion board.

Setup is simple. Find an outlet, take the Standard-286 out of the box, and plug in the monitor. The succinct but reasonably informative user guide provides step-by-step instructions for formatting the hard disk and installing DOS. There's even a three-picture photo essay on how to unpack the machine from its cardboard box. The manual also contains detailed explanations of how to install such options as a 360K floppy disk drive or a hard disk onto the system. A diagnostics disk enables you to configure your system for current memory capacity and peripherals, as well as to perform tests that determine what ails your system when it's down.

Of course, PC Source hopes its customers suffer little if any downtime. Nevertheless, the system's price tag includes a one-year warranty that covers parts and labor, although you must foot the bill for shipping an injured unit back to Austin. PC Source claims a 72-hour turnaround on repairs, and toll-free technical support is available.

> **The PC Master—manufactured by the CAF Computer Corporation of Taipei, Taiwan—is indeed the Standard-286, and vice versa. They just don't bother to change the labels.**

Not too long ago, the Standard-286's price alone would have made it an amazing deal. Compared to some of the other bargains in this roundup, it stacks up well if cost is the only consideration; but it's missing some significant features, such as built-in ports and a switchable clock. The machine also offers the fewest name brand components; forget that PC Source can't muster the resources to paste their own nameplate over the CAF logo. That kind of lapse makes you wonder how both the system and its vendor will fare a year from now. —*Wes Nihei*

Standard-286
PC Source
12303-G Technology Blvd.
Austin, TX 78727
512/331-6700
List price: $1395; Computer
 Memories 20MB hard disk
 $549; Standard 360K floppy
 disk drive $109; Quadram
 Amberchrome monitor $159;
 Standard Monographic Card
 $99; Standard I/O $99

■ And the Winners Are ...

As you may have noticed, there's a ringer in this clone competition: the PC's Limited 286^{12}. Despite its generic name, PC's Limited is emerging as a vendor of stature as it inaugurates significant technical innovations and begins manufacturing its own machines, expansion boards, and peripherals. In the Raw Speed category, the 286^{12} wins hands down. However, if the machine's inability to run *Framework I* is any indication, the 286^{12}'s BIOS could stand another revision.

In the Fabulous Deal department, there's little competition. Club AT's AT Plus 1800 is approximately $200 cheaper than any similarly configured clone in the roundup, delivering 512K RAM, a monochrome monitor and graphics adapter, a floppy/hard disk controller, plus one 1.2MB and one 360K floppy disk drive for an eye-popping $2000. The most surprising aspect of this bargain machine is the abundance of quality Everex components.

If, after all this, you still can't brook the notion of a nameless-brand machine, one final point bears consideration. AT-compatibles from well-known manufacturers are often heavily discounted by dealers, which occasionally puts sale-priced, famous-brand units within striking distance of the more expensive no-name machines. Should you go this route, however, remember to give credit where credit is due. For wherever there's price-slashing, you'll find mail-order clones on the cutting edge. ⬣

Harry Miller is Editor of PC World, and Karl Koessel is Technical Editor, Eric Knorr is Associate Editor, Anita Amirrezvani is Assistant Editor, Richard Landry is Managing Editor, and Wes Nihei is the Editorial Assistant for PC World.

Of MISys and Management

Incorporating
many of the features
of expensive MRP
software, MISys
provides computerized
inventory control to
small manufacturers
at a small price.

Robert J. Popp

David Suter

PC-based materials require-
ments planning (MRP) soft-
ware is the hottest new product
on the assembly line. Aimed at
streamlining operations, MRP
software helps manufacturers
monitor and fine-tune the produc-
tion process from purchase order
to final shipment (see "PCs Gear
Up for Manufacturing" in this is-
sue). At a cost of $15,000 to
$20,000, however, even PC imple-
mentations of MRP may be be-
yond the reach of the small-to-

medium-size manufacturer. With
average sales of 1 to 3 million dol-
lars, these manufacturers have
processes and scheduling and de-
livery cycles that are relatively un-
complicated. For such businesses
*MISys Manufacturing Inventory
System* from Microcomputer
Specialists offers a smart compro-
mise between MRP and manual
systems.

Brave New Inventory

Unlike a full-fledged MRP program, which compiles integrated sales, manufacturing, and financial reports from a common data base, *MISys* takes an essential function of an MRP system—inventory control—and wraps it up in a compact, $995, menu-driven program scaled to the needs of the small- or medium-size manufacturer. *MISys* produces bills of material (BOMs) that itemize the components making up a finished product (or assembly), as well as stock checks that determine what parts and products are in inventory. *MISys* offers 27 reports to help you analyze stock needs (materials requirements), plus standardized and custom purchase orders to keep the production process rolling. For financial and marketing analyses, *MISys* integrates Computer Associates' *EasyBusiness* general ledger and sales inventory programs, and produces ASCII files that can be exported to any willing spreadsheet or data base.

MISys is geared for use on a single PC or in a network, with different departments providing data to the program. In either case, start-up time for *MISys*'s menu-driven system is far less than the 18 to 30 months generally required for an MRP system.

What you don't get from *MISys* is the depth and breadth of MRP. While its recording and reporting capabilities are thorough, *MISys*'s built-in planning features are limited. It cannot anticipate shortages or automatically adjust to changes in production demand over time, nor can it deftly interpret the relationships of nested assemblies (subassemblies within assemblies).

Unlike the manual and reactive inventory system it replaces, *MISys* is proactive. It provides a computerized data base that tracks bills of material and inventory records, analyzes production requirements, and identifies shortages. However, it is largely up to you to interpret the results and determine your—and *MISys*'s—next move. With a little ingenuity, *MISys* can be made to simulate many of the planning features of a $15,000 MRP system.

For the manufacturer moving out from under a manual inventory sytem, *MISys* is a leap into an efficient and neatly ordered world. With its well-oiled software up and running, you have a fighting chance to eliminate the headaches of inventory control. Hot lists and shortage lists, late orders, invalid due dates, and unplanned overtime may become memories.

Data Central

The heart of *MISys* is its data base. Comprising six integrated files that store information on individual inventory items, assemblies, parts vendors, purchase orders, purchase order histories, and job orders, the data base provides information required for *MISys* to calculate stock and costing reports, perform "what if" simulations, and churn out purchase orders. Using menu selections, you can display a file's contents and easily make additions, deletions, or modifications to the data base.

The item file is an inventory of your inventory. In it you identify

every component of the production process—each raw material, purchased or fabricated part, work in progress, finished good, unit of labor, and work center—with a unique alphanumeric code up to 12 characters long and a description up to 30 characters long. Each item's record contains up to 35 pieces of information, including stock locations and levels, lead times, order quantities, standard and average costs, and up to 5 approved vendors (see Screen 1). The only thing lacking is the ability to identify multiple stock locations for a single inventory item.

The Assembly File lists bills of material, which describe the individual inventory items required to create a finished product. One of its better features enables you to clone and modify an existing BOM if you produce several products with only slightly different specifications.

Although one BOM can contain only 128 items, any of those 128 items can be a separate subassembly containing its own 128 items, and so on until you run out of disk space. The problem with this system is that *MISys* can only analyze (or explode) a bill of material at a single level (see Figure 1). You must scrutinize subassemblies separately, even though they are listed as items in a larger assembly.

MISys is not designed to manage labor or routing requirements, but you can simulate these functions by entering labor and work location details as items in a bill of material and as "parts" in the item file. For example, along with the material components that go into building a computer keyboard, you might add "0.5 hour labor" and "work station #4." The data

```
MICROCOMPUTER SPECIALISTS, INC                        Date: Aug 27 86
MISys Manufacturing Inventory System 2.0.6                      1:MI2
Item Inquiry

Item:        [111        ] CABLE, POWER UL/CSA 3-PR 6 FT.
Reference:    989823F4      Order Lead Time: 34
Pick Sequence: F45          Inventory Cycle: 21
Assembly:                   Sales Inventory:    -    -    -

----- Stock Levels ----   ------ Lot Costs -----   ----- Stock Status ----
Minimum:          50      Std.Mat.:      3.45      On Hand:          1703
Maximum:        1000      Std.Lab.:       .56      Committed:           0
Reorder:         250      Std.Ovh.:       .12      On Order:            5
Order Qty:       500      Recent:        3.50      Last Use: 06/28/85
Lot Size:          1      Avg.Mat.:      3.48      Use Count: 1
                         Avg.Lab.:       .24
                         Avg.Ovh.:       .05

Activity Monitor 1: ACTIVE     Volume:          0   Days: 413
                 2: INACTIVE   Volume:              Days:
                 3: INACTIVE   Volume:              Days:

Press RETURN for Screen II, ESCAPE for Next.
```

Screen 1: The item file keeps track of all parts in inventory. Its activity monitor keeps daily tabs on each inventory item and notes when material transfers cause its quantity on hand to drop.

gets treated in the same manner as raw materials and will appear as components of a *MISys* stock check report.

The vendor file contains 19 descriptors for any number of parts suppliers. The file covers fixed data, such as name, address, company contact, and terms; and variable data, such as year-to-date purchases, overdue orders, and latest activity. Each inventory item can list up to five vendors, a ceiling that won't constrain most small manufacturers.

MISys's remaining data base files provide the data required for processing purchase orders, a cumulative log of all purchase orders, and information necessary to produce job status and costing reports.

Traffic Control

MISys's material transfer function acts like an inventory traffic cop, enabling you to record the movement of parts in and out of stock. Unlike on-line systems used by many MRP programs, *MISys* uses a batch file system that forces you to wait for transactions to be manually collected, entered into the system, and posted.

Eighteen menu choices let you designate the type of transfer to be recorded (see Screen 2). You can run "what if" simulations by posting a temporary trial batch against inventory without permanently affecting your records. In this way you can test the outcome of, say, a plan to increase production by 100 units. Potential stock shortages or other problems will show up when you prepare a stock check report (a report that tracks the effect on inventory of a potential or actual material transfer). *MISys* generates a posting journal, or audit trail,

once you permanently post a batch.

MISys includes functions that assist periodic (cycle) and one-time (total) manual inventory counts. The program generates worksheets for the physical count and produces inventory variance reports, which compare *MISys*'s records to the results of the physical count; you can reconcile *MISys*'s data base by posting the results of the physical count as if they were normal material transfers.

A Roomful of Reports

MISys takes its barrage of data and presents you with 27 reports, each of which can cover a selected range of material sorted in a number of ways (see Figure 2). You choose fully detailed printed reports or on-screen or printed summaries. Although Spartan looking, the detail reports are packed with information that helps you exert control over even the most elusive parts of your inventory.

Foreseeing the Future

MRP systems excel at anticipatory analyses: production plans establish a rate of production, master schedules "time-phase" production quantities over any designated period, and rough-cut capacity analyses foresee overloaded machines and work centers. *MISys* provides the raw data for these processes, but because it does not perform time-phased (or forward) planning, you must interpret the results of its reports, create production plans and schedules manually, and adjust your inventory accordingly. To simulate a time-phased system,

```
Date: Oct 03 86   MICROCOMPUTER SPECIALISTS, INC                                    MI2  Page:

Exploded Bill of Material

Assembly         Item or Sub-Item           Description                    Quantity V  Days PrtRef Sub-Assembly
               1 2 3 4 5 6 7 8 9 10 (level)

A01                                          ASSEMBLY, COMPLETE COMPUTER G7
        143                                  ASSEMBLY, COMPLETE COMPUTER G7      1                     A01
          140                                ASSEMBLY, COMPLETE KEYBOARD         1       0 KBD1        A04
            120                              COVER, DISPLAY MOLDED GRAY          1       0 COV5
            116                              PCB, KEYBOARD ASSEMBLY              1       0 KBD3
            112                              KEYCAP, 1X1 WHITE                  78       0
            113                              KEYCAP, 1X1 GRAY                   33       0
            114                              KEYCAP, 1X2 GRAY                    6       0
            115                              SPRING, KEYCAP RETURN 3.5 OZ.     117       0
            102                              SCREW, 6-32 X 1.50 SSPH             4       0
            108                              NUT, #6 HEX SS                      4       0
            109                              CABLE, KEYBOARD COILED 6 FT.        1       0 CBL2
          141                                ASSEMBLY, COMPLETE DISPLAY          1       0 DSP1        A03
            121                              COVER, KEYBOARD MOLDED WHITE        1       0 COV3
            132                              DISPLAY, 11 INCH HI-RES P42         1       0 DIS1
            133                              KNOB, BLACK ABS 0.25 SHAFT          2       0
            103                              SCREW, 8-32 X .25 SSPH              4       0
            107                              NUT, #8 HEX CAP SS                  4       0
            110                              CABLE, VIDEO MONITOR 3 FT.          1       0 CBL3
          142                                ASSEMBLY, COMPLETE PROCESSOR        1       0 PRO1        A02
            122                              COVER, 3405 BEZEL WHITE             1       0 BEZ1
            123                              COVER, PROCESSOR MOLDED GRAY        1       0 COV1
            138                              PROCESSOR, PC-8088 MOTHERBOARD      1       0 PRO1        A06
              118                            PCB, CENTRAL PROCESSOR BLANK        1       0 PCB6
              127                            IC, 74LS04 HEX INVERTER             3       0
              126                            IC, 74LS244 3-STATE DRIVER          2       0
              128                            IC, 74LS00 QUAD NAND GATE           5       0
              129                            IC, 8088-2 MICROPROCESSOR           1       0
              134                            CAPACITOR, 15MF/50V 150D            4       0
            124                              DRIVE, FLOPPY 48TPI DSDD            1       0 FDD1
            124                              DRIVE, FLOPPY 48TPI DSDD            1   1   0 FDD2
            125                              DRIVE, HARD DISK 20MB               1   2   0 HDD1
            131                              CONNECTOR, 25-PIN D-TYPE MALE       3       0 J1-3
            102                              SCREW, 6-32 X 1.50 SSPH             4       0
            104                              WASHER, #6 EXTERNAL TOOTH LOCK      4       0
            108                              NUT, #6 HEX SS                      4       0
            101                              SCREW, 4-40 X 1.50 SSPH             6       0
          111                                CABLE, POWER UL/CSA 3-PR 6 FT.      1       0 CBL1
          135                                CARTON, 4500 TRI-WALL               1       5 BOX1
```

Figure 1: Although an exploded bill of material (BOM) report identifies all subassemblies that make up a larger assembly, you must run separate calculations at each level to identify shortages, overruns, and delays.

you must run "what if" simulations for each future period (Week 1 and Week 2, for example) that you want to scrutinize. Microcomputer Specialists plans to provide time-phased planning, production scheduling, and cost roll-up (cumulative production cost) functions in a version of *MISys* to be released in 1987.

MISys is not a job costing system and will not produce reports that project job costs, prepare bids, or detail actual job costs. At best, its job reports record standard costs rather than actual costs. For this reason, *MISys* is not recommended for job shops—manufacturing operations that produce small batches of one-of-a-kind products. Instead, it is appropriate for manufacturers that produce large numbers of a unique product or modified versions of a standard product.

■ **Fancy Footwork**
With a little footwork, you can fool *MISys* into simulating some MRP planning functions. For example, if you include labor units and work center locations as items on a bill of material, and then list their on-hand quantities in the item file as zero, *MISys*'s shortage report will identify your staffing requirements and work center load profiles—an approximation of a sophisticated rough-cut capacity analysis. By the same token, you can work around *MISys*'s inability to peg material allocation to specific work orders by giving different identification numbers to identical inventory parts. For example, parts #1234-01 and #1234-02 might refer to one part (#1234) pegged to work orders 01 and 02.

```
MICROCOMPUTER SPECIALISTS, INC                    Date: Aug 27 86
MISys Manufacturing Inventory System 2.0.6              1:MI2
Enter/Edit Transfer Batch

Batch Entry: [23  ] of 22      Transfer Date: [08/27/86]

Select Transfer Type: [A]  Dispense On Hand

   A. Dispense On Hand      G. Assemble from On Hand      M. Receive from Vendor
   B. Dispense Committed    H. Assemble from Committed    N. Return to Vendor
   C. Return to On Hand     I. Disassemble to On Hand     O. Transfer from Sales
   D. Return to Committed   J. Disassemble to Committed   P. Transfer to Sales
   E. Commit Items          K. Commit Assembly            Q. Remove Items
   F. Decommit Items        L. Decommit Assembly          R. Void Transaction

   Item:     [111    ] CABLE, POWER UL/CSA 3-PR 6 FT.
   Comment:     [issue to department 12 29 Aug ]
   Quantity:    [       500]
   Job Number:     [1233 ]

   Sales Inventory: [    -    -    -    ]
```

Screen 2: Material transfer batches update
inventory records. You can post trial batches
without permanently updating inventory records.

Stock list	Pre-order report
Stock check	Outstanding order report
Shortage report	Overdue order report
Excess report	Purchase order history report
Unused item report	Vendor list
Item valuation report	Vendor product report
Cost variance report	Vendor performance report
Activity report	Job status report
Variance valuation report	Job cost report
Assembly report	Transfer check journal
Exploded bill of material	Transfer posting journal
Costed bill of material	Inventory check journal
Where used report	Inventory posting journal
Assembly pick list	

Figure 2: MISys's 27 reports. Records in each
report can be limited to a range of inventory items,
reference numbers, or pick sequences and can be
sorted in ascending or descending order.

Purchase Orders

Once you have identified stock shortages through a stock check report (see Screen 3), you can generate purchase orders. After calling up *MISys*'s purchase order function from the main menu, you enter a purchase order number up to six characters long, the appropriate vendor number, and the code for the item you want to order. *MISys* refers to the vendor file and warns you if the chosen vendor is not qualified to supply that item. The program refers to the item file for item description, lot size, typical order quantity, and most recent cost. You can accept or change the defaults and modify or delete entire purchase orders up until the time you actually print the order. The order forms follow a default format designed for preprinted forms from NEBS Computer Forms of Townsend, Massachusetts, or you can create up to 36 order form templates. When you print or confirm a filled purchase order, *MISys* generates a material transfer batch that, once posted, indicates to the item file the status of the order.

The only problem with the purchase order system is that it's not fully integrated with other *MISys* functions. Although the purchase order file displays relevant data gleaned from the item file, once you've entered an item number you cannot call up the appropriate purchase order information directly from, say, a report that warned you of an impending shortage. Instead, you must exit to the main menu, call up the purchase order function, and key in the appropriate purchase order, vendor, and item numbers.

Links to Organized Finance

Although *MISys* does not perform financial operations, its ASCII files can be exported to spreadsheet and data base programs. They can also be transferred directly to and from Computer Associates' *Easy-Business* general ledger and sales inventory accounting modules—the *EasyFiler* data base program, the *EasyPlus* windowing system, and the *EasyPlus* network manager. Integration with *Easy-Business* is straightforward: *MISys* menus follow *EasyBusiness*'s format exactly and include two functions, Consolidate and Print G/L and Update Vendor File, that you use to transfer files directly in and out of *EasyBusiness* programs. Although you don't need the *Easy-Business* system to use *MISys*, the integrated package's common data base offers greater control over a wide range of business operations. Potential *MISys* purchasers should consider tying into *EasyBusiness* even if they already use a computerized accounting system.

Easy Access

MISys is carefully designed for a small staff with little technical expertise. Its menus are consistent and its manual, tutorial, and evaluation disks are straightforward. Brief explanations of inventory management concepts accompany the manual's descriptions of menu functions. Error handling is thorough, and it catches all data entry errors that don't fit the program's logic. For instance, the system alerts you if you enter nonexistent field names or numbers, try to create an al-

ready existing item, or try to delete an inventory item or assembly needed elsewhere in the system. (Of course, no program is immune from a determined error-enterer. If, for example, you enter the wrong quantity of an item, *MISys* will not question your intent.)

You can create ID numbers and passwords for all authorized users and establish privilege codes for each user, authorizing full, partial, or no access to any or all of *MISys*'s 13 major functions.

The Sum of Its Parts

MISys is not the most elaborate manufacturing inventory system available, but for $995 it's one of the best deals going. Its lack of full integration forces you to run separate calculations and study separate reports for BOMs with more than one level of assembly complexity. And you can't jump from one menu function to another without rekeying basic information. For the small-to-medium-size manufacturer, though, *MISys* may be more appropriate than an MRP system. It doesn't match the

planning capabilities of its higher-priced MRP cousins, but you can interpret your own results from its raft of reports or improvise MRP planning functions. For the manufacturer whose manually controlled inventory resembles a wildly fluctuating sea, *MISys* is a port in the storm. ◉

Robert J. Popp is a manufacturing materials and distribution management consultant in Easton, Connecticut.

MISys Manufacturing Inventory System
Microcomputer Specialists, Inc.
18 Lyman St.
Westborough, MA 01581
800/833-1500, 617/366-1200
List price: $995
Requirements: 128K, 10MB or larger hard disk, DOS 2.00 or later version, 132-character-wide printer
Not copy protected

```
MICROCOMPUTER SPECIALISTS, INC                              Date: Oct 07 86
MISys Manufacturing Inventory System 2.0.5                        0:M12
Stock Check

Item     Item Description              Available    Needed    Short
101      SCREW, 4-40 X 1.50 SSPH           4160      4000      640
102      SCREW, 6-32 X 1.50 SSPH           5774      3200
104      WASHER, #6 EXTERNAL TOOTH LOCK   43464      3200
108      NUT, #6 HEX SS                   17484      3200
122      COVER, 3405 BEZEL WHITE           2210       800
123      COVER, PROCESSOR MOLDED GRAY       625       800      175
124      DRIVE, FLOPPY 48TPI DSDD           341      1600     1259
125      DRIVE, HARD DISK 20MB               81       800      719
131      CONNECTOR, 25-PIN D-TYPE MALE      477      2400     1923
138      PROCESSOR, PC-8088 MOTHERBOARD     363       800      437


Press ESCAPE to Exit.
```

Screen 3: A stock check lays bare the effect a proposed or actual production has on inventory.

Easing Into CAD

For those who don't want to go into hock over their first CAD package, EasyCAD offers respectable drawing muscle plus a few surprising features usually found only in packages ten times the price.
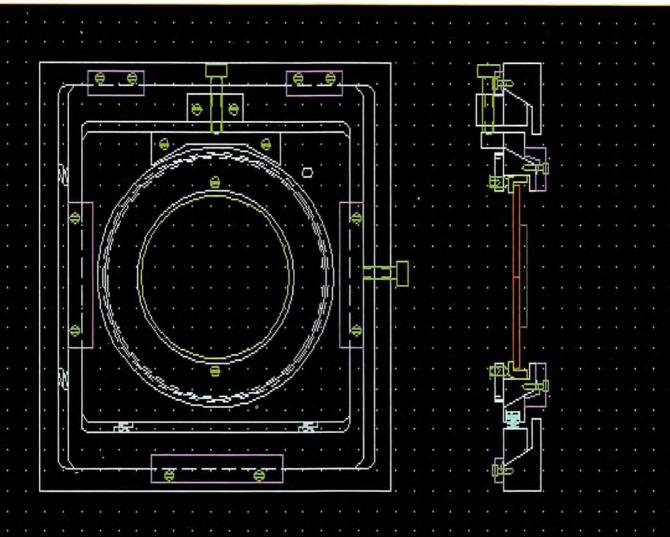
Steven Lord

▌▌▌▌ So you've been itching to chuck your drafting board and move up to CAD, but the price of admission for programs like *Personal Designer* or *Anvil-1000MD* is just too steep. On the other hand, you don't want to settle for one of those low-ball packages—some have a few nice drawing features, but they lack the text and dimensioning capabilities you require. What you crave is a reasonably priced product that's easy to master and has enough power and flexibility to accommodate 90 percent of your drafting needs.

EasyCAD, an entry-level, two-dimensional drafting program, delivers a healthy slice of drafting functionality. Priced at just under $500, this unpretentious program is authored and marketed by Evolution Computing, with additional distribution by T&W Systems, producers of *VersaCAD Advanced,* one of the leading high-end CAD packages for the PC.

EasyCAD's most outstanding feature is associative dimensioning—that is, when you stretch, shrink, rotate, or scale entities in a dimensioned drawing, arrows and leaders follow along and dimensions change accordingly. Usually found only in high-end packages, associative dimensioning is an immense time-saver whenever major changes are required.

Another strong point is *Easy-CAD's* excellent user interface. A straightforward command set combined with pull-down menus makes this program a pleasure to learn and use. With pointing device in hand, you seldom need to touch the keyboard except to enter coordinates or press a function key. Indeed, the command structure seems so elementary you might be tempted to dismiss *Easy-CAD* as a toy. But once you've fully explored the menu tree—and especially when you begin customizing the command set and creating your own symbol library— you'll discover the power behind this program's beguiling exterior.

Screen 1: In this typical mechanical layout created with Easy-CAD, the drawing layer that holds dimensions and labels has been hidden. Multiple colors within a single layer make it easy to differentiate mechanical elements.

Setting Up Shop

EasyCAD's installation procedures are menu-driven and virtually foolproof. The program's freedom from copy protection makes backups and hard disk installation trouble-free. The hardware configuration process enables you to change drivers for a new video card, input device, or plotter without repeating the entire installation routine.

When you start *EasyCAD,* a single menu line across the top of the screen and a command line along the bottom define a capacious drawing area. Unlike some programs that invert the *y*-axis, screen coordinates and angles are set up as a normal Cartesian system. A coordinate's origin may be redefined at any time, and relative and polar coordinates are available on demand.

Using a mouse or a digitizer puck, you access *EasyCAD*'s pull-down menus with a click of either

device's left button. Many users may find pull-down menus preferable to the common columnar menu format, which occupies about one-fifth of the screen's drawing space. With a little practice, you can pluck almost any command from the pull-down menus in one or two seconds.

To prepare the screen for drawing, you begin by choosing an initial working layer from among the 31 available. You then have a choice of 16 line colors and 8 line styles; grid spacing can be set for any increment. The defaults are layer number 1, solid green lines, and no grid. Options include snap-to-grid (snap spacing is independent of grid spacing), orthogonal lines, cursor coordinate display, and the ability to lock or unlock grouped entities.

With *EasyCAD,* you normally draw at full scale, where one dimensionless unit equals one working unit of your choice. The program offers a choice of inches, feet, millimeters, or meters; and you can convert one type of dimension to another in existing drawing files. If none of these standard units is acceptable, the working unit can be made to equal any number of inches. *Easy-CAD* has a full floating-point data base, so entity sizes can range from any small fraction of a unit to millions of units within the same drawing.

The command set for controlling *EasyCAD*'s working window is remarkably thorough. The program offers two ways to pan, one redraw command, and eight ways to zoom (including by window, by factor, and to a specific view). You

can hide or show any or all of the 31 working layers (see Screen 1) and name four areas of the same drawing as separate views, each of which can be summoned with a single command. A handy status screen lists active and hidden layers, drawing extents, current color and line styles, and various attribute settings. This screen is particularly useful if you use a monochrome system, because it's far too easy to lose track of layers or hues while you work.

Interestingly, due to an apparent effort to make the menus less intimidating to beginners, not all of *EasyCAD*'s commands are immediately accessible. Aside from the documentation, the only evidence of some commands is their file names, which are interspersed with the rest of the program's command names in a master file. *EasyCAD* provides a simple procedure for inserting such commands in pull-down menus; you can also invoke commands using the program's extensive macro facility.

EasyCAD's macro features help put it on a par with big league packages. Creating macro command strings can make setting up a drawing environment or executing complex drawing routines a two-key affair. You create macros by editing the master command file with any text editor or word processor, and you can tie these command strings to as many as 40 user-defined key combinations.

▮ Tools for Drawing

EasyCAD's drawing functions resemble those of many other CAD programs. You simply select a drawing command, place the cursor at the desired starting position, and click the left button on a puck or mouse to begin
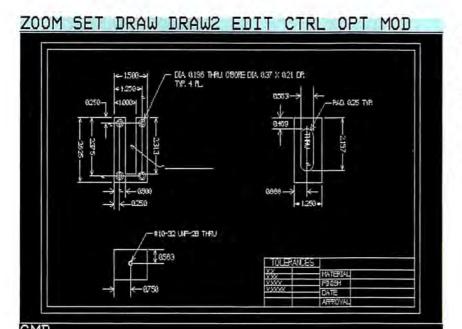
drawing. Alternatively, you can enter absolute, relative, or polar coordinates using the keyboard. Pressing the right mouse button (or <Enter>) terminates most commands, and the program automatically repeats the last command if you click any pointing-device button twice.

EasyCAD's basic drawing elements include 11 geometric entities: point, line, box, polygon, smooth polygon, spline, two types of circles, and three types of arcs. Three standard dimension types and two text types round out the set. Within one drawing layer, you can assign any color or line style to any of these elements.

EasyCAD provides a separate menu of commands, called modifiers, that alter the way basic drawing commands behave. The modifiers allow you to draw lines that are parallel, perpendicular, or at a fixed angle to any given line. Furthermore, you can use modifiers to connect the end point of a new line to the end point, center point, midpoint, or variable point of an existing entity.

In addition to helping you draw certain geometric constructions, modifiers are valuable because they enable you to join lines and dimensions accurately despite limited screen resolution. Without modifiers, it would be easy to create a drawing that appears correct when viewed as a whole but that actually has small mismatches that are evident only when you zoom in—or worse, after plotting.

Another powerful *EasyCAD* feature lets you call in predrawn entities to be scaled, rotated, and positioned as desired (see Screen 2). For example, if you want a flange readily available for several

CMD:

Screen 2: A simple detail drawing created with EasyCAD. Dimensions, borders, and part outlines are each on a separate drawing layer that can be switched on or off as desired. The border and title block are predrawn patterns imported from another drawing.

different mechanical drawings, you draw it, store it as an ordinary drawing file, and then copy it into other drawings as needed using *EasyCAD*'s Part command. With this feature, you can create a convenient library of symbols or parts.

Although *EasyCAD*'s command set has some agreeable surprises, it lacks a few useful elements when compared with *Anvil-1000MD* or *VersaCAD Advanced*. True ellipses, tangent lines, point-to-point curves, regular polygons, and wide lines are conspicuously absent.

For an entry-level program, *EasyCAD*'s screen redraw speed is respectable. Using the program's conversion utility, I exported several large sample drawings to *AutoCAD* version 2.17 for a speed comparision. *AutoCAD*'s redraw was consistently about 20 percent faster—insignificant on small drawings and only a minor advantage on large ones. *AutoCAD* was substantially faster at high-magnification zooms, however—sometimes by as much as four to one.

■ Dimensions That Toe the Line

EasyCAD's associative dimensioning is a potent feature rarely found in PC-based programs. Nonetheless, you'll still need to redraw some dimensions. Formats are limited to horizontal, vertical, and parallel linear dimensions with text and arrows between leaders—an inadequate array if you want to fully dimension engineering drawings without drawing additions.

Using the horizontal and vertical dimension formats, you can choose any two reference points at any angle, and the resulting arrows and leaders will always run truly horizontal or truly vertical. This enables you to dimension objects that are not orthogonal to your desired reference axes, such as an interior bolt hole relative to a corner. Moreover, horizontal and vertical dimensions retain their original orientation throughout rotations (see Screen 3). This may be desirable in many situations, but watch out for strange results in rotations close to 90 degrees—arrows, text, and leaders are forced to occupy a space converging to zero. Mirror-copying an entity with horizontal or vertical dimensions also yields a peculiar result unless the mirror line is perpendicular to the dimension arrows. The text of mirrored dimensions, however, remains right-reading.

Parallel dimensions always have leaders of equal length and arrows running parallel to the two reference points you select. The program treats a dimension's leaders, arrows, and text as a single entity for editing purposes, enabling you to universally—but not individually—scale text to any desired size.

EasyCAD has two basic text formats: single line and paragraph. Choosing either format calls up prompts for the text height, the starting point, and the text angle. In paragraph mode, text is always left-justified. For editing, each line of text is treated as a single entity, and intraline edits are not supported.

Compared with many minicomputer-based programs, *EasyCAD* lacks a number of useful dimensioning formats and symbols, including diameters, radii, angles, call-outs, and external arrows, as well as ordinate and baseline dimensions. You can, of course, produce these missing links using the general drawing commands, but they won't adjust automatically when an object is stretched or scaled.

Editing to Spec

EasyCAD's substantial editing facility is logically structured and simple to use. When you select one of the eighteen editing commands, a submenu asks how you wish to apply the command. For example, if you pick Move, you're prompted to specify the affected entities: all, by window, by layer, or one by one. As you gain experience, you can set up macros and special menus that bypass these prompts.

Many of the *EasyCAD* editing commands (such as Erase, Move, Scale, Rotate, Copy, Array Copy, Break, Trim, Fillet, Mirror, and Mirror Copy) are standard fare, but certain features deserve special mention. For example, the Bend command enables you to choose a point on a line between

fixed end points and stretch that line to create an open triangular shape. And if you want to join two entities quickly, you can mark a pair of points on each entity and execute the Connect command, which automatically moves, scales, or rotates the first entity so that its pair of points meets those of the second.

Like most CAD programs, *EasyCAD* enables you to group entities together as if they were a single entity. The program outstrips some of its competitors by making this function multilevel, so that a group can contain a subgroup, which in turn can contain another subgroup. You can disband the outermost group and leave the subgroups intact or unlock all groups at once.

As you work with specific entities, you may wish to verify their exact coordinates, sizes, or degree values for angles. You perform this check by selecting an entity (or several entities) with the cursor and invoking the List command. This brings up a screen containing all of the relevant information in a common sense format. In addition, a command tucked away in the utilities menu finds the distance in drawing units between any two points, while another calculates the area bounded by a polygonal entity.

Nevertheless, several valuable editing features found in other programs are absent from *Easy-CAD*. Foremost among these are automatic chamfers, automatic cross-hatching of closed areas, circular array copy, and dynamic drag of entities. These facilities would speed up certain drafting operations, although their absence is not especially difficult to work around.
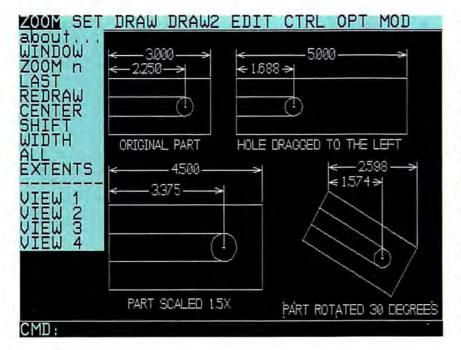
The program's Undo command, however, presents a more significant obstacle. In contrast to its high-end sibling, *VersaCAD Advanced*, *EasyCAD* undoes only the last entity added or the last zoom—and then only if no other commands have been activated in the interim. Worse, the Undo command requires a full-screen redraw, making it quicker to erase drawings of any size than to use the Undo command.

Drawing Muscle for the Masses

For those of you who are skittish about *EasyCAD*'s limitations, the program provides a conversion utility that can import drawings from—or export them to—both *AutoCAD* and *VersaCAD Advanced*. In fact, if a user has been unable to transport drawing files between these two high-end programs effectively, *EasyCAD*'s competence as a translator alone might justify its cost.

In hardware support, *EasyCAD* is no match for *AutoCAD* (which has more drivers than Yellow Cab). Nonetheless, *EasyCAD*'s hardware support is fairly broad. In a pinch, the program can drive the IBM Color/Graphics Adapter in two-color, high-resolution mode; IBM's Enhanced Graphics Adapter and Professional Graphics Adapter are also supported. On the high end, the program drives a number of boards with up to 1280-by-1024-pixel resolution, such as those produced by Matrox, Vectrix, Verticom, Sigma, and Tecmar.

EasyCAD is compatible with most popular plotters from Houston Instruments, Hewlett-

```
ZOOM SET DRAW DRAW2 EDIT CTRL OPT MOD
about...
WINDOW
ZOOM n
LAST
REDRAW
CENTER
SHIFT
WIDTH
ALL
EXTENTS
----------
VIEW 1
VIEW 2
VIEW 3
VIEW 4
```

ORIGINAL PART   HOLE DRAGGED TO THE LEFT

3.000
2.250

5.000
1.688

4.500
3.375

2.598
1.574

PART SCALED 1.5X   PART ROTATED 30 DEGREES

CMD:

Screen 3: EasyCAD's associative dimensioning prowess is shown here, along with the Zoom menu. The original object is on the upper left. A stretched version is shown on the upper right, a scaled version on the lower left, and a rotated version on the lower right. Note that the dimensions have automatically adjusted to the revised geometry and have retained their original orientation despite rotation. Each view took only seconds to create using EasyCAD's Copy, Scale, Drag, and Rotate commands.

EasyCAD screens courtesy of J.M. Lancaster, Inc., of Ashland, Massachusetts.

Packard, and Heath/Zenith, and each plotter driver contains the appropriate wiring and switch-setting data. The plotting program is a separate module that is intelligent enough to draw all lines in one color or thickness before switching to the next color or pen width. Among printers, *EasyCAD* supports the LaserJet as well as a variety of dot matrix printers from IBM and Epson.

On the low end, the program can even run acceptably on a 256K, dual-floppy 8088 machine with an 8087 math coprocessor. During testing *EasyCAD* worked without a hitch on four computers—an IBM AT, a Compaq Deskpro 286, a Zenith Z-150, and a Columbia Data Products MPC-IV—so it should run happily on most other IBM clones. Whatever machine you use to run *EasyCAD*, math coprocessors are a must for serious work.

Clearly, *EasyCAD* is for users who balk at paying twice as much for CAD software as they do for

hardware. Because the program is easy to learn, runs on minimal hardware, and provides all the tools necessary for professional-quality detail drawings, it provides a quick return on a relatively small investment. By following the program's tutorial and reference manual, you can learn most of the basic drawing functions within a few hours. More likely, you'll find your own way to fluency by experimenting with the pull-down menus and accessing the program's on-line help.

On a price-is-no-object basis, *EasyCAD* can't really compete with the versatility of the better high-end programs on the market. But for two-dimensional drafting, it can be nearly as effective a drawing tool as programs that cost ten times the price—provided you've exploited its custom menu, macro command, and symbol li-

brary capabilities. For those who are taking their first step into CAD and want some room to grow, *EasyCAD* is a fast, flexible, inexpensive, and friendly drafting tool. ●

Steven M. Lord is a senior mechanical engineer and freelance writer living in Tewksbury, Massachusetts.

EasyCAD
Evolution Computing
437 S. 48th St. #106
Tempe, AZ 85281
602/967-8633
List price: $495
Requirements: 256K, two floppy disk drives, DOS 2.00 or later version

Professional Property Management

If you need to account for more than the roof over your head, Comtronic Systems' property management program may be just the ticket to relieve you of billing and bookkeeping headaches.

Stephen A. Blumenthal

During the real estate boom of the last decade, the smart money was on multiunit dwellings. Inflation fueled appreciation, bestowing hefty profits on property owners. With the tax advantages that historically redound to real estate investors, rental-property ownership was doubly blessed. This year's watershed tax reform may take some of the blush off the rose, but as long as you treat your real estate holdings like a business, the potential for tidy profits will endure.

For the serious landlord, carbon-paper receipt books clearly don't make it. Tracking vacancies, maintenance fees, rents, expenses, and income for an apartment complex, a commerical building, or a personal-storage warehouse quickly becomes a mind-numbing,

paper-intensive ordeal. In such a miasma, which can only deepen with the passing months, money dissipates like smoke in the wind.

PCs can come to the rescue, but the property owner's traditional software solution has been to jury-rig spreadsheets, data managers, and accounting packages. With the recent growth in dedicated property management software, however, you can kiss patchwork solutions good-bye. Comtronic Systems' *PMSrev*– Property Management System within a *Revelation* data base–is as comprehensive a program as most landlords need. Cosmos's *Revelation* is a sophisticated application development tool, on a par with *dBASE III* and *DataFlex;* a run-time version is included with *PMSrev.*

Comtronic tacitly acknowledges that those who know real estate may not know data management; the package is menu-driven almost to a fault. *PMSrev* maintains separate files for each property and, if necessary, for each property owner. Indeed, the program is suited equally to owners interested in making property management chores less onerous and to individuals or small firms hired to shoulder management tasks. Al-

though rich in off-the-shelf missives, the program taps *Revelation*'s forms editor, enabling you to tailor-make gentle rent-hike notices, as well as snide collection reminders.

The Magnificent Seven
PMSrev's pure and simple organization is a definite confidence builder. A primary menu structure displays the program's seven major components: Property/Owner, Rental Unit, Tenant, Payments, Management Reports, System Maintenance, and General Ledger. General Ledger (GL) is further subdivided into six elements: chart of accounts, vendors, cash receipts, cash disbursements, general journal, and GL reports. Within each of the seven major sections, you can generate and view or print a panoply of reports and summaries. Report default formats are invariably neat and concise and include printer codes that automatically switch your Epson to expanded or condensed print as needed.

Familiarity breeds a certain level of user-friendliness. Each *PMSrev* primary menu, for example, features an entry/inquiry mode in which you can either enter new facts or update existing data. Thus, it's a snap to add essentials about a property, a tenant, a payment, or a deposit or to

```
ABC Property Management Co.
3485 Central Avenue
Seattle, WA  98104



JOHN DICKERSON
19025 PAC HWY S
SEATTLE, WA  98188


                              OWNERS STATEMENT
                               As of 01-01-80


PRO PROPERTY NAME        TOTAL    UNITS     UNITS    VACANT   01-02 GROSS   Y-T-D GROSS    MGMT      01-02
 ID                      UNITS   OCCUPIED   VACANT    RATE     EARNINGS      EARNINGS      FEE      MGMT FEE

001 FAIRCREST APARTMENTS   21       18         3      14.3%        .00           .00      3.50%        .00
002 SHOREVIEW OFFICE       10       10         0       .0%         .00           .00      7.00%        .00
    CENTER               -----   --------   ------   -----    ----------   -----------            --------
                           31       28         3      9.7%         .00           .00                   .00
```

Figure 1: PMSrev generates an owners statement
that itemizes vacancy rates, earnings, and
management fees for each property.

inquire about a particular unit or vendor, wherever that information is stored.

PMSrev prevails on *Revelation*'s support for multivalued fields, displaying them as windows. These windows can store multiple values—a P.O. box number and street address for a given tenant, for instance. The program also features a data buffer that automatically saves data to disk after 30 to 60 seconds of keyboard inactivity.

While there's no mistaking *Revelation*'s underlying presence, *PMSrev* insulates you from the Cosmos program's hassle of many-to-one, hierarchical data structures. A real estate investor may own a number of properties, or a single building may have several owners. Not only does the Property/Owner menu enable you to easily add new properties to the data base, it permits you to access

specific properties by ID number. If you've forgotten the number, you can review the active ID list simply by pressing the slash key. You can retrieve owner information in much the same way—a useful capability if the property is part of a real estate syndication or a limited partnership and its file is not linked to an individual's name. Hired property managers are apt to prize this component of the program for its owners statement—an impressive report that itemizes vacancies, gross earnings, and management fees (see Figure 1).

■ **Raise High the Roof Beams**
A single property may contain dozens or even hundreds of apartments or offices, all of which can be monitored from within the Rental Unit menu (see Screen 1). For each unit, you can create a compendium of repairs, a maintenance planned report (a wish list of improvements), and a maintenance history report (see Screen 2). The rent-rate summary shows all past, present, and proposed

rents for each unit, along with effective dates. If you pair that summary with the maintenance planned report, you can appreciate why a rent increase invariably coincides with a new paint job.

Tenants, of course, account for the lion's share of a landlord's required record keeping. *PMSrev*'s Tenant menu permits quick access to each occupant's dossier. Listing and sorting of tenants is by ID number, although *PMSrev* will also generate an alphabetical list. A tenant status report indicates whether an occupancy is historic, current, or pending.

PMSrev's ability to produce invoices on demand is particularly useful in billing commercial leases. Corporations commonly pay the rent for all their locations through a central office, a practice that requires sending the bill to someplace other than the property leased. *PMSrev* obliges with a tenant mailing-labels feature.

Counting the Cash

Few would argue that a major preoccupation of the "landed gentry" is the accumulation of wealth. *PMSrev* recognizes that a multiunit property produces a wave of cash the first week of each month, and the program makes that swell more navigable. You can enter rent payments and deposits in batch mode and arrange a group of payments by date or by property.

Once you're satisfied that the entries are correct, you can post them all at once and retrieve them later by tenant name. You can produce a payment history for a tenant's entire period of occupancy, so the Santa Claus of character references will remember whether that renter has been naughty or nice. And you can keep your time in the teller's line to an absolute minimum by letting the program print a deposit slip for all payments in the batch.

The Management Reports menu consolidates much of the dirty work of property management. A rent roll and a delinquent-rent report reveal what checks should be coming in and which ones are perpetually in the mail. This is a program without much of a heart; it will print delinquency notices and, if you're at the end of your rope, rent escalation or eviction notices.

Knowing when units will become available is essential to keeping them rented. *PMSrev* sends notices to all tenants whose leases expire within a specified period. The program then fashions a lease expiration report from tenant responses. This document segues into a vacancy analysis summary that computes both the cost per square foot and the vacancy rate. A more comprehensive property

```
UNT.208                    UNIT LISTING (BY UNIT#)      01 JAN 1988   PAGE 1

PRO UNIT    SQFT PMT    CURRENT TENANT NAME              UNIT %  COMMON
 ID  ID          FREQ   UNT RENT                         SHARE   AREA %

001 001           M              - - - - - V A C A N T - - - -          .000
001 100     900   M              JUAN REMIREZ             100.00   5.711
001 101     900   M              JODY CARPENTER           100.00   5.711
001 102     900   M              GUY ROBINSON             100.00   5.711
001 103     900   M              AL MENTICK               100.00   5.711
001 104     900   M              JEFF JONNS               100.00   5.711
001 105     700   M              SAL BUNTZ                100.00   4.442
001 106     700   M              HOWARD WENDT             100.00   4.442
001 107     700   M              FRANK JOHNSON            100.00   4.442
001 108     700   M              - - - - - V A C A N T - - - -          4.442
001 109     700   M              SHARON LICHE             100.00   4.442
001 200     800   M              - - - - - V A C A N T - - - -          5.076
001 201     840   M              AL WILLIAMS              100.00   5.330
001 202     840   M              DORIS NETTING            100.00   5.330
001 203     840   M              MIKE SHIMASKY            100.00   5.330
001 204     800   M              ROY PARKER               100.00   5.076
001 205     840   M              DAVE MARLER              100.00   5.330
001 206     700   M              DAN MAULDING             100.00   4.442

Press <RETURN> to continue?_
```

Screen 1: The unit listing breakdown, accessed from the Rental Unit menu, details a single property's tenants, sublets, apartment sizes, and payment schedules.

```
UNT.215     UNIT MAINTENANCE HISTORY REPORT (BY DATE)    01 JAN 1988 PAGE 1

  DATE    MAINTENANCE DESCRIPTION        PRO UNIT UNIT DESCRIPTION
                                          ID   ID

01-05-85 NEW PAINT                       003 100A 3 BDRM, 2 BATH
01-14-85 CARPET CLEANING                 003 100B 2 BDRM, 1 BATH
01-19-85 NEW PAINT                       001  101 2 BDRM 2 BATH
01-23-85 WINDOW INSULATION               002 1260 4 OFFICES
02-02-85 NEW PAINT                       001  200 2 BDRM 1 BATH W/MOUNTAIN VIEW
02-03-85 NEW PAINT                       001  202 2 BDRM 2 BATH
02-04-85 NEW CARPET                      001  200 2 BDRM 1 BATH W/MOUNTAIN VIEW
02-05-85 KITCHEN PLUMBING                001  102 3 BDRM 2 BATH
03-23-85 BATHROOM PLUMBING               001  104 3 BDRM 2 BATH
03-24-85 BATHROOM PLUBING                001  206 2 BDRM 1 BATH W/OCEAN VIEW
03-24-85 TAKE DOWN WALL DIVIDERS         002 1250 3 OFFICES, RECEPTION AREA
04-05-85 LIGHTING ELECTRICAL             002 1260 4 OFFICES
04-26-85 KITCHEN ELECTRICAL              001  206 2 BDRM 1 BATH W/OCEAN VIEW
04-30-85 CARPET REPLACED                 001  106 2 BDRM 1 BATH
05-14-85 KITCHEN PLUMBING                001  203 2 BDRM 2 BATH
06-01-85 PLUMBING                        002 1280 1 OFFICE, RECEPTION AREA
06-18-85 BATHROOM PLUMBING               001  100 2 BDRM 1 BATH
07-07-85 UTILITIES ELECTRICAL            001  107 2 BDRM 1 BATH

Press <RETURN> to continue?_
```

Screen 2: PMSrev builds a year-to-date history of repairs and maintenance on all properties. A companion report enables you to fashion a wish list of improvements.

status report details the number of units occupied, vacancy percentage, and the gross earnings and management fees both for a given period and for the year to date.

The final management report lists all tenant deposits on hand. Deposit transmittal notices explain security deposits withheld and itemize those that have been refunded. With states becoming increasingly testy over landlords who hold on to security deposits unjustifiably, detailed deposit records may come in more than handy.

Accounting in a Pinch

PMSrev contains an accounting module that's surprisingly easy to use and meshes nicely with its property management components. From the General Ledger menu, you can set up accounts, then enter data about cash receipts and disbursements and about the vendors who supply goods and services to the property. *PMSrev* generates IRS Form 1099, which outlines vendor payments for the year; the GL posting process automatically updates information on this form.

The program's handling of cash receipts is fairly prosaic; it prints out all transactions in the receipts file for the period under consideration. The treatment of cash disbursements is a bit slicker. The program prints checks, maintains a check register, voids checks, reconciles accounts by entering check numbers that have cleared, prints a listing of all outstanding checks, and posts disbursements.

The general journal, the PC equivalent of an accountant's yellow pad, harbors records of

funds transferred and of accounting adjustments. *PMSrev* will print a report of all transactions in the general journal file for any time period. The general journal is then posted to the general ledger. You can post all records within the cash receipts, cash disbursements, and general journal files with a single menu choice. The program will then produce a trial balance, a profit-and-loss statement, and a balance sheet.

PMSrev also contains a catchall internal housekeeping component that stores user-defined codes for property type, deposit type, and rental type. You can generate a list of those codes, and a purge feature will eliminate files on cash receipts, cash disbursements, checks, tenants, payments, and general ledger at the close of the fiscal year.

An Unpretentious Effort

PMSrev is a workmanlike program—straightforward, utilitarian, and competent. No glitz attends its screens or its documentation, but the package does have an inelegant side or two. Stepping back through the menus requires that you type *end* at the prompt line. Program entries are case-sensitive, and error messages reek of computerese. An incorrect entry elicits the alienating response 'invalid pattern match', for example. On-screen help is terse but omnipresent. Documentation likewise is taciturn, but invariably adequate; it assumes you know your business and lets you go about it without lectures on how to manage property.

Indeed, placing the business up front is evident in Comtronic Systems' entire approach. Installation takes 15 minutes and assumes no prior acquaintance with the PC.

The company offers a demo pack, which locks up after you've used it 10 times. *PMSrev* is trained to churn out reports, but much of the work behind those reports isn't visible on screen. Program calculations, searches, sorts, and formatting can take time. In that light, the product's support of the 8087 math coprocessor makes sense.

Automating your property management chores makes sense, too. Fifty tenants in a building write 600 rent checks annually. A year can produce untold numbers of late payments, move-out notices, rent increases, paint jobs, late-night calls to the plumber, and so on. Administering and controlling this process can require that you run at top speed just to stay in place. The difficulty of tracking income and expenses increases exponentially if you own or manage more than one building. Property management software along the lines of *PMSrev* can ensure that worries—and cash flow traumas—won't evict you from the business. ⊜

Stephen A. Blumenthal is a Washington, D.C., attorney and a PC World Contributing Editor.

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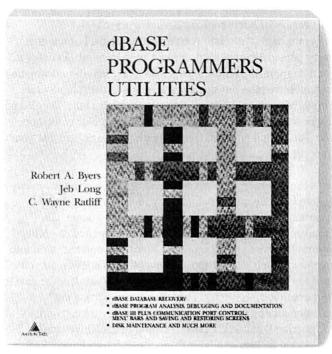
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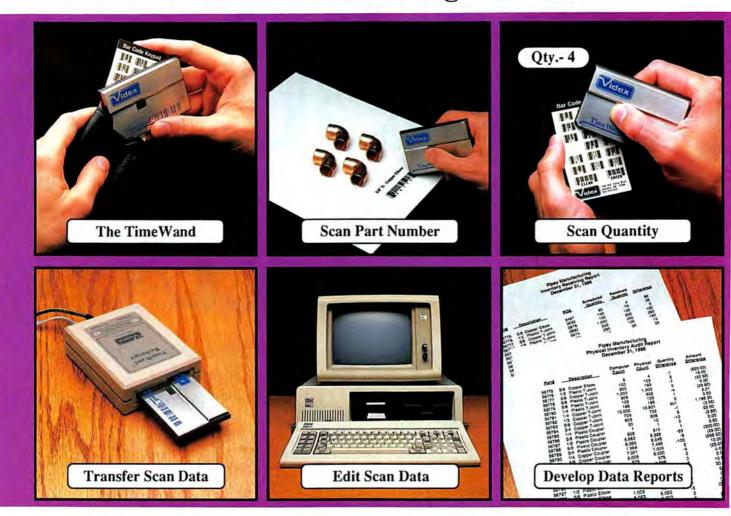
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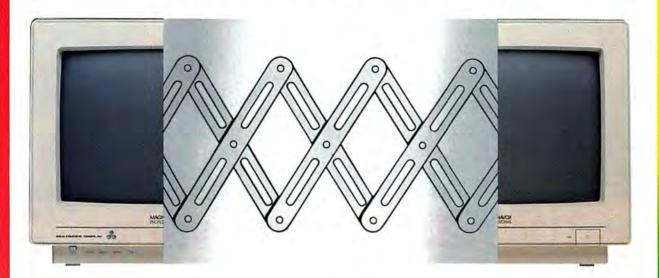
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Circle 581 on reader service card

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"I use a lot of programs on my personal computer, and I copy them all the time."

"I'm a programmer. Every time you copy one of my programs, you're taking away my income—I depend on *sold* programs for a living."

"Oh, come on. I bought it: I have a right to copy it."

"You *do* have a right to make a back-up, that's true. But when you start copying programs for your friends and co-workers, that's breaking the law."

"What law? Any copying I do is in the privacy of my own home."

"It doesn't make any difference where you do it. Every time you copy a program without permission from the publisher, you're committing a federal offense."

"That's all right, I won't get caught."

"You're missing the point. The issue isn't "What can I get away with?"—it's "who am I hurting?"

Remember, lots of people worked hard to produce every program you use: designers, programmers, distributors, retailers, not to mention all the people who support users. They have a *right* to be compensated for their efforts, and their major compensation is through software sales."

"Well, I don't mean to hurt all those people—or anyone, really."

"Unfortunately, that's what copying does: it hurts people. And, ultimately, it hurts people like you, who want new and innovative software."
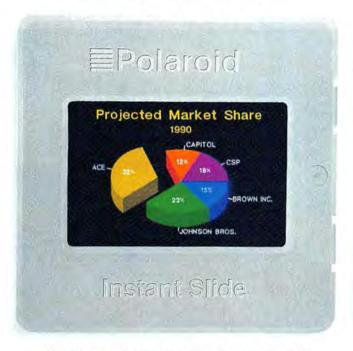
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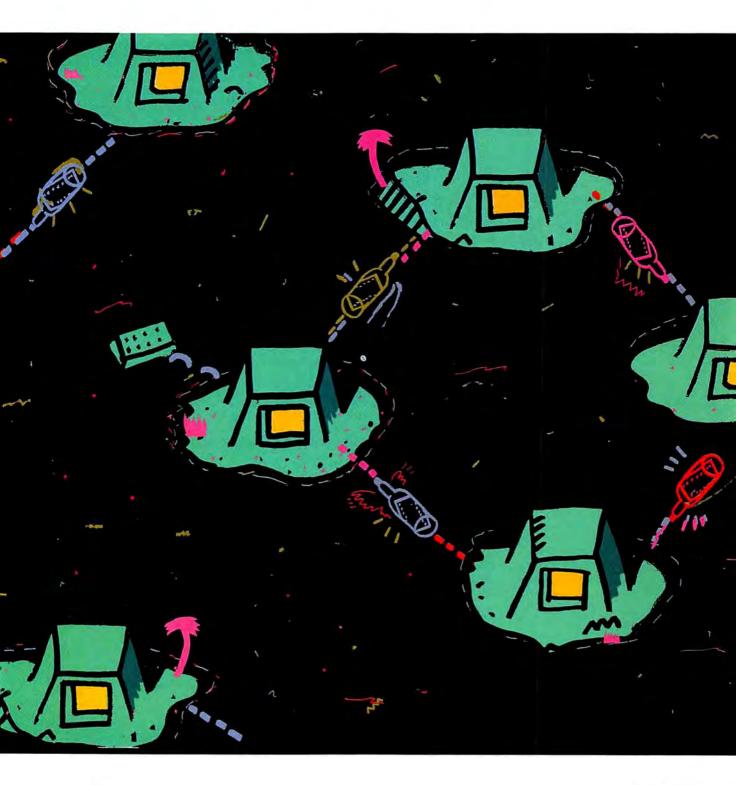
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MAPping the Islands

of Automation

In 1980 General Motors and Boeing began defining network standards for factory automation. Now their Manufacturing Automation Protocol is helping to build next-generation production lines across America.

TJ Byers

▌▌▌▌ Once the exclusive domain of blue-collar workers, the factory floor is now home to AT-controlled robots breakdancing over car body assemblies and metal forges. Every day, new PC-based devices automate a bit more of the production process.

But for PCs to play a significant part in the factories of the future, they need to be more than powerful, inexpensive, and easily programmed. They must perform not only solo but in an ensemble of computer systems, commencing with small groups of machines on the production line and extending to the minis and mainframes that run inventory and materials planning software.

In an automated factory, computer-driven machines on the floor are organized by job function into groups called *islands of automation*. Within these islands, each machine's job is directly related to those

tasks in progress around it. Obviously, the individual computers driving the machinery need to communicate with one another if they are to avoid assembly-line bottlenecks. Each island, in turn, may need to exchange data with other islands or with other computers overseeing the factory's entire operations, thus enhancing overall control of production.

The Manufacturing Automation Protocol (MAP), an industry-standard communications scheme tailored to the needs of the factory floor, is providing a framework for all these links.

Observing Protocols

A factory's requirement for machine-to-machine communications can be met by installing a local area network (LAN), an electronic link that connects two or more computers (network nodes).

LAN designs vary tremendously. In building a network, decisions must be made about how the system is to be constructed—what type of cable to use, how fast the data will travel, how data is encoded, and so forth. All these specifications are defined in the network protocols.

Until recently, however, no standard protocols for factory networks existed. Machines from vendors who implemented disparate approaches could not be linked together. The inability to connect machines crippled advances in domestic factory automation and stifled growth in this corner of the LAN industry.

In early 1980, recognizing the need for an industrywide networking standard, General Motors (GM) took up the gauntlet and called on one of its own staffers, Michael Kaminski. Working with Boeing Computer Services in an unusual attempt to dictate standards to vendors, Kaminski began to forge what would become MAP.

Leading a brigade of seasoned engineers, Kaminski pitted GM's huge budget for factory equipment against each LAN vendor's advocacy of its own proprietary system. Kaminski scored with some clever maneuvering that produced a working display

of a multivendor MAP network at the 1984 National Computer Conference. Big names helped to put MAP on the map—including Gould AMI, Allen-Bradley, Digital Equipment, Hewlett-Packard, and IBM. The demo was the talk of the Las Vegas show, and MAP was on its way to becoming the industrial standard.

The Layered Look

MAP is designed to meet two goals. It must link machines of varying intelligence and capabilities through a common communications protocol, and it must provide the technical services required to control the automated factory in an efficient and cost-effective manner.

MAP's success hinges on the customer's ability to plug MAP equipment from any supplier into any MAP environment with absolutely no changes to either hardware or software. Toward this end, the
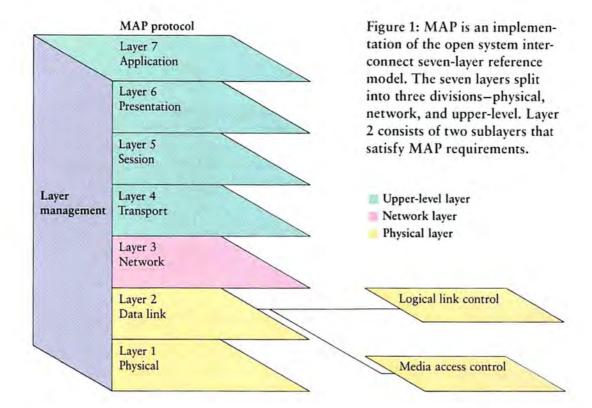
> *MAP's success hinges on the customer's ability to plug MAP equipment from any supplier into any MAP environment with absolutely no changes.*

MAP architecture has drawn heavily from the International Standards Organization's (ISO) open systems interconnect (OSI) reference model. Ethernet, IBM's Token-Ring network, and a number of other LANs employ the same model.

The OSI model is a hierarchical, seven-layer vertical structure with three distinct divisions: physical (Layers 1 and 2), network (Layer 3), and upper-level (Layers 4 through 7). Each division defines a particular function within the communications link. When examining the MAP concept, it's vital to understand how all the layers interact (see Figure 1).

Layers 1 and 2 are critical to all MAP functions; they set the stage for everything that follows.

At Layer 1, known as the physical layer, MAP defines the network medium as coaxial cable, sets

MAP protocol

Layer 7
Application

Layer 6
Presentation

Layer 5
Session

Layer management

Layer 4
Transport

Layer 3
Network

Layer 2
Data link

Layer 1
Physical

Logical link control

Media access control

Figure 1: MAP is an implementation of the open system interconnect seven-layer reference model. The seven layers split into three divisions—physical, network, and upper-level. Layer 2 consists of two sublayers that satisfy MAP requirements.

- Upper-level layer
- Network layer
- Physical layer

the network speed at 10 megabits per second, and specifies broadband (as opposed to baseband) communications.

With baseband communications, an unprocessed signal is placed directly on the network, much as a stereo amplifier routes an audio signal to a speaker. Broadband communications requires a carrier frequency to convey information, a situation similar to a radio station operating at a fixed frequency. In radio broadcasts, the high-frequency carrier signal is modulated by sound information and transmitted over the airwaves for reception by a receiver. In a like manner on the LAN, the digital pulses modulate an RF (radio frequency) carrier frequency for broadcasting data over the LAN cable.

Broadband communications offers numerous advantages over baseband. Because broadband is frequency-selective, more than one channel of information can travel through the cable simultaneously—just as hundreds of radio transmissions fill the atmosphere at all times. This allows for multiple data channels, voice communications, and even video signals. You can simply tune in the channel of interest with a variable-frequency channel selector. (MAP itself handles only data.)

Tokens of Our Appreciation

To prevent two network nodes from grabbing a data channel concurrently—creating a tangle that resembles the confusion on many CB radio channels—Layer 1 also implements a token-passing access protocol that permits only one node to transmit at a time.

Token-passing was chosen for MAP over the competing Ethernet-style contention protocol because its predictable timing offers a better fit for process-control systems in which uncertain response times cannot be tolerated.

Under token-passing, nodes may use the network only by invitation. Network access is determined by a circulating electronic tag called a token. A network can have only one token, and only the node holding the token can transmit. At no time, however, is any node barred from listening to the network.

The node holding the token can use the network for a set amount of time. When that node has

A Glossary of MAP Terms

Backbone. A broadband network that connects smaller elements of the MAP network.

Baseband. Signals carried over network wiring with no carrier frequency or frequency conversion.

Bridge. A device used to connect two distinct networks that use the same protocol.

Broadband. Signals at a radio frequency that are carried over network wiring. Broadband communications may consist of multiple channels that use different carrier frequencies.

Carrierband. Broadband network communications that use only one carrier frequency.

EPA. Enhanced Performance Architecture, a two-pronged approach for speeding MAP communications.

Ethernet. A popular, high-speed local area network system created by DEC, Xerox, and Intel, which relies on an access scheme different from MAP's.

Gateway. A bridge with a protocol language translator that permits communication between networks operating under dissimilar protocols.

Head end. Apparatus located at the physical end of the network cable that converts an incoming frequency to a higher or lower outgoing frequency.

Island of automation. A small group of factory machines or robots performing identical, similar, or related tasks.

Mini-MAP mode. A collapsed communications mode that implements only the first two layers of the MAP scheme.

MRP. Materials requirements planning, a specialized category of application software that addresses the management of a variety of preproduction tasks.

Node. Any device connected to a local area network.

OSI. Open systems interconnect, a seven-layer model for communications protocols developed by the International Standards Organization.

Protocol. A formal set of conventions governing the format and relative timing of message exchange between two communicating devices.

Token-passing. A scheme that secures network access through a circulating electronic tag called a token.

TOP. Technical and office protocol, a communications system designed for office environments. Evolving in parallel with MAP, TOP is based on the same underlying open systems interconnect reference model.
—*TJB*

finished its transmission or its time has expired, the token must be relinquished to the next node.

Layer 2 of the MAP reference model, the data link layer, controls the token's circulation. Generally, the token begins at one end of the network and makes its way to the other end, where the data-link controller returns and recycles it. This network access method guarantees that each node can transmit within a prescribed amount of time.

> *Token-passing was chosen for MAP over the competing Ethernet-style contention protocol because its predictable timing offers a better fit for process-control systems.*

MAP also lets the data-link controller assign levels of priority to nodes. (Priorities might be required, for example, in a precisely timed batch process.) If a critical node's access to the token seems to be running overtime, the data-link controller can retain the token at the critical node.

Additionally, MAP Layer 2 spells out the exact size of each data frame, including address space. Error detection and correction methods are also specified in Layer 2.

Islands in Data Streams
Layer 3, the network tier, is the second division of the MAP model. The network layer specifies the OSI's protocol for routing messages between networks.

When working with complex manufacturing processes like those required to assemble an automobile, several small islands of automation are generally more efficient than one large island. This inspired the island cluster concept, in which each island becomes a MAP subnetwork, autonomous in virtually all respects.

Subnetworks are connected by bridges, which are communications ports that selectively pass data from one subnetwork to another. Each bridge holds three key elements—two network interface devices and a filter. Each network interface connects to one subnetwork and behaves much like any other node. The filter, standing between the two interfaces, scans network activity for messages that need to cross the bridge. MAP's network layer imprints these messages with the proper recognition code for the bridge filter.

Layer 3 also embraces protocols for network gateways, such as the internationally accepted X.25 protocol.

Upper Crust Services
The four remaining MAP layers—transport, session, presentation, and application—handle upper-level services, such as data formatting and access security.

Layer 4, the transport layer, deals with end-to-end data reliability and supports a "datagram" service that permits the wholesale broadcasting of messages to selected groups of nodes or to all nodes. Layer 5, the session layer, translates and synchronizes names and addresses.

MAP Layers 6 and 7—the presentation and application layers, respectively—are highly integrated, with the protocols defined in one directly affecting the other. The business of factory management takes place at this level.

Within this environment are protocols for directory service, file transfer, file management, and software applications. Services in the top two layers will, for example, enable an engineer to reprogram a floor controller with the contents of a CAD/CAM file without relying on an intermediary programmer.

MAP standardization is an ongoing process; Layers 6 and 7 had not been fully polished at press time, but were expected to be completely defined by the end of the year.

MAP Takes to Silicon

Most MAP pioneers have modified existing LAN hardware to sculpt their systems. But as interest in MAP builds, semiconductor houses are quietly forging the VLSI chips needed to support this monumental communications effort.

Two top silicon foundries, Motorola Semiconductor and Gould AMI, have already demonstrated integrated MAP solutions in silicon.
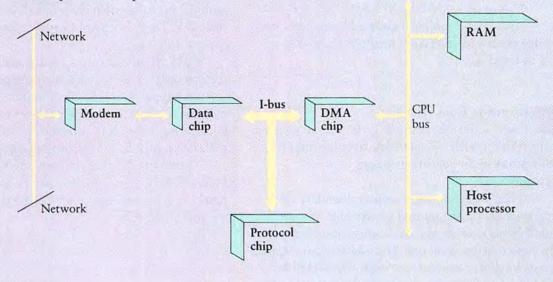
Motorola's Austin plant was the first to produce a single-chip implementation of some MAP functions. Its MC68824 token-bus controller implements the physical connection and media-access control functions of

MAP at 1, 5, and 10 megabits per second. Fabricated in HCMOS (horizontal complementary metal oxide semiconductor), the MC68824 supports both broadband and carrierband modes.

Motorola has already placed the token-bus controller on a 68020-based version of its standard VME interface board, which satisfies all seven layers of MAP version 2.1. In the pipeline is a carrierband modem chip designed to link the MC68824 with the MAP network cable. In the mini-MAP mode, these two chips can serve as a complete MAP network interface.

Gould AMI of Santa Clara, California, has undertaken a more ambitious effort. Also fabricated in standard HCMOS, Gould's three-chip set

Figure A: The Gould AMI MAP chip set consists of DMA-controller, data-controller, and protocol chips.

satisfies all requirements for the first two layers of MAP (see Figure A).

The first chip is a DMA controller that connects the host device, be it a dumb terminal or complex robot, to the protocol chip. The protocol chip is the brains behind the trio, containing the code necessary to implement all MAP media access and control. On the network side of the protocol chip is a data-processing chip that converts the parallel signals of the MAP protocol controller into serial inputs and outputs. The final link in the system is a modem that ties all three to the network media.

While no formal announcement had been made at press time, a single-chip carrierband modem from Gould AMI is believed to be in the works.

Western Digital of Irvine, California, with Siemens A.G. of Munich, West Germany, is about to join Motorola and Gould in the ranks of MAP chip manufacturers. No date has been set for a product release.

If current VLSI trends are any indication, a full-function MAP implementation on a single chip may debut soon—perhaps even before the first GM Saturn rolls off the line. —*TJB*

Software Shortcuts

Communications through MAP travel vertically, one layer at a time. As data progresses, each layer updates its neighbors on the status of that data and awaits a response.
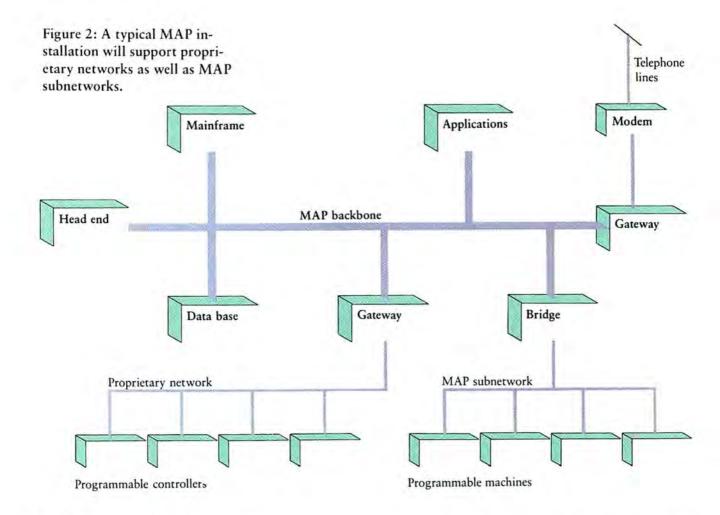
The overhead incurred when a message traverses all these layers can be prohibitive for some real-time systems. Within the MAP standardization

> *The top two layers will enable an engineer to reprogram a floor controller with the contents of a CAD/CAM file without relying on an intermediary programmer.*

effort, a task force—with the formidable name Enhanced Performance Architecture (EPA) group—is attacking the problem on two fronts, hardware and software.

The EPA approach initially expedites matters by rerouting data around selected protocol layers. The first alternate protocol option ties the data-link layer (Layer 2) directly to a modified version of the application layer (Layer 7). A message packet may travel through the collapsed architecture in a snappy .5 milliseconds (ms), substantially quicker than the average 40 ms required of routes through all seven layers.

A more aggressive version of the collapsed architecture, called the mini-MAP mode, improves response time by restricting data flow to Layers 1 and 2, eliminating Layers 3 through 7 altogether. Nodes using this protocol can't communicate directly with a full MAP node and require a dual MAP/EPA interface node to obtain services from the full MAP network.

Figure 2: A typical MAP installation will support proprietary networks as well as MAP subnetworks.

Carrierband Communications

EPA's second flank of attack targets network hardware. The EPA collapsed technology is ideal for intra-island links, enhancing the network through low-cost single-channel *carrierband* transceivers.

In a true broadband network, a node transmits data at one frequency and receives data on another. At the network's *head end,* a frequency converter intercepts all transmissions, converts them to a higher frequency, and retransmits them over the network. Because of its multichannel capabilities, broadband is more complex and expensive than a single-channel system.

In EPA technology, standard broadband LAN communications is reduced to a single-frequency carrierband channel. A carrierband network uses one frequency to both transmit and receive, much like a CB radio.

Carrierband transceivers are expected to significantly affect MAP network designs. Because the internal circuitry can both send and receive, there's no need for a full transmitter and receiver. Carrierband hardware tends to be much less expensive and more reliable than its broadband counterpart and does not require a head-end frequency converter.

In TOP Form

Direct labor accounts for only 10 to 25 percent of manufacturing costs in the United States today, and production workers make up less than two-thirds of the average factory's total employment.

To date, MAP applications have emphasized production lines almost exclusively. While the benefits associated with increased floor automation are substantial, MAP's full payoff won't be achieved until automated production is integrated with other factory computing operations.

This integration will meld into MAP a corresponding communications protocol for office applications known as TOP (technical and office protocol). Initially developed by Boeing and now being defined in parallel with MAP, TOP is built on the same seven-layer OSI foundation. TOP is designed to be completely compatible with MAP, although system architects remain some distance from that goal. Together, the two protocols will structure networks that link computing resources throughout a firm's manufacturing operations.

MAP's full payoff won't be achieved until automated production is integrated with other factory computing operations.

Supporting this alliance is a broadband backbone LAN designed to serve the entire MAP/TOP arena. The backbone's true broadband architecture supports high-speed and low-speed data channels, voice and telephone communications, and video channels. (MAP and TOP support only data, although their wiring can handle other services as well.)

The backbone net uses all seven layers of MAP and includes links to subnetworks through bridges, thus linking all aspects of the factory directly to the floor (see Figure 2).

The backbone can connect central resources such as mainframes running materials requirements planning (MRP) software or specialized CAD/CAM workstations. It will also be capable of connecting supervisory control systems with remote information sources.

When integrated with MAP-based inventory systems from the manufacturer's suppliers, the overall system will foster just-in-time warehousing; when combined with on-line MRP, it will provide powerful new tools for total plant supervision.

Fully realized, the MAP/TOP scheme promises to reduce production costs, improve productivity, increase reliability, ensure on-time delivery, and keep prices competitive worldwide.

Mapping Out a Future

Growing like Topsy, MAP has attracted more than 300 corporate supporters, including manufacturing heavyweights like AT&T, Chrysler, DEC, Ford, IBM, General Electric, and Xerox. IBM recently entered the fray with its MAP Pilot Kit, consisting of XTs and ATs equipped with MAP-compatible interfaces.

At Kaiser Aluminum's Erie, Pennsylvania, forging facility, a MAP network has been fully operational since mid-1985. Plans call for Eastman Kodak's MAP network in Rochester, New York, to be up and running by year-end. Motorola's MAP operation in Austin, Texas, went on line early this year—manufacturing VLSI MAP chips (see the sidebar "MAP Takes to Silicon"). Boeing, Honeywell, DEC, and IBM maintain pilot or production MAP installations, and the list continues to grow.

General Motors, the country's largest manufacturer and the driving force behind MAP, has placed what is far and away the largest wager on the system's success. GM anticipates spending $40 billion by 1988 to implement MAP-based systems. Indeed, the company's ambitious Saturn project—turning out GM's first new nameplate in decades—depends on a fully functional MAP network at the mammoth Spring Hill, Kentucky, plant in time for the 1988 model year. Plans call for the Spring Hill site to churn out 500,000 cars a year—more than double the output of any existing GM facility.

With stakes like GM's on the table, who can resist a chance to sit in?

From the manufacturer's point of view, MAP boasts all the right stuff: worldwide acceptance, flexibility, and modularity. For the LAN supplier, MAP fosters market stability. And as a means of ushering in the robotics era, MAP looks like a winner. ●

TJ Byers is the author of Inside the IBM PC AT *(McGraw-Hill, Inc., New York, 1986).*

Cable TV: The Medium Carries the Message

Don't touch that cable TV dial–PCs are about to broaden this ubiquitous entertainment medium into a full-fledged data communications corridor.

Richard Lewis

▮▮▮▮ Cable TV (CATV) systems link 40 million American households in a vast entertainment network. By 1990, fully 55 percent of the population will be served by cable systems that feed news, local programming, premium services, and movies via coaxial cables snaking beneath neighborhood streets.

Despite this entrenched position, however, cable communications is only now getting down to business. Today, a quiet revolution is moving the cable industry into the information age. The cable that delivers *Max Headroom* and *Not Necessarily the News* to your living room is in fact a broadband highway capable of carrying vast amounts of data at high speed to your office or home PC. Astute information providers, communications companies, and cable TV systems are capitalizing on this broadband opening to reach potentially millions of PCs.

For the most part, video today is a one-way, passive medium; you flick the cable selector and just watch. In the case of a few experimental videotex systems, however, two-way video is a reality, albeit a limited one. The future promises to be interactive, marked by heavy data traffic moving in both directions along existing coaxial pathways. A PC on the cable link can provide a digital avenue for shopping, banking, voting, and polling. For business, the prospect of a variety of interactive services and information data bases beckons.

■ **Behind the Curtain**
Local governments have granted some 7000 CATV franchises to cable companies that deliver TV signals to homes. Communications begins at the cable system *head end*–the ground-based origin of the cable signal. The head end receives UHF and VHF programming and satellite-fed services such as HBO and Showtime (see Figure 1). A vast treelike coaxial-cable network retransmits television signals into home TV sets, assisted along the way by amplifiers.

Major cable systems deliver video in a frequency range of 5 MHz to 400 MHz. Each channel occupies 6 MHz of the bandwidth, which gives a cable system the ability to transmit more than 50 one-way television channels. The cable broadband boasts a generous capacity: A 6-MHz television channel could carry 2000 3-kHz telephone voice channels or move unvarnished data at 6 megabits per second.

Cable systems deliver programming in a one-way direction to subscribers. In 1972 the Federal Communications Commission ruled that new cable systems must provide the capacity for "nonvoice return communications." Some 14 years later, cable systems have finally begun to provide that capability.

For a cable system to offer two-way data communications, the frequency spectrum must allow for a return path; the spectrum must, in other words, be split. The solution is to assign higher frequency ranges (called downstream channels) for transmission, and lower frequency ranges (called upstream channels) for reception. Depending on the relative proportion of data sent to data received, the range of frequencies can be *subsplit*, *midsplit*, or *highsplit* (see Figure 2).

A subsplit configuration uses the 5-to-30-MHz band to receive and the 54-to-400-MHz band to transmit. A subsplit arrangement is ideal for applications that involve sending more data to homes than those residential subscribers send back. Up to now, two-way capacity has been limited to pay-per-view programming, home-security monitoring, and tracking utility usage.

The need for an increased capacity to receive data warrants a midsplit arrangement, with the 5-to-108-MHz band assigned to reception and the 174-to-400-MHz band reserved for transmission. The cable system may also be highsplit, with the spectrum about equally divided between the sending and receiving frequencies. In all three cases, signals must be amplified in both directions.

One-way transmission to home PCs looms as the principal application for residential cable-based data communications. One cable system executive projects growth in home PC usage at 15 to 17 percent and is enthusiastic at that prospect.

■ Riding the Subcarrier

Early this year, McGraw-Hill, Telecrafter (a cable marketing company), and TeleCommunications (a major cable system operator) jointly launched the Xpress Information Service, perhaps the foremost cable-based data communications system to date (see *Password: Communicate*, *PCW*, May 1986).

Xpress delivers time-sensitive news and financial information over cable systems. For $19.95 a month, Xpress subscribers can access more than 30 international news services and receive securities quotes on 15-minute delay. Individual news categories and

stocks can be monitored, and with *Xpress* software, stock activity can even be graphed. Information flows 24 hours a day, every day of the week.

The primary Xpress earth station receives data by phone line, microwave, and satellite. In an arrangement akin to that of Lotus's Signal, which relies on unused fringes of the FM radio band, *Xpress* economically piggybacks its data stream on a subcarrier—an unused portion of the cable video signal (see "Data on Your Dial," *PCW*, February 1986). A unified data stream rides on subcarriers of Cinemax and the Chicago "superstation" WGN for transmission by the Galaxy I satellite to cable systems.

A cable system receives the signal at the head end, where a video receiver prepares data for transmission. Xpress data travels at 9600 bps over the cable network at a radio frequency (RF) not normally used by other services (usually between TV channels 4 and 5 or 6 and 7).

Xpress data enters a subscriber's home through the CATV coaxial cable. An Xpress decoder changes the analog signal into a digital signal for transmission at 9600 bps through the PC's serial port.

■ **A Decent Interval**
Data Broadcasting Corporation (DBC) has joined Xpress as the second major provider of financial information to cable subscribers equipped with PCs. Data Broadcasting is a joint venture of Merrill Lynch and the Financial News Network (FNN), a national channel serving 1200 cable systems.

DBC's data-delivery technology—somewhat different from the method used by Xpress—is called the *vertical blanking interval* (VBI). A standard television picture consists of 525 lines per frame. The VBI uses 21 of those lines to blank the screen between successive frames. You can detect the VBI when your picture requires vertical adjustment; it's that portion of the television signal that appears as a horizontal black bar. In the 1960s, British Broadcasting Corporation engineers discovered that the VBI could be used to carry information.
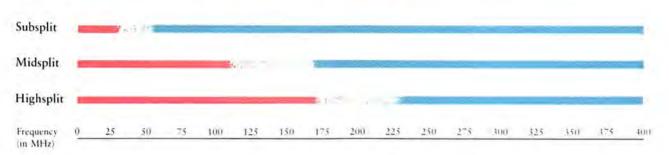
Data Broadcasting uses three lines of the FNN VBI to deliver real-time and delayed stock market information. Monthly fees range from $45 to $110, depending on the level of service received. The DBC *WatchWare* program permits simultaneous viewing of up to five on-screen windows for tracking specific securities, portfolios, ticker symbols, and other information. Visual and audible alarms flag activity in monitored stocks.

Time-sensitive stock quotes and related data are collected at DBC headquarters in Vienna, Virginia. Data is then beamed by satellite to the FNN studio in Southern California, where it is combined with the FNN video signal and finally uplinked to RCA's SATCOM 3R satellite for transmission to affiliate cable systems.

Once at the cable head end, financial data moves along the FNN video signal at 19.2 kilobits per second. The subscriber's special DBC/DataReceiver retrieves em-

Figure 1: This overview of the CATV system traces the system from head end to subscriber TV. Note that satellite and microwave transmissions feed the head end.

Figure 2: Cable systems rely on three distinct frequency schemes, based on the nature of two-way traffic. The subsplit scheme (top) offers the user the smallest portion of bandwidth for communications with the head end; a midsplit arrangement (center) increases the bandwidth; and a highsplit scheme (bottom) enlarges it even more.

■ Receive
■ Transmit

Subsplit			
Midsplit			
Highsplit			

Frequency (in MHz) 0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400

bedded data, decodes it, and transfers it to the PC at 9600 bps via the serial port. In setting up the DBC software, the user can either specify the FNN channel or let the program's Autoscan mode search the cable frequency spectrum for the incoming FNN signal.

■ Cultivating Corporate Cable

Crazy quilts of cable franchises cover many major metropolitan areas—greater Los Angeles has as many as 20 franchises, for instance. Although the cable business starts as a local affair, multiple-system operators (MSOs)—such as TeleCommunications, Storer Cable Communications, and American Television and Communications—have been acquiring local cable franchises and placing them under corporate umbrellas. This consolidation, in turn, has spurred growth in cable-based communications aimed expressly at business.

Franchise contracts have often stipulated that the cable operator provide government institutions with a cluster of dedicated cables, independent of residential cable service. These institutional networks, called I-nets, serve municipal facilities, schools, and hospitals with video, audio, and data communications. According to the Elra Group, a telecommunications consulting firm in San Francisco, 210 institutional networks comprising 12,000 miles of cable are now in place. Some 40 percent of

economical local data communications than the baby Bells can offer. Several recent rulings have exempted cable systems from "common carrier" regulations.

The typical I-net consists of a group of coaxial cable lines working independently of the residential cable network. James Elsenbeck, a product manager for General Instruments, notes that the typical residential cable system

■ *Institutional networks, called I-nets, serve municipal facilities, schools, and hospitals with video, audio, and data communications.*

these I-nets operate independently of local residential systems.

While I-net penetration doesn't come close to the general growth of cable systems, innovative cable operators have seized on the AT&T breakup to extend I-nets to businesses in need of faster, more

is designed to deliver television programming to viewers, leaving a constricted bandwidth for data. Most business-oriented data travels over I-nets at a relatively slow 9600 bps, although at some installations rates exceed 1.5 megabits per second. PCs commonly communicate with cluster controllers or data concentrators before entering the cable network.

In addition, a dedicated I-net offers data security for businesses concerned about residential subscribers' gaining access to private data. Data security issues aside, the multiple connection points in a residential system tend to increase signal loss.

Inside the I-net

An I-net operates in much the same way as an oversize, broadband local area network. A midsplit, 400-MHz I-net might have downstream channels in the 174-to-400-MHz band and upstream channels in the 5-to-108-MHz band. For two-way communications, a frequency translator must transfer data from the transmitting channel to the receiving channel.

In practice, Business A would transmit data along the upstream channel to the cable system head end, where the frequency translator would shift the signal to the 174-to-400-MHz downstream channel for transmission to Business B (see Figure 3). Depending on the level of traffic, a single translator can handle several 6-MHz channels.
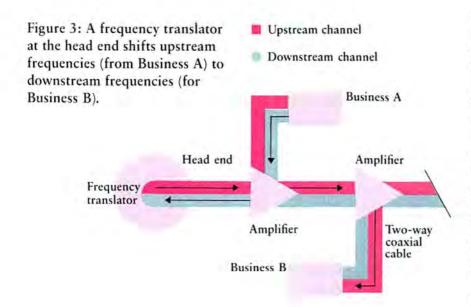
Frequency division multiplexing (FDM) enables business users to share broadband cable's immense capacity to transmit data by partitioning frequencies. Each 6-MHz channel is thus divided into numerous data subchannels. Using a subchannel of 50 kHz, each 6-MHz channel can yield up to 120 subchannels.

Broadband data communications relies on RF modems, which cost significantly more than common voice-grade modems. These more sensitive devices can be tuned to frequency slices as small as 50 or 100 kHz. You can achieve full two-way data communications by assigning transmitting and receiving frequencies to the modems at either end, thereby reducing 120 subchannels to 60.

I'll Take Manhattan

American Television and Communications, the second largest MSO, has put broadband technology to work in two metropolitan areas—New York City and Austin, Texas. The company's New York City showcase I-net, Manhattan Cable TV (MCTV), has established itself as a pioneer provider of CATV technology for business data communications.

MCTV is the franchised cable operator for the southern section of Manhattan, where it currently serves more than 200,000 residential subscribers. MCTV initially offered a limited data communications service over the residential network. In 1974 the firm installed a separate cable cluster to serve the downtown financial district and the midtown commercial area. Today, a midsplit, 300-MHz I-net acts as a data communications highway to 17 firms, such as Citicorp and Shearson/American Express, in addition to the city of New York itself. MCTV is currently expanding the 20-mile I-net with redundant, dedicated cable and installing PCs to monitor signal amplifiers.

Each I-net customer is assigned a frequency for data communica-

Figure 3: A frequency translator at the head end shifts upstream frequencies (from Business A) to downstream frequencies (for Business B).

■ Upstream channel

◉ Downstream channel

tions. The most common configuration is site-to-site, but at least two customers use the network in a site-to-multiple-site arrangement. Carl Gambello, Manhattan Cable's corporate development vice president, reports that some

width. A separate 2000-mile dedicated cable cluster provides entertainment programming to area homes.

The Austin school district uses the I-net for energy management and data communications. A mul-

For the cable television industry to reach out from its home base to the business community, providers will increasingly need to offer services that businesses demand—and provide them economically and conveniently. That may mean moving away from concentration on one-way video entertainment toward more generic, two-way information services.

Innovative cable MSOs are cultivating business communications opportunities. Such firms have seized the chance to beat the rising cost and shorten the long lead times of local telephone service, providing users with economical, high-speed leased lines. With affordable, quickly installed I-nets, MSOs are beginning to fill the communications gap for businesses that need data instantly and cheaply—in short, just about every business. ◓

> *Today, an I-net acts as a data communications highway to 17 firms, such as Citicorp and Shearson/American Express, in addition to the city of New York itself.*

customers' data rates have increased from 19.2 kilobits per second to 1.5 megabits per second.

The Reuters Monitor Service delivers real-time financial news and data over a 6-MHz MCTV channel. Other MCTV clients, like Merrill Lynch, can transfer data at 9600 bps from the Reuters terminal to the PC through a serial port.

Austin Cable Limits

Austin CableVision, American Television and Communications' Texas cable system, is completing a 250-mile I-net to serve the capital city's main business district. The midsplit system now serves eight commercial and government users, with more on the way.

In the Austin I-net, a translator at the head end shifts upstream communications from the 5-to-108-MHz bandwidth to the downstream 174-to-400-MHz band-

tiple-site, 50-kHz-channel system monitors and controls air-conditioning and heating for participating schools. A 12-mile, site-to-site, 256-kilobit-per-second link connects the city's public works and planning departments. In the past, the planning department needed 30 minutes to transmit an intricate graphics file at 9600 bps over leased telephone lines; today, the high-speed cable link can accomplish the same task in less than 2 minutes.
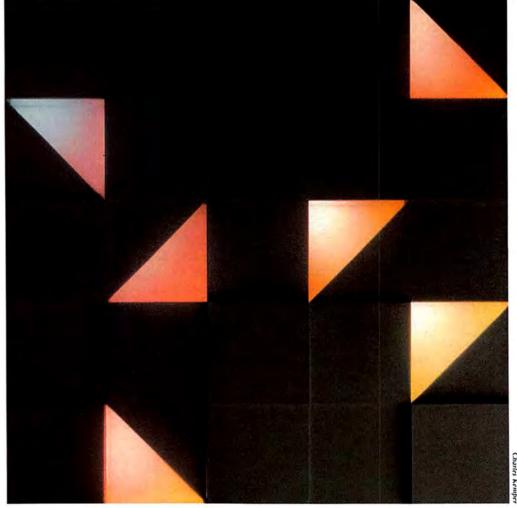
Playing the CATV Game

Current efforts to forge television signals and digital information into interactive communications channels may have a significant impact on Americans at home and at work.

Still, Gerhard Hannenman, Elra Group president, believes most cable systems have no more than two years "to capitalize on the communications opportunity" before feeling a strong competitive squeeze from specialized fiber optics and satellite carriers.

Richard Lewis is president of RLA Communications, a communications service organization in Van Nuys, California.

A Prolog
to the Future

Awaiting an expert
systems solution that
can provide you with
invaluable decision
support? Meet
Prolog, the artificial
intelligence underdog
that may soon have
its day.

Charles Kemper

Robert Lewis

Trying to define artificial intelligence echoes the late Supreme Court Justice Potter Stewart's attempt to characterize obscenity. Stewart joked that he couldn't define the term but added, "I know it when I see it."

Although a meaningful definition of artificial intelligence (AI) may elude the strict constructionist, the PC community knows what it's looking for and increasingly has the tools to find it. Computer scientists have pinpointed the ability of machines to approximate human reasoning, learning, and communication as AI traits. After what some observers characterize as too many false starts and too few promises fulfilled, artificial intelligence has assertively moved out of the laboratory and into the personal computing mainstream.

AI terminology now peppers the PC vernacular with terms like *knowledge engineer, LISP, domain expert, ICOT,* and *natural language parser.* AI is fodder for bullish industry savants. "Look for the AI industry to be worth billions by the 1990s," predicts one analyst. "You can write your own natural language front end," another pundit proclaims. Meanwhile, the PC market welcomes a clutch of dedicated AI hardware, exemplified by Gold Hill's 80386-based HummingBoard, which runs a 386 version of LISP.

But perhaps the most telling sign of the times is the sudden explosion in affordable, PC-based implementations of Prolog, an AI language. Borland International has led the charge with Turbo Prolog, which was released last April to mixed notices. At $99, it's a rich, if slightly unorthodox, Prolog version that boasts windows and graphics. Chalcedony Software and Automata Design are also touting low-cost, high-powered versions of Prolog.

In offering a vocabulary for artificial intelligence, a language like Prolog is a natural development vehicle for expert systems (which crunch rules and facts in ways analogous to human analytic processing), English-like interfaces, data management, simulations, or other applications that make use of pattern matching and deduction.

Although any PC user can work with the tools needed to write programs using AI concepts, don't expect expert systems to sprout from every AT. Prolog's true value isn't as a mass-market item but as a sophisticated development tool for highly specialized AI applications. Groundbreaking development work in Prolog for the PC family is emanating from such firms as Lotus Development spin-off Arity and Expert Systems International. IBM has entered the fray with VM Prolog, a mainframe incarnation. According to one industry analyst, Big Blue reportedly feels that "small systems artificial intelligence" is three to four years away.

Anatomy of an AI Language

AI languages perform very differently from traditional high-level programming languages: They are *declarative* rather than *procedural.* With a declarative language, the programmer defines a "problem space" (that is, the problem parameters) rather than writing an algorithm (an ordered set of instructions to solve the problem). Languages used in AI are not primarily computational in design; they process and manipulate symbols rather than numbers.

In working with symbols, the programmer must describe objects in terms of qualities, not quantities. Symbolic languages support familiar operators like $=$ and $>$,

and programs written in AI languages often include computational procedures. But the AI programmer is bound to symbol manipulations and can be in the soup when a concept like "almost" must be placed in a knowledge base. Suddenly, the programmer inhabits a messy, wordy, almost subjective universe. In order for programmers—and thus users—to prevail, AI languages must possess special faculties.

Declarative programming requires the ability to represent data in the program's knowledge base using a variety of data types. A symbol-processing language must be interactive, it must be capable of pattern matching, and it must possess adequate facilities for building structures based on knowledge. It should be able to mix procedures and knowledge. And perhaps most importantly, it should be recursive. An operation that stands for, or calls, itself is recursive. Unlike a BASIC GOTO loop that describes a set number of iterations, a Prolog function can call itself; in Prolog, that loop is controlled by the logic structure, which will halt the recursion.

AI's Dynamic Duo

Prolog, which stands for *programming in logic*, and LISP, an acronym for List processing, are the dominant AI programming languages. LISP, developed in the late 1950s at the Massachusetts Institute of Technology, has enjoyed a longevity among computer languages that is second only to the venerable FORTRAN. Prolog was developed at the University of Marseilles in the early 1970s and has been the prevailing AI language in Europe.

Although the differences between any two computer languages exist in several dimensions, the respective origins of LISP and Prolog shed some light on their divergent metaphors. In the United States, where LISP has come of age over the decades, AI researchers have had access to the abundant memory and processing power of university mainframes. LISP, as a heavy consumer of processing horsepower, has spawned a family of minilike workstations dedicated to running—and optimizing—the language. The future promises LISP coprocessor boards and, soon, LISP-encoded silicon.

Because computing power and memory cost more in Europe, researchers there developed Prolog along lines more suited to PC technology. In addition to being less memory-intensive than LISP, Prolog is, at least on the surface, easier to learn. But despite Prolog's popularity in Europe and its current status as the AI language of choice for PC users, LISP has remained dominant, particularly in this country.

In 1980 the Japanese selected Prolog as the language for that nation's "fifth generation" supercomputer development project. Japan's choice seemed to imply that Prolog was in some manner the superior language. The AI establishment in the United States has since taken a more serious look at Prolog.

Despite the current interest in LISP and Prolog, most PC-based applications that aspire to AI continue to be written in C, Pascal, assembly language, and even FORTH. The Intelligent Assistant, the natural language interface for Symantec's *Q&A* data manager, was developed in C and assembly

Artificial intelligence has assertively moved out of the laboratory and into the personal computing mainstream.

language, then embellished with specialized LISP routines. M.1, the Teknowledge expert system toolkit, was initially developed in Prolog but later translated into C.

In the Storm of the AI

Although Prolog and LISP are constructed from very different theoretical metaphors, they can be made to behave in much the same way. Both offer specific advantages in areas of AI problem solving.

LISP is an elaborate list-processing vehicle; it allows both data and procedures to be represented by a common list structure, which can also represent declarative and procedural program elements. Lists have been widely used to represent features of the AI problem space because AI program data, unlike data in other applications, must be capable of repre-

senting disorder—language, semantic nuances, symbols rather than numbers, and logic that by mathematical standards is fuzzy. A list structure can efficiently represent a variety of data types. And since an AI program may change or reorganize its control structure as it runs, the ability to represent both control and data within a list is a decided advantage.

Prolog shares these capabilities with LISP but has a markedly different structure: It's a language of relationships rather than lists. Its programs don't resemble those written in other languages (see Listing 1). A simple Prolog program consists of a knowledge base made up of two parts: rules and facts. The rules manipulate facts that are stored in the knowledge base (see the sidebar "How Prolog Works").

Call in the Experts

For the business community, artificial intelligence has made its greatest mark in the form of expert systems. Developed by inhouse corporate AI departments, spin-offs of university AI laboratories, and budding software firms, expert systems are currently providing assistance in design, manufacturing, planning, and troubleshooting (see "Experts on Call," *PCW*, September 1985).

Paul Harmon, coauthor of *Expert Systems* (John Wiley and Sons, New York, 1985) and publisher of the newsletter *Expert Systems Strategies*, counts nearly 150 commercially available expert systems, the vast majority of which were developed in LISP. Other sources put that figure above the 300 mark.

By Harmon's accounting, a spare handful of Prolog-based expert systems have been released. These include *AALPS*, an aircraft loading program developed by the army and Quintus Computer Systems; *Beacon*, a program the Bur-

roughs Corporation developed to help configure Burroughs mainframe hardware; *Component Impact Analysis System*, an advisory package for nuclear power plant operators developed in C and Quintus Prolog by the Argonne National Laboratories; and Thomas Cook Travel's *Train Travel Advisor*, which assists travel agents in planning itineraries (see the sidebar "Prolog at Work").

Expert systems come in various sizes as determined by the number of rules or by what's known as the telephone call metaphor—if you consult with an expert by phone and solve your problem within 20 minutes, you're talking with someone who's only a moderate expert. The number of rules may not, of course, be an accurate measure of program complexity; 1000 one-line rules may occupy the same space as 200 multiple-line rules.

Most of today's expert systems are bulky and costly, and have been tailored to run on mainframes or dedicated LISP machines. Harmon suggests that UNIX workstations that run LISP are already supplanting some LISP

machines—a trend that LISP chips and 386-based PCs are apt to accelerate.

Given that trend, Prolog is now poised to challenge LISP's hegemony, according to Prolog vendors. At least on the surface, the claim appears to have merit. Prolog offers several real advantages for expert system development.

The Prolog Plus

As illustrated in the sidebar "How Prolog Works," the Prolog clause is an excellent device for representing knowledge and writing rules, two key requirements for most expert systems. For example, the Prolog rule clause closely resembles the IF ... THEN statements found in expert systems. In addition, Prolog facts easily translate into the object-attribute-value (O-A-V) relationship. O-A-V structure is a subset of the semantic network, which is a powerful technique for representing knowledge in AI.

> *Although any PC user can work with the tools needed to write programs using AI concepts, don't expect expert systems to sprout from every AT.*

```
                                         COMMENTS
                             %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
house(red)                   %  A fact = The red house.            %
                             %                                     %
owns(homer) :-               %  A rule = Homer owns the red        %
     house(red).             %           house.                    %
                             %                                     %
yard((house(red)),large,swim_pool).  % A fact = The red house has a    %
                             %  large yard with swimming pool.     %
bedrooms(owns(homer),4).     %  Homer's house has four bedrooms.   %
kitchen(owns(homer),range,frig).  %                               %
dine_rm(owns(homer),table(oak),chair,8,  % What follows is a group of facts  %
     table_service,8).       %  of varying complexity. The number %
parlor(owns(homer),sectional,recliner,  % of arguments that appear within  %
     end_table).             %  the parentheses are arbitrary,    %
garage(owns(homer),attached,maxima,  % although the convention of    %
     work_bench,tools).      %  signifying ownership with the      %
family_rm(owns(homer),tv,vcr,stereo,  % first argument is followed in  %
     pool_table,rack(fly_rod,3)).  % this sample program.          %
lives_in(owns(homer),homer,wife(gwen),  %                           %
     daughter(bunny),daughter(marg),  %                             %
     son(lamont)).           %  Rules can also be simple or        %
                             %  complicated.  The rule with the    %
large_house(X) :-            %  predicate = "large_house(X)" is     %
     bedrooms(owns(X),4).     %  a simple one.                      %
                             %  "Should_be_jealous" is complex.    %
has_the_good_life(X) :-      %  It is constructed from two other   %
     yard(_,_,swim_pool),     %  rules, "large_house" and           %
     family_rm(owns(X),_,_,_,_  %  "has_the_good_life".             %
          rack(fly_rod,3)),   %  The substitution of a "_" for a    %
     garage(owns(X),_,maxima,_,_).  %  variable or object tells the  %
                             %  program to only look for           %
                             %  named objects or variables. This   %
should_be_jealous_of(X) :-   %  simplifies programmimg and         %
     large_house(X),          %  execution.                         %
     has_the_good_life(X).     %  X = Homer is the value returned    %
                             %  in all the examples.               %
                             %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Listing 1: A simple Prolog knowledge base, The House of Homer

The O-A-V relationship is built from an object referenced by a predicate that describes a property or an attribute of that object (see Figure 1). The attribute, in turn, is influenced by a value. This is easier to understand than it sounds. Unlike a fact, an attribute is a verb—a "has" or an "is." Together, attributes create a set of relationships, many of which are implied; if an object has a legbone, a kneebone, a thighbone—and they're connected—relationships can be surmised. This is a semantic network, consisting of three O-A-V groupings, or triplets.

Though Prolog offers some advantages over LISP—at least in PC-size systems—recent AI industry behavior indicates that expert systems, whatever the code, are far

is_a(homer,home_owner) = Homer is a home owner.

attribute   object   value
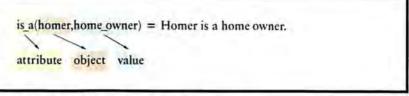
Figure 1: This Object-Attribute-Value diagram illustrates the Prolog "semantic network"— a way of grouping verbs and facts that builds a relationship and represents knowledge in expert systems.

> *The AI programmer is bound to symbol manipulations and can be in the soup when a concept like 'almost' must be placed in a knowledge base.*

from becoming generic tools. In the main, PC-based expert systems are cut to fit job-specific applications, and the more specific the job, the better the system works. Most of these tools can be classified as shells, or subsets, of the language from which they descend. Shells are simply frameworks that provide the requisite "consultation paradigm," typically prediction or diagnosis.

ESP Advisor, from Expert Systems International (ESI), is one

such Prolog shell. Released in 1984, *ESP Advisor* was written in a version of the language known as Prolog 1, and was recently upgraded in the more potent Prolog 2. ESI president Angelo Kolokouri suggests that ambitious, business-oriented Prolog development has been held back by the absence of a powerful programming environment—one that Prolog 2 now provides.

Says Kolokouri, "With the new Prolog, you have a modular environment that offers windows and graphics." Given Prolog 2's graphics capabilities, a programmer can generate logical relationships that the Prolog interpreter will read and return in the form of knowledge-based rules. Compiled Prolog 2 reportedly improves on the performance of interpreted Prolog 1 by 20 times.

Arity Corporation, an offshoot of Lotus's Advanced Development

Group, has entered the field with Arity/Prolog, a full Prolog environment. In addition to Arity/Prolog, the Arity product line includes an expert system development package and a screen design tool.

Arity's agenda calls for augmenting its expert system shells with Prolog-based business applications. The firm is close-mouthed about what it calls "a smart professional environment for end users at all levels," due out by spring. Meanwhile, Arity/Prolog has met with enough success for Arity to triple its business plan in the shell game.

Both Arity and ESI view themselves as committed Prolog houses. In that respect, they differ decisively from Teknowledge, another player in the expert systems arena, which has pointed itself in a radically different direction. M.1, the firm's expert system tool, originally written in Prolog 1, has been rewritten in C. Teknowledge made the move in part to fulfill a corporate goal of maximizing the

How Prolog Works

Working in Prolog means relying on an unorthodox approach to problem solving. The Prolog programmer, after all, describes the problem rather than a precise way to solve it.

The basic data unit in the Prolog knowledge base is the *fact,* which corresponds to a record in a traditional data base. The boundaries of a Prolog fact are arbitrary and are established by the programmer.

The basic form of a fact is:
predicate(argument 1, argument 2,
... argument *x*). A fact may be complex, as in:
infield(1st_base, 2nd_base,shortstop, 3rd_base).
Or it may be simple:
Error(shortstop).

The predicate declares that a relationship exists, and the arguments designate the objects or values that the relationship includes. Multiple arguments are separated by commas within the parentheses. Argument order is arbitrary, although certain conventions may apply, as they do in most languages. (Note that Prolog requires arguments or predicates to be one unit with no spaces; hence *1st* must be connected to *base* by _.)

Facts set forth the attributes of objects and their relationships. To build a knowledge base about selected houses on your block, you could describe them by color:
house(red)
house(white)
house(green-white)

This data can qualitatively mark differences among the houses by defining "houseness" in terms of color.

To represent more complex information concerning the houses on your street, you could indicate ownership. You'd begin by telling the PC that Homer owns a house:
owns(homer,house)

If you wanted to be still more specific, you could state:
owns(homer,house(red))

This last statement demonstrates Prolog's ability to treat an existing factual relationship as a single object when that association is used as an argument. Information can be nested to any depth; the only constraint is system memory.

Once your knowledge base is in place, you can ask questions using Prolog's query capability. You query the knowledge base by asking if Homer owns a house:
owns(homer,house)?

The PC answers with a resounding 'yes', confirming that you've already entered this fact in your knowledge base. Prolog is demonstrating its prowess as a pattern matcher.

Asking questions via the query is a fine exercise, but it quickly becomes prosaic. To further raise the level of your knowledge-base manipulations, you can declare *rules* about data. A rule is defined as an instance in which a fact or group of facts defines another fact. Asking what colors of houses exist, for example, requires a different form:
house_colors(Color) :- house(Color).

The uppercase C in Color enables Prolog to recognize Color as a variable. (Unlike variables in

BASIC and other languages, Prolog variables are transitory, good only for the clause they're included in.) The computer will return:

Color = red

If you follow that by asking if any other colored houses exist, you'll be told "Color" also equals white and green_white. This Prolog rule (sometimes referred to as an IF ... THEN rule) takes the form shown in Figure A.

A rule is interpreted: "Should the tail (the right-hand clause) or IF conditions be satisfied, THEN something will happen." Rules may be constructed from very complex tail structures. The head (the left-hand clause) will "fire" as a "condition met" if all the tail statements are found in the knowledge base. In this way, by firing the head—that is, by meeting the tail conditions—the programmer can reorganize a problem, teach new facts to the knowledge base, or advise a user that program reasoning has occurred and

head	if	tail
house_color(Color)	:-	house(Color)

Figure A

that it's now time to move on to something else. You could, for example, help a substitute meter reader find the location of the water meter in the red house.

The program in our example executes in the following way. First, it finds the :- (the IF symbol). This symbol essentially says, "Prolog, you have a goal. The goal is to determine whether the fact or facts listed to the right are in the knowledge base." The program searches the knowledge base for the fact. If it finds a match, the head will fire and you get the news. When Prolog is working to find a match, it uses a search strategy known as backtracking.

Backtracking starts with the first clause to the right of the IF symbol. Each fact in the knowledge base is checked until a match is discovered. If the first fact matches, the

matched fact is marked, and the program moves to the next statement on the right. The search continues until all facts in the tail are matched. If no match is found for a statement, the search returns to the preceding match and regroups.

This reorganization is purposeful, not random; the program follows a pattern defined by the rule (the tail conditions). It is via this matching process that new information is added and that Prolog programs "learn."

All Prolog code has a distinctive look and executes in this unique manner. These rudimentary examples provide only the most cursory sense of the language's special quality. —R. L.

potential for software integration. The conversion to C reportedly enabled M.1 to run more than four times faster than its Prolog predecessor.

■ Speaking in Natural Language

Conversing with the PC in everyday English is about on a par with trying to get a straight answer from a politician. To the degree that AI technology is proven and available, its capacity for understanding natural language rests at the foggy end of the spectrum. Natural language translators are available for a few data bases, but their reliability and flexibility are suspect. Prolog may ultimately alter that equation.

Symantec's Intelligent Assistant is a PC-based interface that enables users to put commands to the *Q&A* data base in plain English. By writing the interface in C, LISP, and assembly language, designer Gary Hendrix used a technique known as phrase structure grammar. Prolog, Hendrix explains, uses a different theoretical construct that may have its own advantages.

With Prolog, the programmer can use logic to approach the problem of writing a module that understands natural language. According to Hendrix, "You try to prove a theorem that says the string of words making up the input sentence is in fact a sentence."

Fernando Pereira, senior computer scientist at SRI International, worked on developing the first Prolog compiler and is a leader in applying Prolog to natural language research. Says Pereira, "Prolog is especially well suited to the data base query problem."

According to Pereira, the way to express the problem of natural language data base queries is to supply a set of rules that describe how a sentence is broken down into parts, and how the meanings of the parts come together to form the meaning of the sentence. The sentence by itself won't fully determine the precise reassembly of the

An interface like the Intelligent Assistant requires a separate engine for each kind of processing. In a natural language system built around Prolog's unification algorithm—that is, backtracking—you can, as Hendrix says, "throw everything in one pot and let the unification algorithm figure it out for you."

Does all this mean you'll soon be able to pick up a generic, Prolog-based natural language front end for your favorite spreadsheet?

■ *Ambitious, business-oriented Prolog development has been held back by absence of a powerful programming environment—one that Prolog 2 now provides.*

parts; the structure of the rules themselves, however, resembles the Prolog IF ... THEN clause.

"With an abundance of rules," says Pereira, "there doesn't seem to be any simple way they are all going to fit together—except by trying out several alternatives. This kind of nondeterministic rule application is built into Prolog as backtracking." (See the sidebar "How Prolog Works" for more on backtracking.)

Prolog offers the additional advantage of permitting the processing engines for syntactic (organizational), semantic (meaning-related), and pragmatic (real-world) information to coexist within one system. Remember that criteria for AI languages include an ability to recognize different data types and mix data and procedures.

Not in the foreseeable future. Natural language interfaces are currently limited to highly specialized applications. Engineering a system imbued with general understanding would require the programmer to clean up the cluttered language universe that all logic systems inhabit.

■ The Populist Prolog

Borland International is marketing its Prolog as a compiler for the masses, and company president Philippe Kahn appears intent on shaking up the AI establishment. Some believe Kahn is attempting to duplicate his Turbo Pascal strategy by bringing new

users into the fold and essentially redefining the language. A full complement of Turbo Prolog tools—and applications—are in the works.

Borland's prominence does raise the issue of a Prolog standard. Two University of Edinburgh professors, W. F. Clocksin and C. S. Mellish, established the de facto standard for Prolog in the late 1970s. Although Borland claims its product is a "large superset" of the Edinburgh standard, Turbo Prolog doesn't fully meet the conventions set forth by Clocksin and Mellish. Other inexpensive implementations of Prolog are, however, compatible with Clocksin and Mellish's standard: Chalcedony Software sells a sleek, intepreted version, Prolog i, for less than $100. Automata Design offers several levels of its Prolog for prices ranging from $29 to $200. Arity is even enticing Borland users to move into a more conventional Prolog environment by offering a $50 rebate.

Before Prolog can really take center stage, the language must shake its reputation as LISP's understudy. Teknowledge's Steven Hardy, who headed the design team for the Prolog version of M.1, suggests that some of the language's early advantages have diminished. As the cost of hardware has declined, Hardy reasons, the "need for expert system developers to work within the limits of 1970s hardware" has made Prolog a less attractive environment for developers.

Hardy cites two other potential problems with Prolog as an application language. First, in large applications, backtracking is difficult to control. In addition, Hardy describes Prolog as having two learning curves. Application or procedural programming in Prolog is more difficult to grasp than working in the declarative mode. Fernando Pereira puts it this way: "Learning Prolog is like climbing a very smooth, rounded hill. You get to the top of that hill and suddenly you find this huge cliff. You need to scale the cliff and several more if you're going to get into serious artificial intelligence programming."

■ **Growth: It's Logical**
Looking on the bright side, Symantec's Gary Hendrix sees Prolog as a unique language for building "models of quantitative facts," as our Homer example demonstrates (see the sidebar "How Prolog Works"). Virtually anything that can be described in a declarative English sentence can be modeled and manipulated in Prolog.

Prolog programmers must, in a sense, be more adept than developers working in other languages because the declarative milieu can be so inexact. Says ESI's Angelo Kolokouri, "Prolog requires that the programmer be trained to unambiguously define the problem at hand." Fernando Pereira concurs. "If you're introduced to programming through Prolog, you're working at a much higher level of expressing relationships.

"I don't think the problems in artificial intelligence are going to be solved with language A or language B," Pereira continues. "We don't lack programming languages—languages can only help us express what we know, once we have figured that out." ⬗

Robert Lewis is a professor in the Department of Cinema at San Francisco State University and a long-time student of artificial intelligence.

(continues)

Prolog at Work

While the expert systems field is not yet teeming with commercial Prolog applications, it's proving to be increasingly fertile soil for developers. Large expert systems written in Prolog are up and running at Boeing Aircraft, SRI International, and the Argonne National Laboratories.

At SRI International's Menlo Park, California, headquarters, Prolog serves as the vehicle for an expert system that models technical developments and market conditions in the petrochemical industry. Prolog is the basis of an interface to an existing hierarchical model written in C. The resulting system analyzes the market impact of potential new product introductions.

In the SRI system, Prolog analyzes a large data base of industrial plants, manufacturers, and technologies. Prolog also controls a rule-based deductive reasoning system that guides corporate decision making in the marketing arena. According to SRI analyst Jaffer Syed, Prolog shines "when we don't know how 'hard'

the constraints are. Prolog enables us to put in conditions that allow for leeway."

At Boeing, Prolog lies at the heart of CASE (Connector Assembly Specification Expert), an expert system that helps workers select appropriate tools and materials for assembling electrical connectors. The system sifts through tens of thousands of pages to locate the specifications that govern electrical connector assembly. Prolog has earned its keep with an easy rule-building facility that permits the isolation of individual specification processes and encourages an incremental approach to design. By separating the specification processes into separate knowledge bases, designers are able to simplify maintenance and product revision. Moreover, Prolog's interactive capability enables users to query the program to find the right specs.

Soon, a Prolog program may be offering guidance to nuclear power plant operators.

One nascent system that does just that was developed at Argonne West, a branch of the Argonne National Laboratories in Argonne, Illinois. The Argonne program consists of a decision support system that interprets sensor readings and provides a graphics display, thereby showing plant operators how to configure valve and switch settings in accordance with plant requirements. As with the SRI application, Prolog's ability to work with a C language component proved a major plus.

All three systems are too ambitious and hardware-hungry for an ordinary PC. All were developed in Quintus Prolog, marketed by Quintus Computer Systems of Mountain View, California. For now, Quintus Prolog is limited to DEC VAX, Sun Microsystems, and IBM RT machines. Quintus spokesperson Debbie Staff says the firm is evaluating 80386-based machines as possible hosts for its offspring.

If you're looking for a set of tools with which to build and use an expert system, you might consider APES (Augmented

Prolog for Expert Systems). APES was developed in 1984 by Logic Based Systems of London. As an expert system shell, APES runs on top of MicroProlog Professional, a PC version of Prolog from Logic Programming Associates, also of London.

According to Anthony Kowalski, president of Programming Logic Systems, the American distributor of the package, APES applications range from diabetes management to the design of highway retaining walls. "For the type of rule-based expressions [included in APES], Prolog applications are many times smaller than programs written in procedural languages," Kowalski says.

APES features a set of system-building tools, including a natural-language translator that enables the programmer to enter rules and facts using English-like sentences. A simple rule for a medical diagnostic program might be written as follows:

Patient [a variable] is advised to take a drug [a variable] if patient suffers from symptom [a variable] and the drug suppresses the symptom and the drug doesn't harm the patient.

Other prominent features of APES are:

A query-the-user system. This rudimentary learning system asks you for information missing from the program. If the program needs a fact or an assertion to solve a problem, APES requests the information and incorporates it into its solution.

A full explanation facility. When APES reaches a conclusion, you can ask the application to retrace and play back the steps that led to that conclusion.

A browser. The program can refer to a file outside APES as a way to generate an in-depth explanation of a specific event.

Other APES tools include windows, menus, and a screen editor. The package automatically flags contradictory information and features data-validity checks. —R. L.

M.1
Teknowledge, Inc.
1850 Embarcadero Rd. #10119
Palo Alto, CA 94303
415/424-9955
List price: $5000
Requirements: 512K, two disk drives, DOS 2.00 or later version
Not copy protected

Micro/Prolog Professional
Programming Logic Systems, Inc.
List price: $245
Requirements: 256K, one disk drive, DOS 2.00 or later version
Copy protected

Prolog
Automata Design Assocs.
1570 Arran Way
Dresher, PA 19025
215/646-4894
List price: $9.95 to $250 depending on version
Requirements: 320K, one disk drive, DOS 2.00 or later version
Not copy protected

Prolog i
Chalcedony Software
5580 La Jolla Blvd. #126
La Jolla, CA 92037
619/483-8513
List price: $99.95
Requirements: 256K, one disk drive, DOS 2.00 or later version
Not copy protected

Turbo Prolog
Borland Int'l, Inc.
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
408/438-8400
List price: $99.95
Requirements: 384K, DOS 2.00 or later version
Not copy protected

Straight Line to the Bottom Line

Making projections with a spreadsheet has until now been a hit-or-miss affair. But with 1-2-3's new linear regression function, you can take sure steps through a fog of financial data to more accurately project future sales, the cost of making goods, or even the effectiveness of advertising—and double-check your assumptions.

Andrew T. Williams
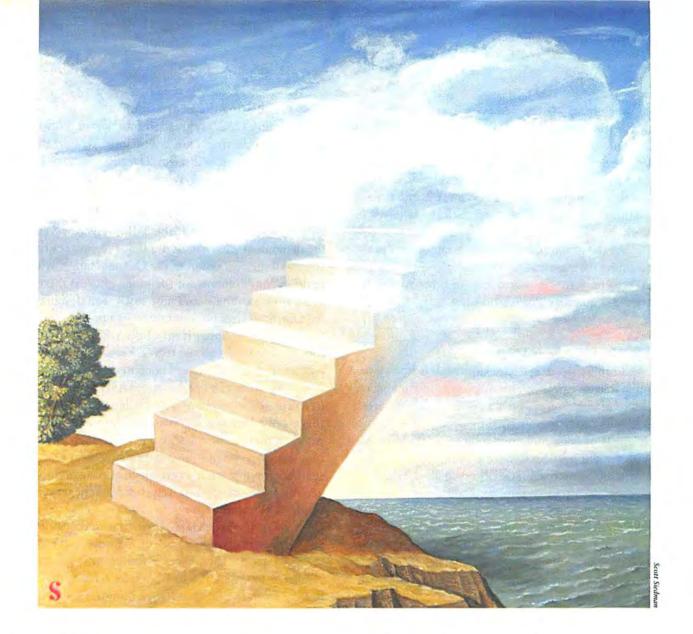
‖‖‖ Statistical regression is like Esperanto—lots of people have heard of it, few understand it, and fewer still can put it to any practical use. Yet regression analysis can illuminate the causal relationship between variables affecting the bottom line—and thus enable you to more accurately predict your company's fortunes.

Until recently, regression analysis was featured only in sophisticated statistical programs typically used by those with training in mathematics. Thankfully, Lotus Development has included a palatable—and for the layperson, usable—form of regression analysis in release 2 of *1-2-3*. Setting up a worksheet and getting serviceable results are well within the ability of the intermediate user, although interpreting those results may mean dipping your toes in the murky waters of statistical analysis.

■ **What Is Regression Analysis?**
Regression is a widely used statistical technique for analyzing related historical data (the number of unfilled potholes and shock absorber sales between 1978 and 1985, for example) and deriving an equation that embodies the relationship. If you've amassed an accurate collection of historical data, you can, on the strength of this relationship, plug new values into the equation and make some reasonable financial projections.

Consider a possible real-life application: Imagine you are in the research department of Batter-Up

Beer, "The Sports Fan's Favorite Brew." The brewmaster wants to know how much beer to make each quarter, and she has asked you to project future sales. Furthermore, she is convinced that Batter-Up's sales are heavily influenced by the amount of sports programming on TV and expects you to use this as a basis for your projection.

To do the job right, you must gather two sets of historical data by quarter: beer sales (in cases) and average number of hours of daily TV sports programming. Luckily, the data is close at hand, so open a new worksheet and type in the headings and data shown in Figure 1 for columns A, B, and C. To format column B for commas and no decimals, select /*Range Format* and type **,0 < Enter > B5.B20 < Enter >**.

Data can be entered in either columns or rows, but *1-2-3* requires that each range hold the same number of data points. Note that you can use 16 variables (like Sports on TV), but that the accompanying data must be in adjacent columns or rows.

Plotting History

To visualize the historical relationship between beer sales and sports programming, you use *1-2-3*'s Graph command to generate a scatter diagram, which is just an *x-y* graph without the connecting lines. Convention places the independent variable—the basis for the projection—on the horizontal, or *x*-axis. The dependent variable—the one being projected—is plotted along the vertical, or *y*-axis.

To construct the scatter diagram, select /*Graph Type XY* and designate the Sports on TV data as the

x-axis by typing **XC5.C20 < Enter >**. To specify Beer Sales as the first data range, type **AB5.B20 < Enter >**.

Since a scatter diagram only shows the data points, not the connecting lines, select *Options Format A Symbols Quit Quit* to suppress the line that *1-2-3* would normally draw to connect Beer Sales data points. To display the graph, select *View* (see Screen 1).

As the graph plainly shows, when sports programming increases, so do Batter-Up's sales. The next step is to perform the regression—in other words, to have *1-2-3* quantify this relationship.

The Straight and Narrow (Line)

In this case, *1-2-3* calculates what is known as a simple linear regression, because only one independent *x* variable (Sports on TV) is used and because the results can be represented by a straight line. In the words of one economist, a regression "draws the 'best' straight line through a cloud of data," the "best" line being one that's closest to all the data points in a scatter diagram. Extend this line (in effect, plugging new values into the equation), and you can make predictions based on historical trends.

The standard regression equation also happens to be the equation for a straight line: $y = a + bx$, where *y* and *x* represent the dependent and independent variables, respectively. The key elements of the equation are the constants *a* and *b*. In an *x*-*y* graph, *a* is the point where a line crosses the *y*-axis; in other words, *a* is equal to the value of *y* when *x* is 0. Thus, if the regression chews through the historical data and determines that *a* equals 10,000, this means that 10,000 cases of Batter-Up Beer will be sold even when there is no sports programming on TV.

The constant *b* is the slope of the line and indicates how much *y* changes as *x* changes. If the regression finds that the value of *b* is 3500, then a 1-hour increase in Sports on TV should increase Beer Sales by 3500 cases.

When *1-2-3* performs the regression, it calculates values for both *a* and *b*. With these figures in hand, using the equation to predict future beer sales is a matter of plugging different values into the *x* variable, Sports on TV (information available from network and local broadcast statistics), and solving the equation for *y*.

Calculating the Regression

Setting *1-2-3*'s regression function in motion is a matter of selecting a few commands. To start things off, quit the graph and select */Data Regression*. The options are X-Range, Y-Range, Output-Range, and Intercept.

The X-Range identifies the independent variable, Sports on TV, while the Y-Range is reserved for the dependent variable, Beer Sales. *1-2-3* places the results of the regression in the Output-Range, which requires four columns for the range (more if there are over two *x* variables) and nine rows. You designate the Output-Range by pointing to its upper-left corner. Keep in mind that if the Output-Range isn't large enough to contain all the regression statistics, *1-2-3* will write over existing cell contents.
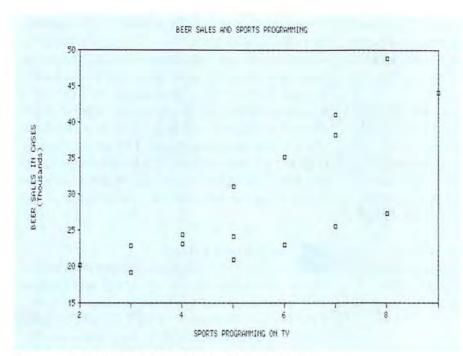
The Intercept option automatically directs *1-2-3* to calculate the value of *a*. You could set *a* at 0, but this is only done when you already know from the problem that if *x* equals 0, *y* must too. Such a situation doesn't arise in this case, but a medical researcher attempting to correlate heart rate and oxygen intake knows all too well that when heart rate is 0, so is oxygen intake.

To run the regression, first choose the Sports on TV data in column C. Select *X-Range* and type **C5.C20 < Enter >**. Then select *Y-Range* and type **B5.B20 < Enter >** to designate the Beer Sales data as the Y-Range. From the *Output-Range* option, type **G5 < Enter >** to designate the upper-left corner of the Output-Range. Pick *Go* from the Data Regression menu, and *1-2-3* calculates the regression, dropping the output into the worksheet starting at cell G5, as shown in Figure 1.

Reading the Results

What materializes in the Output-Range might seem perplexing at first, but remember that the idea of the regression is to compute values for the *a* and *b* constants, labeled here Constant and X Coefficient(s). The other values in the regression output merely indicate how accurate these two numbers are—and whether you should rethink your assumptions, or at least consider other factors that may affect sales. Obviously, the more reliable *a* and *b* are, the more accurate your predictions.

Constant expresses the rock-bottom beer consumption (in cases) when there is no TV sports programming. In this instance, *1-2-3* estimates the value

BEER SALES AND SPORTS PROGRAMMING

Screen 1: You can quickly view the historical relationship between beer sales and sports programming with a 1-2-3 scatter diagram.

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2		BEER	SPORTS									PROJECTED
3	QUARTER	SALES	ON TV									SALES
4												
5	1-81	19,254	3				Regression Output:					20,409
6	2-81	24,175	5				Constant		9938.484			27,389
7	3-81	38,218	7				Std Err of Y Est		6195.082			34,369
8	4-81	25,621	7				R Squared		0.584049			34,369
9	1-82	21,011	5				No. of Observations		16			27,389
10	2-82	27,358	8				Degrees of Freedom		14			37,859
11	3-82	44,125	9									41,349
12	4-82	23,059	6				X Coefficient(s)	3490.103				30,879
13	1-83	22,952	3				Std Err of Coef.	787.1731				20,409
14	2-83	31,156	5									27,389
15	3-83	41,001	7									34,369
16	4-83	23,126	4									23,899
17	1-84	24,434	4									23,899
18	2-84	35,125	6									30,879
19	3-84	48,822	8									37,859
20	4-84	20,198	2									16,919

Figure 1: Columns B and C of the worksheet contain historical data. When the regression is complete, 1-2-3 displays the appropriate output in columns G through J. To test the accuracy of the regression, output values (along with historical data) are used to generate the projected sales figures shown in column L.

of *a* at 9938 cases. The Standard Error of Y Estimate is a somewhat arcane value used by statisticians to assess the accuracy of predictions. *1-2-3* users should keep in mind that the smaller this estimate is, the better.

R Squared indicates how "good" a prediction you can make based on *a* and *b*. Put another way, R Squared gauges the correlation between *x* and *y*, answering the perennial question, "How dependent are beer sales on televised sporting events?" The value of R Squared ranges anywhere from 0 to 1. If the correlation is perfect (Beer Sales are inextricably linked to Sports on TV), R Squared is 1. If there is no correlation, R Squared is 0. Naturally, the closer R Squared is to 1, the more realistic your projections.

As Figure 1 shows, R Squared is .584049. About 58.4% of the variation in Beer Sales is due to

> *Regressions can help you estimate the cost of production based on output levels, or project profitability based on sales figures, or investigate the influence of advertising expenditures on sales.*

Sports on TV. The message here is clear: There are other significant factors affecting sales. You can improve R Squared by introducing more *x* variables into the regression.

Number of Observations is the total number of data pairs used in the regression. Degrees of Freedom subtracts the number of constants used in the regression from Number of Observations. (In this example, Degrees of Freedom is 16 − 2, or 14.) Although this figure is generated with the statistician in mind, a small number (say, less than 7) indicates that there isn't enough historical data to support the regression.

The X Coefficient is the value of *b* in the equation $y = a + bx$. This is the second, and last, piece of the prediction puzzle. Recall that *b* is the amount beer sales jump or slump when TV sports broadcasts change by one unit. According to this regression, increase sports broadcasts by an average of one hour a day, and Batter-Up Beer sales increase by 3490 cases. A complementary statistic, the Standard Error of Coefficient, evaluates *b*'s reliability. If *b* has a significant effect on the regression, it should be at least twice as large as the Standard Error. While such an interpretation may make statisticians wince, it should serve you in evaluating the quality of your projections.
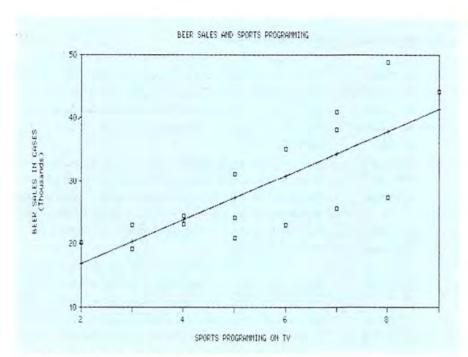
▪ Checking the Future

Of course, *1-2-3*'s regression output isn't the only way to make sure your crystal ball isn't cracked. With values for *a* and *b* in hand, the equation now looks like this: Beer Sales = 9939 + (3490 × Sports on TV). You could start making projections immediately by substituting a value for Sports on TV and calculating the result, but how reliable would your projections be?

The simplest way to test the soundness of *a* and *b* is by running real information—such as Sports on TV data from column C—back through the equation. If the projected sales are close to the historical values in column B, the constants form a good basis for making projections. In this example, the test projections are displayed in column L and then plotted against the historical Beer Sales with *1-2-3*'s Graph function.

To generate test projections, type **+$J$6 + I$12*C5** into cell L5. This *1-2-3* formula is the equivalent of *a* + *bx*; $J$6 is the cell holding 9938.484 (the constant *a*), while $I$12*C5 multiplies the first value in the Sports on TV column by 3490.103 (the value of *b*). Change the format of the cell to commas and no decimals. To test the equation against the historical data, copy it in column L by selecting /*Copy* and typing **L5 < Enter > L6.L20 < Enter >**. The test projections will pop into the column.

The scatter graph generated earlier should still be current. To designate these projected beer sales as a second data range and to represent them as a line cutting through the historical data, select /*Graph B* and type **L5.L20 < Enter >**. Select *View* and *1-2-3* lays the regression line through the cloud of historical data (see Screen 2).

BEER SALES AND SPORTS PROGRAMMING

Screen 2: Will your projections cut the mustard?
You can test the regression's validity by laying a
line representing projected sales through a scatter
diagram of the actual data.

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2		BEER	SPORTS	AVG.								PROJECTED
3	QUARTER	SALES	ON TV	TEMP	SUMMER							SALES
4												
5	1-81	19,254	3	50	0			Regression Output:				18,939
6	2-81	24,175	5	60	0		Constant		-5393.09			24,922
7	3-81	38,218	7	75	1		Std Err of Y Est		3341.170			41,347
8	4-81	25,621	7	60	0		R Squared		0.896295			26,517
9	1-82	21,011	5	55	0		No. of Observations		16			22,728
10	2-82	27,358	8	65	0		Degrees of Freedom		12			29,508
11	3-82	44,125	9	75	1							42,941
12	4-82	23,059	6	60	0		X Coefficient(s)	797.2703	438.8117	8247.838		25,719
13	1-83	22,952	3	55	0		Std Err of Coef.	629.2570	174.2333	3326.845		21,133
14	2-83	31,156	5	65	0							27,116
15	3-83	41,001	7	80	1							43,541
16	4-83	23,126	4	70	0							28,513
17	1-84	24,434	4	55	0							21,931
18	2-84	35,125	6	70	0							30,107
19	3-84	48,822	8	80	1							44,338
20	4-84	20,198	2	55	0							20,336

Figure 2: This worksheet is an extension of the
first. Two new variables—Average Temperature and
Summer—are added to the regression. The change
is startling: When the new regression output is
used to calculate sales, the values are much closer
to the historical data.

Multiple Regression: Honing the Values
While the simple regression just calculated is
the best estimate of the historical relationship be-
tween the two variables, Beer Sales and Sports on
TV, it's also evident from the graph (and from the rel-
atively low R Squared) that the values predicted by
the regression don't fit the historical data very closely.
Many of the actual sales figures (represented by
boxes in the graph) are relatively far from the equa-
tion line. Clearly, other factors besides Sports on TV
affect Beer Sales, and projections based on the one
variable alone will be wide of the mark.

In fact, your assistant, Joe Eager, thinks that
weather is a big factor. "When it gets hot," he says,
"people are thirstier and beer sales go up. Further-
more, beer is a summer drink. When summer rolls
around, sales naturally increase."
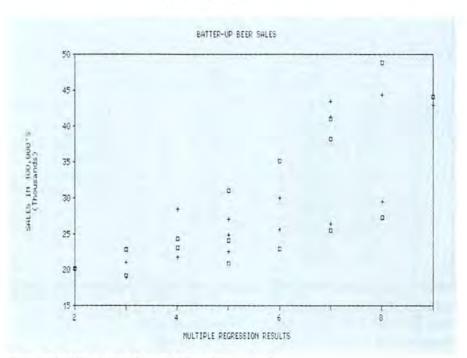
To back up his ideas (and to get a leg up on
your job), Joe has gathered meteorological data on
the average temperature per season, and he's created
a "dummy variable" where 1 stands for summer and
0 for the other seasons. Dummy variables are a
powerful way to include either/or variables in a re-
gression analysis.

Figure 2 shows the new x variables–Average
Temperature and Summer–entered next to the origi-
nal x variable, Sports on TV. Remember that *1-2-3*
requires all x variables to be in adjacent columns or
rows. To follow the example, key in the data in col-
umns D and E.

A regression involving two or more indepen-
dent variables is appropriately called a "multiple re-
gression," and its standard equation is a variation on
an earlier theme: $y = a + b_1x_1 + b_2x_2 + b_3x_3$. In
this case, each independent variable is assigned its
own b constant.

At this point, you can make fast work of a mul-
tiple regression because *1-2-3* remembers the last X-
Range, Y-Range, and Output-Range. Select /*Data Re-
gression X-Range* and *1-2-3* highlights the previous
X-range–Sports on TV. Press **< CursorRight >** twice
to stretch the X-Range to include the new indepen-
dent variables and then press **< Enter >**. The Output-
Range and the Y-Range stay the same, so select *Go*.
1-2-3 then displays the new regression results in the
Output-Range.

Screen 3: Checking the validity of a multiple
regression. Boxes represent the historical data;
the plus signs represent the projected cumulative
values of Sports on TV, Average Temperature,
and Summer. As can be seen, the projected data
and historical data form a close match.

Notice that R Squared has jumped from 0.584 to 0.896. The additional variables explain a good deal more about Beer Sales than did Sports on TV alone. Another reason for feeling more confident about projections based on the new regression is that the Standard Error of Y Estimate has fallen sharply, from 6195 to 3341.

With the values for b_1, b_2, and b_3, you now know that an extra hour of Sports on TV adds about 797 cases to a quarter's sales, while a 1-degree increase or decrease in temperature affects sales by 439 cases. Summertime alone accounts for an additional 8248 cases of beer. The equation now reads: Beer Sales = $-5,393$ + (797 × Sports on TV) + (439 × Avg. Temp.) + (8,248 × Summer).

As with the first regression, predicting beer sales is a matter of substituting the values for a and b_1, b_2, and b_3 from the outputs, plugging in your estimates for the different variables, and calculating the result.

Graphing a Multiple Regression

To quickly see how well the multiple regression overlaps actual sales figures—and, by extension, how well your projections will stack up—you can once again funnel historical data through the equation and graph the results. Type the formula **+$J$6+$I$12*C5 +$J$12*D5+$K$12*E5** into cell L5. Since the range is already formatted, complete the column of test projections by selecting /*Copy* and typing **L5 < Enter > L6.L20 < Enter >**.

When graphing projected sales versus historical data, keep in mind that data from three x variables is being fed into each data point (represented here by plus signs). Since *1-2-3* cannot graph data in multiple dimensions, suppress *1-2-3*'s urge to connect the points by selecting /*Graph Options Format B Symbols Quit Quit*. When you choose *View*, projected sales are plotted with the actual data (the rectangles) in a scatter diagram (see Screen 3.)

As you can see, projections closely match the historical data; in several cases, the values are identical. The fit in this case is snug, thanks to the additional independent variables.

Extensions

In your quest for a tighter fit, you might want to include other pertinent variables—the effect of advertising (yours and the competition's) or the unemployment rate (more time to drink beer, but less money to spend). Whatever variables you stir into the equation, follow the statistician's number one rule of thumb and always gather as much relevant historical data as possible. The more data, the more accurate your predictions.
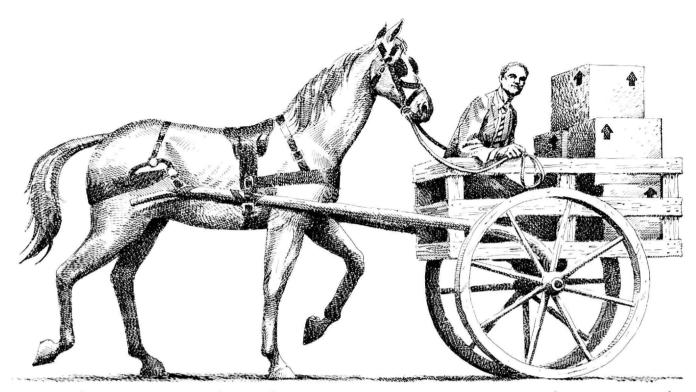
You can use regression analysis to investigate a variety of common business problems. For example, regressions can help you estimate the cost of production based on output levels, or project profitability based on sales figures, or investigate the influence of advertising expenditures on sales. If you sell real estate, you could formulate a regression to predict housing prices based on such factors as square footage, number of bedrooms, average income, and so on. You could even use regression analysis to predict your bowling team's performance based on individual records. If nothing else, a regression can weigh the effect different variables have on your predictions, thereby sifting the wheat from the chaff.

Lies, Damn Lies, and Statistics

When applying the power of *1-2-3*'s linear regression function, it's important to remember that a great deal of skill and knowledge is needed to properly interpret the results. In particular, be careful when projecting future values on the basis of historical relationships. In certain situations, a relationship that was valid yesterday may not be valid tomorrow. By the same token, don't make projections far beyond the range of historical experience. If you only have sales figures for the last five years, don't make predictions through 2020.

Finally, don't fall into the trap of blindly believing statistics. Carefully measure your results against what common sense and your knowledge of business tell you. If something smells fishy, chances are it's rotten. ⬢

Andrew T. Williams is a PC World Contributing Editor and the author of several books, including 1-2-3 Release 2: ASAP (John Wiley, New York, 1986).

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Like what you see? Find out more: Call our toll-free hotline for your copy of the Sysgen product family brochure, or for the DuraPak dealer nearest you.

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Trademarks: Sysgen, DuraPak–Sysgen, Inc.; IBM PC/XT, PC-AT–International Business Machines Corporation. Registered Trademarks: The Bernoulli Box, Iomega–Iomega Corporation; IBM–International Business Machines Corporation. * Based on suggested retail price information available 6/1/86.

SYSGEN
I N C O R P O R A T E D

Password: Communicate

Information and insights on the PC communications marketplace

This month: on-line gateways for a highly useful travel information and ticket service and a not-so-useful computer-product data base

Edited by Jeremy Joan Hewes

On Line

Passengers Take Command With On-Line OAG

Looking for the best airfares to Hawaii or winter hotel and motel availability in Miami Beach? Then look no further than your computer and your favorite on-line data base service. There you can join thousands of business and pleasure travelers who have discovered the Electronic Edition of the *Official Airline Guides (OAG)*.

"Ninety percent of business travelers already know the flight and fare they want when they call their travel agent to book a trip," says Joe Bernardo, general marketing manager for electronic publishing at *OAG* headquarters in Oak Brook, Illinois. "Our published guides are the traditional source of that information. But with the dramatic changes in the airline industry brought on by deregulation, a printed directory could no longer supply our customers with accurate, complete information. We make 30,000 fare changes every night on the electronic *OAG*, which gives you an idea of what the industry is like today."

The *OAG* Electronic Edition was instituted in May 1983 as an

The database used now be used

Introducing dBASE III PLUS.™

The PLUS stands for all the improvements we've made to the world's number one selling database management software.

```
Up  Create  Update  Position  Ret:
    ┌──────────────────────┐
    │ Database file        │
    │ Format               │
    │ View                 │
    │ Query                │
    │ Report               │
    │ Label                │
    └──────────────────────┘
```

The Assistant helps beginning users accomplish day-to-day data management tasks without programming.

Mind you, dBASE III PLUS still has the powerful dBASE programming language, dot prompt, and all the features that have made dBASE III the standard of the industry.

We've simply raised the standard.

And just as dBASE III introduced more power to the people, our new dBASE III PLUS introduces more people to the power.

People who aren't all that crazy about programming, for example.

The Assistant feature in dBASE III PLUS now provides them with new easy-to-use pull-down menus for creating, using and modifying multiple databases.

So now anyone who can manage a simple cursor can manage day-to-day data management tasks. Without programming.

And by using our new Screen Painter, anyone can create custom screens. Without programming.
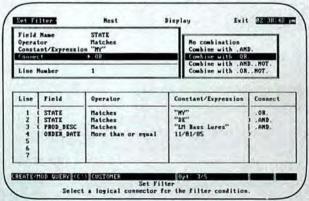
Or using View, access related information in several databases at one time. Without programming.

With Advanced Query System, another new non-programming feature, any user can build complex queries just by selecting from the dBASE III PLUS pull-down menus.

For rapidly creating entire programs, there's even a new Applications Generator.

And for all those who wish to learn to program, the Assistant can be of further assistance. By teaching you programming commands as you go along. Without disrupting your work flow.

These are only a few of the dBASE III PLUS features that can help new users quickly get up to speed. And experienced users quickly increase their speed. (Sorting, for example, is up to two times faster and indexing up to ten times faster than dBASE III.)

```
 Set Filter         Nest        Display        Exit  02:30:48 pm
 ┌──────────────────────────┐   ┌──────────────────────────┐
 │ Field Name    STATE      │   │ No combination           │
 │ Operator      Matches    │   │ Combine with .AND.       │
 │ Constant/Expression "MY" │   │ Combine with .OR.        │
 │ Connect        ▶ .OR     │   │ Combine with .AND..NOT.  │
 │                          │   │ Combine with .OR..NOT.   │
 │ Line Number    1         │   └──────────────────────────┘
 └──────────────────────────┘

 ┌──────┬──────────┬──────────────────┬─────────────────────┬─────────┐
 │ Line │ Field    │ Operator         │ Constant/Expression │ Connect │
 ├──────┼──────────┼──────────────────┼─────────────────────┼─────────┤
 │  1   │ STATE    │ Matches          │ "MY"                │ .OR.    │
 │  2   │ STATE    │ Matches          │ "DE"                │ ).AND.  │
 │  3   │ PROD_DESC│ Matches          │ "LM Bass Lures"     │ ).AND.  │
 │  4   │ ORDER_DATE│ More than or equal│ 11/01/85          │ )       │
 │  5   │          │                  │                     │         │
 │  6   │          │                  │                     │         │
 │  7   │          │                  │                     │         │
 └──────┴──────────┴──────────────────┴─────────────────────┴─────────┘
 CREATE/MOD QUERY <<:> CUSTOMER         Opt: 3/5
                          Set Filter
              Select a logical connector for the filter condition.
```

Advanced Query System lets you set up and answer complex queries without programming.

by more people can
by more people.

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dBASE III PLUS

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on-line version of the standard printed guide, which covers all scheduled flights with origins or destinations in the United States. This on-line guide is currently available by direct subscription and as a service on most commercial information utilities, including CompuServe, The Source, Western Union EasyLink, Dow Jones News/Retrieval, Dialog, and NewsNet.

The on-line *OAG* is a premium service on the information utilities, so you'll incur an extra connect charge whenever you use it, in addition to the utility's standard access rates. The surcharge varies among services but generally ranges from $21 to $48 per hour during nonprime time (evenings and weekends) and $32 to $72 per hour in prime time (weekdays). CompuServe is the least expensive, and Dow Jones News/Retrieval is at the high end of the scale. Businesses can obtain free access to the *OAG* if they make travel arrangements through the Thomas Cook Travel Agency.

Using the *OAG* is straightforward and relatively simple. You choose a primary category of information, such as schedules or fares, and then specify departure and destination points, date, and time. The data base responds with a list of available flights or fares. (Screen 1 shows a fare list for flights from San Francisco to Honolulu.) If you've specified fares, the list is arranged from least to most expensive, making the Electronic Edition easier to use than the printed edition in this regard.

```
PLEASE ENTER A NUMBER
  ◄3

ENTER RETURN DATE
OR PRESS RETURN KEY TO USE 10 JAN
  ◄17 JAN

FARES IN US DOLLARS           SAT-10 JAN
SELECTED FOR SFO-HNL

#  ONE-WAY  RND-TRP ARLN/CLASS FARECODE
 NO LOWER FARES IN CATEGORY
1*          398.00   UA/M      MWR14
2*          398.00   WA/M      MWR14
3*          398.00   HA/M      MWR14
4*          398.00   NW/M      MWR14
5*          398.00   AA/M      MWR14
6*          458.00   NW/B      BWR7
7*          458.00   WA/M      MWR7
8*          458.00   HA/B      BWR7
 * ENTER L# TO VIEW LIMITATIONS
ENTER +,L#,X#,S#,R#,M,RF(#=LINE NUMBER)
```

Screen 1: Fare list from OAG's Electronic Edition

You can then expand your search to check more fares or flight times or to obtain details of the on-screen listings. For example, you can specify return flight schedules, display the limitations for any fare category, or check connecting flights.

The *OAG*'s commands are the same whether you subscribe directly or log on through another service. The *OAG* Electronic Edition provides on-screen help and command summaries, and the information services also offer on-screen explanations of the *OAG* commands. If you study these instructions before logging on to the *OAG* itself, you can save on the premium charges for this connection. The Source's introduction to using the *OAG* Electronic Edition is especially helpful, offering step-by-step examples.

The Electronic Edition has expanded the *OAG*'s traditional

market, according to Joe Bernardo. "Our printed guides are priced for the business market—no one would buy them just to plan a vacation," he explains. "On services like CompuServe and The Source, however, you only pay for the Electronic Edition when you use it, and we've begun to get home users. Our main market is still business executives who travel often, but the home market could become more significant with increased home automation."

In the past year the Electronic Edition has added services not available in its standard printed version, including a hotel and motel guide that is available in print only by separate purchase. The electronic service's most ambitious expansion to date is on-line airline ticketing through the Thomas Cook Travel Agency. You

(continues)

QUICK STUDY.

The Epson EX-1000, shown here with optional color upgrade.

Introducing the Epson® EX-1000 wide carriage personal computer printer. A simple-to-use machine that's smart enough to handle your most demanding jobs. Very, very quickly.

The EX-1000's nine-pin print head turns out high speed drafts at a breathtaking print head speed of 300 characters per second. And produces sharp, near letter quality documents at 60 CPS —three times faster than the average daisy wheel.

You'll be equally impressed with how little time it takes to *operate* the EX-1000—thanks to an advanced control panel that lets you change typestyles, print quality and pitch at the mere touch of a button. No exotic codes, DIP switches, or engineering degree required.

The EX-1000 goes on from here with a list of standard features that can only be called "exceptional." (Although, on other printers, they're usually called "optional.")

Sophisticated paper handling features, for instance. Like automatic single sheet loading. And a push/pull tractor that makes working with continuous form paper a study in simplicity.

For fast access to your computer while the printer is running, there's a built-in 8K buffer.

And, for faster, more versatile graphics, the EX-1000 comes equipped with bidirectional printing capabilities and IBM® graphic style characters. If you'd like the additional versatility of color printing, an inexpensive, easy-to-install color option is also available.

Of course, like all Epson printers, the Epson EX-1000 works with virtually all IBM compatible hardware and software, and comes with Epson's one-year limited warranty.

To experience the Epson EX-1000 for yourself, visit your nearest Epson dealer. (For the same features in an 80-column printer, ask to see the EX-800.)

You'll quickly discover the intelligent answer to all your printing needs.

For more information on Epson's full line of dot matrix, daisy wheel, ink jet and color printers, call (800) 421-5426. Or (213) 539-9140 in California.

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EPSON
P R I N T E R S

can charge tickets to a credit card and then pick them up at the airport, have them mailed to you, or—if you have an account with Thomas Cook—have them delivered by courier. To date the *OAG* has not added on-line hotel and motel reservations, but Bernardo believes that this service might be forthcoming.

The Electronic Edition is easy to use, but it's still not as effortless as calling a travel agent; nor does it offer special package deals or discounts. Nevertheless, it has become well established as an on-line service. Bernardo declined to reveal average monthly usage but confirmed that 27,000 businesses and government agencies are direct subscribers. And he would not divulge how many others use the Electronic Edition through the 20 on-line systems that carry it; however, a reasonable estimate indicates that at least 10 percent of the 1.1 million people who subscribe to commercial information services use the *OAG* at least once a year.

At stake for most of these users is personal control of their travel plans, based on clear, up-to-date, unbiased information. "I want to check the schedules myself rather than rely on a travel agent," says Judy Pease, assistant to the president at QO Chemical in Oak Brook, Illinois, a direct subscriber to the Electronic Edition. The firm switched from another travel agency to Thomas Cook, and Pease now buys airline tickets for employees on line. "I use it at least three or four times a week," she says. "It gives us all the fares in an unbiased listing."

Not all users buy tickets on line, however. For Jim Dinnan, travel coordinator for Oxford Industries of Atlanta, Georgia, a Fortune 500 company with branches nationwide, the Electronic Edition is mainly a tool for checking travel information. "We only have one terminal in the home office," he points out, "so while I do sometimes order tickets through Thomas Cook, I mainly use it to double-check travel schedules and costs. People in our branches call me and I check fares on the *OAG*. This is especially useful when we are flying into new market areas where we don't have experience with the rates and schedules. The *OAG* shows us what prices we should be getting."

Whether or not they buy tickets on line, many travelers will find the *OAG* Electronic Edition an extremely useful planning tool—particularly as the airlines continue to merge, expand, and even fold in an increasingly competitive travel marketplace. —*G. Berton Latamore*

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2000 Clearwater Dr.
Oak Brook, IL 60521
800/323-3735
Cost: direct subscription one-time $50 fee, plus 10 cents per minute of connect time, 20 cents per schedule screen displayed, and 30 cents per fare screen displayed; gateway services fees vary with service

Product Potpourri

Looking for accounts receivable software for your flower shop? Want a second opinion (or a third or fourth) on purchasing *dBASE III* for your personnel department? Desperate for guidance in choosing from among the hundreds of dot matrix printers on the market? Help is available (to a limited extent) with Microsearch —an on-line computer-product data base accessible on Compu-Serve; The Source; or ORBIT (On-line Retrieval Bibliographic Information Timeshare), a scientific and technical data base service from Systems Development Corporation of Santa Monica, California.

The Microsearch data base includes more than 32,000 abstracts of product reviews and manufacturers' specifications for 12,000 personal computer products (more than 40 percent are IBM PC-compatible). Microsearch adds 450 new abstracts to the data base twice monthly.
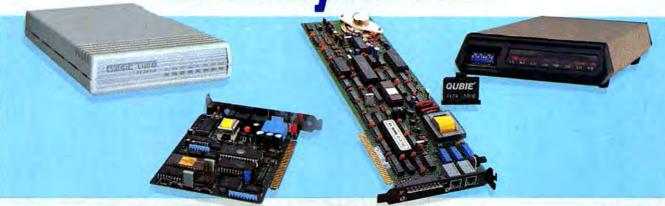
Sixty percent of the abstracts are based on reviews from 180 computer and trade magazines and newspapers. Microsearch claims to examine every page of these publications and to select reviews for the data base within approximately 30 days of their publication.

The remaining 40 percent of the abstracts come from product literature supplied by some 5000 hardware manufacturers and software

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publishers. The Microsearch data base includes a manufacturer directory of company addresses and phone numbers (updated yearly) that permits searches by company name, although not, unfortunately, by location.

Selection of products for inclusion in the data base is determined by three major criteria: which computer the product runs on (the IBM PC and compatibles, Apple II line, and Macintosh have highest priority); current consumer interest (desktop publishing is currently a hot topic); and whether the review is merely descriptive or strongly opinionated (the latter is preferred).

While the number of abstracts alone seems to indicate that the Microsearch data base is impressive in the depth and breadth of its product coverage, the usefulness of all this information is another matter. The determining factor remains—how much search do you get for your buck?

First, the buck. CompuServe adds a $10 surcharge each time you access Microsearch, in addition to its standard rates (e.g., $15 per hour for prime time at 1200 bps). The Source costs $25.80 per hour with no surcharge. ORBIT is in another league altogether at $75 per hour.

Now, the search. Search times on CompuServe and The Source are comparable; for example, a CompuServe search took 87 seconds to report that the data base contained 6471 abstracts on IBM PC software. At such a point you could narrow the search with any of the 1000-plus subject-specific

(continues)

Looking for a printer at the top-of-the-line? Worried about the bottom line?

You need a Brother.

Everybody needs a Brother.

It figured that the leader in daisy wheels would come up with a winning line of dot matrix printers too. One that's full of proven performers which dangle some very exciting price tags.

Case in point. The formidable 24-pin Brother 2024L. It sets a new pace by marrying the speed and graphic capabilities of a dot matrix printer to letter quality printing that, at 96 cps, is two to three times faster than any daisy wheel. At 160 cps, drafts are faster still.

But that's not the half of it. The 2024L comes with four typefaces and the ability to add virtually any other fonts available. It handles a host of versatile print functions. And it profits from a buffer memory plus built-in tractor and optional cut-sheet feeders. With either parallel or serial interfaces, it works with almost every system made. And it helps keep the office blessedly quiet.

Of course, maybe you don't need a printer like the 2024L. But even on a shoe-string budget, you net many of its best features.

The compact Brother M-1509 sizzles with bi-directional printing at a racy 180 cps for drafts...45cps for near

Dot matrix printers.

letter quality. It credits both serial and parallel interfaces to its features. And, along with most of the 2024L's print functions, it's equipped with a one-inch paper cut function to save paper and a buffer memory to save time.

And if your budget's even less than a shoe-string, the new Brother M-1109 is for you. Its standard features include both a friction-feed platen and a built-in tractor feed. Like the M-1509, it has dual interfaces and a spectrum of print options. All of which adds up to big system advantages at a small system price.
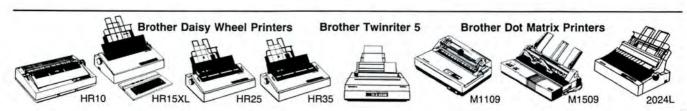
So if you're looking for the top-of-the-line, but worried about the bottom line, look no more. See your nearest Brother dealer or contact: Brother International Corp., 8 Corporate Place, Piscataway, NJ 08854.

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HR10   HR15XL   HR25   HR35   M1109   M1509   2024L

U

keywords, which are grouped into 20 subject categories. Or you could specify a manufacturer, product, name or date of a publication, or document type to pinpoint abstracts of reviews or manufacturer information. You can use only one search criterion at a time, but you may continue to narrow or expand the search indefinitely. Each subsequent search can take 20 to 50 seconds, so cost mounts quickly.

Once you decide to view the selected abstracts, Microsearch displays the most recent entries first on The Source and ORBIT and the oldest entries first on CompuServe.
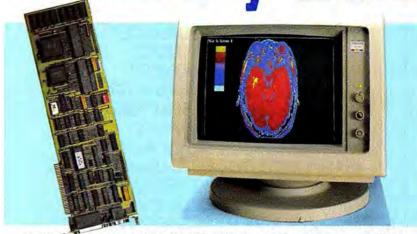
Access time and display considerations aside, the key issue is whether the quality of information justifies the cost of accessing it. Are the selection criteria well implemented so that all major reviews from leading publications are included? Can you make a well-informed purchasing decision based on the abstract alone, or will you have to read the review for more details? Four test searches indicate that the answer to both these questions is no.

Microsearch's menus make conducting a search fairly easy (though off-line planning saves money). Basic navigational commands for moving among the menus are provided in a CompuServe help file or in a brochure Microsearch will send on request.

Thinking I might buy an accounting program for the PC, I decided to put Microsearch through its paces. To begin my

(continues)

search I selected 'Accounts Receivable' as the most appropriate keyword in the accounting category. The search located 253 abstracts, so I had to narrow my subject or go broke. Unfortunately, no further subject-specific breakdown existed for this type of product, so I decided to search by publication. This was my chance to test Microsearch's review selection criteria. I chose *PC World* as the publication to search.

The data base included abstracts of four *PC World* reviews, the most recent being four months old. Microsearch had either overlooked or chosen not to include a comparison review of three entry-level accounting programs from important manufacturers that had appeared three months earlier—an injustice to Microsearch customers.

In another search, I specified dot matrix printers as a subject. Unfortunately, there was no breakdown by product type into categories such as price, number of pins, or color option. Microsearch included a review of three 24-pin printers from *PC World*'s November 1985 issue but did not abstract reviews of two Epson printers appearing in the same issue. Since any Epson product is significant among dot matrix printers, I once again questioned the implementation of Microsearch's stated selection criteria.

Adopting a product-specific search strategy, I decided to compare *dBASE III* reviews from different publications, with two questions in mind: Was the *PC*

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World December 1984 review included? And were the review abstracts detailed enough to help me decide whether *dBASE III* could do a specific job? The answer in both cases was, again, no. The abstracts do, however, manage to communicate whether a review was mainly negative or positive and the reviewer's opinion of major product features. You also get the publication date in case you want to read the actual article. If you're willing to take the manufacturer's description on faith, you can always choose that route instead.

One benefit of Microsearch is that it serves as an index and screening filter to locate reviews worth reading, although it does not include all the salient ones. Product literature and abstracts of reviews are preliminary resources in deciding what to buy. At the very least, Microsearch's manufacturer directory is handy for locating phone numbers and addresses.

Some other on-line product data bases—all more expensive than Microsearch and with varied product coverage—are available on Dialog. These include Computer Database from Information Access Company; Menu—The International Software Database from International Software Database Corporation; and Microcomputer Index from Database Services.

Microsearch's limitations suggest that this market niche may be ready for the advent of CD-ROM product data bases. *—Christine Whyte*

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G. Berton Latamore is a regular contributor to this column and the editor of VideoPrint, *a communications industry newsletter. Christine Whyte is the Product Review Editor for* PC World. ⬤

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The Help Screen

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A software patch caution, adjusting Enhanced Color Display contrast, COLOR.BAT and DOS 2.xx, BASIC timing, and step-by-step instructions for 2K clusters on a 10MB hard disk

Karl Koessel

Why Won't It Work?

Q. The DEBUG patch that you offer to WordStar 3.30 [The Help Screen, PCW, September 1986] does not work properly under DOS 3.10. After I made the patch, WordStar correctly logged on to the specified drive but presented some strange characters when I tried to return to the original drive.

Is an additional patch to WordStar 3.30 required for DOS 3.10?

Albert E. Hayes, Jr.
Yucca Valley, California

A. The *Help Screen* item in September's issue states explicitly that the patch is for those using DOS 3.00. *WordStar 3.30* doesn't have a problem changing the logged drive under other versions of DOS. In short, if it ain't broke, don't fix it.

Secrets of the Enhanced Color Display

Q. I laboriously typed in PCOLOR.BAS from November's Help Screen, but when I tried to adjust the contrast on my IBM Enhanced Color Display, nothing happened. Is it broken, or am I doing something wrong?

John M. Harder
St. Louis, Missouri

A. Adjusting the contrast has no effect on certain color combinations or under certain lighting conditions. Because PCOLOR shows all the possible color permutations, I suspect you didn't pull the contrast knob out before turning it. If my suspicions prove correct, don't be embarrassed. I had to be told, too.

COLOR.BAT for DOS 2.xx Users

Q. I have tried unsuccessfully to create and run the COLOR.BAT file described in August 1986's Help Screen. ANSI.SYS is properly installed, and I can get the specific PROMPT commands to work from DOS, but COLOR.BAT will not execute. I even renamed the file COLOUR.BAT, because I have another file called COLOR.COM that seems to take precedence. COLOUR.BAT runs, but every time I include BACKGREEN as a parameter, the 'Label not found' error message pops up, and I am kicked out to DOS. I've checked my work repeatedly, but I can't discern any difference between my listing and COLOR.BAT published in PC World. Please help.

Richard Kuper
Forest Hills, New York

A. Pardon the oversight. PC-DOS 2.00, 2.10, and their MS-DOS counterparts do not recognize batch file labels that are more than 8 characters long (excluding the requisite colon). PC-DOS 3.00 and 3.10, on the other hand, simply ignore any label characters after the first 8 and continue to execute their batch files. (PC-DOS 1.00 and 1.10, of course, do not recognize any batch file labels or GOTO commands.) That's why COLOR.BAT, running under DOS 2.xx, cannot GOTO the label :BACKGREEN–it's 1 character too long.

There are two quick, easy ways to fix COLOR.BAT for DOS 2.xx. The first is to simply insert a space between the 8th and 9th characters in a label, thus yielding
:BACKBLAC K,
:BACKGREE N,

(continues)

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:BACKBROW N,
:BACKMAGE NTA,
and :BACKWHIT E.
The contents of the help file, COLOR.HLP, which includes a list of COLOR.BAT's acceptable parameters, needn't be altered, because you can use parameters that exceed 8 characters–DOS will ignore the excess and locate the appropriate 8-character label.

The other method, used in John Bagwell Jr.'s original COLOR.BAT (*.*, PCW, Vol. 2, No. 4), uses the letter *B* instead of BACK as the prefix for the background color labels. Thus, BACKMAGENTA becomes BMAGENTA. The COLOR.BAT file you have can easily be modified by globally replacing all occurrences of BACK with *B* using an ASCII word processor. Remember to do the same to COLOR.HLP's list of parameters–but not, of course, to the word *background* in the sixth line of COLOR.HLP.

Does Anybody Really Know What Time It Is?
Q. I am attempting to write a routine in BASIC for a program I am going to compile that will enable me to time operations with greater precision than that offered by the reserved variable TIME$. (TIME$ returns values only to the nearest minute.) By PEEKing into offsets 1132, 1133, and 1134 of segment 0 (DEF SEG = 0), I have come up with a routine with a precision of about six one-hundredths of a minute. But is there a method that does not use PEEKs

The Help Screen

and is more precise? I am not well versed in accessing DOS interrupts and functions.
Stephen W. Shay
Kansas City, Missouri

A. You can use DOS function 2C hexadecimal by MOVing the value 2C into register AH (MOV AH,2C) and calling interrupt 21 hexadecimal (INT 21) to obtain time with a precision of one-hundredth of a second. On return, register CH will contain the hours (0 through 23), CL will contain the minutes (0 through 59), DH the seconds (0 through 59), and DL the hundredths of a second (0 through 99).
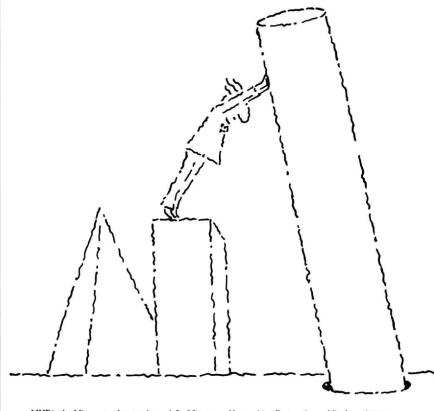
However, BASIC 2.0's TIMER function is easier to use than DOS function 2C and yields results just as precise. TIMER is a read-only variable containing the number of seconds (to the nearest hundredth) since midnight or system reset. Programs using the TIMER function can be compiled with IBM's BASIC Compiler 2.00 or with Microsoft's QuickBASIC Compiler.

2K Hard Disk Clusters
Several readers have asked for step-by-step instructions after failing to implement Bill Todd's "Hard Disk Elbowroom" (*.*, PCW, April 1986). That item showed readers how to reduce a 10MB hard disk's cluster size from 4K to 2K. But it contained the phrase "place the DOS Supplemental Programs disk into the floppy drive and enter the commands listed in DISKSIZE," which

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Circle 405 on reader service card

led many readers to believe that DISKSIZE was a file on the Supplemental Programs disk. DISKSIZE is actually the name of the figure on the following page of that issue. It lists the DEBUG commands used to patch the boot (first) sector of the hard disk. Other readers figured that out but were thrown a curve because of the instruction "Run the FDISK program to create a DOS partition ..." That sentence should have read "Run the FDISK program to delete and then recreate a DOS partition ... "

So let's take it from the top. The following procedure is for those with 10MB hard disks, and it requires DOS 3.10—*not* 3.00 or 3.20. If your hard disk is 20MB or larger, simply formatting it with DOS 3.00 or a later version will give your hard disk 2K clusters; therefore, this procedure does not pertain to your system. (Note, too, that if your hard disk is smaller than 10MB, this procedure cannot be followed.)

Assuming you have a 10MB hard disk, your first step is to check the current cluster size. Log onto the hard disk's DOS directory or insert a copy of the DOS disk in drive A:. Make the drive containing the DOS files the default drive, and at the DOS prompt type **CHKDSK C:** and press < Enter > . (If your PC's hard disk is not drive C:, substitute the appropriate drive designator wherever C: is specified.) Write down the number preceding 'bytes available on disk'. Next, make the hard disk the default drive (type **C:** and press < Enter >), type **COPY CON**

(continues)

DUMMY, and press < Enter > . Then type DUMMY, followed by < Ctrl > - Z and < Enter > . Run CHKDSK C: again, and subtract the number of 'bytes available on disk' given by the second CHKDSK from the value given by the first CHKDSK. This value is the current cluster size of your PC's hard disk; if it is 2048, your hard disk already has 2K clusters. In any case, issue the command ERASE C:DUMMY < Enter > to remove the dummy file.

If the cluster size is larger than 2048, back up the hard disk file by file. (If you use certain copy-protected programs, you may have to uninstall them before backing up the hard disk.) If you are back-ing up to floppies, you'll need about 28 blank 360K floppies. Be sure to format and number the disks before you begin the backup procedure.
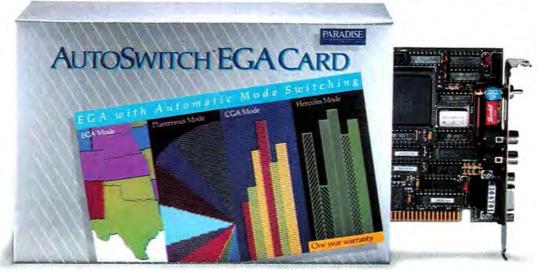
Once the backup is complete, place an unmodified copy of DOS 3.10 in drive A: and restart the PC. Set the date and the time. Type FDISK and press < Enter > . Type 3 and press < Enter > to de-lete the existing DOS partition. Type Y and press < Enter > to ver-ify your intention. Then press < Esc > , type 1, and press < Enter > to create a DOS parti-tion. If you are going to use the entire disk for DOS (in other words, if you're not planning to install an additional operating sys-tem), simply press < Enter > two

more times. Otherwise, type N < Enter > , enter the desired size and starting cylinder, and press < Esc > three times. Reset the date and time, type FORMAT C:, and press < Enter > . (Do not use the /V or /S options.) Type Y and press < Enter > .

Next, replace the DOS disk with one containing a copy of DEBUG.COM from the DOS Sup-plemental Programs disk. Type the following boldface characters, pressing < Enter > at the end of each line and substituting the ap-propriate hard disk number for $n-1$ if drive B:, 2 if drive C:, 3 if

drive D:, and so on. Don't omit any spaces, and note that the 0 is a zero, not the letter O.

```
A>DEBUG
-L 0 n 0 1
-E D
xxxx:000D 08.4
-E 16
xxxx:0016 08.15
-W 0 n 0 1
-Q
```

Now place the DOS 3.10 disk in drive A: and restart the PC with < Ctrl > - < Alt > - < Del > . Although the DOS prompt is present and DOS 3.10 is already loaded, you must restart the system. Set the date and time, type FORMAT C:/S/V, and press < Enter > . Type Y and press < Enter > to proceed with formatting the hard disk. When prompted, enter a volume label.

If you would like to verify that the disk now has 2K clusters, follow the procedure discussed earlier to create the DUMMY file. Do not reload the files IBMBIO-.COM and IBMDOS.COM (called IO.SYS and MSDOS.SYS by some compatible versions of DOS); doing so renders what you've done so far useless, forcing you to reformat the hard disk and start over. If your backup contains a version of COMMAND.COM other than from DOS 3.10, do not reload it either. If you are using DOS's RE-STORE command, you can use the /P option, which asks if you want system files restored to the disk.

Finally, remove any disk in drive A: and restart the PC from the hard disk. That's it.

Do you have any questions concerning the IBM PC or compatibles? Send them to The Help Screen, PC World, *501 Second St. #600, San Francisco, CA 94107, or electronically to CompuServe 74055,412, MCI Mail PC-WORLD, or* The Source *STE908.* ●

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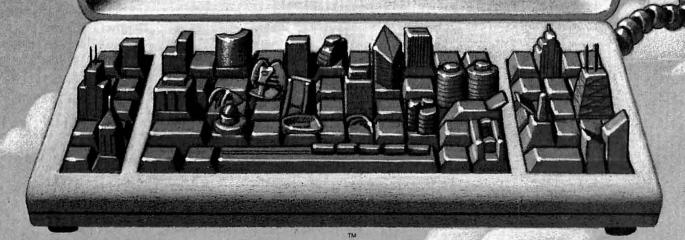
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What's the Difference Between this Bunch of PCs..

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Star-Dot-Star

A global exchange of personal computer discoveries

This month: X-MAKER revisited; running two PCs with one keyboard; a Turbo joystick; an AUTOEXEC copilot; plugging security leaks; and a better CLOCKTIC program

Edited by Steven Cook

X-MAKER Improved

Some of the most popular items in *.* are small machine-language programs. But typing in a machine-language program is no fun: The listing consists of a series of bytes, with no visual clues that might reveal an error to the untrained eye. Since virtually every byte plays a vital role in a program's operation, a single incorrect character can transport your computer into electronic limbo.

Several techniques that minimize the problems associated with transcribing machine-language programs have been introduced in this column. The first was X-MAKER.BAS, a BASIC program designed to catch errors while converting printed listings into machine-language programs. More recently, we've been publishing programs using the Softstrip format devised by Cauzin Systems of Waterbury, Connecticut. (Since the Softstrip reader costs $200, we continue to publish programs using the X-MAKER.BAS method as well.)

X-MAKER.BAS has performed quite nicely over the past few years, but it does not work well when used with programs whose filenames have an .EXE extension. .EXE files contain large blocks of descriptive information, which must be transcribed from the data list produced by DATAMKR.BAS, X-MAKER.BAS's companion program.

Fortunately, a descriptive block consists mostly of zeros. In transcribing such a block from a listing, you can usually enter the first line of zeros and then use BASIC's editing features to copy the line several times until the entire block is entered.

A better solution is to modify X-MAKER.BAS and its companion DATAMKR.BAS to treat a sequence of zeros as a single item. The revised programs are X-MAKER2.BAS and DATAMKR2.BAS, respectively.

In its new form, X-MAKER watches for data items preceded by an asterisk. This character indicates that the decimal number immediately following it represents the number of zero bytes beginning at that position in the original program. Only groups of two or more zeros are encoded in this manner. Individual zeros are still shown in the data list.

These modifications to X-MAKER.BAS do not affect the program's ability to recreate programs from previously published lists of data. We hope you find these improvements a useful addition to your software library.

Remote Control

When we converted our office record-keeping system from *dBASE II* to *dBASE III Plus*, we wanted to make sure the new system worked perfectly before using it on a regular basis. The obvious solution was to run both versions in parallel until we were confident the new system worked properly. The problem? We had no way of using both systems simultaneously without typing everything twice.

We solved the problem by writing two programs. KEYOUT.EXE transmits keyboard characters out a serial port, while KEYIN.EXE reads characters from a serial port and places them into the keyboard

(continues)

.

```
10 DEFINT A-Z : KEY OFF : DEF FNHEX(X$)=VAL("&h"+X$)
20 MSG$="Now testing for data errors...please wait" : GOSUB 190
30 SUM=0 : READ LN : IF LN<0 THEN 80
40 READ H$ : IF VAL(H$)<0 THEN 70
50 IF LEFT$(H$,1)="*" THEN GOSUB 210 : GOTO 40
60 SUM=(SUM+FNHEX(H$))*2 : SUM=(SUM\256)+(SUM MOD 256) : GOTO 40
70 READ CKSUM$ : IF SUM=FNHEX(CKSUM$) THEN 30 ELSE GOTO 170
80 MSG$="Press any key except ESC to create "+F$+": "
90 GOSUB 190 : A$=INPUT$(1) : PRINT : IF A$=CHR$(27) THEN END
100 LOCATE 6,1 : PRINT "Working...";
110 OPEN F$ AS #1 LEN=1 : FIELD #1,1 AS BX$
120 READ LN : IF LN<0 THEN 160
130 READ H$ : IF VAL(H$)<0 THEN READ CKSUM$ : GOTO 120
140 IF LEFT$(H$,1)="*" THEN GOSUB 240 : GOTO 130
150 LSET BX$=CHR$(FNHEX(H$)) : PUT #1 : GOTO 130
160 CLOSE : PRINT : PRINT F$;" has now been created." : END
170 PRINT : PRINT "Error in DATA line";STR$(LN);" :"
180 PRINT "Check your work." : BEEP : END
190 LOCATE 3,1 : PRINT "X-Maker II" : RESTORE : READ F$
200 LOCATE 5,1,1 : PRINT MSG$; : RETURN
210 ZZ=VAL(MID$(H$,2)) : FOR I=1 TO ZZ
220 SUM=SUM*2 : SUM=(SUM\256)+(SUM MOD 256)
230 NEXT : RETURN
240 ZZ=VAL(MID$(H$,2)) : FOR I=1 TO ZZ
250 LSET BX$=CHR$(0) : PUT #1 : NEXT : RETURN
```
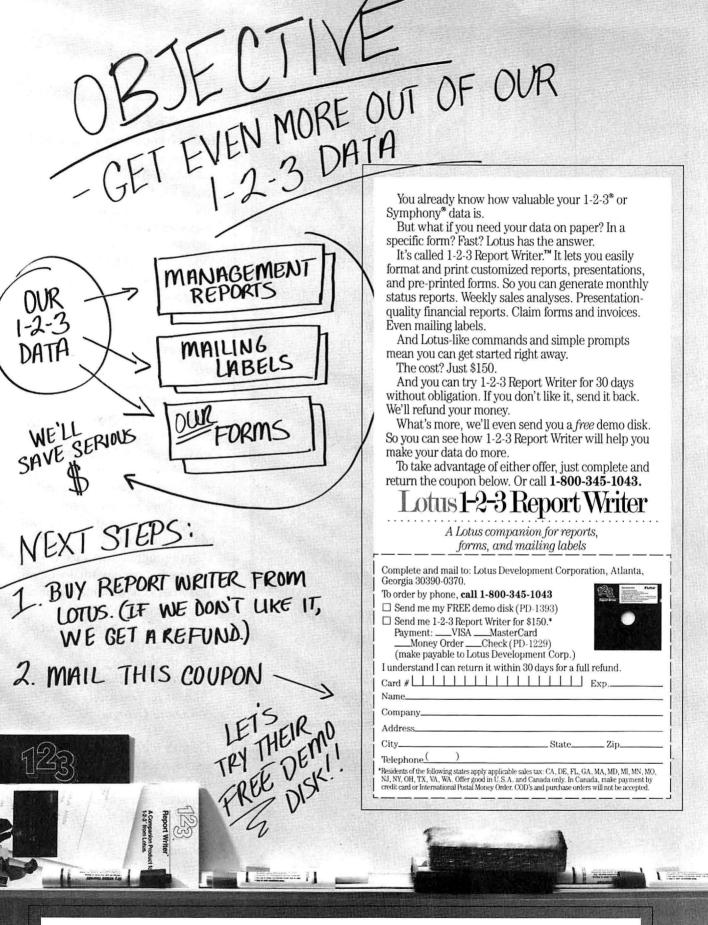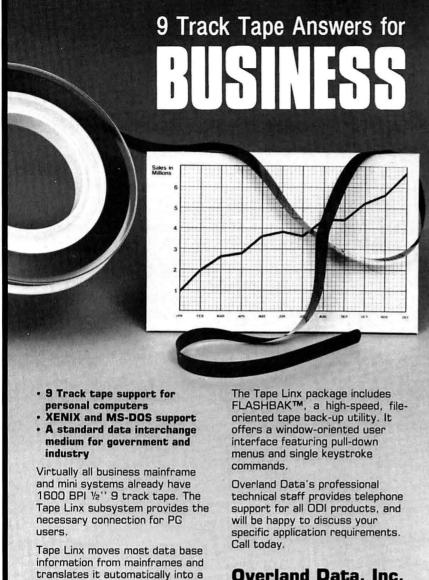
X-MAKER2.BAS: Star-Dot-Star's program-creating program revamped

```
10 DEFINT A-Z : CLS : KEY OFF : LOCATE 5,1 : PRINT "Data Maker II"
20 DEF FNH$(X)=RIGHT$("0"+HEX$(X),2) : CM$=CHR$(44)
30 PRINT : INPUT "Input filename--",N$ : IF N$="" THEN END
40 OPEN N$ AS #1 LEN=1 : BYTES=0
50 FIELD #1,1 AS BYTE$ : LENGTH=LOF(1)
60 INPUT "Output filename--",F$
70 OPEN F$ FOR OUTPUT AS #2
80 LN=0 : ZZ=0 : BYTES=0 : INPUT "Beginning DATA line number";BL
90 PRINT #2,STR$(BL);" DATA "; : WRITE #2,N$
100 PRINT "File length =";LENGTH : PRINT "Working";
110 SUM=0 : LN=LN+1 : LX=0 : PRINT ".";
120 PRINT #2,BL+(LN*10);"DATA";          'start a new line
130 IF BYTES=LENGTH THEN 200 ELSE GET #1 : BYTES=BYTES+1
140 X=ASC(BYTE$) : SUM=(SUM+X)*2 : SUM=(SUM\256)+(SUM MOD 256) 'checksum
150 IF LX=0 THEN PRINT #2,STR$(LN);          'line number
160 LX=LX+1 : IF X=0 THEN ZZ=ZZ+1 : GOTO 130
170 IF ZZ>0 THEN GOSUB 230
180 PRINT #2,CM$;FNH$(X); : IF LX<16 THEN 130          'count bytes per line
190 PRINT #2,CM$;"-1";CM$;FNH$(SUM) : GOTO 110          'terminate after 16
200 IF ZZ>0 THEN GOSUB 230
210 IF LX>1 THEN PRINT #2,CM$;"-1";CM$;FNH$(SUM);CM$;  'partial checksum
220 PRINT #2,"-1" : PRINT "Complete." : CLOSE : GOTO 30
230 IF ZZ=1 THEN ZX$=FNH$(0) ELSE ZX$="*"+MID$(STR$(ZZ),2)
240 PRINT #2,CM$;ZX$; : ZZ=0 : RETURN
```

DATAMKR2.BAS: Star-Dot-Star's companion, likewise improved

(continues)

buffer. These programs let us control two computers from a single keyboard.

KEYOUT.EXE intercepts calls to the BIOS keyboard routine (INT 16H) on machine A; each character returned by the BIOS routine is also sent to the COM1 serial port. The KEYIN.EXE program runs on machine B, taking characters from the COM1 port and putting them into the machine's keyboard buffer. Note that the function keys, cursor keys, and <ALT>-<key> combinations are not supported.

To improve reliability, the programs perform simple bit-error checks by sending each code followed by its 2's complement. Machine A waits for an acknowledgment from machine B before proceeding, and retransmits the previous character if no acknowledgment is received.

Both programs are memory-resident but occupy small amounts of memory. With some modification and extension, these programs could form the basis of a simple networking scheme.

Shinn Neu Lee
Mathew L. Miller
James R. Thomson
Atlanta, Georgia

Editor's note: To create the programs, load BASIC, type in the lines shown in X-MAKER2.BAS, followed by the lines shown in KEYOUT.DAT, then type **RUN** *and*

(continues)

.

```
1000 DATA "keyout.exe"
1010 DATA 1,4D,5A,D1,01,02,*3,20,*3,FF,FF,*4,D7,-1,2A
1020 DATA 2,A5,00,01,*2,1E,*3,01,*739,EB,-1,AD
1030 DATA 3,79,90,*2,FB,80,FC,01,74,19,52,51,50,CD,60,2E,-1,8C
1040 DATA 4,A3,03,01,58,80,FC,00,B9,08,00,74,0C,59,5A,2E,A1,-1,DE
1050 DATA 5,03,01,CF,CD,60,CA,02,00,2E,A1,03,01,E8,1F,00,F6,-1,EA
1060 DATA 6,D8,E8,1A,00,8A,C4,E8,15,00,F6,D8,E8,10,00,E8,1C,-1,1C
1070 DATA 7,00,3C,47,74,02,E2,E1,59,5A,2E,A1,03,01,CF,50,8A,-1,6F
1080 DATA 8,FD,03,EC,A8,20,74,F8,BA,F8,03,58,EE,C3,51,B9,FF,-1,EA
1090 DATA 9,01,BA,FD,03,EC,A8,01,75,02,E2,F6,83,F9,00,74,08,-1,64
1100 DATA 10,59,BA,F8,03,EC,24,7F,C3,59,C3,1E,B8,*2,50,E8,-1,B7
1110 DATA 11,25,00,B8,*2,8E,D8,FA,A1,58,00,A3,80,01,A1,5A,-1,AE
1120 DATA 12,00,A3,82,01,C7,06,58,00,05,01,8C,0E,5A,00,FB,BA,-1,16
1130 DATA 13,7B,01,B4,31,CD,21,C3,BA,FB,03,B0,80,EE,BA,F8,03,-1,22
1140 DATA 14,B0,0C,EE,BA,F9,03,B0,00,EE,BA,FB,03,B0,1A,EE,BA,-1,FC
1150 DATA 15,F8,03,EC,BA,FC,03,B0,03,EE,BA,F9,03,B0,00,EE,C3,-1,37
1160 DATA -1
```

KEYOUT.DAT: Add these lines to X-MAKER2.BAS to create KEYOUT.EXE.

```
1000 DATA "keyin.exe"
1010 DATA 1,4D,5A,08,00,03,*3,20,*3,FF,FF,*4,BE,-1,E3
1020 DATA 2,DB,00,01,*2,1E,*3,01,*739,E9,-1,37
1030 DATA 3,A7,00,47,4A,*11,1E,-1,FE
1040 DATA 4,56,52,53,50,FB,B0,20,E6,20,B8,40,00,8E,D8,BA,FD,-1,15
1050 DATA 5,03,EC,BA,F8,03,EC,2E,8B,1E,05,01,2E,88,87,08,01,-1,3C
1060 DATA 6,2E,00,06,07,01,2E,FF,06,05,01,2E,8B,1E,05,01,80,-1,AF
1070 DATA 7,FB,04,75,4E,2E,C7,06,05,01,*2,2E,8A,1E,07,01,-1,E6
1080 DATA 8,2E,C6,06,07,01,00,80,FB,00,74,09,BB,04,01,E8,38,-1,4E
1090 DATA 9,00,EB,2F,90,BB,03,01,E8,2F,00,FA,8B,1E,1C,00,8B,-1,B6
1100 DATA 10,F3,43,43,3B,1E,82,00,75,04,8B,1E,80,00,3B,1E,1A,-1,96
1110 DATA 11,00,74,0F,2E,A0,08,01,2E,8A,26,0A,01,89,04,89,1E,-1,C9
1120 DATA 12,1C,00,FB,58,5B,5A,5E,1F,CF,BA,FD,03,EC,A8,20,74,-1,F0
1130 DATA 13,F8,BA,F8,03,2E,8A,07,EE,C3,1E,B8,*2,50,E8,27,-1,9B
1140 DATA 14,00,B8,*2,8E,D8,FA,A1,30,00,2E,A3,0C,01,A1,32,-1,1F
1150 DATA 15,00,2E,A3,0E,01,C7,06,30,00,10,01,8C,0E,32,00,FB,-1,CC
1160 DATA 16,BA,AA,01,B4,31,CD,21,C3,E4,21,24,EF,E6,21,BA,FB,-1,4B
1170 DATA 17,03,B0,80,EE,BA,F8,03,B0,0C,EE,BA,F9,03,B0,00,EE,-1,3F
1180 DATA 18,BA,FB,03,B0,1A,EE,BA,F8,03,EC,BA,FC,03,B0,0B,EE,-1,0D
1190 DATA 19,BA,F9,03,B0,01,EE,C3,-1,92,-1
```

KEYIN.DAT: Add these lines to X-MAKER2.BAS to create KEYIN.EXE.
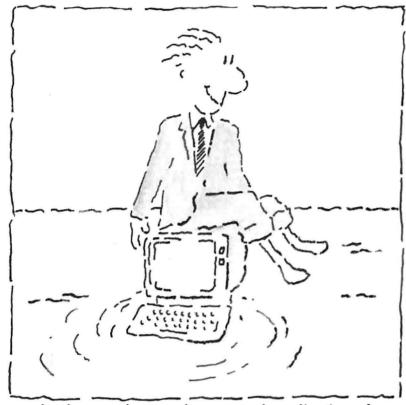
*press < Enter > . Next, delete lines numbered 1000 and higher (***DELETE 1000- < Enter >** *), type in the lines shown in KEYIN.DAT, then type* **RUN** *and press < Enter > again. To use the programs, simply connect a cable between the serial ports of two computers (you'll need a female-to-female cable), start the computers, and, with a copy of KEYOUT.EXE in the default drive, type* **KEYOUT** *at the DOS*

prompt on one machine and **KEYIN** *at the DOS prompt on the other. The assembly language source code for these programs is presented in KEYOUT.ASM and KEYIN.ASM, for those readers who would like to modify and extend them.*

(continues)

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```
;=====================================================
;
;      KEYOUT PROGRAM FOR MACHINE A TO SEND
;      KEYSTROKES TO COM PORT 1 AND WAIT FOR ACK
;
;=====================================================
;
;======== VECTORS SEGMENT ========
;
VECTORS SEGMENT AT 0H
        ORG     16H * 4
KEYBOARD_IO_VECTOR       LABEL   DWORD
        ORG     60H * 4
TEMP_VECTOR     LABEL   DWORD
VECTORS ENDS
;
;======== CODE SEGMENT ========
;
CODE_SEG        SEGMENT
        ORG     100H
        ASSUME  CS:CODE_SEG, DS:CODE_SEG
BEGIN:
        JMP     INIT_VECTORS
;
; LOCAL VARIABLES
;
KEY     DW      ?
;
;=========================================
;
;      INTERCEPT KEYBOARD_IO SERVICE
;
;=========================================
;
INTERCEPT_KEYBOARD_IO   PROC    FAR
        ASSUME  CS:CODE_SEG,DS:NOTHING
        STI
        CMP     AH,1            ;SERVICE 1 ?
        JE      SERV1           ;Y: SKIP
        PUSH    DX
        PUSH    CX
        PUSH    AX
        INT     60H
        MOV     CS:KEY,AX       ;SAVE SCAN CODE AND ASCII CODE
        POP     AX
        CMP     AH,0            ;SERVICE 0 ?
        MOV     CX,8
        JE      INTER1          ;Y: SKIP
;
;       SERVICE 2
;
        POP     CX
        POP     DX
        MOV     AX,CS:KEY       ;SET RETURN VALUE IN AX
        IRET
;
;       SERVICE 1
;
SERV1:
        INT     60H
        RET     2
;
;       SERVICE 0
;
INTER1:
        MOV     AX,CS:KEY       ;GET SCAN CODE IN AH AND ASCII CODE IN AL
        CALL    SNDMSG          ;SEND AL TO RS232
        NEG     AL
        CALL    SNDMSG          ;SEND - AL TO RS232
        MOV     AL,AH           ;
        CALL    SNDMSG          ;SEND AH TO RS232
        NEG     AL

        (continues)
```

KEYOUT.ASM: The assembly language code that creates KEYOUT.EXE

✱•✱

```
                CALL    SNDMSG          ;SEND - AH TO RS232
                CALL    GETRSP          ;WAIT FOR RESPONSE
                CMP     AL,"G"
                JZ      EXIT            ;EXIT IF ACK
                LOOP    INTER1          ;SEND AGAIN IF NAK FOR 8 TIMES
        ;
        EXIT:
                POP     CX
                POP     DX
                MOV     AX,CS:KEY       ;SET RETURN VALUE IN AX
                IRET
        ;
        INTERCEPT_KEYBOARD_IO   ENDP
        ;
        SNDMSG  PROC    NEAR
                PUSH    AX              ;SAVE AL (CHARACTER TO BE SENT OUT)
        SND0:
                MOV     DX,3FDH         ;TEST TRANSMITTER READY?
                IN      AL,DX
                TEST    AL,20H
                JZ      SND0            ;N: LOOP
                MOV     DX,3F8H         ;Y: SEND MESSAGE
                POP     AX              ;RESTORE AL
                OUT     DX,AL
                RET
        SNDMSG  ENDP
        ;
        GETRSP  PROC    NEAR
                PUSH    CX
                MOV     CX,1FFH
        WAIT:
                MOV     DX,3FDH         ;TEST RECEIVER READY ?
                IN      AL,DX
                TEST    AL,01H
                JNZ     GETRS0          ;Y: SKIP
                LOOP    WAIT            ;N: LOOP FOR 511 TIMES
        GETRS0:
                CMP     CX,0            ;LOOP EXPIRED ?
                JZ      GETRS1          ;Y: SKIP
                POP     CX              ;N: CLEAR STACK, READ CHARACTER IN
                MOV     DX,3F8H
                IN      AL,DX
                AND     AL,7FH
                RET
        ;
        GETRS1:
                POP     CX              ;CLEAR STACK
                RET
        GETRSP  ENDP
        ;
        ;****************************************
        ;
        ;       INIT RS232 AND VECTORS
        ;
        ;****************************************
        ;
        INIT_VECTORS    PROC    NEAR
                ASSUME  CS:CODE_SEG,DS:VECTORS
                PUSH    DS
                MOV     AX,0
                PUSH    AX
                CALL    INIT_RS232
                MOV     AX,VECTORS      ;SET UP THE DATA SEGMENT FOR VECTORS
                MOV     DS,AX
                CLI
        ;
        ;       SAVE BIOS KEYBOARD_IO ROUTINE AND CHANGE VECTOR
        ;
                MOV     AX,WORD PTR KEYBOARD_IO_VECTOR
                MOV     WORD PTR TEMP_VECTOR,AX
                MOV     AX,WORD PTR KEYBOARD_IO_VECTOR[2]
                MOV     WORD PTR TEMP_VECTOR[2],AX
                MOV     WORD PTR KEYBOARD_IO_VECTOR,OFFSET INTERCEPT_KEYBOARD_IO
```

(continues)

KEYOUT.ASM *(continued)*

.

```
            MOV     WORD PTR KEYBOARD_IO_VECTOR[2],CS
    ;
            STI
            MOV     DX,OFFSET INIT_VECTORS          ;TERMINATE AND STAY RESIDENT
            MOV     AH,31H
            INT     21H
            RET
    ;
    ;       INIT. RS232 CONTROLLER
    ;
    INIT_RS232      PROC    NEAR
            MOV     DX,3FBH         ;INIT BAUD RATE
            MOV     AL,80H
            OUT     DX,AL
            MOV     DX,3F8H
            MOV     AL,0CH
            OUT     DX,AL
            MOV     DX,3F9H
            MOV     AL,0
            OUT     DX,AL
            MOV     DX,3FBH         ;INIT LINE-CONTROL REGISTER
            MOV     AL,1AH
            OUT     DX,AL
            MOV     DX,3F8H         ;CLEAR RECEIVER BUFFER
            IN      AL,DX
            MOV     DX,3FCH         ;INIT MODEM CONTROL REGISTER
            MOV     AL,03H
            OUT     DX,AL
            MOV     DX,3F9H         ;DISABLE INTERRUPTS
            MOV     AL,00H
            OUT     DX,AL
            RET
    INIT_RS232      ENDP
    ;
    INIT_VECTORS    ENDP
    ;
    CODE_SEG        ENDS
            END     BEGIN
```

KEYOUT.ASM *(continued)*

```
    ;=========================================================
    ;
    ;       KEYIN PROGRAM GETS KEYBOARD INPUTS FROM COM PORT 1
    ;
    ;=========================================================
    ;
    ;======== VECTORS SEGMENT ========
    ;
    VECTORS SEGMENT AT 0H
            ORG     0CH*4
    RS232_INT_VECTOR LABEL   DWORD
    VECTORS ENDS
    ;
    ;======== BIOS DATA ========
    ;
    ROM_BIOS_DATA   SEGMENT AT 40H
    ;
            ORG     1AH
    BUFFER_HEAD     DW      ?
    BUFFER_TAIL     DW      ?
            ORG     80H
    BUFFER_START    DW      ?
    BUFFER_END      DW      ?
    ;
    ROM_BIOS_DATA   ENDS

    (continues)
```

KEYIN.ASM: The assembly language code that
creates KEYIN.EXE

.

```
;
;======== CODE SEGMENT ========
;
CODE_SEG        SEGMENT
        ORG     100H
        ASSUME  CS:CODE_SEG,DS:CODE_SEG
BEGIN:
        JMP     INIT_VECTORS
;
;       LOCAL VARIABLES
;
ACKMSG:
        DB      "G"
;
NAKMSG:
        DB      "J"
;
COUNT   DW      0
SUM     DB      0
KEY_BUF DB      4 DUP(?)
TEMP_VECTOR     DD      ?
;
;=========================================
;
;       RS232 INTERRUPT HANDLER
;
;=========================================
;
RS232_HANDLER   PROC    FAR
        ASSUME  CS:CODE_SEG,DS:ROM_BIOS_DATA
        PUSH    DS              ;SAVE REGISTERS
        PUSH    SI
        PUSH    DX
        PUSH    BX
        PUSH    AX
        STI
        MOV     AL,20H          ;SEND EOI
        OUT     20H,AL
        MOV     AX,ROM_BIOS_DATA        ;SET UP DATA SEGMENT
        MOV     DS,AX
        MOV     DX,3FDH         ;READ LINE STATUS REGISTER
        IN      AL,DX
        MOV     DX,3F8H         ;READ DATA REGISTER
        IN      AL,DX
        MOV     BX,CS:COUNT
        MOV     CS:KEY_BUF[BX],AL       ;STORE MESSAGE IN LOCAL BUFFER
        ADD     CS:SUM,AL
        INC     CS:COUNT
        MOV     BX,CS:COUNT
        CMP     BL,04H          ;4 BYTES RECEIVED ?
        JNE     INTER2          ;N: EXIT
        MOV     CS:COUNT,0      ;Y: RESET COUNTER AND SUM
        MOV     BL,CS:SUM
        MOV     CS:SUM,0
        CMP     BL,0            ;SUM = 0 ?
        JZ      INTER0          ;Y: SKIP
        MOV     BX,OFFSET NAKMSG        ;N: SEND NAK
        CALL    SNDMSG
        JMP     INTER2
;
INTER0:
        MOV     BX,OFFSET ACKMSG        ;SEND ACK
        CALL    SNDMSG
        CLI
        MOV     BX,BUFFER_TAIL          ;UPDATE KEYBOARD BUFFER PTR.
        MOV     SI,BX
        INC     BX
        INC     BX
        CMP     BX,BUFFER_END
        JNE     INTER1
        MOV     BX,BUFFER_START
INTER1:
        CMP     BX,BUFFER_HEAD
        JE      INTER2
        MOV     AL,CS:KEY_BUF

(continues)
```

KEYIN.ASM *(continued)*

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.

```
            MOV     AH,CS:KEY_BUF+2
            MOV     [SI],AX           ;PUT SCAN CODE AND ASCII CODE IN KB. BUFFER
            MOV     BUFFER_TAIL,BX    ;UPDATE PTR.
    INTER2:
            STI
            POP     AX
            POP     BX
            POP     DX
            POP     SI
            POP     DS
            IRET
    ;
    RS232_HANDLER   ENDP
    ;
    SNDMSG  PROC    NEAR
            MOV     DX,3FDH           ;TRANSMITTER READY ?
            IN      AL,DX
            TEST    AL,20H
            JZ      SNDMSG            ;N: LOOP
            MOV     DX,3F8H           ;Y: SEND OUT MESSAGE
            MOV     AL,CS:[BX]
            OUT     DX,AL
            RET
    SNDMSG  ENDP
    ;
    ;****************************************
    ;
    ;       INIT RS232 AND VECTORS
    ;
    ;****************************************
    ;
    INIT_VECTORS    PROC    NEAR
            ASSUME  CS:CODE_SEG,DS:VECTORS
            PUSH    DS
            MOV     AX,0
            PUSH    AX
            CALL    INIT_RS232
            MOV     AX,VECTORS        ;SET UP DATA SEGMENT FOR VECTORS
            MOV     DS,AX
            CLI
    ;
    ;       SET UP NEW RS232_INT_HANDLER
    ;
            MOV     AX,WORD PTR RS232_INT_VECTOR
            MOV     CS:WORD PTR TEMP_VECTOR,AX
            MOV     AX,WORD PTR RS232_INT_VECTOR[2]
            MOV     CS:WORD PTR TEMP_VECTOR[2],AX
            MOV     WORD PTR RS232_INT_VECTOR,OFFSET RS232_HANDLER
            MOV     WORD PTR RS232_INT_VECTOR[2],CS
            STI
            MOV     DX,OFFSET INIT_VECTORS         ;TERMINATE AND STAY RESIDENT
            MOV     AH,31H
            INT     21H
            RET
    ;
    ;       INIT. RS232 CONTROLLER
    ;
    INIT_RS232      PROC    NEAR
            IN      AL,21H
            AND     AL,0EFH
            OUT     21H,AL
            MOV     DX,3FBH           ;INIT BAUD RATE
            MOV     AL,80H
            OUT     DX,AL
            MOV     DX,3F8H
            MOV     AL,0CH
            OUT     DX,AL
            MOV     DX,3F9H
            MOV     AL,0
            OUT     DX,AL
            MOV     DX,3FBH           ;INIT LINE-CONTROL REGISTER
            MOV     AL,1AH
            OUT     DX,AL
            MOV     DX,3F8H           ;CLEAR RECEIVE REGISTER

    (continues)
```

KEYIN.ASM *(continued)*

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```
        IN      AL,DX
        MOV     DX,3FCH        ;INIT MODEM CONTROL REG.
        MOV     AL,0Bh
        OUT     DX,AL
        MOV     DX,3F9H        ;ENABLE RECEIVER INTERRUPTS
        MOV     AL,01H
        OUT     DX,AL
        RET
INIT_RS232      ENDP
;
INIT_VECTORS    ENDP
;
CODE_SEG        ENDS
        END     BEGIN
```

KEYIN.ASM *(continued)*

Turbo Joystick

As part of a recent project to convert a program to run under Turbo Pascal, I developed the joystick interface routine shown in JOYSTICK.PAS.

A single byte contains all the necessary information for two joysticks. Bits 0 and 1 indicate the *x* and *y* positions, respectively, for joystick 1. Bits 2 and 3 indicate the *x* and *y* positions of joystick 2. Bits 4 and 5 represent the two buttons on joystick 1; bits 6 and 7 represent the buttons on joystick 2.

To determine the position of a joystick, you must output a value (any value will do) to the joystick port, then test the *x* and *y* bits for that joystick until they are both zero. The length of time each bit remains set indicates the relative position of the joystick along each axis.

The program demonstrates the process for one joystick. It returns values representing the relative length of time the axis bits remain set and also the status of the joystick buttons. Pressing both buttons terminates the program.
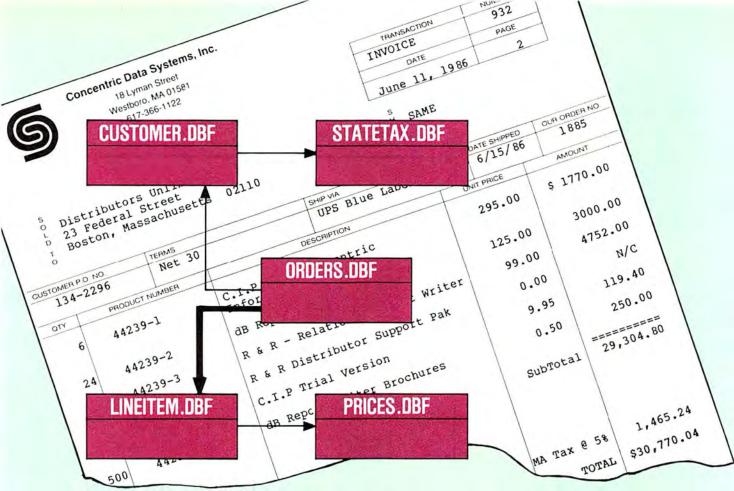
Gregg Kelly
Columbia, Pennsylvania

AUTOEXEC Autopilot

I use a number of different computers in my work—all of them configured differently. Some have two floppy disk drives, some have one; some have a hard disk, some do not. I designed an AUTO-BAT.BAT file to determine which drive letter refers to the RAM disk, so that my start-up process operates properly on every machine.

The technique relies on the fact that when the system is turned on, there are no files in the RAM disk. The first IF EXIST command tests for the presence of files on drive C:. If there are none, drive C: is the RAM disk. If a file is present, drive C: must be a hard disk, so the batch file branches to :isDhard and checks whether drive D: has any files. If there is no file, drive D: is the RAM disk; if there is, drive E: is the RAM disk.

Once the drive letter of the RAM disk is determined, the batch file uses the SET command to assign that letter to a variable that can be used by other commands within the batch file. The

(continues)

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```
VAR x,y,                          { X and Y stick direction }
    button1,button2,              { Fire buttons }
    portnum,                      { Byte read at port 201h }
    checkx,checky     : integer;  { Masked value from portnum }
BEGIN
  clrscr;
  gotoxy(30,10);write('Direction     Button');
  gotoxy(30,11);write('  X    Y       1 2');
  REPEAT
      button1    := 0;
      button2    := 0;
      x          := 0;
      y          := 0;
      port[$201] := 0;            { Initializes port byte to FF }
      REPEAT
          portnum := port[$201];
          checkx := portnum AND 1;
          IF checkx <> 0 THEN
              x := x + 1;
          checky := portnum AND 2;
          IF checky <> 0 THEN
              y := y + 1;
      UNTIL (checkx = 0) AND (checky = 0);  { Both X and Y bit have }
                                            {       reset to 0        }
      IF (portnum AND 16) = 0 THEN
          button1 := 1;
      IF (portnum AND 32) = 0 THEN
          button2 := 1;

      gotoxy(31,13);
      write(x:2,' ',y:2,'          ',button1,' ',button2);

  UNTIL (button1 = 1) AND ( button2 = 1);
END.
```

JOYSTICK.PAS: The Turbo Pascal joystick program.

```
echo off
cls
if exist c:*.* goto isDhard
echo No fixed disk present
set ramdisk=C:
goto :more
:isDhard
if exist d:*.* goto D
echo Fixed disk is drive C:
set ramdisk=D:
goto more
:D
echo Fixed disk is drive D:
set ramdisk=E:
:more
echo RAM disk is drive %ramdisk%
copy a:autobat2.bat %ramdisk% >nul
%ramdisk%
autobat2 %ramdisk%
```

AUTOBAT.BAT: A start-up batch file that determines which drive letter refers to a RAM disk

following command uses that variable as the drive letter and copies a second batch file to the RAM disk. The second batch file contains the remainder of the start-up commands and executes from the RAM disk. When the first batch file transfers execution to the second, it passes the RAM disk drive letter on as a command line parameter for use by other commands within the second file.

Bill Sautter
San Carlos, California

Editor's note: If you often use different PCs, and one has more than two hard disks or a hard disk that

(continues)

Circle 827 on reader service card

is divided into more than two volumes, you must modify AUTO-BAT.BAT to also check those drives for files.

Date Differences

Attention *1-2-3* release 2 users: There is a big difference between the @TODAY function in release 1A and the @NOW function in release 2.

Be careful when using the @NOW function for calculations between dates. For example, if cell A2 contains the formula @DATE(86,12,1) and cell B2 contains @NOW, the difference between B2 and A2 on December 6, 1986, will be 5 days if the time is before noon, and 6 days if it is noon or later.
Alfredo Izquierdo
Miami, Florida

Editor's note: You can avoid this problem by using the formula @INT(@NOW) to obtain only the integer portion from the @NOW function.

Security Leak

When you use an encryption program to secure a data file, it's important to make sure that you encrypt or destroy all copies of the file as well.

Many spreadsheet programs, word processors, and data base managers automatically make backup files, usually with the

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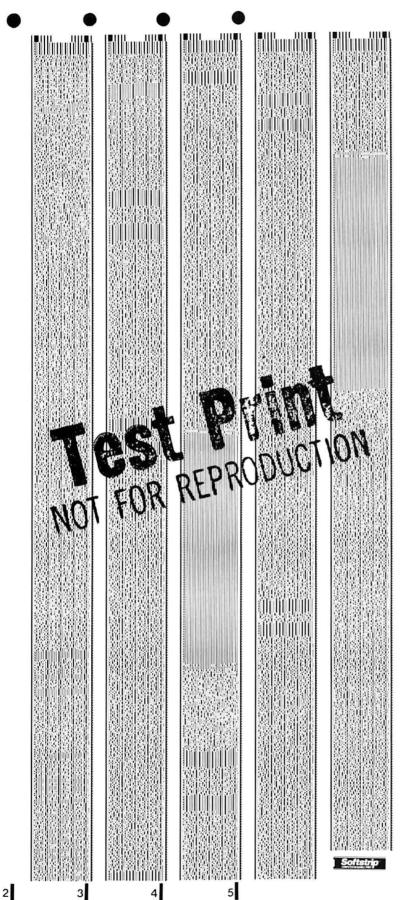
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Softstrip

.BAK extension. Simply deleting those files does not make your data secure. Anyone can use a file recovery program (such as *PC Tools* or *The Norton Utilities*) to gain access to the contents of "deleted" files.

A more insidious danger: Many programs create temporary files and only later delete them. (You may notice these files if a program is halted by an error.) Because you don't see these files listed in the directory, you might not think to destroy them.

The best solution is to copy the encrypted file onto another disk, then format the original disk to eliminate any sensitive data.

David Fickbohm
San Rafael, California

Editor's note: If you use a hard disk, you'll find destroying such latent data virtually impossible. At least one encryption program, Datasafe *from Trigram Systems in Philadelphia, sports a command that erases data from unused disk sectors. Another solution is to use a RAM disk to hold sensitive data files during program execution, then encrypt the result and copy it back to a floppy or hard disk.*

Son of CLOCKTIC

The CLOCKTIC.COM program [*.*, *PCW*, July 1986] will not display the time on systems equipped with a monochrome display

(continues)

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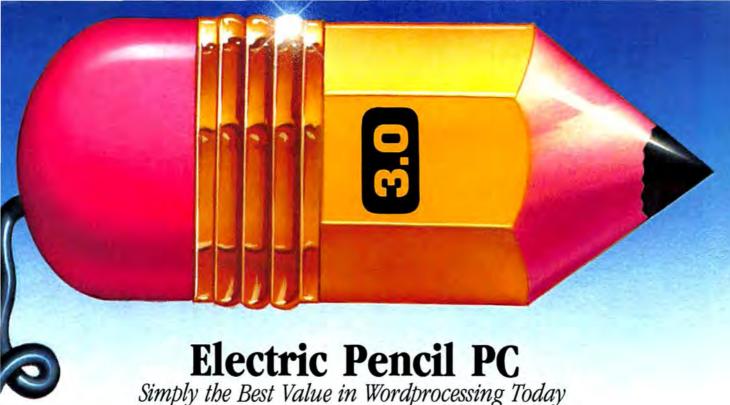
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1030 DATA  3,9C,1E,06,50,51,52,56,57,B8,40,00,8E,D8,A0,49,00,-1,49
1040 DATA  4,2E,A2,1E,01,A1,6E,00,2E,A3,1B,01,2E,3B,06,17,01,-1,8A
1050 DATA  5,74,03,E8,F0,00,2E,A0,1E,01,3C,04,72,07,3C,06,77,-1,46
1060 DATA  6,03,E9,04,00,2E,8B,0E,03,01,3C,01,77,03,83,E9,05,-1,F6
1070 DATA  7,8E,C1,BF,8C,00,89,06,00,FC,2E,8B,16,05,01,2E,8B,-1,B8
1080 DATA  8,B5,7F,00,EC,A8,01,75,FB,FA,EC,A8,01,74,FB,8B,C6,-1,12
1090 DATA  9,AB,FB,E2,EA,2E,A1,1B,01,3D,0C,00,76,03,2D,0C,00,-1,F9
1100 DATA  10,3D,0A,00,72,1B,B1,31,B5,07,BF,96,00,50,EC,A8,01,-1,9D
1110 DATA  11,75,FB,FA,EC,A8,01,74,FB,8B,C1,A3,FB,58,2D,0A,00,-1,1A
1120 DATA  12,05,30,00,B4,07,8B,C8,BF,98,00,EC,A8,01,75,FB,FA,-1,AD
1130 DATA  13,EC,A8,01,74,FB,8B,C1,AB,FB,B9,5A,07,BF,9A,00,EC,-1,7D
1140 DATA  14,A8,01,75,FB,FA,EC,A8,01,74,FB,8B,C1,AB,FB,A1,6C,-1,49
1150 DATA  15,00,BA,00,00,B9,50,04,F7,F1,BA,30,07,3C,0A,72,06,-1,A1
1160 DATA  16,FE,C2,2C,0A,EB,F6,8B,CA,BF,9C,00,50,2E,8B,16,05,-1,A0
1170 DATA  17,01,EC,A8,01,75,FB,FA,EC,A8,01,74,FB,8B,C1,AB,FB,-1,F1
1180 DATA  18,59,80,C1,30,B5,07,BF,9E,00,EC,A8,01,75,FB,FA,EC,-1,9D
1190 DATA  19,A8,01,74,FB,8B,C1,AB,FB,5F,5E,5A,59,58,07,1F,9D,-1,F8
1200 DATA  20,2E,FF,2E,07,01,2E,83,3E,19,01,1C,75,16,E4,61,24,-1,4C
1210 DATA  21,FC,E6,61,2E,A1,1B,01,2E,A3,17,01,2E,C7,06,19,01,-1,2A
1220 DATA  22,00,00,C3,2E,83,3E,19,01,00,75,13,B0,B6,E6,43,B8,-1,FD
1230 DATA  23,0C,02,E6,42,8A,C4,E6,42,E4,61,24,FC,E6,61,E4,61,-1,C
1240 DATA  24,8A,E0,24,FC,80,F4,03,80,E4,03,0A,C4,E6,61,2E,FF,-1,14
1250 DATA  25,06,19,01,C3,CD,11,25,30,00,3D,30,00,75,11,2E,C7,-1,78
1260 DATA  26,06,03,01,00,B0,2E,C7,06,05,01,BA,03,EB,0F,90,2E,-1,D9
1270 DATA  27,C7,06,03,01,00,B8,2E,C7,06,05,01,DA,03,1E,B8,40,-1,62
1280 DATA  28,00,8E,D8,A1,6E,00,2E,A3,17,01,1F,B8,1C,35,CD,21,-1,F3
1290 DATA  29,2E,89,1E,07,01,2E,8C,06,09,01,BA,1F,01,B8,1C,25,-1,C7
1300 DATA  30,CD,21,BA,84,02,CD,27,-1,64,-1
```

CLOCKTC2.DAT: Add these lines to X-MAKER.BAS to create a version on CLOCKTIC.COM that works on both monochrome and color displays.

adapter. The program also generates video snow when used with many types of color graphics boards in 80-column text mode.

You can create an improved version of CLOCKTIC.COM that works well with both monochrome and color displays. To create the new version, load BASIC, type in the lines shown in X-MAKER.BAS followed by the lines shown in CLOCKTC2.DAT, then type **RUN** and press < Enter > .

Michael J. Mefford
Gleneden Beach, Oregon

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Kevin Strehlo

In which the author explains the rules for software entrepreneurship

Unintentional Software, Inc.

Mind you, it wasn't intentional. I was surprised to come back from vacation and discover I'd become a software entrepreneur. But the dozens of letters that awaited my return were incontrovertible proof: Each contained a check for my *ToDo* program. There was no denying it—I had become a software company.

Originally, I hadn't bumbled my way through writing a to-do list processor in order to sell it. My motivation was more desperate. I was constantly forgetting to do things. I once signed up for a memory improvement class and forgot to go. And I was always behind, constantly overbooking my time.

Spending 100 hours writing *ToDo* may not have been the most efficient way to get back on track, but it seemed like a good idea at the time. And I was quite pleased with the result. *ToDo* solved all the problems that commercially available calendar programs had raised for me.

But I don't really want to tell you how wonderful my package is. That's what got me into this mess

in the first place. I'm really more behind now than ever, what with running a company and all.

The problem began when I tried to recoup some of the program's development costs by writing an article about it. That would have been okay except for the paragraph tacked on at the last second, offering copies of *ToDo* for $5. Sending out a few disks had seemed easier than cutting the article enough to make room to list the whole program.

How was I to know that running a software company was tougher than being a writer or an editor? Certainly no one in the computer magazine business had ever suggested that.

But laziness was not my only motivation. Pride was another big factor. Telling people about my program wasn't enough. I wanted them to try it, so they could write me admiring notes: "Hey, Strehlo, nice work!"

You see, I've never been good at doing things with my hands—I never built a beautiful bookcase,

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restored a classic car, or even wrote anything with real staying power. But now I had created this handsome little program that really got the job done.

I was already committed to using it through the rest of the decade, after entering friends' and relatives' birthdays through 1990 with the PeriodicTask function. Others, doubtless, would do the same.

I had finally created something with staying power, and I wanted to show off. That seemed a perfectly good foundation for a software company.

But so far my experience in the software business makes it clear that I'm not destined to become another Bill Gates. For one thing, he and his high school buddy Paul Allen founded Microsoft on purpose. For another, his motivation was both more complex and more sound.

Much of Bill's motivation came from his firm grasp of the microcomputer's future impact. When he and Paul spotted the new MITS Altair computer on the cover of *Popular Electronics* while walking around Harvard Square, "it made us really mad," Bill remembers. "That was our vision, the free intelligence of the microcomputer, and it was happening and we weren't part of it."

My vision of a program that would remind me to do things on time dims in comparison.

Then came Bill's strong business orientation. When the company he first worked for went bankrupt,

(continues)

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Kevin Strehlo

he and Paul bought some of its assets at auction and resold them for a hefty profit. And when in 1976 the Altair prompted them to develop a version of the BASIC language, Bill quit school and moved to Albuquerque to make sure the project succeeded.

In contrast, I've done nothing to make sure *ToDo* is a success. I never really thought about its potential market, what the company should be like, or any of the other items on Bill's checklist of standard business practices.

"I was always very commercially oriented in terms of figuring out what stuff would have impact, how business works, what it's like to actually hire people, and how customers decide things," Bill says. "And we always had a goal. I knew I wanted to leverage my abilities through other people. We knew we weren't going to be the 'Bill and Paul programming shop.'"

Soon Bill was hiring friends from his high school days. When all the good programmers had been hired, he began interviewing and hiring strangers. He ran the company conservatively and negotiated good prices for Microsoft's products, so the start-up enjoyed a strong cash flow and did not need to borrow.

Bill's careful attention to business details contrasts with my relative inattention.

Take my approach to pricing. Pride-based pricing—which maximizes the number of people who will have a chance to admire your handiwork—is not taught at any of the better business schools. Had I

(continues)

Kevin Strehlo

picked up a Harvard MBA, I might not have priced *ToDo* to move at $5.

I didn't realize how cheap that figure was until I found that many customers refused to send just $5. There were several checks for $10, one envelope with a $10 bill and a $5 bill, and one guy even sent a money order for 20 Canadian dollars. (Did people send Borland three times the asking price for *SideKick?* A little quick research told me no.)
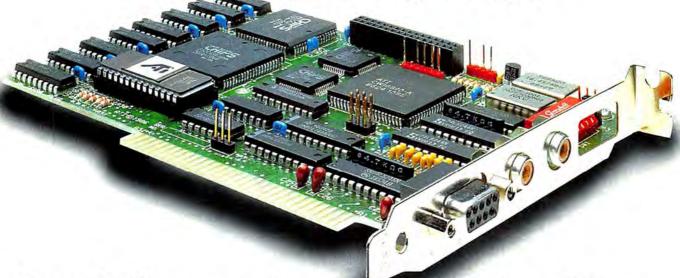
Only after I faced the actual chore of producing and shipping *ToDo* did I stop to figure what a $5 price did to the pretax profit margin. My initial calculations pegged the margin near 50 percent; I was ready to hire someone to help me ship the disks out until it occurred to me to add in the cost of labor. Discovering that I'd end up losing money if I paid for help, I temporarily postponed my expansion plans.

And it wasn't only Bill's business savvy that separated us. Bill thrilled to the challenge of writing tight, fast code. And he wanted to write it more quickly than anyone else.

Microsoft was still based in Albuquerque when Intel came by for a BASIC compiler. "We said 'Okay, we can do this in three weeks,'" Bill recalls. "And they said, 'Come on, be serious, can you do it in nine months?' So we reconsidered and said we could do it in, uh, three weeks."

Gates laughs, because there was no business reason to push for a tight deadline. "We were just looking at each other and saying

(continues)

f the space program had dvanced as fast as the omputer industry, his might be he view from our office.

And space stations, Martian colonies, and inter-ellar probes might already be commonplace. Does at sound outlandish? Then bear these facts in mind:

In 1946 ENIAC was the scientific marvel of the day. This computer weighed 30 tons, stood two stories high, covered 15,000 square feet, and cost $486,840.22 in 1946 dollars. Today a $2,000 kneetop portable can add and subtract more than 20 times faster. And, by 1990, the average digital watch will have as much computing power as ENIAC.

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something like, 'Hey, how tough are you, how fast can you do it?' We were just code cowboys out there in the desert."

Code cowboys are more than fast—they write elegant code. To perfect his craft, Bill continually sought out more experienced programmers to review his code. Sometimes the process was painful. "You get to this point and you think, I'm there: I've got optimal algorithmic coding of the brain. Then you run into somebody who's at a whole other level. It really opens your eyes."

But I wouldn't be the least bit surprised. I'm no code cowboy. Unlike Gates, I've never expected to reach optimal algorithmic coding of the brain.

Nor am I driven to make my accidental software company a success. *ToDo* is a slow, fairly large FRED program that requires *Framework II* to run, so its potential market is relatively small.

And yet I consider *ToDo* a great success. Without it, I couldn't have safely offered to mail people disks—I would have misplaced their addresses or forgotten to ship their orders altogether. And writing it gave me a fuller appreciation for the real masters of programming.

Indeed, the only drawback to my success—other than the disappearance of my free time—is that if I were to use *ToDo*'s Heave-

Forward function too often before I actually dropped disks in the mail, the product might acquire a "vaporware" label hard to live down.

I n many ways, my moonlighting with *ToDo* is reminiscent of Wayne Ratliff's early experience as the one-man company behind his *Vulcan* data base.

"I got completely overstressed," Wayne Ratliff told Susan Lammers in her book *Programmers at Work*, published this year by Microsoft Press. "I did everything myself. When an order came in, I typed out the order, filled out the

(continues)

invoice, packaged the program, made a fresh copy of the disk—the whole nine yards.... I'd come home from my job, work again until midnight, go to sleep exhausted, get up the next day, and repeat the process."

Although for several weeks now my public has made similar demands of me, I doubt this predicament will last. Magazines, even those with wonderful articles about to-do programs, have a short shelf life. My amazing $5 ToDo offer will soon disappear.

Vulcan didn't disappear. Wayne eventually hooked up with George Tate, who changed Vulcan's name

to dBASE II and earned Wayne far more than the $100,000 that he had dreamed about in his most optimistic moments.

And while I have no hope of reaping huge financial rewards from ToDo, I'm glad I wrote it. Let the code cowboys laugh at ToDo's sloppiness—my customers seem happy, and that's what counts.

"I haven't done any programming and am amazed at your ability to create such a program," one loyal buyer wrote. "Wow." Of course, she hadn't used the program at that point—only read the review written by the author. Still, the compliment felt good.

Samuel Johnson once said that only a fool writes for anything but money. Bill Gates probably would agree, although he might make an exception for optimal algorithmic coding. But I think that writing a program that actually satisfies a need is reason enough.

And wowing 'em occasionally doesn't hurt either. ⬢

Kevin Strehlo hunts for PC tales and occasionally mails PC software from an office overlooking Silicon Valley.

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January Preview

Communications

- **Compaq's Deskpro 386**
  Compaq Computer blasts open the 80386 market with its latest desktop PC. Remarkably fast, the Deskpro 386 also has the potential for a multitasking, megamemory future. *PC World* editors review this impressive new machine.

- **Microsoft Access**
  Through an innovative blend of programming and on-line accessibility, *PC World* helps you unleash the power of *Microsoft Access*. Our program lets CompuServe, NewsNet, and the Dow Jones News/Retrieval service search for all the news you want and then prints it automatically on a laser printer—a custom-made morning newspaper at your command.

- **Beyond the 9600-bps Barrier**
  If you thought 2400 bits per second was fast, take a gander at *PC World*'s review of two new products that are even faster. The age of supersonic modems is here, but without compatibility standards, they don't necessarily talk to each other...

- **Alpha/three**
  Discover an easy-to-use and inexpensive data management program that ingeniously expands the possibilities of industry standard *dBASE III*; *Alpha/three* uses *dBASE III* file formats and includes a built-in word processor.

C-1

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Modems