

SETTING THE STANDARDS

15
YEARS

Inside: Bonus LAN Supplement PAGE 211

PRODUCT FOCUS



Multiuser
Operating Systems

REVIEWS

- ALR MicroFlex 7000
- AST Bravo/286
- Sysgen's Removable Hard Disk
- HyperPAD
- Arriba

BYTE

SEPTEMBER 1989

A MCGRAW-HILL PUBLICATION

THE WORLD'S FIRST 486

*Fresh from the U.K.
Apricot's VX FT Server Leads the Pack*

Lotus 1-2-3 release 3.0

Database Trends, *In Depth*

Bus Wars

Laptop Technologies

Graphics Formats

5 Short Takes



SEPTEMBER 1989
BYTE
APRICOT 80486 • MULTIUSER OPERATING SYSTEMS • DATABASE TRENDS
Volume 14, Number 9



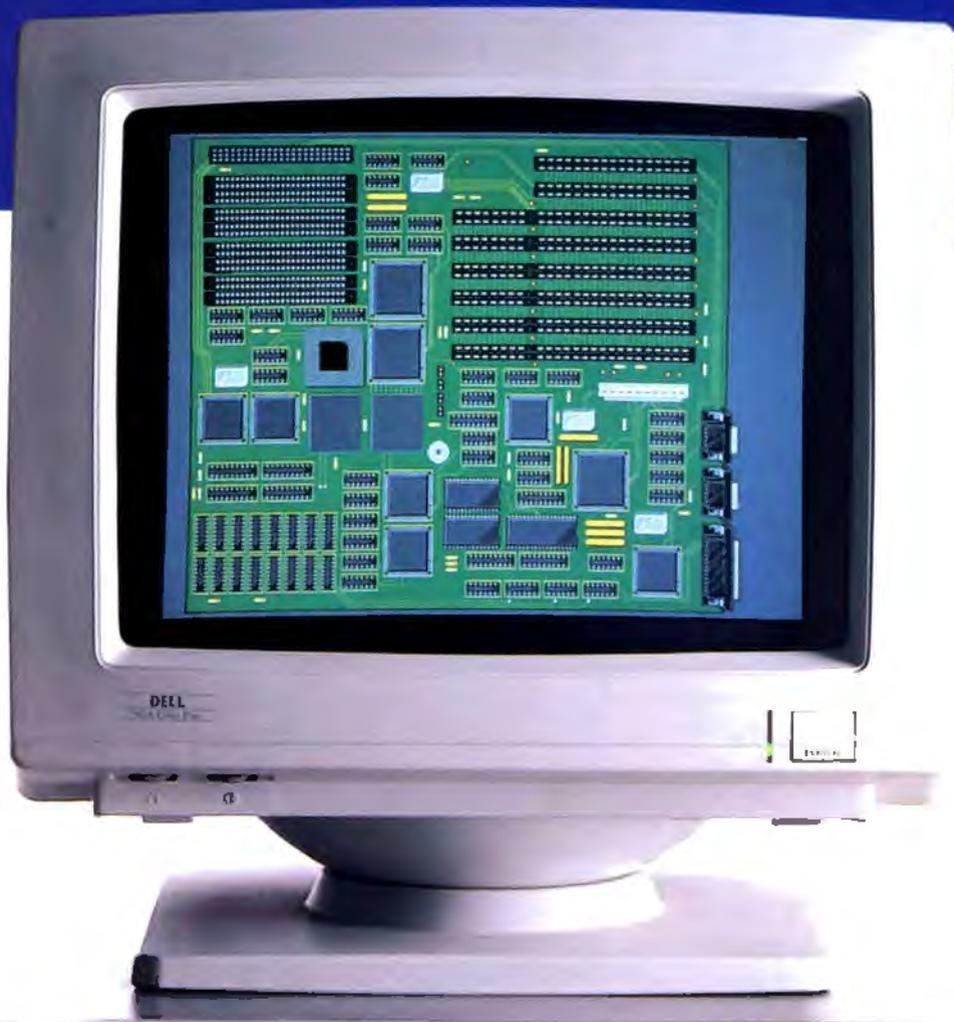
\$3.50 U.S.A./\$4.50 IN CANADA
0360-5280

**SO HOW COME
YOU NEVER CALL?**



*"The new
top-of-the-line
Dell System 325 is
a flagship worth
putting out in front
of the fleet."*

February 14, 1996





THE DELL SYSTEM® 316
20 MHz 386

The best combination of performance and value available in its class.

STANDARD FEATURES:

- Intel 80386 microprocessor running at 20 MHz;
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (using a dedicated high-speed 32-bit memory slot);
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high-speed static RAM cache;
- Page mode interleaved memory architecture;
- VGA systems include a high performance 16-bit video adapter;
- Socket for 20 MHz Intel 80387 or 20 MHz WEITEK 3167 math coprocessor;
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive;
- Dual diskette and hard drive controller;
- Enhanced 101-key keyboard;
- 1 parallel and 2 serial ports;
- 200-watt power supply;
- 8 industry standard expansion slots (6 available).

**Lease for as low as \$135/month.

△ Extended Service Plan pricing starts at \$251.

- 40 MB TTL Monochrome System \$3,699
- 40 MB VGA Color Plus System \$4,199
- 100 MB VGA Color Plus System \$4,699
- 100 MB Super VGA Color System (800x600) \$4,799

Prices reflect 1 MB of RAM. 150 and 322 MB configurations also available.

*Performance Enhancements (Systems 325, 310, 316 and 220): within the first megabyte of memory, 384 KB of memory is reserved for use by the system to enhance performance. 4 MB configurations available on all systems. Call for pricing.



THE DELL SYSTEM® 316
16 MHz 386SX

Expandable, affordable access to 386 architecture.

STANDARD FEATURES:

- Intel 80386SX microprocessor running at 16 MHz;
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (8 MB on system board);
- Page mode interleaved memory architecture;
- VGA systems include a high performance 16-bit video adapter;
- LIM4.0 support for memory over 1 MB;
- Socket for 16 MHz Intel 80387SX math coprocessor;
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive;
- Integrated high performance hard disk drive interface and diskette controller on system board. (ESDI based systems include a hard disk controller.)
- Enhanced 101-key keyboard;
- 1 parallel and 2 serial ports;
- 200-watt power supply;
- 8 industry standard expansion slots (7 available).

**Lease for as low as \$98/month.

△ Extended Service Plan pricing starts at \$234.

- 40 MB TTL Monochrome System \$2,699
- 40 MB VGA Color Plus System \$3,199
- 100 MB VGA Color Plus System \$3,799
- 100 MB Super VGA Color System (800x600) \$3,899

Prices reflect 1 MB of RAM. 150 and 322 MB configurations also available.



THE DELL SYSTEM® 220
20 MHz 286

It's faster than many 386 computers. But selling for much less. The footprint is small, too.

STANDARD FEATURES:

- 80286 microprocessor running at 20 MHz;
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (8 MB on system board);
- Page mode interleaved memory architecture;
- LIM4.0 support for memory over 1 MB;
- Integrated diskette and VGA video controller on system board;
- Socket for Intel 80287 math coprocessor;
- One 3.5" 1.44 MB diskette drive;
- Integrated high performance hard disk interface on system board;
- Enhanced 101-key keyboard;
- 1 parallel and 2 serial ports (integrated on system board);
- 3 full-sized 16-bit AT expansion slots available.

**Lease for as low as \$109/month.
△ Extended Service Plan pricing starts at \$264.

- 40 MB VGA Monochrome System \$2,999
- 40 MB VGA Color Plus System \$3,299
- 100 MB VGA Monochrome System \$3,599
- 100 MB VGA Color Plus System \$3,899

Prices reflect 1 MB of RAM. External 5.25" 1.2 MB diskette drive available.



THE NEW DELL SYSTEM® 210
12.5 MHz 286

The price says this is an entry-level system. The performance says it's a lot more.

STANDARD FEATURES:

- Intel 80286 microprocessor running at 12.5 MHz;
- 512 KB, 640 KB, 1 MB, or 2 MB of RAM expandable to 16 MB (using 6 MB on system board);
- Socket for Intel 80287 math coprocessor;
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive;
- Integrated diskette and high performance 16-bit VGA video controller on system board;
- LIM4.0 support for memory over 1 MB;
- Page mode interleaved memory architecture;
- Integrated high performance hard disk interface on system board;
- Enhanced 101-key keyboard;
- 1 parallel and 2 serial ports;
- 3 full-sized 16-bit AT expansion slots available.

**Lease for as low as \$64/month.
△ Extended Service Plan pricing starts at \$190.

- 20 MB VGA Monochrome System \$1,699
- 20 MB VGA Color Plus System \$1,999
- 40 MB VGA Monochrome System \$1,899
- 40 MB VGA Color Plus System \$2,199

Prices reflect 512 KB of RAM. 770KB versions of the above systems are available for an additional \$80. 100 MB configurations also available.

THE DELL SYSTEM® 325 25 MHz 386.

When you need a truly high-performance 386 computer, this is it.

STANDARD FEATURES:

- Intel 80386 microprocessor running at 25 MHz;
- Choice of 1 MB, 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high-speed 32-bit memory slot);
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache;
- Page mode interleaved memory architecture;
- VGA systems include a high performance 16-bit video adapter;
- Socket for 25 MHz Intel 80387 or 25 MHz WEITEK 3167 math coprocessor;
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive;
- Dual diskette and hard drive controller;

- Enhanced 101-key keyboard;
- 1 parallel and 2 serial ports;
- 200-watt power supply;
- 8 industry standard expansion slots (6 available).

**Lease for as low as \$199/month.
△ Extended Service Plan pricing starts at \$370.

- 40 MB VGA Monochrome System \$5,499
- 100 MB VGA Color Plus System \$6,299
- 100 MB Super VGA Color System (800x600) \$6,399
- 150 MB Super VGA Color System (800x600) \$6,899

Prices reflect 1 MB of RAM. 322 MB configurations also available.

All systems are photographed with optional extra.

Technically speaking, the Dell System[®] 325 is the most advanced 386[™] computer we've ever built. And, according to PC Magazine, it's one of the most advanced 386 computers they've ever tested.

In benchmark after benchmark, the 25 MHz Dell System 325 ran circles around

THE FIRST PERSONAL COMPUTER THAT'S REALLY PERSONAL.

Of the more than 150,000 personal computers we've sold to date, each one has been individually configured to fit the needs of its owner.

The System 325 takes that idea

to its logical extreme.

For example, it runs either MS-DOS[™], MS-OS/2, or our own Dell UNIX[™] System V. Which is compatible with AT&T's System V Interface Definition. And the world of XENIX[™] applications.

If speed is of the essence, we can include an optional Intel[®]

THE DELL 386 SYSTEM 325 HAS A 25 MHz CLOCK RATE, CACHE MEMORY CONTROLLER, IDE OR ESDI HARD DISK DRIVE, PAGE MODE INTERLEAVED MEMORY, AND 100% COMPATIBILITY WITH MS-DOS, OS/2 AND UNIX SYSTEM V.

a field of 386-based systems. A field that included the Compaq[™] 386/25.

A show of prowess that earned the System 325 PC Magazine's Editor's Choice award.

It was a goal we set for ourselves from the very beginning. And an objective anyone with a penchant for power and performance can appreciate.



80387 or WEITEK 3167 math coprocessor. And since nothing about this system is lightweight, the standard mass storage is a 100 MB hard disk drive. Or we can configure it with a 40, 150 or 322 MB hard drive.

As you might expect, the output is just as intense. You can choose between VGA monochrome with

paper-white screen, VGA Color Plus, or Super VGA for high resolution colors displayed on a larger screen.

Even though the 325 gives you all this performance, it still leaves you six open slots for whatever else you might want to add.

And once you've told us what you want, we'll make sure what you want works—by burning-in the entire system unit.

COMPUTER RETAILERS ARE NO KNOWS.

There are some good reasons computer retailers won't know much about the System 325.

First, with all the new and increasingly sophisticated systems they have to keep up with on a daily basis, you can hardly expect them to know everything.

Second, because Dell sells direct.

Which means you now have the unique opportunity to talk directly with the people who make them. And ask things like, "What is page mode interleaved memory?" or, "How much SIMM RAM should I add?"

In other words, the kinds of details that are important to people who make computers and people who use them.

So dealing direct not only can save you up to the 35% mark-up, but 100% of the frustration.

WE COME WHEN WE'RE CALLED.

One of the things that very clearly sets Dell systems apart from other computers is not

just how they're sold but how they're supported.

Overkill was one description used in a recent PC Week article.

Perhaps.

But then, we think you'll agree, when something goes wrong, you want as much help as possible, right?

MAYBE YOU SHOULDN'T BUY ONE AFTER ALL.

No matter how many reasons we give you to buy a Dell system, sometimes it makes more sense to lease one instead.

Whether you need a single computer, or an entire office

BEST OF ALL, YOU WON'T HAVE TO EXPLAIN TO A COMPUTER RETAILER WHAT ALL THAT MEANS.

Which is why every Dell system comes with a toll-free technical support line and self-diagnostic software. We're able to solve 90% of all problems right over the phone. The other 10% receive next-day, desk-side service. Thanks to our new alliance with Xerox Corporation.

And you get all this help for a full year—whenever you need it—at no extra charge.^Δ

As you've probably guessed, one of the things that drives us most is customer satisfaction.

So we'd like to give you the ultimate guarantee:

Try a System 325 in your office for a month. Run your toughest applications. Put it through its paces, at your pace. If you're not completely satisfied, send it back anytime within 30 days. And we'll refund your money.

No questions asked.

full, there is a leasing plan for your business that is just like 100% financing.

And just as we can custom configure your computers, we can see to it you get a custom designed lease plan to fit your exact business needs.[†] A fact that has not gone unnoticed. Especially by the Fortune 500. Over half of whom now own or lease Dell systems.

And just as we welcome their business, we welcome your business, too.

Just call us, toll-free. And don't be afraid to ask us the tough questions.

That's the part we like best.



TO ORDER, CALL
800-426-5150
IN CANADA, CALL 800-387-5752
IN GERMANY, CALL 0610 9701100
IN THE UK, CALL 0800 414535



powerCache 4... The most advanced What else would you expect



PC MAGAZINE, January 1989,
"In a field of powerhouse machines
there can only be one winner, and
ALR's FlexCache is it."

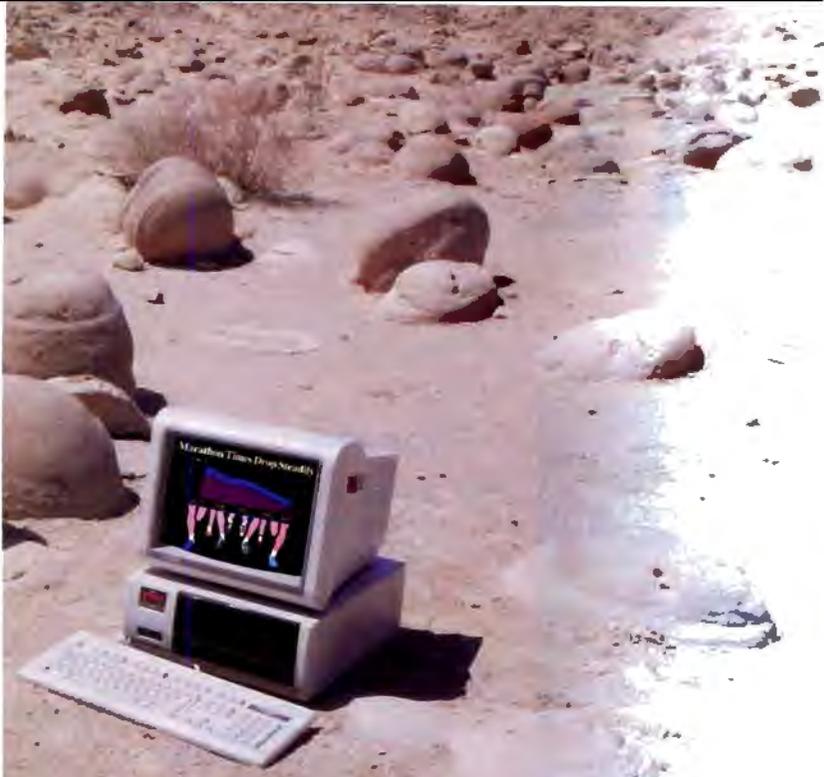
INFO WORLD, July 1989,
"ALR Systems Unleash 486 Power. The
PowerCache 4 shines in the CPU-
specific portion of the InfoWorld Auto-
mated Benchmark Test, gaining a score
of 16.3."

PC WEEK, July 1989,
"Based on a series of benchmarks run
last week on Advanced Logic Research,
Inc.'s prototype 486 desktop system,
ALR will enter the 486 market with a
bang."

At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we've designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR's custom ASIC chips which deliver the fastest processing speed ever.

More important, PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing a better than zero wait state performance as compared to the i386. Furthermore, the ALR PowerCache 4 is 100% IBM® PS/2™ Micro Channel™-compatible supporting bus mastering devices and giving

	ALR M130 Desktop	ALR M150, M350 M650 Floor-Standing	IBM M70-A21 Power Platform™
CPU	25 MHz i486	25 MHz i486	25 MHz i486
Bus	MCA	MCA	MCA
External Cache	128 KB cache Read and Write-Back	128 KB cache Read and Write-Back	None
Video Opt. on board	640x480 1024x768	640x480 1024x768	640x480 None
I/O Slots	6 expansion slots	6 expansion slots	3 expansion slots
Storage Expansion	4-3 1/2"	1-full height 2-1/2"-height 2-3 1/2" drives	3-3 1/2" drives
Disk Capacity	130 MB-260 MB	150 MB-650 MB	110 MB
Price	\$9,990	Starting at \$11,490	\$12,990



**California Anza-Borrego
Desert State Park**

(Cannonball-shaped sandstone. These concretions are formed of onion-skin layers of minerals resistant to erosion.)

i486™ system in the world. from the leader in 386™ technology.

you a more efficient system for a variety of multi-user and fileserver applications. Like most ALR computers, the PowerCache 4 is a truly balanced system. The fastest power is achieved by enhancing our PowerCache 4 design with the industry's fastest disk drives and interface. The PowerCache 4 systems come standard with a high-speed 15MHz ESDI and 32 KB hard disk cache on the disk controller. What more could you possibly need.

It's no wonder ALR remains ahead of the pack with our innovative design expertise. As far back as 1986, we've been recognized in the industry as a leader in performance. Recently, the highly acclaimed 386/220 won us "Best of 1987" from *PC Magazine*. 1988 brought us the honor of receiving the *PC Magazine* Award for Technical Excellence for designing the industry's most advanced cache architecture. As for 1989 we've already begun to excite the industry with the PowerCache 4.

Now, what else would you expect from a company who is so committed to innovation and high-performance technology that we take you a step beyond. At ALR, we are concerned with your processing needs. Our technical support staff is available to assist you by one simple phone call. All our systems are backed by a one year warranty. Call today for more information on the new PowerCache 4 and the name of an authorized reseller nearest you.

1-800-444-4ALR



PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing better than zero wait state performance as compared to the i386.



Advanced Logic Research, Inc.
9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9240
For our Canadian office:
1-800-443-4CAN
For our UK office:
0 635-521 844 FAX: 0 635-521 844
For our Singapore:
(65) 258-1286 FAX: (65) 258-1285

ALR and Advanced Logic Research, Inc. are registered trademarks. PowerCache 4 is a registered trademark of Advanced Logic Research, Inc. IBM and PC, PS/2, Micro Channel are registered trademarks of International Business Machines Corporation. Intel, 386 and i486 are registered trademarks of Intel Corporation.

BYTE

SEPTEMBER 1989

VOL. 14/NO. 9

PRODUCTS IN PERSPECTIVE

49 What's New

81 Short Takes

Studio/1, *Electronic Arts' decolorized version of Studio/8*
DeScribe Word Publisher, *an OS/2 word processor from Lennane Advanced Products*
SuperGlueII, *Solutions International's Macintosh utility*
Ami Professional, *Samna combines word processing and desktop publishing*
POSTcard, *an add-in card from Award Software that monitors your PC*

FIRST IMPRESSIONS

90 Not Quite As Simple As 1-2-3

by Andrew Reinhardt
Release 3.0 of Lotus 1-2-3 has many new features and functions, but these improvements come with a price in performance.



COVER STORY

The 486s Are Here!

*by Paul Lavin
and Michael E. Nadeau
page 95*

Britain's Apricot
is the first to
announce a complete
80486-based system.

REVIEWS

- 148 Product Focus:
The Multiuser Solution**
*by Howard Eglowstein
and Stanford Diehl*
Multiuser operating systems have mainframe-style connectivity.
- 165 ALR Revs Up MCA**
*by Bill Catchings
and Mark L. Van Name*
The MicroFlex 7000 is the fastest MCA clone that we've tested to date.
- 173 Long Live the Low End**
by Roger C. Alford
AST's 8-MHz Bravo/286 has both a small footprint and a small price.
- 177 Data to Go**
by Don Crabb
Sysgen's removable hard disk platter works on both the Mac and the PC.
- 183 Mastering the PCX Format**
by Bert Tyler
PCX Toolkit from Genus lets you add PCX features to your graphics program.

EXPERT ADVICE

103 Computing at Chaos Manor: The World on CD-ROMs

by Jerry Pournelle
Jerry also looks at WORM drives and uninterruptible power supplies.

117 The Unix /bin: Unix on Personal Computers: Why and How

by David Fiedler
There are some good reasons to install Unix on a personal computer.

123 Down to Business: On the Road Again

by Wayne Rash Jr.
Who says portables have limited capabilities?



- 127 Macinations:
Disaster Recovery**
by Don Crabb
Don's hard disk drive goes down, and getting back to work takes some doing.

131 OS/2 Notebook: Talking to OS/2 Developers

by Mark J. Minasi
Views on OS/2 from Dave Nanian, Doug Hamilton, and Martin Heller.

143 NetWorks: The Mailman Cometh

*by Mark L. Van Name
and Bill Catchings*
Like traditional mail, E-mail involves the delivery, storage, and security of messages.

LAN
SUPPLEMENT



212
LAN Standards: Do You Need Them?
by Jonathan Schmidt

221
The Glue for Internetworking
by William Stallings

227
LAN-Aware DOS Programs
by Barry Nance

235
Building Heterogeneous Networks
by L. Brett Glass



FEATURES

296 **A Bus Tour**
by George White
EISA, ISA, MCA,
NuBus... here's what you need
to know about what bus your
next machine will use and why.

305 **Graphics Formats**
by Gerald L. Graef
A universal image format
is much needed, but will
it ever come about?

315 **The Unix Shell**
by Greg Comeau
More than just a collection
of commands, the Unix shell
is often used to
build applications.

A Bus Tour/296

189 **A HyperCard for the PC**
by Bob Stepno
Brightbill-Roberts's HyperPAD
brings Mac-like programming
to DOS.

197 **Arriba: The Painless PIM**
by Lamont Wood
Good Software's personal
information manager is easy
to use.

202 **Reviewer's Notebook**
A compilation of brief reviews
and updates to previously
published evaluations.

IN DEPTH

244 **Introduction:
Database Trends**

247 **A Brave New World?**
by Fabian Pascal
Fundamental changes are
now occurring in database
management. Where are
we headed?

259 **Serving Up Data**
*by Mark L. Van Name
and Bill Catchings*
Database servers provide
centralized data management
while preserving the individual
user's independence.

267 **Sharing the Wealth**
by Ralph Davis
Give your applications
a global reach with
a distributed DBMS.

277 **A Family of Models**
by Joseph Dawson
Are the days of the relational
database numbered?

291 **The Data File**
A guide to personal computer
database systems.

HANDS ON

323 **Under the Hood:
Laptop Technology Redux**
by L. Brett Glass

Major innovations in small
peripheral devices increase
the laptop's utility.

333 **Some Assembly Required:
Stalking the 8-bit Spectrum**
by Tom Thompson

How to circumvent a prickly
problem when using the Mac's
color palettes.

DEPARTMENTS

- 8 Editorial:
A Billion Bits of BYTE
- 17 Microbytes
- 34 Letters, Ask BYTE, and Fixes
- 47 Chaos Manor Mail
- 391 Coming Up in BYTE
- 397 **NEW** Setting the Standards:
15 Years
- 400 Print Queue
- 404 Stop Bit

READER SERVICE

- 390 Editorial Index by Company
- 392 Alphabetical Index to Advertisers
- 394 Index to Advertisers
by Product Category
- Inquiry Reply Cards: after 396

PROGRAM LISTINGS

- From BIX: See 312
- From BYTENet:
call (617) 861-9764
- On disk or in print:
See card after 80

BYTE (ISSN 0360-5280) is published monthly with an additional issue in October by McGraw-Hill, Inc. Postmaster: Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520. Second-class postage paid at Peterborough, NH 03458, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America.

Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.
Copyright © 1989 by McGraw-Hill, Inc. All rights reserved. Trademark registered in the United States Patent and Trademark Office.



Subscription questions or problems should be addressed to BYTE Subscriber Service, P.O. Box 551, Hightstown, NJ 08520.

Microsoft profession something other lang



al languages give you uages don't. Leverage.



In an industry that evolves practically overnight, it's tough to stay ahead of the crowd.

You need tools that not only give you an edge day-to-day, but open up endless possibilities.

Tools that can only come from Microsoft.

Combine Microsoft® C and Macro Assembler and you've got enough power to create programs for MS-DOS®, Windows and OS/2 systems.

What's more, you can do it all in record time because our renowned CodeView® Debugger, Linker, Microsoft Editor, and MAKE utility work ingeniously and seamlessly together.

In other words, you've got the leverage of the most inventive and comprehensive tools around.

When you develop under OS/2 systems, you've got options no one else can touch. Like multi-tasking. And blasting through the 640K barrier.

In addition, Microsoft C and Macro Assembler can accommodate more third party add-ons than any other PC professional languages.

Maybe that's why the most popular applications on the market today were developed through the unique power of our C and Assembler: Lotus® 1-2-3®, WordPerfect® 5.0, Microsoft Excel. And Aldus® PageMaker.®

So drop by your nearest Microsoft dealer soon. And start turning out the most airtight, fine-tuned code ever to touch a disk.

After all, you've got the leverage.

Microsoft
Making it all make sense.



A BILLION BITS OF BYTE

BYTE enters its fifteenth year of publication—and you're the reason why

The following note was printed at the bottom of the first table of contents in the first issue of BYTE, back in September 1975: "From inception to press in seven weeks—surely a magazine creation record. Guinness please take notice."

Of course, what really mattered wasn't BYTE's speedy birth, but the rocket-like start of the microcomputer industry itself and the rapid emergence of a group of technically advanced, sophisticated microcomputer users. These people got the personal computer industry started, and the same sort of people drive the industry today. But you know that: You're part of that group.

You, along with millions of other advanced microcomputer users, have also shaped and driven BYTE for the last 15 years and have made it possible for BYTE to reach this computer publishing milestone. It's a happy anniversary for us, and we want to make it rewarding for you, too.

You'll see the fifteenth anniversary logo (above) on at least one specially commissioned article in each of the next 12 issues. These articles will offer valuable commentary on how the microcomputer industry has gotten where it is, what the major issues are today, and what's in store for the future. One example: Because this year is also the twenty-fifth anniversary of BASIC and the fifteenth anniversary of the original Microsoft BASIC written by Bill Gates, we've commissioned Bill to write an article on the state of BASIC today.

Readers Then and Now

Anniversaries are also a time to take stock. Over the years, the magazine has changed in some dramatic ways, evolving along with reader interests and with the changes in the industry. For example, "Photographic Notes on Wire Wrapping" was popular when it ran in 1976, but it would be pretty silly today.

Other things haven't changed at all. For example, like the original BYTE readers, today's readers are among the most knowledgeable, demanding, and eclectically minded microcomputer users there are. Like the readers 15 years ago, they still insist on making their own decisions. They demand objective, authoritative, and unbiased information on the entire spectrum of today's products and technologies—not just on one brand, or one architecture, or one operating system. That's why BYTE has been a platform-independent magazine since its inception.

BYTE readers won't accept superficial reporting. That's why we devote 25 to 50 pages a month to the In Depth section in order to provide you with enormous detail on an important topic. That's also why we rewrote our benchmarks from the ground up to make them the most complete and comprehensive available.

BYTE readers demand definitive product information. BYTE invented the microcomputer review and the head-to-head comparative review (one of each appeared in the very first issue of BYTE). Our benchmarks can be traced back to BYTE's third issue. And a de facto microcomputer lab—the industry's first—followed soon thereafter. Today, with upgrades to the LAN Lab and an expansion of the review staff, our product coverage is second to none.

Our readers insist on timely coverage of important new product announcements. That's why BYTE was first with coverage of the IBM PC and the Mac—long before there were any PC or Mac

magazines. And that's why, just in this last year, we've been the first magazine to bring you news of the NeXT cube, the Mac SE/30, the first 33-MHz 80386s, Sun's PC-priced workstations, and this month's cover machine—the world's first 80486-based microcomputer.

Our readers are hungry for information on new technologies. That's why we track important developments from womb to tomb, through their complete life cycle. Breaking technology news appears in *BYTEweek*, on BIX, and in the Microbytes section of each issue. The What's New, Short Takes, and First Impression sections follow technologies as they emerge from R&D departments and come to market. Meaty R&D information also appears in feature articles and in the In Depth section.

BYTE readers want to "push the envelope" and extend the usefulness of their computers into new, innovative, and practical areas. BYTE brought you that kind of coverage as far back as 1979, when we published "A Small Business Accounting System," the first solution-oriented microcomputing article.

BYTE readers demand information on the entire world of microcomputing, not just what happens in one place. That's why BYTE covers important microcomputer developments in the Far East, Europe, and North America.

Fifteen Years and Counting

With this issue, BYTE enters its fifteenth year of publication—the only general-circulation computer magazine ever to reach this milestone. The text alone of all those BYTES adds up to some 150 megabytes—well over a billion bits. We're deeply honored that you've chosen to read BYTE, and we pledge to continue to do our best to meet your high standards—for the next billion bits, as well.

Guinness, please take notice.

—Fred Langa
Editor in Chief
(BIX name "flanga")

At last, an assistant that follows your directions



Wouldn't it be great to delegate your routing?

You can! We know your time is valuable. That's why Wintek pioneered comprehensive and affordable CAD packages for IBM personal computers. HiWIRE-Plus continued that tradition, integrating schematic-capture features and printed-circuit-artwork capabilities into one versatile package.

New autorouter.

The Autorouter for HiWIRE-Plus is powerful enough to handle the most demanding design problems, yet simple enough for a casual user. Just turn it loose on your design. It's hassle free because it works long hours, without supervision or errors.

100% autorouting.

The autorouter for HiWIRE-Plus rips-up, reroutes, and with appropriate design rules, racks up 100% completion.

- Forget gridded routers. This autorouter places vias and traces anywhere your design rules allow. With 1-mil resolution.
- Vary trace width and spacing for individual networks. Route 1, 2, 3, or more tracks between IC and connector pins.
- Set up boards from 1 to 250 layers, up to 60" x 60".
- Specify shape, size, and type of vias, layer-by-layer: through-hole, blind, buried, micro. Specify via types for individual networks.
- Use fewer vias and layers than comparably priced autorouters.
- For use on your IBM PC, XT, AT, PS/2, or compatible with 640K RAM.

Why pay more for a 100% autorouter?

Compare the features and performance to packages costing five times more. HiWIRE-Plus and the Autorouter for HiWIRE-Plus sell for \$895 each. Both have a no-nonsense, 30-day money-back guarantee. With unlimited, toll-free, no-charge technical support.

Let HiWIRE convince you that it makes a great assistant. Call us toll-free at (800) 742-6809 today and put HiWIRE-Plus and the Autorouter for HiWIRE-Plus to work for you tomorrow.



Wintek Corporation
1801 South Street
Lafayette, IN 47904-2993
Fax: (317) 448-4823
Phone: (317) 742-8428 or

(800) 742-6809

OUT-STANDING

The Company

Gateway 2000 has consistently led the pack of competitors in this highly competitive field. We have the most aggressive pricing in the industry, the most aggressive support policies, and lead the pack in quality. So shop around, then call Gateway 2000 to discover just how far ahead of the competition we really are.

The Products

Your Gateway 2000 computer system will arrive thoroughly tested and ready to run. All of our top quality systems come standard with our own *Crystalscan 860* monitor and a 16 bit VGA card that is expandable to 512K. We have a variety of options available to suit anyone's needs. So call Gateway 2000, and we'll custom configure a system just for you.

12 Mhz 286 VGA

80286-12 Processor
2 Megs RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2295.00

16 Mhz 286 VGA

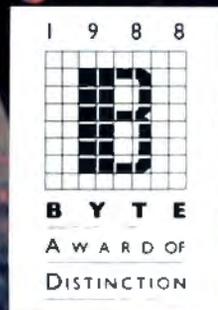
80286-16 Processor
2 Megs RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2395.00

20 Mhz 286 VGA

80286-20 Processor
2 Megs RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2495.00



Due to the Volatility in the DRAM Market all prices subject to change.

IN THEIR FIELD

The Service

Gateway 2000 backs its computer systems with a full one year warranty and 30 day money back guarantee. If a problem does arise, you will promptly receive a solution over the phone or via *Federal Express* at our expense. In addition to this, we offer *lifetime toll-free support*, even after the warranty expires. So call Gateway 2000 for the best overall value on the market today.



20 Mhz 386 VGA

- 1 Meg RAM
- 1.2 Meg 5 1/4" Drive
- 1.44 Meg 3.5" Drive
- 80 Meg 28ms Drive
- 16 Bit VGA Board
- 14" VGA COLOR Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$2995.00

(Upgrade to 4 Megs \$500)

25 Mhz 386 VGA

- 4 Megs RAM
- 1.2 Meg 5 1/4" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg 16.5 ms ESDI Drive
- 16 Bit VGA Board
- 14" VGA COLOR Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$4495.00

(64K Cache Add \$500)

33 Mhz 386 VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5 1/4" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg 16.5 ms ESDI Drive
- 16 Bit VGA Board
- 14" VGA COLOR Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

\$5995.00

Gateway 2000

P.O. Box 2000

Sgt. Bluff, IA 51054

800-779-2000

712-943-2000



BYTE

EDITOR IN CHIEF
Frederic S. Longa

PUBLISHER/GROUP VICE PRESIDENT
J. Burt Totaro

OPERATIONS

Glenn Hartwig *Associate Managing Editor*

REVIEWS (Hardware, Software, Product Focus)

Michael Nadeau, *Associate Managing Editor*, Dennis Allen *Senior Technical Editor*, Software, Richard Grehan *Director*, BYTE Lab, Stephen Apiki *Testing Editor*, BYTE Lab, Stanford Diehl *Testing Editor*, BYTE Lab, Howard Eglowstein *Testing Editor*, BYTE Lab, Stanley Wazola *Testing Editor*, BYTE Lab

NEWS AND TECHNOLOGY (Microbytes, What's New, Short Takes)

Rich Malloy *Associate Managing Editor*, D. Barker *Senior Editor*, News and Technology, Anne Fischer *Senior Editor*, New Products, Andrew Reinhardt *Associate News Editor*

Peterborough: Roger Adams *Associate News Editor*, David Andrews *Associate News Editor*, Martha Hicks *Associate News Editor*

West Coast: Gene Smarte *Bureau Chief*, Costa Mesa, Nicholas Baran *Senior Technical Editor*, Frank Hayes *News Editor*, Jeffrey Bertolucci *Associate News Editor*, San Francisco

SENIOR TECHNICAL EDITORS

Ken Sheldon *Features*, Jane Morrill *Tazelaar in Depth*, Tom Thompson *At Large*

TECHNICAL EDITORS

Janet J. Barron, Alan Joch, Robert Mitchell, Robert M. Ryan, Ben Smith, Jon Udell

SENIOR CONTRIBUTING EDITOR

Jerry Pournelle

CONTRIBUTING EDITORS

Don Crabb, David Fiedler, L. Brett Glass, Hugh Kenner, Mark Minasi, Wayne Rash Jr.

CONSULTING EDITORS

Jonathan Amsterdam, Laurence H. Loeb, Trevor Marshall, Stan Miatkowski, Dick Pountain, Phillip Robinson, George A. Stewart, Mark L. Van Name, Peter Wayner

COPY EDITORS

Lauren Sticker *Chief*, Cathy Kingery *Copy Administrator*, Susan Colwell, Jeff Edmonds, Judy Grehan, Nancy Hayes, Margaret A. Richard, Warren Williamson

EDITORIAL ASSISTANTS

Peggy Dunham *Office Manager*, Linda C. Ryan, June N. Sheldon, Lynn Susan Valley

ART

Nancy Rice *Director*, Joseph A. Gallagher *Assistant Director*, Lisa Nardocchia *Assistant*, Jan Muller *Assistant*, Alan Easton *Technical Artist*

PRODUCTION

David R. Anderson *Director*, Virginia Reardon *Senior Editorial Production Coordinator*, Barbara Busenbark *Editorial Production Coordinator*, Denise Chartrand *Editorial Production Coordinator*, Michael J. Lonsky *Editorial Production Coordinator*

TYPOGRAPHY

Sherry Flske *Systems Manager*, Donna Sweeney *Applications Manager*, Christa Patterson

ADVERTISING/PRODUCTION (803) 924-8448

Lisa Wozniak *Director of Advertising Services*, Linda Fluhr *Customer Service Supervisor*, Lyda Clark *Senior Account Coordinator*, Dale Christensen, Karen Cilley, Roxanne Hollenbeck, Rod Holden, Wai Chiu Li *Quality Control Manager*

ADMINISTRATION

Donna Nordlund, *Publisher's Assistant*

MARKETING AND PLANNING

Pamela Petrakos-Wilson *Marketing Communications Manager*, Dawn Matthews *Public Relations Manager*, Lisa Jo Steiner *Assistant Promotion Manager*, Stephanie Warnesky *Marketing Art Director*, Sharon Price *Associate Art Director*, Julie Perron *Senior Market Research Analyst*, Faith Kluntz *Copyrights Coordinator*, Cynthia Damato *Sands Reader Service Coordinator*, Carol Pitman *Marketing Assistant*

FINANCIAL SERVICES

Philip L. Penny *Director of Finance and Services*, Kenneth A. King *Business Manager*, Marilyn Parker, Diane Henry, JoAnn Walter, Jaime Huber, Agnes Perry

CIRCULATION

Dan McLaughlin *Director*, Vicki Weston *Assistant Manager*, Karen Desroches *Distribution Coordinator*, Louise Menegus *Back Issues*

PERSONNEL

Patricia Burke *Human Resources Administrator*, Beverly Goss *Receptionist*

BUILDING SERVICES

Tony Bennett *Manager*, Cliff Monkton, Mark Monkton, Gary Graham

BIX BYTE INFORMATION EXCHANGE

DIRECTOR

Stephen M. Laliberte

EXECUTIVE EDITOR

George Bond

MANAGING EDITOR

Tony Lockwood

MICROBYTES DAILY

D. Barker *Coordinator*, Peterborough, Rich Malloy *New York*, Gene Smarte *Costa Mesa*, Nicholas Baran *San Francisco*, Rick Cook *Phoenix*, Frank Hayes *San Francisco*, Martin Heller *Boston*, Jason Levitt *Austin, TX*, Laurence H. Loeb *Wallingford, CT*, Brock N. Meeks *San Francisco*, Stan Miatkowski *Peterborough*, Wayne Rash Jr. *Washington, DC*, Andrew Reinhardt *New York*, Sue Rosenberg *Washington, DC*, David Reed *Lexington, KY*

GROUP MODERATORS

David Allen *Applications*, Leroy Casterline *Other*, Marc Greenfield *Programming Languages*, Jim Howard *Graphics*, Gary Kendall *Operating Systems*, Steve Krenek *Computers*, Brock N. Meeks *Telecommunications*, Barry Nance *New Technology*, Donald Osgood *Computers*, Sue Rosenberg *Other*, Jon Swanson *Chips*

EXCHANGE EDITOR

Laurence H. Loeb, *Macintosh Exchange Editor*

BUSINESS AND MARKETING

Patricia Bausum *Secretary*, Denise A. Greene *Customer Service*, Brian Warnock *Customer Service*, Tammy Burgess *Customer Credit and Billing*

TECHNOLOGY

Clayton Lisle *Director*, *Business Systems Technology*, ISCO, John Spadafora *Programmer/Analyst*, Wayne Power, *Senior Business Systems Analyst*

ADVERTISING SALES

Steven M. Vito *Associate Publisher*, *Vice President of Marketing*

Sara Lyon *Administrative Assistant*

Arthur H. Kossack *Eastern Regional Sales Manager*,

(312) 751-3700

Jennifer L. Bartel *Western Regional Sales Manager*,

(214) 844-1111

Susan Vernon *Sales Assistant*

NEW ENGLAND

ME, NH, VT, MA, RI, ONTARIO, CANADA &

EASTERN CANADA

John C. Moon (617) 262-1180

ATLANTIC

NY, NYC, CT, NJ (NORTH)

Kim Norris (212) 512-2648

EAST

PA, KY, NJ (SOUTH), MD, W.VA.

DE, DC

Thomas J. Brun (215) 496-3833

SOUTHEAST

NC, SC, GA, FL, AL, TN, VA, MS

Thomas H. Tolbert (404) 252-0626

MIDWEST

IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH

Kurt Kelley (312) 751-3740

SOUTHWEST, ROCKY MOUNTAIN

CO, WY, OK, TX, AR, LA

Karl Heinrich (713) 462-0757

SOUTH PACIFIC

SOUTHERN CA, AZ, NM, LAS VEGAS, UT

Ron Cordek (714) 557-8292

Tom Harvey (213) 480-8243

NORTH PACIFIC

HI, WA, OR, ID, MT, NORTHERN CA, NV (except

LAS VEGAS), WESTERN CANADA

Bill McAfee (408) 879-0371

Christine Kopec (415) 362-4800

TELEMARKETING

L. Bradley Browne *Director*

Susan Boyd *Administrative Assistant*

NATIONAL SALES

Liz Coymann (603) 924-2518

Dan Harper (603) 924-2598

Elisa Lister (603) 924-2598

BYTE BITS (2x3)

Mark Stone (603) 924-8830

THE BUYER'S MART (1x2)

Brian Higgins (603) 924-3754

REGIONAL ADVERTISING SECTIONS

Scott Gagnon (603) 924-4380

Larry Levine (603) 924-4379

Barry Echavarría (603) 924-2574

BYTE POSTCARD DECK MAILINGS

BYTE DECK

Ed Ware (603) 924-6186

COMPUTING FOR DESIGN & CONSTRUCTION

COMPUTING FOR ENGINEERS

Mary Ann Goulding (603) 924-9281

INTERNATIONAL ADVERTISING SALES STAFF

See listing on page 393.

EDITORIAL AND BUSINESS OFFICE:

One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.

West Coast Branch Office: 425 Battery St., San Francisco, CA 94111, (415) 954-8718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-8292.

New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.

BYTENet: (617) 961-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).

Editorial Fax: (603) 924-2560. Advertising Fax: (603) 924-7507. Telex: (603) 924-7861.

SUBSCRIPTION CUSTOMER SERVICE: Outside U.S. (609) 426-7070; inside U.S. (800) 525-5003.

For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520

Officers of McGraw-Hill Information Services Company: President: Walter D. Serwatka. Executive Vice Presidents: Kenneth E. Gazzola, Aerospace and Defense; Ira Herenstein, Computers and Communications; Russell C. White, Construction; Robert P. McGraw, Healthcare; Brian H. Hall, Legal. Senior Vice Presidents—Publishers: Laurence Altman, Data Communications; David J. McGrath, Engineering News-Record. Senior Vice Presidents: John W. Fink, Finance; Michael J. Koetter, Human Resources. Group Vice Presidents: J. Burt Totaro, BYTE; Norbert Schumacher, Energy/Process Industries. Vice Presidents: George Ettinger, Circulation; Julia Lanard, Systems Planning and Technology; Elisabeth K. Allison, Planning and Development.

Officers of McGraw-Hill, Inc.: Joseph L. Dionne, Chairman, President, and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel, and Secretary; Robert J. Bahash, Executive Vice President and Chief Financial Officer; Frank D. Pengilase, Senior Vice President, Treasury Operations.

Founder: James H. McGraw (1860-1948). Executive, editorial, circulation, and advertising offices: One Phoenix Mill Lane, Peterborough, NH 03458, phone (603) 924-9281. Office hours: Monday through Thursday 8:30 AM-4:30 PM, Friday 8:30 AM-1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520. Subscriptions are \$29.95 for one year, \$54.95 for two years, and \$74.95 for three years in the U.S. and its possessions. In Canada and Mexico, \$31.95 for one year, \$59.95 for two years, \$79.95 for three years. \$75 for one-year air delivery to Europe. \$28,800 for one-year air delivery to Japan, \$14,400 for one-year surface delivery to Japan, \$45 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is \$3.50 in the U.S. and its possessions, \$3.95 in Canada, \$4.50 in Europe, and \$5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 29 Congress St., Salem, MA 01970. Specify ISSN 0360-5260/83, \$1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WC1R 4EJ, England

BYTE and **BYTE** are registered trademarks of McGraw-Hill, Inc.



PC WEEK POLL: C COMPILERS

	Overall Weighted Score	Overall Reliability	Complete of Command Descrip.	Overall Perform.	Complete & Organiz. Document.	Document Clarity	Compiling Process Efficiency	Product Support Quality	Value Relative To Cost	Product Support Access.
Turbo C 2.0 (Borland International)	81	87	79	84	77	78	86	72	70	93
C Optimizing Compiler 5.1 (Microsoft Corp.)	76	83	80	81	78	74	76	68	67	70
C++ 1.07 (Zortech Inc.)	66	68	64	71	63	63	69	60	58	76

"Microsoft was No. 1, but they have been unseated by Borland." PC Week, May 8, 1989

PC WEEK POLL: SOFTWARE DEBUGGERS

	Overall Weighted Score	Overall Reliability	Effective. Programmer Interface	Document Clarity	Complete. Command Descrip.	Complete. & Organiz. Document	Overall Perform.	Integration Within Programming Environment	C Compiler Compatibility	Product Support Quality	Product Support Access	Value Relative To Cost
Turbo Debugger 1.0 (Borland International)	84	89	90	81	81	81	89	88	81	73	72	93
Codeview 2.2 (Microsoft Corp.)	73	80	71	72	74	74	74	74	78	67	64	72

"Borland's Debugger outshines Microsoft's Codeview." PC Week, May 15, 1989

It's two winners in one.

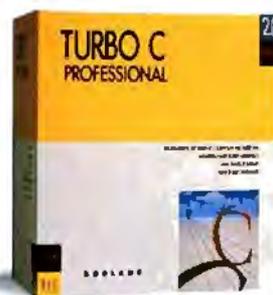
Turbo C,* the core of Turbo C Professional, was the outright winner in PC Week's Poll of Corporate Satisfaction on C compilers. Overall, Borland won with 81. Microsoft* placed second.

Turbo Debugger,* also included in Turbo C Professional, was the outright winner in EVERY category in PC Week's Poll Of Corporate Satisfaction on Debuggers. And, once again, we topped the score with 84, overall. Microsoft came in second-best, 11 points behind.

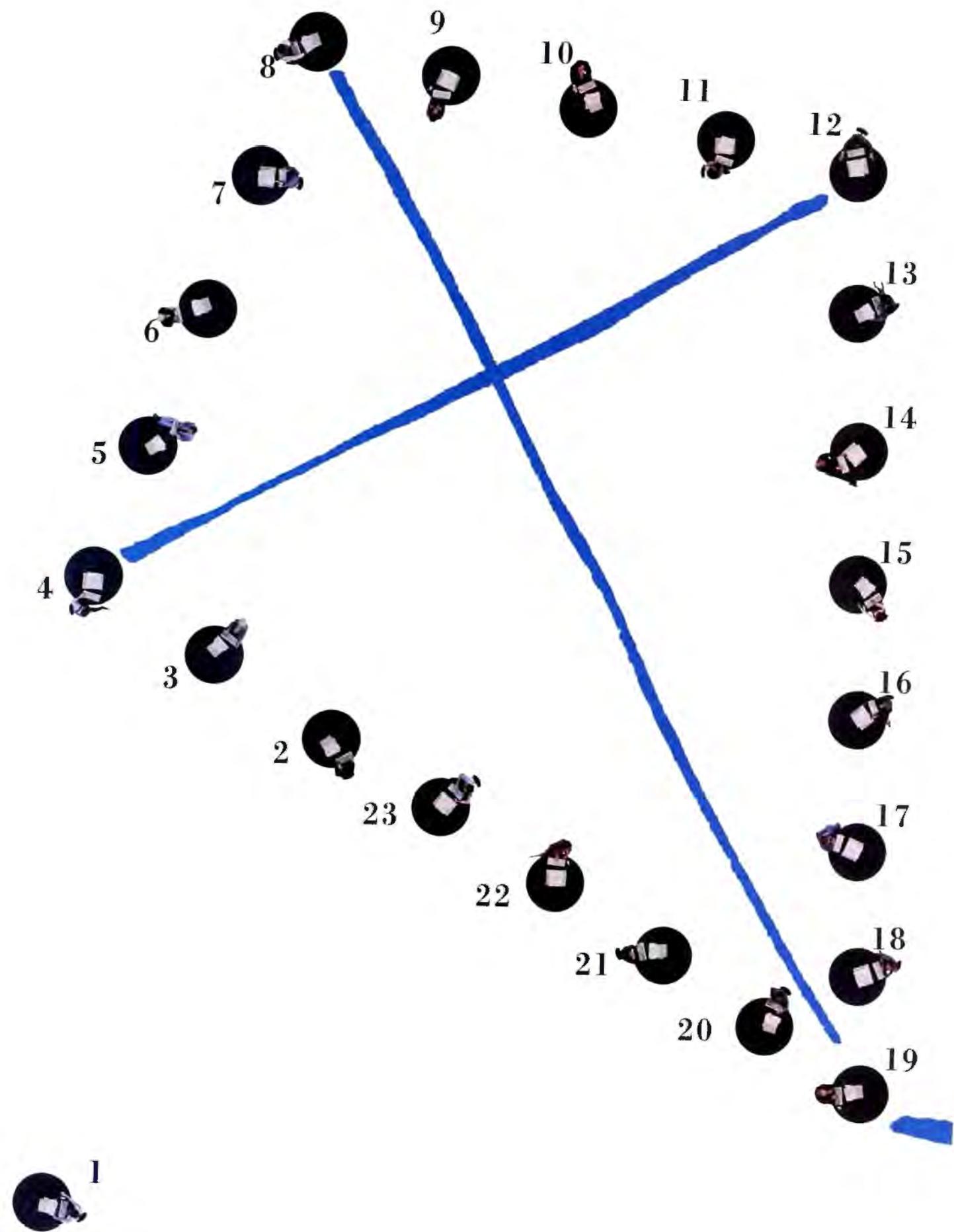
Get Borland's Turbo C Professional and get the best of both worlds: our top-rated C compiler and our top-rated Debugger.

Call (800) 345-2888* and we'll send you both PC Week polls and technical specifications on Turbo C and Turbo Debugger.

Turbo C Professional includes both Turbo C 2.0 and Turbo Assembler® & Debugger.



B O R L A N D



Getting a network off the ground is easy with AIX.™ Because AIX, IBM's enriched version of the UNIX® operating system, brings a whole new standard of performance, documentation and security to the open systems environment.

Your plans to connect up all your systems will fly a lot easier with AIX.

In fact, AIX has improved upon other UNIX systems in so many ways, the Open Software Foundation recently chose AIX as its core operating system.

AIX gives you a very high degree of flexibility. AIX lets you create a transparent network between platforms from a broad range of vendors—from SUN® to DEC® to AT&T® and HP®.

It also lets you link up a broad range of IBM systems—from the PS/2® to the RT,™ all the way up to the System/370®.

All for one, and one for all. AIX can integrate a network so effectively, you'd swear it was a single system.

Distributed Services on the RT lets everyone in the network share files, programs and devices. And to optimize your PS/2 and System/370 investment, AIX's Transparent Computing Facility lets you shift power from one processor to another, as the need arises.

And since AIX allows you to merge DOS and UNIX functions, you protect your software investment, too.

AIX's ease of use also sets a new standard. AIX is well documented, easy to learn and provides connectivity through multiple communications protocols.

So if you want to raise the quality of your networking, connect with your IBM marketing representative or IBM Business Partner today about AIX. The one system that connects the flexibility of open standards with all the classic strengths of IBM.

For more information, call 1 800 IBM-2468, ext. 148. AIX from IBM. Making your business together.

The IBM logo, consisting of the letters "IBM" in a bold, blue, sans-serif font with horizontal stripes through the letters.



Creative License.

If you've ever tried to combine windows, menus, forms, and text entry to create an effective user interface, you know how challenging it can be.

Perhaps you've turned to a third-party library for help. Only to run into restrictions, limitations, and dead ends. So you had to compromise your design. Or modify the library source code. Or start over.

Which is precisely why we designed Vermont Views™, the new generation of Windows for Data®, the best-selling C library for user interfaces.

Vermont Views offers unbridled, unrestricted creative license.

The Human Interface Of Your Dreams

Vermont Views offers an unparalleled set of interface building blocks that you can combine in unlimited ways:

- Menus can be created in any style you choose, made scrollable vertically and horizontally, and nested to any level. Features include n-th character selection, checkmarks, and unavailable items.

- Data entry forms can be bigger than their display windows, have scrollable regions for the entry of variable lines of items, lists of choices for data entry, context sensitive help, and special decimal, date, time, and toggle fields.

- A mini word processor can be attached to a field window in a form or

used as a pop-up note taker.

You're In Charge

Because you can write and attach functions to the beginning and end of menus, forms, fields, and to keys, you're always in control.

Use these control functions to call up subsidiary forms and menus, change field values and the active field, exit or abort a form, do almost any task you can imagine.

All interactive capabilities of Vermont Views use a unique system of accessible keytables, so you can easily change or disable key assignments - even add to the functions provided for menus, forms, text entry, and windows.

One For All

Vermont Views is available for DOS, OS/2, UNIX, XENIX, and VMS. Maintain the same user interface on all of these operating systems with the same source code.

Vermont Views provides international portability as well, with full support for IBM international characters, flexible date and time formats, and changeable decimal and thousands separators.

Novice Or Expert

Despite its depth and flexibility, Vermont Views is easy to learn and use. Each major facility is covered in a single, self-

contained section of the manual, so you only need to learn capabilities as you use them.

To help you become an expert in no time, we include a free copy of the Norton Guides™ Engine and our own comprehensive Pop-Up Reference™. You'll have immediate, on-line access to function names, reference pages, structures and tables.

No-Time-Limit Guarantee

We've only touched on a fraction of what makes Vermont Views special. The only way to know it is to use it.

Try Vermont Views on your hardest problems.

For as long as you want. At no risk.

If not fully satisfied, return for a full refund. Anytime.

To Order Today Call 1-800-848-1248

Call to order Vermont Views today. And we'll send your "creative license" right away.

Prices: DOS \$395; with Source \$790. UNIX, XENIX, VMS, OS/2 please call.



Vermont
Creative
Software

Pinnacle Meadows, Richford, VT 05476

MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry, compiled from Microbytes Daily and BYTEweek reports

Mac-Like Interface Brings Another Look to Unix

Unix users who don't like the new user interfaces from the Open Software Foundation (OSF/Motif) or AT&T-backed Unix International (Open Look) will have another choice. A small company called Visix Software (Arlington, VA) is developing a graphical user environment for Unix systems that's similar to the Macintosh Finder. Looking Glass, which will run on any Unix machines that support the X Window System, will provide graphical means for managing directories and files, as well as desktop icon panels, an application launcher, environment control utilities, an on-line help system, and other typical end-user control functions.

Looking Glass's big selling point will be the way it performs and its efficient use of memory, said Visix chairman and CEO Jay Wettlaufer. The Looking Glass interface uses only about 800K bytes of memory, a small amount in the Unix world. A comparable interface based on the Motif interface would use at least twice the memory, Wettlaufer said. He claimed the low memory requirements will make Looking Glass attractive for X Window terminals, which do not support paged memory and therefore must use memory more efficiently.

While Motif and Open Look provide specifications and toolkits for developing a consistent user interface, Looking Glass already is a complete, ready-to-use, end-user interface. So far, no one has released interfaces or applications that conform to Motif or Open Look, although Sun was expected to offer an end-user interface for Open Look this summer.

Applications developers won't have to modify their programs to run under Looking Glass as long as they conform to the X Window standard and use X Window primitives for the screen imaging model, Wettlaufer said. Visix will also offer a version that supports Adobe's Display PostScript.

Visix demonstrated an alpha version of Looking Glass, running on a DECstation 3100, at the recent Xhibition conference in San Jose, California. A beta version was scheduled to start shipping to test sites in July, with final software scheduled for late this month. Looking Glass will sell for \$595. If Looking Glass indeed runs on all X Window-based systems and requires no modifications to the host's applications, it could be a way to get a slick, graphical user interface without waiting for applications toolsets to run under Motif or Open Look.

First Wave of 4-megabit Memory Chips Arriving, But at What Cost to Users?

The first wave of denser dynamic memory chips is here. IBM, proving that it pays to make your own chips, announced in late July a memory upgrade for PS/2 Model 70s and 80s that uses the new 4-megabit DRAMs. Most other major chip makers are either offering samples of their 4-megabit DRAMs or gearing up for full-tilt production. Hitachi America says it already has the 4-megabit chips in volume. Toshiba, which fabricated its first 4-megabit memories last November, expects to be making them at the rate of 1 million per month by next March. IBM has three facilities in various stages of 4-

megabit DRAM production. Fujitsu, Motorola, NEC, Mitsubishi, Oki Electric, Sanyo, Sharp, and U.S. Memories, the new co-op/company formed to produce memory chips in the U.S., all expect to be cranking out the denser memories within the next year or so.

Bigger and faster memory chips are coming, but it's not yet clear what price patterns the new DRAMs will follow in the next year. Except for IBM with its new memory upgrade—\$1795 for the 2-megabyte card, \$3495 for the 4-megabyte card—none of the companies are yet talking specific

continued

NANOBYTES

After months of rumors to the contrary, the U.S. Department of Transportation announced officially that it will **not impose a ban** that would keep passengers from taking **laptop computers** and other electronic equipment aboard commercial aircraft. Although DOT officials have considered such a ban, a spokesperson for the department said that there would be no significant changes regarding the use or transport of electronic equipment on domestic flights. The Federal Aviation Administration, however, is directing much tighter screening of such equipment on overseas flights by U.S. airlines, particularly in the Middle East and Europe, an FAA spokesperson told Microbytes. The screening will be the tightest on flights coming into the U.S. Earlier this year, an FAA official said a ban on laptops and other devices "is an option we must consider." Traveling computer users were in general aghast at the very idea.

Toshiba Computer Systems (Irvine, CA) **cut prices** on nine of its laptop computers. The cuts ranged from \$200 on the low-end models to more than \$2000 on the upper-edge 80386-based models. The T1200H, for example, has dropped from \$3499 to \$2799; the T5200 went down from \$9499 to \$7699. The company also lowered the price of its 2-megabyte memory module for the T5200 series, from \$1399 to \$999. Toshiba claims that it has 22 percent of the U.S. market for portable computers.

Top three lessons Lotus CEO **Jim Manzi** said he learned during the saga of 1-2-3 release 3.0: One: "Don't announce new products prematurely." Two: "Keep customers informed" if you don't announce products publicly. Three: "It's a whole new world out there from a [software] development standpoint."

NANOBYTES

Future display: Sharp Microelectronics (Mahwah, NJ) has developed a new film supertwist (FST) display that incorporates an organic retardation film and a single layer of supertwisted liquid crystal into a thinner, lighter display than is possible with conventional double supertwist approaches, the company says. The FST technology is also better at transmitting light, Sharp says, and can be used in reflective or transmissive LCD panels. "We expect our new film-compensated supertwist technology to become the standard display on equipment whose space requirements are extremely limited," said Steve Sedaker, display products marketing manager for Sharp.

Digital Research (Monterey, CA) reports that it has licensed 2 million copies of its **DR DOS** operating system. DR DOS can run all MS-DOS applications but offers extensions such as hard disk partitions of up to 512 megabytes, password protection for all files and subdirectories, and a help system built behind each utility. DR DOS, which DRI sells to computer manufacturers, can be squeezed into and executed from ROM. The latest computer makers to adopt the ROMable operating system are both from Taipei, Taiwan: Autocomputer, Ltd. for its VIP series, and Sun Moon Star Co. for its SMS line.

The Computer and Business Equipment Manufacturers Association (Washington, DC) wants the federal government to **thwart computer viruses**. In a letter to the Senate Subcommittee on Technology and the Law, CBEMA said Congress should aim antivirus statutes at the "criminal behavior" itself rather than at the equipment or techniques used to perpetrate a virus; train law enforcement officials in the ways of computer crime; establish a partnership with companies in the computer industry to develop safeguards; and, above all, make research into viruses a top priority, with the National Institute of Standards and Technology leading the offensive.

prices. Toshiba says 4-megabit DRAMs will achieve "price-per-bit parity" with 1-megabit chips sometime in mid-1990. What Toshiba means by *parity* is that 4-megabit parts will cost "between five and six times the 1-megabit DRAM price." (As a point of reference, 1-megabit chips now cost less than three times what 256K-bit chips do on the retail market.) Toshiba bases its projection on its experience with 1-megabit DRAM chips.

In dollars, many current guesstimates say that the 4-megabit chips will cost about \$100 each in big volumes. Some observers are forecasting that the prices will then drop until the memory/price curve is more in line with the current situation. At today's prices, \$100 per chip will make the 4-megabit DRAMs considerably more expensive than 1-megabit DRAMs (which are currently selling for about \$17 each), even when you consider that it takes four of the less roomy chips to make

up one of the 4-megabit devices. If such prices sustain, it would also mean that memory costs would add at least \$1000 to the price of a 4-megabyte 80386-based microcomputer to run OS/2 or Unix. If you want a machine equipped with 8 megabytes of RAM, which is sort of what Microsoft had in mind when it first started sketching out OS/2 (in the days when memory was cheaper), you might have to pay \$3000 or more for the memory.

Although the 4-megabit chips will eventually be fairly common, there is still a great deal of life left in 1-megabit chips, which continue to drop in price and rise in speed. The technology of 1-megabit chips got a boost this summer, when IBM reported that it has produced what could be the fastest DRAM to ever come off an assembly line. IBM said that the new chip has an access time of only 22 nanoseconds, meaning that it can fetch a bit of information in 22 billionths of a second.

OOP Tools Designed to Make Interface Building Like Writing a Letter with a Word Processor

Delta Logic (Monterey, CA) has designed a set of new object-oriented development tools that could someday show up in the ROM of hand-held computers. The Entryway development software will provide tools for creating user interfaces compatible with IBM's Systems Application Architecture (SAA). Delta Logic, started by former programmers at Digital Research, is a division of Poqet Computer, which is supposed to start shipping its new hand-held microcomputer this year.

The basic concept behind Entryway is to "move the application development process more toward the process of building a letter in a word processor," according to John Hiles, the founder of Delta Logic and now a vice president at Poqet. Entryway operates very much like a word processor, except that it has a set of tools for defining on the screen user-interface objects, such as buttons, forms, and menus. With Entryway, you can construct the text of the application and the objects in the same way that you would write a plain text document. Text can become "live" by attaching an object to a word or phrase, so that when the user clicks on the expression, some action is performed (e.g., opening a database or

presenting a data entry field).

The Entryway system is designed for integrating microcomputers into larger office applications without requiring a professional programmer. Basically, if you can write macros in WordPerfect or Lotus 1-2-3, you can probably learn Entryway quite easily. It provides an intuitive way to build interfaces and "front ends" for less technical users.

The core of the Entryway system is a script language of more than 200 statements that are similar to the syntax of the macro language of WordPerfect 5.0. In addition to the script language, Entryway has 12 built-in objects, including a calendar and a timer, a table and index system, a script recorder, and tools for generating forms and menus. Entryway also supports the concept of hypertext, allowing words on the screen to be associated with other text documents (e.g., a programmer could develop context-sensitive help screens wherein the user clicks on the keyword, which then opens the appropriate help screen). The system also comes with a set of debugging tools and facilities for connecting to network drivers so that Entryway interfaces can be used with distributed

continued

The fastest way to see what you think.



Introducing the MultiSync[®] Graphics Engine[™] Board. Now when an idea pops into your head it won't take long to pop up on screen. Because NEC's MultiSync Graphics Engine Board is the first graphics board specifically designed to increase productivity in Windows, CAD/CAM and desktop publishing applications. For instance, in Windows 386, you'll see up to three times more information as much as four times faster. And with our graphics board, Presentation Manager applications run up to five times faster. What's more, the MultiSync Graphics Engine Board is compatible with VGA, Super VGA (800 x 600) and 1024 x 768 interlaced and non-interlaced resolutions. So whether you're a power user, professional designer or publisher, you can see your ideas on screen in world-class time. For technical details and information, call NEC Home Electronics (USA) Inc. at 1-800-FONE-NEC. For product literature call 1-800-826-2255. The MultiSync Graphics Engine Board. When you've got tons of thoughts racing through your mind, it's the fastest route from head to screen.



MultiSync is a registered trademark of NEC Home Electronics (USA) Inc. Graphics Engine is a trademark of NEC Home Electronics (USA) Inc. NEC is a registered trademark of NEC Corporation. Windows and Windows 386 are registered trademarks of Microsoft Corp. Presentation Manager is a registered trademark of the International Business Machines Corporation. © 1989 NEC Home Electronics (USA) Inc.

C&C Computers and Communications

Circle 206 on Reader Service Card

NEC



CSR 286/14



CSR 286/20 SL

After years of f we built

Introducing the best built, best backed 286- and 386-based systems.

Since 1983, CSR has been a leading microcomputer maintenance provider. We repair all major brands - IBM[®], Compaq[®] and the best-known peripherals - for the largest dealer networks and third-party service companies nationwide. So when we decided to build our own 286- and 386-based systems we knew how to make them even better.

With CSR, you can put your confidence in a company that has it all - the service, support, performance and IBM compatibility you expect - but at prices that will surprise you.

The industry's best 2-YEAR warranty.

For the first full year we provide complete on-site service on all parts and labor. During the second year we'll repair or replace any parts that fail. This revolutionary warranty demonstrates the high degree of confidence we have in the quality and reliability of our computers.

Plus, when you call our toll-free Technical Support Hotline you'll be connected to a highly-skilled Customer Engineer (CE). Your CE will either fix the problem over the phone or dispatch a Service Engineer to your site - within 24 hours of your call - for prompt, professional problem resolution.

And what's best about this CSR-exclusive is that everything is included in the price of your computer!

High performance, not a high price.

CSR delivers high performance in every machine we make. Our 286/20 uses an Intel[®] based 80286 chip that runs at a blazing 20 MHz and outperforms most 386-based machines.

And unlike some of our competitors, we don't imbed the VGA or disk controllers on the mother board - that can just lock you out of future innovations. Instead, we provide a high-speed VGA controller which supports all VGA modes. And a totally IBM-compatible disk controller which features the latest in track-buffer technology to boost drive performance by an amazing 30% to 50%.

Compatible with reality.

You've invested a lot in software. That's reality. So we designed our machines to be 100% compatible with all your MS-DOS[®] and OS/2[®] software.

And we know you have software on both 3 1/2" and 5 1/4" media. That's why *all* CSR computers have both size drives - even the low profile, small footprint 286/20 SL. It's a convenience we've added without adding to the price.

Plus you'll find our high resolution high contrast VGA monitors and "clickable" keyboard to be consistent with your definition of how a computer should look and feel.

Compatible with your budget.

You may have computing needs that are incompatible with what *other* computer companies would like you to spend. Tell us the details of your needs. Then tell us your budget. And we'll build *you* a system that's compatible with both.

So if you want a better built, better backed computer system, compare warranties. Compare specifications. Then pick up the phone and call us at 800-366-1277. We'll deliver what you need at prices that will surprise you.

Full leasing options available. Rates begin as low as \$60/mo. We accept MasterCard, VISA and certified checks.

†The brands or product names mentioned are trademarks or registered trademarks of their respective holders. MS-DOS and OS/2 are registered trademarks of Microsoft Corporation.
Made in the USA

CSR 386/20



CSR 386/25c



Doing their best, ours better.

CSR 286/14

CSR 286/14 SL

- 80286 Intel based microprocessor running at 14 MHz.
- 1 MB RAM expandable to 16 MB (8 MB on the system board).*
- Page mode interleave memory architecture.
- High speed VGA controller.
- Dual Diskette/Hard Disk Controller.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- Socket for Intel 80287 or Weitek math coprocessor.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 8 industry standard expansion slots.**
- Power reset switch.
- Security keylock.
- AMI bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

1 MB to 16 MB of high speed memory.
80287 math coprocessor.
Slim line case with one 5.25" and two 3.5" drive bays accessible.

NOTE: *Up to 8 MB in SL case. ** 5 expansion slots in SL case.

CSR 286/14 Hard Disk Drives	Monitors / Adapters Monochrome VGA Mono / VGA Color		
20 MB 90 MS ST-506	\$1,699	\$2,099	\$2,399
40 MB 40 MS ST-506	\$1,899	\$2,299	\$2,599
40 MB 22 MS ST-506	\$1,999	\$2,399	\$2,699
90 MB 18 MS ESDI	\$2,599	\$2,899	\$3,299
150 MB 18 MS ESDI	\$3,099	\$3,299	\$3,699

CSR 286/20 SL

CSR 286/20

- 80286 Intel based microprocessor running at 20 MHz.
- 1 MB RAM expandable to 16 MB (8 MB on the system board).*
- Page mode interleave memory architecture.
- High speed VGA controller.
- Track buffered high speed dual diskette/hard disk controller.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- Socket for Intel 80287 or Weitek math coprocessor.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 8 industry standard expansion slots.**
- 3 speed selectable 8 MHz, 16 MHz or 20 MHz speed.
- Power reset switch.
- Security keylock.
- AMI bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

2 MB to 16 MB of high speed memory.
30 MHz math coprocessor.
Slim line case with one 5.25" and two 3.5" drive bays accessible.

NOTE: *Up to 8 MB in SL case. ** 5 expansion slots in SL case.

CSR 286/20 Hard Disk Drives	Monitors / Adapters VGA Mono / VGA Color	
3.5" 1.44 MB Diskette Drive	\$1,999	\$2,299
10 MB 22 MS ST-506	\$2,599	\$2,799
60 MB 22 MS	\$2,799	\$2,999
90 MB 18 MS ESDI	\$3,499	\$3,799

CSR 386/20

- Intel 80386 Microprocessor running at 20 MHz.
- 1 MB RAM expandable to 16 MB on the system board.
- Page mode interleave memory architecture.
- Socket for 20 MHz Intel or Weitek math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Track buffered high speed diskette/hard disk controller.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- High speed 16 bit VGA controller.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 200 watt power supply.
- 8 industry standard expansion slots.
- Power reset switch.
- Security keylock.
- AMI bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

2 MB to 16 MB expansion memory options.
25 MHz Intel coprocessor chip.
Internal or external tape backup.

CSR 386/20 Hard Disk Drives	Monitors / Adapters VGA Mono / VGA Color			
	1MB RAM	4MB RAM	16MB RAM	32MB RAM
10 MB 22 MS ST-506	\$3,099	\$4,099	\$3,399	\$4,399
60 MB 22 MS	\$3,199	\$4,199	\$3,499	\$4,499
90 MB 18 MS ESDI	\$3,699	\$4,699	\$4,099	\$5,099
150 MB 18 MS ESDI	\$4,199	\$5,199	\$4,499	\$5,499
322 MB 18 MS ESDI	\$4,799	\$5,799	\$5,099	\$6,099

CSR 386/25c

- Intel 80386 Microprocessor running at 25 MHz.
- 1 MB RAM expandable to 16 MB on the system board.
- Advanced Autek Cache memory controller with 32K of high speed static RAM Cache.
- Page mode interleave memory architecture.
- Socket for 25 MHz Intel or Weitek math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Track buffered high speed diskette/hard disk controller.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- High speed 16 bit VGA controller.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 200 watt power supply.
- 8 industry standard expansion slots.
- Power reset switch.
- Security keylock.
- Award bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

2 MB to 16 MB expansion memory options.
25 MHz Intel coprocessor chip.
Internal or external tape backup.

CSR 386/25c Hard Disk Drives	Monitors / Adapters VGA Mono / VGA Color			
	1MB RAM	4MB RAM	16MB RAM	32MB RAM
90 MB 18 MS ESDI	\$4,799	\$5,799	\$5,199	\$6,199
150 MB 18 MS ESDI	\$5,299	\$6,299	\$5,699	\$6,699
322 MB 18 MS ESDI	\$5,699	\$6,699	\$6,099	\$7,099

To order, please call **800-366-1277**

CSR
Computer Systems Research
We build ours better.

NANOBYTES

Intel's Programmable Memory Operation (Folsom, CA) has developed a **4-megabit EPROM**, incorporating 4 million memory cells in a chip measuring just three-eighths of an inch on each side. Since developing the first EPROM in 1971, Intel has increased density of the chips by 2000 times, a company official said.

Rochester Institute of Technology (Rochester, NY) has established a center for the study of **electronic visual design**, geared toward graphics and industrial designers who use digital systems to do such things as animation, developing videodisks and interactive media, and other areas of endeavor.

The newest **still-video camera** from **Sony** (Park Ridge, NJ) uses two charge-coupled devices to handle information about an image's appearance. Sony says the new ProMavica MVC-5000 is the first camera of its kind to have one chip for chrominance data (color hues and levels of color saturation) and another one for luminance (related to contrast and definition). Images scanned by the electronic camera are saved in analog form on 2-inch floppy disks. Before you can manipulate the images digitally, you have to send them to a special Sony workstation. Prices for the ProMavica start at \$6495, which doesn't include a lens.

Tiara Computer Systems (Mountain View, CA) says its new LAN analyzer and diagnostics package, currently called "Network Inspector," will provide "60 percent of the functionality of the Sniffer [from Network General] for a fraction of the cost." The Network Inspector is expected to be available soon for around \$1000. It will have sophisticated functions such as cable break detection, single- and multinode addressing tests, and dynamic performance measurement (such as network loading measurement) with graphics. More unusual features include jabbering node detection and a software implementation of a time domain reflectometer, used to locate cable breaks, a Tiara official said.

applications on a network.

The Entryway software costs \$795 for a full development system and \$250 for a run-time version that you supply with a completed end-user application.

Poqet plans to provide Entryway in ROM on its hand-held computers, with the intention of building interfaces

between Poqet portables and home-office networks or database servers, Hiles said. Part of the company's strategy is to build software tools into the ROM of its portable computers, which could thus increase the performance and decrease the storage requirements of these small computing machines.

Can COBOL Be the Catalyst for OS/2?

Could COBOL help make OS/2 a big hit? That might sound a bit unlikely, but remember that there are probably more applications written in COBOL than in any other language. And now MicroFocus, an English company that carved its niche with a mainframe-compatible COBOL that runs on microcomputers under MS-DOS or OS/2, has designed a version of its COBOL/2 compiler that will include extensions for developing Presentation Manager (PM) applications in COBOL; those applications will comply with IBM's Systems Application Architecture. The PM extensions will let COBOL programmers embed the commands necessary to call the OS/2 Resource Compiler routines from the Presentation Manager Toolkit (e.g., routines for defining icons, and maximizing and minimizing windows).

With its PM extensions, MicroFocus claims to be the first firm to offer a programming language other than C that can write applications under OS/2 using the PM graphical user interface. This means that mainframe COBOL programmers will be able to write PM applications running on microcomputers, providing a graphical interface to

mainframe COBOL applications. Micro/Focus COBOL/2 can also call C and assembly language routines. According to one of the developers of COBOL/2, Raymond Obin, "COBOL can do everything you can do in C and assembler."

MicroFocus COBOL/2 comes with a programmer's toolkit that will allow use of dynamic segment swapping and dynamic linking, techniques that Borland recently claimed as breakthroughs with its VROOMM technology (see the August Microbytes, page 17). The COBOL/2 implementation of dynamic segment swapping allows applications that are 50 percent larger than available memory to execute with "negligible degradation," Obin said. The toolkit also allows COBOL applications to use extended memory when running under DOS.

The base COBOL/2 compiler is \$900. The toolkit, which also includes an editor and run-time utilities, costs an additional \$900. A complete workbench with an advanced source-level debugger, menu system routines, and mainframe programming tools costs an additional \$1800. Current COBOL/2 users will receive the upgrade free as part of their maintenance agreement.

OSF Seeking Shrink-Wrapped Unix Software

The key to the success of Unix and the Open Software Foundation's Motif graphical user interface will be determined by the number of shrink-wrapped software programs that will run on all versions of Unix, said OSF president and CEO David Tory. In an interview with Microbytes Daily after his keynote speech at Xhibition '89 recently, Tory was deliberately vague about when we can expect programs running under Motif. He said that "many developers are working on applications as we speak," but he

declined to give any numbers or an estimate as to when these products will be on the market. OSF, headquartered in Cambridge, MA, has so far issued 73 licenses for Motif, but company officials refuse to speculate on how many of those licenses will translate into Motif-compliant software packages.

Two current OSF Requests for Technology are crucial to the success of Motif and to the success of Unix in the 1990s, Tory said. One RFT is for

continued

Now any dBASE® user can do statistical analysis.



Introducing dBASE STATS™ for your personal computer.

dBASE® software makes your data organized and accessible. But now you can take your dBASE data a step further, using it in more meaningful ways to make your business more successful. With dBASE STATS, you can forecast sales revenue, analyze customers' purchasing habits, determine trends, and much more.

Two industry standards: dBASE software and SPSS/PC+

Based on SPSS/PC+ software, the PC standard for statistical analysis, dBASE STATS provides all the analytical tools you need to summarize, forecast and make sound business decisions with your dBASE data. It offers you a useful set of basic and advanced statistical procedures, including frequency tables, correlation, and regressions.

dBASE STATS is easy.

dBASE STATS contains help screens, a glossary, and a

menu to guide you through the program. It's easy because you use the same familiar keystrokes you use in the dBASE IV™ Control Center.

**Use as a stand-alone product,
or access from within dBASE software.**

dBASE STATS reads/writes dBASE III PLUS™ and dBASE IV files (.dbf files) directly up to 254 fields and a virtually unlimited number of records. Uses CHARTMASTER® to create graphs. Or outputs files in formats compatible with DRAW APPLAUSE™ Symphony and Lotus 1-2-3.

**See your dealer or call 1-800-234-TATE, Ext. 908
(1-800-234-8283).**

Or simply return the order form below. Call now, for the power to make your dBASE data more meaningful and persuasive.

YES, TATE PUBLISHING!

Send me _____ copies of dBASE STATS at \$99995 each today!

Check Format: 525" (9126-91020)
 35" (9126-92020)

Name _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone _____

SUBTOTAL _____

Sales Tax* _____

Shipping **\$4.50** _____

TOTAL _____

Form of Payment

Visa MasterCard American Express

Card #: _____ Exp. Date: _____

Signature _____ Date: _____



*Please add appropriate sales tax and allow 3-4 weeks for delivery.
NO RISK, 30-DAY MONEY BACK OFFER! For fast service, see your dealer or order toll free by calling 1-800-234-TATE (1-800-234-8283), Ext. 908. Call between the hours of 7 a.m.-6 p.m. M-F Pacific Time.

Or mail this order form to: Tate Publishing, A Division of Ashton-Tate, 20801 Hamilton Avenue, Torrance, CA 90502-1309

Providing productivity solutions from independent authors and developers.



Finally. An input device based on your input.



Introducing SummaSketch® II.

The new SummaSketch II tablets have been created with one thing in mind — you, the people who use tablets every day. You told us what you wanted in the ultimate tablet, and we put it all into SummaSketch II.

We kept all the features that have made SummaSketch the industry standard — features that have led to more SummaSketch tablets being used today than any other brand.



✓ The industry standard.

You said you wanted a complete plug and play package, not a basic tablet with a list of optional extras. So we're giving you the works — both in PC and Macintosh® SE and II versions. A 12" by 12" or 18" by 12" active area tablet; your choice of a four-button cursor and two-button stylus or 16-button cursor; utilities diskette and more. The PC version includes interface cables for the IBM® PC, PS/2, AT and compatibles, while the Macintosh version has a unique Apple® Desktop Bus interface device to connect the tablet to the computer.



✓ A complete plug and play package.

When asked about the one key benefit you look for in deciding on an input device, your answer was productivity. And SummaSketch II delivers.

Unlike a mouse, our stylus gives you a more natural "pen-to-paper" feel for free-hand drawing. Our 4- and 16-button cursors can be programmed to move you quickly through the most sophisticated software. For the PC market, we offer a free tablet template (US and Canada only) that puts hundreds of software commands in view . . . and at your finger tips. No need to memorize commands or scroll through two or three screen menus to use the functions you want.



✓ Push-button productivity.

IBM Compatible inquiries circle 276; MAC inquiries circle 277, and dealer inquiries circle 278 on Reader Service Card.



No tablet offers more software compatibility than SummaSketch. Our tablets work with over 250 PC programs and all Macintosh SE and II software written under the Apple Software Developers guidelines.

Since we are the standard, most competitive tablets offer software compatibility by emulating Summagraphics tablets (just look it up in their manuals). In fact, in a recent article comparing IBM PC version tablets, all nine competitive tablet manufacturers emulated Summagraphics in order to provide software compatibility.

But that's not all. Our PC version utility diskette also includes diagnostic test and reset software, an Autodesk® Device Interface™ driver, Universal Mouse Emulator™ and a Microsoft® Windows driver.



✓ The most software compatibility.

When it comes to digitizing, the one deciding factor every tablet buyer wants (and every tablet manufacturer touts) is accuracy. SummaSketch II tablets have an accuracy measurement of ± 0.015 inches. This figure is based on the average accuracy found over the entire SummaSketch II surface — not just a "sweet spot" found in the center of the tablet. And both the 4- and 16-button cursors come with an easy-to-view cross-hair sight for precise tracing.

SummaSketch II tablets also come with high proximity so you can trace from documents up to 1/2" thick. And selectable resolution of up to 1,016 lines per inch (or twice the degree of resolution needed for most graphics applications).



✓ High accuracy and control.

Add up all the benefits, then add in convenience features such as a power/proximity light, on-off switch, wedge shape design for easy use, lightweight construction for portability — and it's easy to see why SummaSketch has been, and will continue to be, the best selling tablet in the world.

Whatever the application — CAD/CAM/CAE, business or design graphics, animation, cartography, cost estimating and more — SummaSketch is the overwhelming choice of today's computer professionals. Simply stated, you can't go wrong or be "second-guessed" when you choose SummaSketch, which is why more people make that buying decision than any other.



✓ The choice of professionals.

The deciding question — price. Would you pay more to get a tablet that has everything in the box, that gives you the most software compatibility, a choice of cursors and includes added productivity tools?

That's the one decision you don't have to make, because SummaSketch II tablets come with everything you need, all at an affordable price. And that makes our new SummaSketch II tablets the easiest buying decision you have to make.

Why not find out more about SummaSketch II today? For literature and the name of a local dealer call 1-800-888-2028, Ext. 304. For technical information call 203-881-5400.



✓ Price/performance leader.



Summagraphics™

Every decision should be this easy.™

NANOBYTES

A Bay Area company is readying a new **sound and music board** for IBM PCs and compatibles that will provide stereo sound, voice synthesis, voice digitization, and even a MIDI port, all for less than \$200. **Brown-Wagh Publishing** (Los Gatos, CA) already makes a \$100 board called the Game Blaster that can output stereo sound and is supported by popular games from Sierra On-Line and others. The new Killer Kard will output stereo music and digitized sounds such as animal calls, voices, and special effects. It will also digitize sounds or speech input through a microphone, using direct memory access for speed and a proprietary compression algorithm to conserve RAM. The card has a host of interfaces, including a speaker connection (with a built-in amplifier powerful enough to drive room speakers), a microphone jack with amplifier, an analog joystick connector, and a MIDI interface for keyboards or instruments. The Killer Kard should be available in October.

A new adapter from **Ten X Technology** (Austin, TX) is designed to let most WORM drives connect to computers through a SCSI port. The Ten X OCU adapter makes the WORM drive appear to be a normal read/write device; this makes the WORM drive much easier to install and use.

Thomson-CSF, the gigantic Paris-based producer of military electronics equipment, said it will "standardize" its defense products on Motorola's **88000 RISC** processor. Motorola also granted Thomson the rights to manufacture a militarized version of the 88100 CPU, the 88200 memory management unit, and future components in the 88000 series. Motorola says that more than 50 companies are designing products based on the 88000. One of the latest computer designers to announce a computer built upon Motorola's RISC chip was **Bolt Beranek and Newman's** Advanced Computers subsidiary, which has developed a machine using more than five hundred 88000 processors.

an Architecture Neutral Distribution Format, which would allow software developers to write a single version of their Unix program that, theoretically, would run on most of the 200-plus existing versions of Unix. The other RFT is for a method of standardizing distributed processing—an interface between application programs and network protocols, device drivers, and kernel code.

A few technical details of Motif have yet to be ironed out, Tory said, including a final decision on which imaging model to use; the imaging model handles the way in which fonts and graphics are put on the screen. Motif currently uses a component of MIT's X Window, but it's not clear what the finished Motif will use. Tory called Display PostScript "excellent technology" but admitted that Adobe's refusal to hand over its source code to OSF has made Display PostScript somewhat less appealing.

An official of AT&T-backed Unix International, which is developing its own Unix user interface called Open Look, said recently that AT&T would support development of a common application programmer interface for both Open Look and Motif. Such an

API would theoretically make it easier for developers to write applications that would work in both environments. The OSF can't get behind this idea, however. Donal O'Shea, OSF vice president of operations, dismissed the proposed API as an attempt to "confuse the issue." He said Motif "clearly is the winner in this race." When asked why developers should write programs for OSF/1, the OSF's forthcoming version of Unix, when AT&T's System V is a composite of earlier versions, Tory said that OSF will be providing a "nonproprietary solution."

Motif consists of components from several leading companies in the computer industry. DEC provides the library of graphical tools and presentation description language; Hewlett-Packard provides the window manager; and Microsoft, which is not an OSF member, gives it all the "look and feel" of Presentation Manager.

OSF officially offered Motif to "the industry at large" in July and planned to release the "fine-tuned" version 1.0 in late August, a company official said. Cost of a binary license now ranges from \$40 down to \$10, depending on the number of copies.

Group to Start Testing 88000-Based Software

The 88open Consortium has established a technical center (in San Jose, CA) devoted to developing binary compatibility standards for the Motorola 88000 RISC processor. The basic set of compatibility tests will be ready this month, said 88open official Roger Cady.

The 88open Consortium began operating last November; original sponsors include Sanyo/Icon, Motorola, Data General, NCR, Opus Systems, and Dolphin Server (a subsidiary of Norsk Data). As part of its "software initiative," the collective is hoping to attract developers to write programs for the 88000 RISC platform. Ryan McFarland, Quadratron Systems, Accler8 Technology, Statware, UniPress, and Olympus Software are among the companies that have said that they will develop 88000-compatible applications.

To back up its promises of binary compatibility, 88open recently demonstrated a series of public domain Unix applications running on four different 88000 platforms: Data

General's Aviiion, Opus Systems' Opus 8000 board for the PC AT, a Motorola VME-based 88000 system, and the Sanyo/Icon 88000 machine. Each system was equipped with a QIC-format tape drive, and it was possible to swap the applications between the systems. The 88open compatibility standard defines a data format for floppy disks and QIC tape.

Notably, the demonstration involved only simple text-based applications and no graphics programs. While 88open's plan for "plug and play" software applications looks promising, the big question is whether all the vendors can agree on graphics standards. The same problem applies to OSF's goal for shrink-wrapped software. While both 88open and OSF have specified X11 as the windowing standard, it is unclear what imaging model will be standard (the imaging model defines the text fonts, icons, and other graphical images that appear within the window). For example, DEC, which is a major OSF player, is

continued

IBM PRESENTS
THE SOLUTION TO THAT
AGE-OLD BUSINESS
QUESTION.

"When Fosberry said a PS/2 with Micro Channel would let him juggle ten things at once and still have time to break for lunch, he meant it."



How're you going to do it?

These days, no matter what size your company, you've got to be able to keep a lot of balls in the air to stay competitive.

The Genius Of Micro Channel. Which is why IBM developed the Personal System/2[®] with Micro Channel[™]. Micro Channel can support multiple operating microprocessors. So you can, for example, separately manage peripherals, while freeing up the main processor to crunch numbers. A bus master can even be sending a fax while another manages traffic on a network, all with greater reliability.

Naturally, every PS/2[®] with Micro Channel runs DOS and OS/2[™]. So with OS/2 Presentation Manager[™], you can do multiple tasks concur-



PS/2 it!

rently, all with an easy-to-use graphical interface. What's more, with Micro Channel, there are no DIP switches to set, for simpler, more reliable installation. You can find and reset cards anywhere in the network—right from your desk!

The Solution Is IBM. So, to manage lots of information, jobs, hardware and software, invest in the PS/2 with Micro Channel. Contact your IBM Authorized Dealer or IBM marketing representative. For a dealer near you, call 1 800 IBM-2468, ext. 142. You'll learn there's almost nothing you can't do if you PS/2 it!



NANOBYTES

Roland (Los Angeles), famous for its electronic music instruments, has a new device that one company representative said is "really a 3-D plotter." Actually, the CAMM-3 is a **computer-controlled miniature machining tool**. You can use AutoCAD to design something in three dimensions, then attach the CAMM-3 to your computer's parallel or serial port, and clamp a block of plastic, wax, wood, aluminum, or brass in place, and the CAMM-3 will carve out your design. At \$14,500 it's a little more expensive than the average PC plotter, though.

Autodesk (Sausalito, CA) has given "technology demonstrations" of a work-in-progress at the Autodesk Research Lab. "Cyberspace" uses a head-mounted display with separate LCD screens for each eye, a head-tracking device that changes the display with head movement, and a Dataglove for reaching into the display. It's not a product yet, but Autodesk insists that this is where CAD is going. The company also announced new versions of AutoCAD: One uses the Phar Lap 386 DOS extender and is supposed to be available by the end of the year and cost \$3000; another is AutoCAD OS/2, which will run under Presentation Manager and is slated to be available in the fall.

GUIs are the equivalent of "hanging a big rock over the head of character-based DOS," said Bobby Orbach of 47th Street Computers, one of the nation's largest dealers, at a recent panel discussion. He called DOS extenders "life extenders," and said that from a dealer point of view, "Macintosh and DOS are the only stable operating systems."

It was a comparison that almost every citizen in New England could understand. Lotus CEO Jim Manzi told company shareholders that during the long, fabled time between 1-2-3 release 3.0's announcement and actual shipping dates, the company had become "the moral equivalent of the Boston Red Sox."

using Display PostScript as its imaging model. Other OSF members are currently either undecided on an imaging model or using the limited font set that comes with X Window.

Until a standard imaging model exists, it will be impossible to simply run applications out of the box on a variety of systems. Application developers will have to write separate versions of programs for separate

imaging models. That's exactly what Frame Technology has done with its FrameMaker desktop publishing program. The company has written separate versions for Display PostScript systems, Sun's X11/News system, and the X Window-based imaging model from MIT. An engineer at Frame said that most of the porting time between systems involves converting the imaging model.

User Group to Vendors: Try a Little Friendliness

Some companies are better than others at working with the very people who provide them with their revenue—the users. According to members of the Intergalactic Users Group, those companies are Apple Computer, Acius, Borland International, Intel, and Microsoft. At the second Intergalactic Users Group Officers Conference in New York City recently, representatives from nearly 100 of the country's most active computer users groups awarded certificates of appreciation to those five companies for their efforts in working with users groups.

As for other companies in the computer industry, too many of them

still need to be educated about the value of users groups, said Jerry Schneider, executive director of the Association of PC Users Groups. "They have this stereotype that we are a bunch of teenagers making copies of software," he said.

Schneider said that one study noted that more than 60 percent of future computer hardware and software sales will be to individuals and companies with fewer than 50 employees, rather than to the Fortune 500 firms that many computer companies seemingly envision as their customers. "Users groups provide the way to reach that 60 percent of future customers," Schneider said.

Microsoft Joins SQL Tool with Excel

Microsoft is now offering a Windows-based Structured Query Language query tool as a component of the DOS version of the Excel spreadsheet program. The Q+E (for Query and Edit) system works only with dBASE database files (DBF files).

Q+E, developed by Pioneer Software (Raleigh, NC), appears as a series of additional menu choices in Excel's Data menu selection. Adding Q+E to Excel involves a simple setup procedure when you install the spreadsheet program. Q+E is also a stand-alone product that runs under Microsoft Windows and can exchange data with any Windows application.

The Q+E facility allows you to graphically query and perform relational operations on DBF-type files and bring the data into an Excel spreadsheet. For example, you could open multiple files in multiple windows and simply click on the columns needed in a relational join. Using Microsoft's Dynamic Data Exchange feature in Windows, links between Excel and the database accessed by Q+E are maintained, so the Excel spreadsheet is updated if you make changes to the database.

Programmers can also use Q+E to embed SQL query commands into Excel spreadsheet cells.

NEWS STAFF SEEKS NEWS. DIAL (603) 924-9281.

The BYTE news staff is always interested in hearing about new developments that might affect microcomputers, the way they work, or the way people work with them. If you know of a project that could shape the state of the art, please give us a call at (603) 924-9281 or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.

Without Teamwork[®] on your PS/2,



your development teams will never shift into high gear.

Now you can speed up the performance of your entire work group with a true multi-processing development environment for OS/2. Teamwork is the first CASE toolset to support OS/2 software developers. So if you've been driving DOS-based CASE tools and you're ready for workstation power, get ready to fasten your seatbelt.

The intuitive graphic user interface and the advanced multi-window, multi-tasking capabilities of Teamwork immediately improve individual and team productivity. Each developer creates, edits, and inspects multiple design views simultaneously with simple point and click operations. Teamwork fully integrates graphics and data for structured analysis, data modeling, real-time analysis, and structured design models. Rigorous support of standard methods, complete syntactical checking and balancing assure system quality.

Teamwork's own configuration management and project status help manage and control even your largest projects. Projects can be partitioned to allow parallel development by multiple analysts and designers. The project manager controls the process by the baseline, merge, and reconcile features of Teamwork.

If you're just getting started with CASE tools, Teamwork/PCSA is a DOS-based structured analysis tool that can also run on your PS/2. As your projects grow, Teamwork/PCSA gives you an easy migration path since it is fully compatible with Teamwork for OS/2.

Thousands of developers with applications ranging from financial to avionics already rely on the power of Teamwork. In fact, Teamwork is the world's leading workstation-based CASE toolset.

Cadre's hotline support, maintenance services, excellent documentation, and effective educational offerings make sure you get started right on the right track. That's all a part of Teamwork.

Call (401) 351-CASE

If you're ready to shift into high gear, then you're ready for Teamwork. Anything less, just won't meet your standards.

CADRE

Cadre Technologies Inc.
222 Richmond St.
Providence, RI 02903

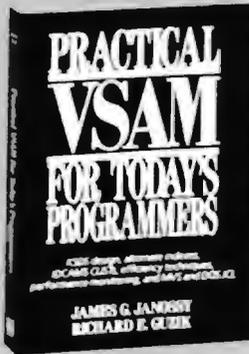
As your introduction to
**The Library of Computer
 and Information Sciences...**

Take Any 3 Books

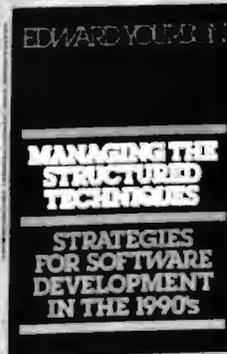
(Publishers' prices shown)



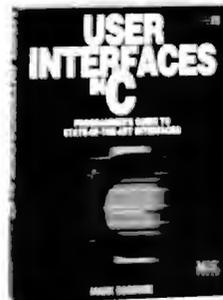
54434 \$32.00



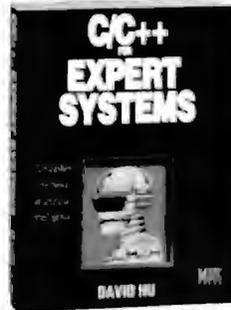
69959 \$29.95



60395 \$35.00



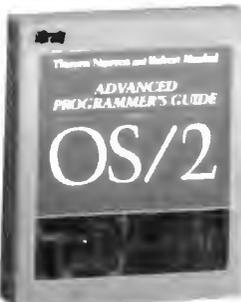
85624 \$24.95



37161 \$24.95



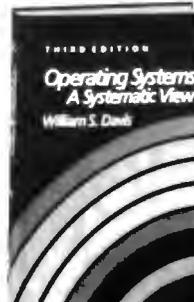
42044 \$31.00



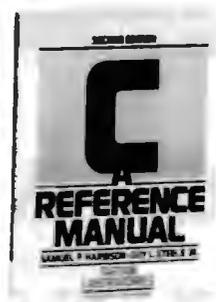
32264 \$29.95



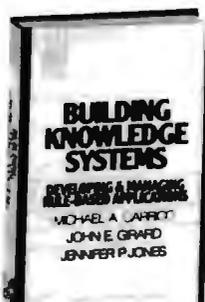
56530 \$32.00



66004-2 \$46.00
 (Counts as 2 choices)



37177 \$24.95



36956-2 \$39.95
 (Counts as 2 choices)



39984-2 \$40.95
 (Counts as 2 choices)



42270 \$27.95



41652-2 \$37.50
 (Counts as 2 choices)



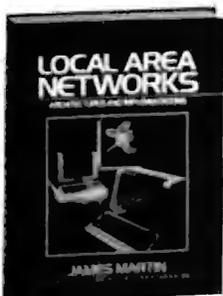
43935 \$24.95



62880 \$34.00



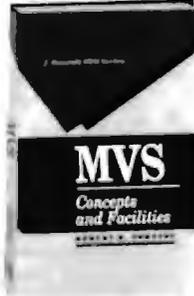
70674 \$24.95



58751-2 \$40.00
 (Counts as 2 choices)



81670 \$31.00



63276-2 \$39.95
 (Counts as 2 choices)



60362 \$20.33



79162-2 \$44.95
 (Counts as 2 choices)

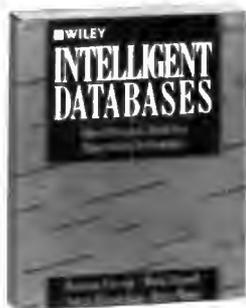


69939 \$35.00

For Only \$1.00 Each

values
to
\$105⁰⁰

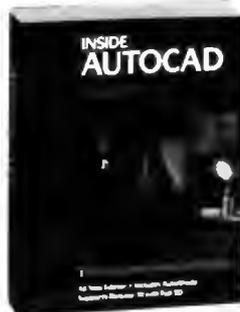
You simply agree to buy 3 more books—at handsome discounts—within the next 12 months.



55826 \$24.95



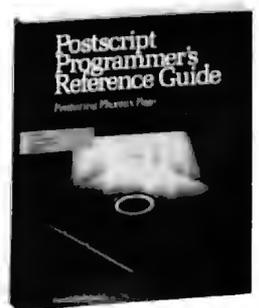
57767 \$24.95



55504 \$29.95



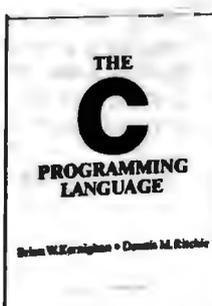
74779 \$24.95



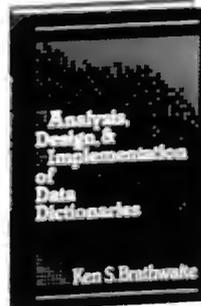
69621 \$24.95



70686 \$32.95



37206 \$27.00



33413-2 \$39.95
(Counts as 2 choices)



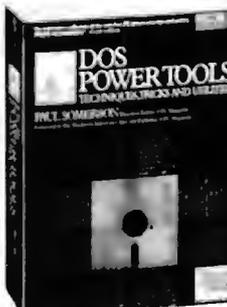
39823 \$22.95



41648-2 \$49.00
(Counts as 2 choices)



41624-2 \$39.95
(Counts as 2 choices)



67521-2 \$44.95
(Counts as 2 choices)



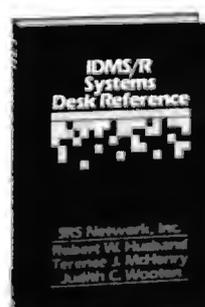
59862 \$22.95



32288 \$29.95



34040-2 \$39.95
(Counts as 2 choices)



54566-2 \$39.95
(Counts as 2 choices)



80769 \$35.00

4 Good Reasons to Join

1. The Finest Books. Of the hundreds of books submitted to us each year, only the very finest are selected and offered. Moreover, our books are always of equal quality to publishers' editions, *never* economy editions.

2. Big Savings. In addition to getting 3 books for only \$1.00 each when you join, you keep saving substantially, up to 30% and occasionally even more. (For example, your total savings as a trial member—including this introductory offer—can easily be over 50%. That's like getting every other book free!)

3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of 65% off the publishers' prices.

4. Convenient Service. At 3-4 week intervals (16 times per year), you will receive the Library of Computer and Information Sciences News, describing the Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection, do nothing, and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

If reply card is missing, please write to The Library of Computer and Information Sciences, Dept. 7-FG3, 900 Chester Avenue, Delran, NJ 08075, for membership information and an application. Byte 9/89

How To Write Bug-free Code

Jerry Pournelle says, "It has already saved me several hours, and I haven't had it a week. Highly recommended." (Chaos Manor, BYTE, March 1989)

"Deep bugs", the kind that show up after you deliver the program, are usually the result of logic flaws. Such bugs include redundancies, contradictions, unique conditions without specified actions, etc.

Logic Gem, a proven programmer's tool, helps you avoid these bugs in three ways:

- ◆ Catches logical errors before you code the program. Saves hours of debugging time.
- ◆ Automatically generates flawless code for the "guts" of your program... in C, BASIC, Pascal, FORTRAN, and dBASE.
- ◆ Automatically produces written documentation of your logic, which insures good communications between designer and coder. (And helps remind you of the logic from one work session to the next.)

Logic Gem works with whatever compiler you are using. The only change: with Logic Gem you catch and correct the logic bugs before you write the program.

Avoid hours and days of needless debugging time. Call 1-800-722-7853 now for details about Logic Gem. Or put Logic Gem to work for you immediately: Order a copy (it costs only \$99) and use it for 90 days at our risk. You can return it for any reason within 90 days for a complete refund.

Sterling Castle, Inc.
702 Washington St. #174
Marina del Rey, CA 90292
1-800-722-7853
1-800-323-6406 (in CA)
1-213-306-3020
1-213-821-8122 FAX



Download demo
(213)453-7705 • 3/12/24,8,N,1

LETTERS

and Ask BYTE

Suggestion Box: Mac OS

"The Mac Interface: Showing Its Age" by Don Crabb (Macintosh Special Edition, June) made some very good points, particularly that the lack of genuine multitasking on the Macintosh should be an embarrassment to Apple Computer.

While I believe that some of Crabb's suggested "improvements" would be frivolous rather than functional, multitasking and a command-line interface for those who want to use it should be high on Apple's list of priorities. On the other hand, I'm not going to hold my breath waiting for these capabilities.

I use a Mac II at my office, but when I decided to buy a new machine to use at home, I selected the Amiga 2000 precisely because it offered both of those utilitarian features. Perhaps Crabb should try an Amiga.

On the matter of Apple's "look and feel" legal claims, I must take issue with the views expressed in Crabb's article. The Macintosh user interface did not originate at Apple Computer, and Apple should not be permitted to make any claims against other "similar" products based on that supposition. Xerox was the originator of the windowed mouse-and-icon environment. No doubt the original designers of that system are amused by the pretensions of Apple's lawyers.

It is a serious defect of our legal system that it permits patent and copyright claims to be awarded based on the "earliest filing date" rather than the actual date of creation. I hope Apple's spurious claim will be struck down eventually by some sensible judge who believes in the

spirit of the law rather than merely the words on the page.

Gary Lee Phillips
Chicago, IL

Ackerman Function Revisited

Alf P. Steinbach (Letters, April) elegantly solved Christopher Greaves's challenge to show the value of Ackerman(5,5). Unfortunately, Steinbach's generalization about operations is wrong. He showed that the Ackerman function is a variation on $x \text{ op}_m y$, where op_1 is addition, op_2 is multiplication, op_3 is exponentiation, and op_4 is the next step above exponents. In other words,

$x \text{ op}_3 y = (((x x) x) x) \dots x$] y repetitions of x

and

$x \text{ op}_4 y = (((x^y)^2)^2) \dots x$] y repetitions of x .

Some interesting observations arise for operations above addition (for m an integer, $m > 1$):

$$\begin{aligned} x \text{ op}_m 1 &= x \\ 1 \text{ op}_m x &= 1 \\ 2 \text{ op}_m 2 &= 4 \\ x \text{ op}_m 2 &= x \text{ op}_{m-1} x \end{aligned}$$

I take exception to the general equation

$$x \text{ op}_m y = x \text{ op}_{m-1} (x \text{ op}_m (y-1)),$$

which has the effect of collecting parentheses of an expansion to the right. This is true for op_2 and op_3 , because the expansions are commutative. Close inspection of the concepts of "operation" and "number" leads to the conclusion that these expansions of parentheses (i.e., order of operation) must collect to the left. This leads to a different general equation for higher operations ($m > 1$):

$$x \text{ op}_m y = [x \text{ op}_m (y-1)] \text{ op}_{m-1} x.$$

Jeremy Broner
Palo Alto, CA
continued

WE WANT TO HEAR FROM YOU. Please double-space your letter on one side of the page and include your name and address. We can print listings and tables along with a letter if they are short and legible. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Because of space limitations, we reserve the right to edit letters. Generally, it takes four months from the time we receive a letter until we publish it.

WHEN YOU NEED YOUR DESK FOR MORE THAN JUST A COMPUTER...

NETWORLD 89
September 12-14, Dallas Intermet
Booth 2266



Introducing Emerald's LANstation I.

The LANstation I, a 286 diskless workstation, delivers lightning fast performance, an ultra-small footprint, dazzling EGA video display, and compatibility with any network card or operating system at an affordable price.

Emerald has incorporated the latest technologies in every feature to eliminate the typical space, noise, heat and security problems that plague standard PCs on a network.

Design experts agree . . .

. . . that the LANstation I is the finest example in functional ergonomic design. International Design Magazine said "products like yours express the leading edge of contemporary design."

Emerald provides the best warranty program in the industry. 48-hour repair or replace, guaranteed—at no charge!

For more information on the latest in diskless workstation technology contact your Emerald Computers marketing representative at (800) 321-5711.



\$2,195.
Suggested List for 12 MHz 286



EMERALD COMPUTERS, INC. COMMERCIAL PRODUCTS GROUP
7324 SW Durham Road Portland, Oregon 97224
(800) 321-5711 (503) 620-6094 FAX: (503) 639-7932



Circle 105 on Reader Service Card

Optimizing Compilers

The past few years have seen a lot of activity in the development of optimizing compilers. Unfortunately, most of these compilers are doing the wrong optimizations.

Compilers should optimize those things over which the programmer has no control, not trivialities that can easily be expressed in the source language. Examples of such useless optimization include common subexpression elimination, loop invariant removal, and loop unrolling. There is no point in developing a program to recognize situations that could benefit from these techniques because they are all common sense—any programmer other than a complete novice should automatically write code that cannot be optimized by such basic mechanical analysis.

There are many useful optimizations that should be performed that cannot easily be accomplished by simple local source code rearrangement. These include in-line expansion of functions called only once and reorganization of program routines so that functions that often call each other are closer together,

so shorter call instructions can be used.

Optimization shouldn't compensate for sloppy programming. Optimizing compilers should try to generate the best possible code for a program *the way it was written* and not try to analyze whether the program could have been written more efficiently. There's no sense in developing huge, complex programs to do what can already be done simply.

James Hague
Richardson, TX

Amiga Graphics Set Right

I am writing in regard to "Variations on a Screen" by Phillip Robinson (Graphics Supplement, April).

I was offended that the IBM PC and Mac screen shots were both of professional applications, while the Amiga screen shown was that of a game. There are many professional applications on the Amiga for desktop publishing, two-dimensional and three-dimensional rendering and animation, word processing, spreadsheets, video titling, synthesizer programming and control, terminal emulation, image processing, and so forth. Why not show the interfaces of one of

these if you couldn't use Amiga artwork?

By the way, why didn't you mention what system produced the ray trace on the cover of the supplement? Could it have been an Amiga?

I also take issue with the statement that "Because these chips [the Amiga's custom graphics, data movement, and audio processors] can handle video information while the main CPU is working on other tasks, the Amiga has a degree of 'multitasking'—the ability to handle more than one job at a time." The custom chips give the Amiga a degree of *parallel multiprocessing*. Multitasking is an attribute of an operating system, not of hardware. Of course, the Amiga's operating system has more than a "degree" of multitasking, with both large- and small-grain multitasking, priorities, interrupts, message passing, and shared program libraries.

Robinson's categorization of the possible Amiga display resolutions is incorrect. The resolutions mentioned are the nonoverscanned resolutions; for each of 320 by 200 pixels, 320 by 400 pixels, 640 by 200 pixels, and 640 by 400 pixels,

continued

This Should Go On Your Desk For The Same Reasons It Goes On The Road.

Remember when sending a fax meant leaving your desk? Or when faxing on the road was almost impossible?

Those days are over. Introducing the WorldPort 2496™ portable fax and data modem.

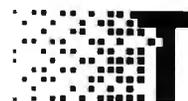
Since it's external to your computer, it's easily shared around the office. And since it's battery powered and uses RJ11s or optional acoustic couplers, it connects to public phones and PBXs anywhere. Via Bell and CCITT standards worldwide. It even sends and receives fax and

data messages unattended or while you run applications.

But best of all, from your desktop or laptop, you can instantly connect with practically anyone anywhere who owns a fax or modem.

Unless, of course, they've ventured out on the road without one.

Call us today at 800-541-0345 (in New York, 516-261-0423) for more on the WorldPort line and the dealer nearest you.



Touchbase Systems, Inc.
160 Laurel Avenue
Northport, NY 11768
(516) 261-0423
Fax (516) 754-3491

WorldPort 2496 is a trademark of Touchbase Systems, Inc., © 1989 Touchbase Systems, Inc.

Now there's a battery-powered 286 with the one feature you've been waiting for.



That little package you've been expecting from us has just arrived.

The new Toshiba T1600. The fastest battery-powered portable computer we've ever made.

It packs a powerful 12MHz 286 microprocessor. One full megabyte of RAM that's expandable to 5MB. Plus a fast 20MB hard disk.

Equally impressive is its 144MB 3½ inch diskette drive, detachable, backlit EGA-compatible display and two expansion slots for access to an internal modem, LANs, mainframes and much more.

But at a total weight of under 12 pounds, the T1600 is bound to spend a lot of time *outside* the office. Which is why we added some other important features.

Like AutoResume, which lets you restart your work wherever you finished. And space for two removable, rechargeable battery packs no larger than the palm of your hand.

All of which makes one thing about the T1600 unmistakably clear.

It was definitely worth the wait.



T1600: Battery-powered 80C286/12MHz, 20MB hard disk at 27msec, 144MB 3½" diskette drive, 1MB RAM expandable to 5MB, detachable backlit EGA-compatible LCD, removable rechargeable battery pack, coprocessor socket, 7 standard interfaces, 2 expansion slots for general purpose options. For information call 1-800-457-7777. Toshiba PCs are backed by the Exceptional Care Program (enrollment required).

In Touch with Tomorrow
TOSHIBA

Toshiba America Information Systems, Inc., Computer Systems Division

Circle 329 on Reader Service Card (DEALERS: 330)

there are corresponding overscan resolutions, nominally 352 by 262 pixels, 352 by 524 pixels, 704 by 262 pixels, and 704 by 524 pixels. These overscan resolutions are another good reason to use the Amiga in video work, because overscan is required to properly fill a video screen. Note that the Hold and Modify (HAM) mode can be used in any low-resolution mode. Note also that all these resolutions can be displayed simultaneously, through the use of multiple,

slidable intuition screens.

The statement that video RAM is separate from system RAM is not correct—at least not if Robinson is speaking of what is known on most systems as a frame buffer, the area of RAM reserved for the displayed images. In the case of the Amiga, the bit maps for graphics must be located in the lower 512K bytes (1 megabyte in newer machines) of system memory, as must audio waveforms, disk I/O buffers, and any other data to be

accessed by the custom chips. There is no limitation on what else can be kept in this lower area of memory—programs, data stacks, and so forth are perfectly acceptable. In fact, while it cannot multi-task more than a couple of large Amiga applications (or five to eight smaller ones), a 512K-byte Amiga is perfectly capable of running programs and displaying graphics simultaneously.

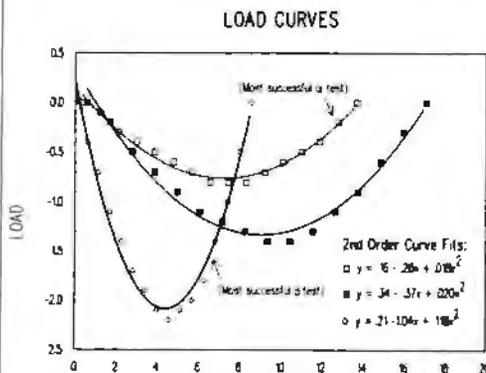
The statement that the custom chip can manipulate five bit planes is misleading. The Amiga hardware reference manual does not mention such a limitation. In fact, HAM-mode images use six bit planes, and they're easily manipulated using a blitter and the Copper.

The statement that the next release of Denise will incorporate a 64-color screen mode is misleading. Except for the earlier Amiga 1000s, almost all Amigas can already use extra halfbrite mode. Another statement, that the Amiga's smaller market share has led to a smaller library of programs, is also misleading. Both the Mac and the IBM PC have been around for more years than Amiga. Remember, more than 1 million Amigas have been shipped. This is a number to reckon with, and it will continue to grow.

Also, despite Robinson's statements to the contrary, the Amiga comes with more standard simultaneously displayable colors than the Mac II (4096 as opposed to 256). And for less than a third of the price of a Mac II, that doesn't seem a bad buy. But even if the Amiga had fewer colors, it seems contradictory to say in one sentence that "The Amiga has also fallen behind the Mac II in the sheer number of colors that can be displayed on the screen—and so is less competitive as a design and industrial or business graphics tool," and then in the very next sentence to say, "The Amiga's real strength is shown in pure graphics tasks such as games, animation, and video work." After all, what requires more realistic rendering capability—CAD and business graphics, or video painting and animation? It should be obvious that Robinson is indulging in some wishful thinking in this case.

Mark Cashman
Windsor, CT

Engineers and Scientists Found Plotting Behind Businessmen's Backs!



with
**TECH*
GRAPH*
PAD...**

Plotting and graphing software for engineers and scientists.

100% LOTUS Compatible

Still trying to get engineering & scientific graphs from spreadsheets or business programs? If so, you need **TECH*GRAPH*PAD**, the industry standard technical graphing & plotting software for engineers & scientists. Directly reads data from Lotus 1-2-3 worksheets, other spreadsheets, & most data acquisition hardware & software. **GUARANTEED** easy-to-use or your money back!

According to PC MAGAZINE, "TECH*GRAPH*PAD is fast, easy-to-use, and produces good-looking output."



- X-Y, Semi-log, Log/Log, Polar Plots
- Curve Fitting • Data Smoothing
- Full control of Labels & Scale
- Independent X-Y Axes ; Dual Y Axes
- Error Bars • Greek Letters • Symbols
- Laser Printer, Plotter, Printer Output
- IBM PC/XT/AT, PS/2, Apollo, DEC compatible

CALL for FREE Demo Disk

(617) 290-5900

Dealer Inquiries Invited;
International dealers fax (617) 890-1340

binary engineering

400 Fifth Ave. • Waltham, MA 02154 • Tel: (617) 290-5900 • Fax: (617) 890-1340

Software Despotism

Like Ezra Shapiro ("Software Despotism: Truth and Fiction," May), I have felt the pressure to conform to computer software that I didn't like simply because the boss wanted everyone to standardize. Of course, the software of choice is what the boss wanted to use, not what any of

continued

Faster computers sooner... from FORTRON.



NetSet™ 286
12, 16, 20 MHz

NetSet™ 325, 333 Desktop or Power

Desktop 286 or 386
12, 16, 20 MHz

As fast as products are designed, that's about how fast you can get them from Fortron. In early 1987 we were one of the first to ship an Intel 386™ based personal computer.

Now we're ready to dazzle you with speed again: the NetSet™ 325 and NetSet™ 333 personal computers, based on Intel 386™ 25 MHz and 33 MHz microprocessors. Designed for optimum performance of CAD/CAM, UNIX, XENIX, and network server applications.

Like all our other personal computers, these come with **one full year of service, free, at your site (USA)**. We're that sure of the reliability. And because we manufacture the computers ourselves, right here in California, you know exactly who to call with any technical questions; and if they do need service, we can fix them fast. **Speed, service, and savings. That's Fortron.**

BASIC SYSTEM PRICES START AT:

NetSet 286-12	386-16	386-20 Plus	NetSet 386-325	NetSet 386-333
\$995	\$1950	\$2400	\$3290	\$5450
512K	2MB	1MB	1MB	4MB

To Order Call Toll Free
1-800-821-9771

In CA 415-373-1008

Leasing Program Available
International Distributors Wanted

386™ is a trademark of Intel Corp.
NetSet™ is a trademark of Fortron/Source Corp.

FORTRON

Fortron/Source Corp.
6818-G Patterson Pass Road
Livermore, CA 94550
Tel: 415-373-1008
FAX: 415-373-1168 TELEX: 559291

- Please have a sales representative call me.
- Please send me more information.
1. I am most interested in
A. 286-based systems
B. 386-based systems
2. I am a
A. End User
B. VAR
C. Corporate Purchaser
D. DP/MIS.

Name _____

Title _____

Company _____

Address _____

City _____

State _____

Zip _____

Phone No. _____

9/89

the rest of us liked.

I work in a U.S. government laboratory, and most of our computer work is word processing, which we do periodically. For some years now, my personal favorite has been Microsoft Word, especially because of its excellent editing control via the mouse. But my supervisor demands that we all write with WordPerfect, whether we know how to use it or not. I'm not smart enough to remember both sets of commands at the same time, so I decided to switch to WordPerfect to make it easier on myself.

It really hurt a few weeks ago when I tried to go back to Microsoft Word and found that I couldn't remember the codes anymore. By then, I'd learned about exporting foreign file formats, but I figured, why bother? To add insult to injury, we are now doing collaborative work with another laboratory that uses Microsoft Word exclusively. After final editing is complete, I convert the finished files into Microsoft Word for the other laboratory.

Michael D. Kawalek
Corvallis, OR



ASK BYTE

Failing Memory

In November of 1988 I upgraded from an Atari 800 to a 10-/12-MHz AT with 512K bytes of memory. I bought the machine from American Semiconductor of Tampa, Florida. The clock wouldn't hold the time and date, so I returned the system and received in exchange an 8-/12-MHz baby AT board with only 1 megabyte of memory available on the motherboard. (The original machine could accept up to 4 megabytes on the motherboard.)

After four more motherboard replacements—due to various failures—the company told me that I had to take back the baby AT board, like it or not. The person I contacted also told me that it's cheaper and better to get a memory card.

I have read that memory on the motherboard is faster. Also, I can't afford to lose an expansion slot.

I would appreciate your opinion on this situation.

Tony D. Kyritsis
Ft. Lauderdale, FL

Motherboard memory is generally faster. If the memory chips have low enough access times, the CPU can access them at

up to the CPU clock rate, rather than the (usually slower) bus speed. Card-based memory could be as fast, or faster, if the motherboard memory requires a few wait states or the bus speed is cranked beyond the standard 8 MHz.

If the machine inserts wait states, don't expect 12-MHz performance. If the bus runs faster than 8 MHz, expect compatibility problems with I/O cards built for the standard AT bus.

Perhaps most important, you have the right to get what you ordered. If your original order explicitly requested the machine with a 4-megabyte memory capacity, a vendor can't force you to accept another product.—S. A.

Protection, Please

I have a compact-size Seagate ST-225 hard disk drive on my AT clone. I would like to install a write-protect switch or at least devise foolproof write protection in software. Is there any way to do this?

Louis Robichaud
Montreal, Quebec, Canada

The hard disk drive you refer to is connected to the standard AT disk controller through two cables. One is a 34-pin control bus that normally has connectors for two drives. The other is a smaller cable that passes raw data to or from the disk controller. The 34-pin cable handles all the command and status communications between the disk and the controller; it's the cable I'll focus on.

Pin 6 is a signal called -WRITE GATE, which goes from the controller to the drive and tells the drive when to enable writing. Normally high, the signal goes low whenever the controller wants to write data to the drive. Pin 12 is -WRITE FAULT, which goes low only when the drive cannot perform the write operation and needs to inform that controller that a catastrophic failure has occurred. One way to write-protect a drive is to prevent the -WRITE GATE from getting through to the disk and simultaneously fool the controller into thinking that the write operation has failed.

You'll want to find a spare disk cable, a double-pole, double-throw toggle switch, and a good hobby knife. Identify lines 6 and 12 in the larger 34-pin cable. Carefully split along the sides of the two lines about an inch or so somewhere between the controller side and the first drive connector. Having isolated the two lines, cut them in half, separating the drive side from the controller side. Connect the switch as shown in figure 1. If you choose to mount the switch on the back of your microcomputer, use some

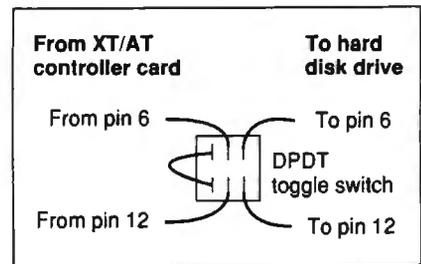


Figure 1: Switch-wiring diagram for write-protecting a hard disk drive.

longer wire as necessary, but keep the cable lengths to a minimum.

Turn off the computer and exchange your modified cable for the one in the machine. Try copying files with the switch in each position. The write-protected mode will cause a "general failure" message during writes because of feedback from the -WRITE GATE, to the -WRITE FAULT.—H. E.

Breaking the 32-megabyte Barrier

I have an 80286 PC clone with a 40-megabyte hard disk drive, 640K bytes of RAM, cache memory, and VDisk. What would be a good interim solution for breaking the 640K-byte RAM and 32-megabyte disk barriers until OS/3 (or whatever they'll call the 80386 version of OS/2) is available? When OS/3 shows up, I'll probably buy an 80386 machine.

Kenneth L. Dunn
Olmsted Falls, OH

I've heard this question numerous times (see "Breaking the Barrier" in the May Ask BYTE), and the answer always depends on what you're doing with your microcomputer.

If you need DOS, the surest way to break the 32-megabyte disk barrier is with DOS 4.0 (see "PC-DOS: Pulling Out the Stops," June BYTE). But if you're not tied to DOS, you can solve both memory and disk restrictions by installing Unix on your machine. The Santa Cruz Operation (400 Encinal St., P.O. Box 1900, Santa Cruz, CA 95061, (800) 626-8649) markets an 80286 Xenix. Going with Unix would allow you to upgrade to an 80386 without switching to a new operating system.—R. G.

More Fax

In the past two years, optical character recognition (OCR) boards have gone down in price and up in efficiency. But one thing that hasn't changed much is the price of the necessary scanner.

Most fax machines have a fine mode,
continued

Breakthrough \$899 Offer—Now You Can Drive CD-ROM

For a limited time Compact Disk Products (CDP) is packaging the state-of-the-art NEC CD-ROM drive with Microsoft's most popular CD-ROM software:

Package A—For \$899, includes **Microsoft Bookshelf**, a coupon to purchase both **Microsoft Stat Pack** and **Microsoft Small Business Consultant** for only \$50 each, a **FREE** copy of **CD-Play Demo** and **FREE** Federal Express delivery.*

Package B—For \$1189 also includes **Microsoft Programmer's Library**

YOU SAVE OVER \$750!

Buy CD-ROM now! CDP sells over 200 quality CD-ROM titles for libraries, schools, legal and medical professionals, programmers, and many others. Over 25 new titles are being published each month. With IBM, NEC, and HP announcing new CD-ROM based PC's or Mini's, a CD-ROM drive is becoming as necessary as a floppy drive.

"I believe more than ever that CD-ROM products will be a major force in the expansion of the information industry." **Bill Gates.**

CDP is the largest specialized supplier of CD-ROM products in the U.S. Since 1987, CDP has supplied you with prompt service and expert advice... at the best prices. CDP is committed to CD-ROM and it shows. Our Unconditional Guarantee is unmatched. Our free Federal Express delivery is an industry first. Call now and tomorrow you will be driving these power CD-ROM products.

Circle 62 on Reader Service Card

UNCONDITIONAL GUARANTEE

- 1) If FOR ANY REASON you are unhappy with your purchase you may return it within 30 days for a FULL REFUND.
- 2) During the 90-day NEC warranty period CDP will ship replacement drives overnight.

ORDER NOW! 800-MEGABYTE (634-2298)

(Order line open M-S, 9AM-9PM EST)

Fax Orders 212-737-8289 • Inquiries/Free tech. Support 212-737-8400

DEALER INQUIRIES WELCOME

FREE CD-ROM: Mail in your order coupon and receive the CD-ROM Source Disk FREE. Includes demos of many popular CD-ROM products and retails for \$89.

*Federal Express delivery free for phone/fax orders within continental U.S. only.

Please send the package I've checked below.

- Package "A"**—Complete NEC CD-ROM drive kit (internal or stand-alone) plus **Bookshelf** and **CD-Play Demo** (includes a coupon to purchase both **Stat Pack/Small Business Consultant** for \$50 each) for only \$899!
- Package "B"**—Complete NEC CD-ROM drive kit (internal or stand-alone) plus **Bookshelf**, **CD-Play Demo** and **Programmer's Library** (includes a coupon to purchase both **Stat Pack/Small Business Consultant** for \$50 each) for only \$1199!

Please send the following drive configuration with my order:

- Stand-alone NEC CDR-77; Select PC/XT/AT/386 or Microchannel
- Internal NEC CDR-80(PC/XT/AT/386 Only)

COMPACT DISK PRODUCTS

Microsoft

NEC



Now! Get
Use Your CD-ROM Drive
as an Audio CD Player!

NEC CD-ROM drives (retail \$1198): Once again NEC has established an industry standard. Using 64K buffers (older drives use 8K) NEC delivers the speed users demand. Each drive includes full audio CD hardware (accessible with CD-Play Demo). The CDR-77 stand-alone drive also operates with Macintosh computers (\$99 interface kit required).

Microsoft Bookshelf (retail \$295): An indispensable collection of writers' references for word processor users. This is the most popular CD-ROM title published. You get instant access to: **The World Almanac**, **Chicago Manual of Style**, **Bartlett's Familiar Quotations**, **Roget's II. Electronic Thesaurus**, **American Heritage Dictionary**, **Business Information Sources**, **The U.S. Zip Code Directory**, **Houghton Mifflin Spell Checker and Usage Alert** and more! All Microsoft CD-ROM's are RAM resident and include powerful cut and paste features for popular word processing packages.

Microsoft Stat Pack (retail \$125): Now you have easy access to the abundance of statistics published by the Federal Government—census data, business statistics, agricultural surveys and much more, plus Microsoft Excel and Lotus 1-2-3 spreadsheet files for all tables. A must for marketers and planners.

Microsoft Small Business Consultant (retail \$149): The most popular publications of the Small Business Administration and Deloitte, Haskins and Sells on running a small business. Answer tax, accounting, legal, personal, and financing questions in an instant. A gold mine for businessmen, accountants, and consultants.

Microsoft Programmer's Library (retail \$395): All the critics are raving "... a masterpiece of simplicity and function." **PC World**, May '89. A complete library (over 20,000 pages) of the latest releases of Microsoft's Technical Reference Manuals covering OS/2, Windows MS-DOS, C, MASM, etc. with 8 megabytes of source code.

Also includes **FREE CD ROM** Networking software. PC Professionals need this **NOW!**

COMPACT DISK PRODUCTS

Compact Disk Products, Inc.
223 East 85th Street, New York, New York 10028
(212) 737-8400

- Please send me a free CDP Encyclopedia of CD-ROM Products
- Corporate / personal check money order enclosed
- Charge my (circle one) American Express Optima VISA
MasterCard Diner's Club

Acct. # _____ exp. date _____

Signature _____

Name _____

Company _____

Address _____

City/State/Zip _____

Phone _____

Please include Federal Express shipping and handling.
New York residents add 8.25% sales tax.

People are talking about us.

"Lahey F77L is definitely for the programmer's market, with features for the casual and professional user...*EDITOR'S CHOICE*" *PC Magazine*

"It is a fantastic product." *PC Australia*

"This is a very good implementation of FORTRAN, better than the one I use on my minicomputer system." *IEEE Software*

"It should be the last FORTRAN compiler you will need to buy..." *Your Computer*

"Lahey F77L was by far the easiest compiler to use..." *Programmer's Journal*

"Compilation speed is Lahey FORTRAN's most remarkable feature; it is unbelievably fast...Realistically, Lahey FORTRAN is the most efficient and productive FORTRAN development tool for the DOS environment..." *BYTE*, Nov. '87, p.187—David W. Burleigh



When people talk about FORTRAN
the name mentioned most often is

Lahey
Computer Systems, Inc.

Contact us to discuss our products and your needs. (800) 548-4778
Lahey Computer Systems, Inc. P.O. Box 6091, Incline Village, NV 89450
Tel. (702) 831-2500 FAX: (702) 831-8123 Tlx. 9102401256

NOW!! A high speed stand alone copier for 5¼ and 3½ inch diskettes duplicates virtually any format

When your requirements call for unattended, high speed duplication of virtually any 5¼ or 3½ inch diskette, Victory's Stand-Alone V3200 Duplicator is what you need. The reliable, desk-top design is ideal for both office and industrial use.

The V3200 features:

- Simple push-button operation
- Switchable 3½ and 5¼ inch copy drives
- Support for most formats including IBM, Apple, Amiga, and Atari
- Copy speed up to 250 disks/hour
- Batch Processing multiple jobs with different formats
- Production statistics display
- Exceptional copy quality

Top quality copying

Victory Duplicators actually improve the quality of copies during duplication. The V3200 validates the integrity of each master disk and verifies copies bit for bit to ensure quality. The system automatically sorts copied disks into an accept or reject output canister.

Do-it-yourself service

Victory systems have built-in diagnostics to test and maintain the system. A preventive maintenance indicator alerts you at regular intervals to check drive alignment and clean drive heads using utilities included with the system.

The modular design of the V3200 and Victory's overnight shipment of replacement parts let's you service the system at your location, avoiding costly offsite repair and downtime. Victory stands behind the V3200 with a four month warranty.

Call (800) 421-0103.

And ask about Victory's family of affordable Autoloaders.



**VICTORY
ENTERPRISES**
Technology, Inc.

Victory Plaza
1011 E. 53½ Street
Austin, TX 78751-1728
(512) 450-0801

In Europe call BFI Paris (33-1) 45330337
Frankfurt (49-6074) 27051, Milan (39-2)
3300535, England (44-6) 2288246,
Loadplan-London (44-1) 200-7733,
Loadplan-Australia (61-3) 525 8088



CALL ABOUT A VIDEO TAPE DEMONSTRATION

which has good enough resolution for OCR. It seems to me that a fax interface could be incorporated on the OCR board. The board would give the fax machine the signal to begin transmitting, make the A/D conversion, and calculate the scan rate and linear conversion to use the fax signal. I see quite a market for such a board. What are the problems?

Robert R. Stevens
Phuket, Thailand

I believe you're describing the fax-machine-on-a-board technology, which has progressed rapidly in the past year. Products of this type can now be had for about \$400 or so. It would be a simple matter to have the fax call up the microcomputer with the fax board and transmit the digitized document to the microcomputer. What's missing then is the software to feed the received fax to the OCR board. A few hundred dollars will get you the necessary file-conversion software and drivers. Contact the manufacturer of the OCR board you'd like to use.

With scanners now down to \$1000, it might be easier just to buy an inexpensive scanner. If you've just spent thousands on a good OCR board, you'll have to spend \$400 or more for a fax card and a few hundred more on software.

Another approach to your problem is to turn to the class of fax machines that incorporate storage and serial connections for computers. They were made specifically to work in the way that you've described. You connect the output of the fax machine directly to your computer. When you feed in the document, the fax acts like a scanner, sending the digitized document to the microcomputer. Fax management software can send this to an OCR board or software product, convert it to a graphic for desktop publishing, and so on. Fax machines with this capability are available from Canon and other manufacturers. There is commercially available software that does all the necessary routing and conversions. FaxMate from Bright Ideas (87A Ocean St., South Portland, ME 04106, (207) 767-6031) performs all these functions, as well as using the fax as a modem and a printer.

—H. E.

Model 100 Goes to School

Some years ago I purchased a Tandy 100 laptop. Now I want to use it as an electronic notebook for college. How do I dump my files from it to my IBM clone (a 12-MHz 80286 machine)?

Arthur L. Peasall
APO, NY

continued

Here's How We Protect Your Software And Profits Better.



We'll Never Tell.

Because our key-interrogation routines are *encrypted*, and our hardware is custom-wired to distinguish each of our clients' keys, our clients have the highest degree of security available.

Unlike other manufacturers, our routines assume responsibility for all hardware, software and timing issues. And what this means is that your engineering time and money won't be wasted reinventing protection schemes.

We offer two high security products for copy control: the KEY and the MEMORY KEY.

Our protection devices can also be used for serialization techniques, software leasing,

modular software management, creative revenue sharing, demo control and a path for future upgrades.

The information stored in the MEMORY KEY can be dynamically reprogrammed by your application software or a technician.

user's site via software disk or modem. All our products attach conveniently to a printer port, are transparent and allow for unlimited back up copies.

For serious software protection, call now. And start protecting your profits. Hands down, we're better.

Encrypted routines provide the highest degree of security

Custom hardware and software for each developer

No batteries to fail or replace



No programming adapters necessary

Can be dynamically reprogrammed at the user site via diskette or modem.

Over 55 languages supported in DOS, XENIX and OS/2



MICROPHAR

In Europe: Microphar, 42, Ave. Sainte Foy 92200, Neuilly Sur-Seine France
Tel: 33-1-47-38-21-21 Fax: 33-1-46-24-76-91. Call to obtain distributor addresses in:
Belgium, Ireland, Italy, Netherlands, Portugal, Spain, Switzerland, U.K. & W. Germany.

In the Americas and the Pacific: ProTech, 9600-J Southern Pines Blvd. Charlotte, NC 28217
Tel: 704-523-9500 Fax: 704-523-7651 Hours: Mon-Thurs: 8:30-7:00 ET, Fri: 8:30-5:30 ET
FOR A DEMONSTRATION PACKAGE OR ADDITIONAL INFORMATION, PLEASE WRITE OR CALL.

**PROTECH
MARKETING, INC.**

1-800-843-0413

Se Habla Español

You have fine taste in computers—the Model 100's light weight and good battery life make it an excellent choice for taking notes (I own a Model 100 myself).

The Model 100 has a standard RS-232C serial port that supports all the expected speeds up to 19.2 kilobits per second. To connect it to an AT clone, you'll need a cable that looks like what I've shown in figure 2.

Find some telecommunications software for your AT that can handle ASCII file transfers with XON/XOFF handshaking. Almost anything will do. Connect the cable and set the AT to full-duplex, 2400 bps, no parity, 8 data bits, and 1 stop bit. From the Model 100 main menu, move the cursor to TELCOM and press Return. Press F3 for STAT(us). For 2400 bps, the status setting is 68N1E. Press F4 for TERM. Type a few characters on the Model 100; you should see them appear on the AT. Test the setup on the AT, too.

When you're ready to transfer a file from the Model 100 to the AT, start the software on the AT side "receiving" or "downloading" an ASCII file. On the Model 100, press F3 (Up). Enter the filename and press Return. After the file is

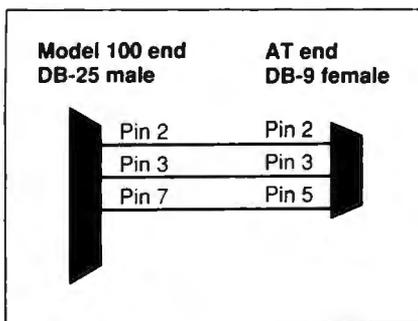


Figure 2: Diagram for a PC AT-to-Model 100 cable.

transferred, stop the AT's receive operation. The file you receive on the AT will still be formatted for the Model 100. Paragraphs are represented as one long line with a carriage return at the end. Depending on your word processor, you may need software to convert the carriage return character to a carriage return/linefeed pair.

To send a file to the Model 100, set the AT to "send" or "upload" a file. If possible, make sure that the AT strips off linefeed characters. Press F2 (Down) on

the Model 100 to start the transfer. Enter a filename and press Return, and then start the receiving process on the AT. You may want to try other transmission speeds; check your Model 100's documentation for changing the data transfer rates.

A less-technical means of saving files on the AT is a product called Disk+ from Personal Computer Support Group (4540 Beltway Dr., Dallas, TX 75244, (214) 404-4008). Disk+ is a ROM chip that fits in the Model 100 and a disk that you load on your AT. You connect the cabling between the computers and run both software packages. You simply position the cursor over the file you want to transfer, and Disk+ automatically sets the data transfer rates and transfers the file. You'll still need to do some simple file conversions to use the file in your AT's word processor. Personal Computer Support Group will even sell you the cable if you don't want to make it yourself.

By the way, if the keyboard noise bothers your fellow classmates, gently pry off the keytops and place small orthodontic rubber bands around the keyswitch posts. This cuts down on the noise.—H. E.

continued

Programmers Wholesaler™

800-228-3736
(Canada 800-344-2495)

✓ Check our values!

ASSEMBLERS

	List	1-2	3+
MS Macro Assembler	150	97	92
Turbo Assembler/Debugger	150	98	93

BASIC & ADDONS

	List	1-2	3+
MS Quick BASIC 4.5	99	67	64
QuickPak Professional	149	109	99

C LANGUAGE- COMPILERS

	List	1-2	3+
Lattice C - 3.4	250	156	143
Microsoft C 5.1	450	287	283
Microsoft Quick C	99	67	64
Turbo C by Borland	150	98	94

COBOL

	List	1-2	3+
MS COBOL 3.0	900	599	569
Realia COBOL	995	799	769

DATABASE MANAGEMENT

	List	1-2	3+
Clarion	695	399	379
D the data language	395	339	289
Magic PC	299	259	229
Paradox 3.0	725	489	479

DBASE

	List	1-2	3+
Clipper Summer '87	695	429	419
dBASE IV	795	489	479
FoxBASE + 2.1	395	209	199

DBASE TOOLS

	List	1-2	3+
Clear+ for dBASE	200	149	139
dBRIEF w/BRIEF	275	Save	Save
dSalvage	100	83	79
R&R Relational Reportwriter	149	99	93

DEBUGGERS/ DISASSEMBLERS

	List	1-2	3+
Periscope II	175	129	109
Periscope III	1395	1069	999
Soft Probe II/TX	395	269	239

DEVELOPMENT TOOLS

	List	1-2	3+
Clear+ for C	150	143	139
PC-Lint	139	99	89
PolyMake	149	129	123
PVCS Professional	395	339	309

EDITORS

	List	1-2	3+
BRIEF	195	Save	Save
Epsilon	195	139	109
KEDIT	150	129	109
SPF/PC	245	169	144
Vedit+	185	109	99

FILE ADDONS

	List	1-2	3+
Btrieve ISAM	245	169	144
XQL	795	579	529
c-tree by Faircom	395	279	249
d-tree	495	319	299
r-tree	295	199	179

FORTRAN

	List	1-2	3+
MS FORTRAN	450	299	289
RM/FORTRAN	595	409	389

GRAPHIC ADDONS

	List	1-2	3+
GSS Development Toolkit	620	459	429
Halo '88	395	256	238
Hoops	495	389	369

OBJECT-ORIENTED

	List	1-2	3+
Actor	495	399	379
Smalltalk/V	100	59	54
Zortech C++	150	129	Save

OS - SUPPORT

	List	1-2	3+
DESQview	130	79	73
MS Windows/286	99	67	64

OTHER PRODUCTS

	List	1-2	3+
Carbon Copy Plus	195	115	104
CO/SESSION	249	179	159
HEADROOM by Helix	95	Save	Save
Link & Locate	350	249	219
Norton Utilities Advanced	150	79	77
PC Tools Deluxe	80	45	43
Remote2	195	104	99

SPREADSHEETS

	List	1-2	3+
1-2-3	495	299	289
Excel	495	239	229
Multiplan	195	139	129
Quattro	248	164	159
SuperCalc V	495	319	299

TEXT SCREENS ADDONS

	List	1-2	3+
C Worthy w/Forms	295	Save	Save
Greenleaf DataWindows	295	179	159
Vermont Views	395	319	299

WORD PROCESSING

	List	1-2	3+
Sprint	200	134	129
WordPerfect	495	239	234
Wordstar	495	259	249

Over 1,000 popular products!

Prices subject to change without notice.

Introducing New SmartWare® II

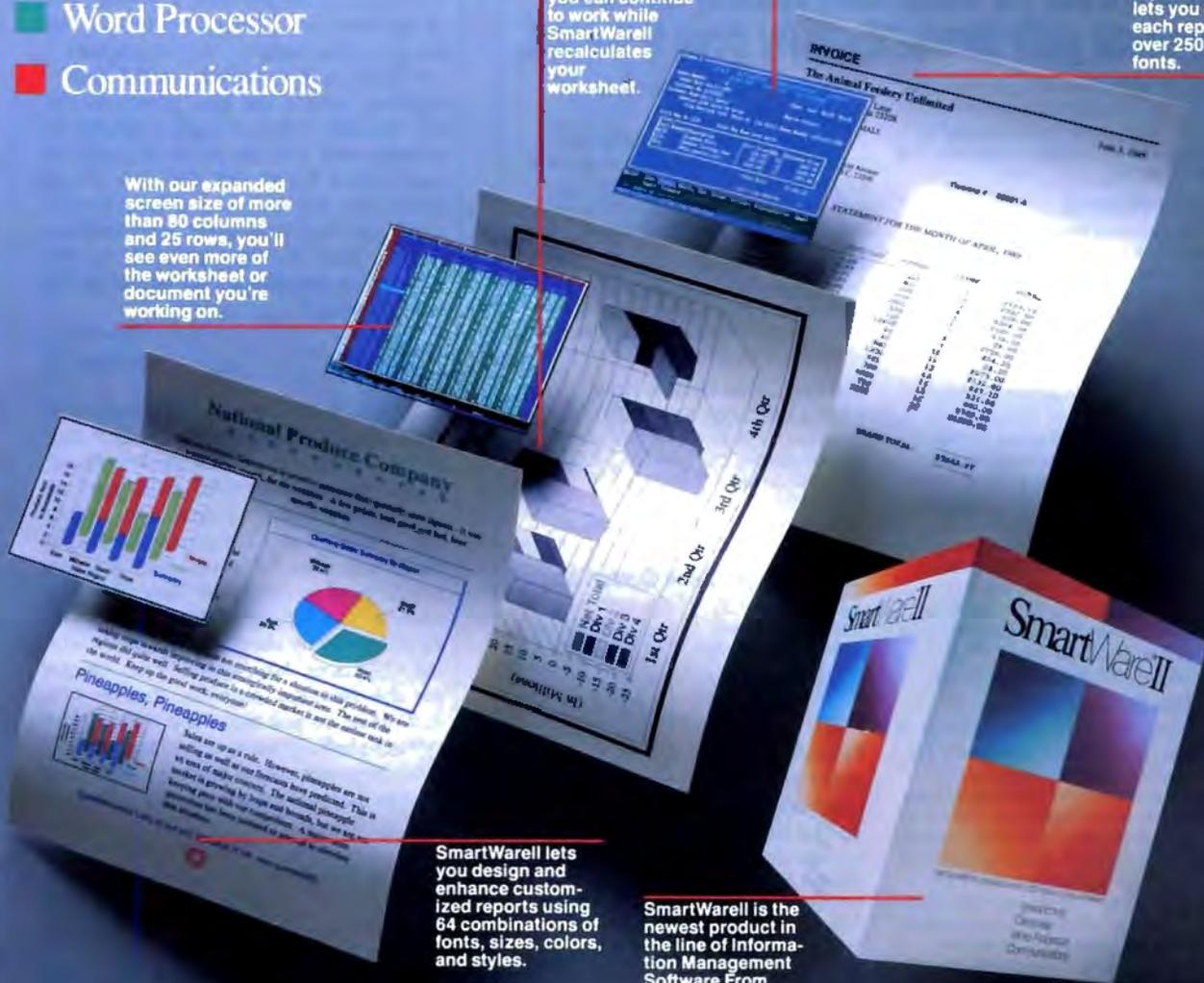
- Spreadsheet
- Database
- Word Processor
- Communications

With our expanded screen size of more than 80 columns and 25 rows, you'll see even more of the worksheet or document you're working on.

Display your graphics in black and white, or color, using multiple fonts. And with background recalculation, you can continue to work while SmartWare II recalculates your worksheet.

SmartWare II gives you the ability to create customized data screens that can display combined data from up to 127 different files.

The easy-to-use report generator is built-in, and allows you to combine over 100 separate data files into one report. SmartWare II lets you customize each report using over 250 different fonts.



SmartWare II lets you design and enhance customized reports using 64 combinations of fonts, sizes, colors, and styles.

SmartWare II is the newest product in the line of Information Management Software From Informix.

The Ultimate Form of Self-Expression. It's so simple, it's brilliant. Imagine having the power of a Word Processor, Spreadsheet, Database, and Communications — all in one package. Envision the amazing ability to leap back and forth between each application, gathering presentation-ready

information, and creating the perfect business document. Suddenly, new ideas start coming to mind. You're thinking, this is the edge I need to succeed. I'm not going to look like everyone else anymore. I'm going to look smarter.

INFORMIX
INFORMATION MANAGEMENT SOFTWARE

For your upgrade information or free demo disk, and the name of your nearest authorized SmartWare dealer, call 1-800-331-1763, ext 1000. (In Canada call 1-416-566-7024.)

Circle 137 on Reader Service Card (DEALERS: 138)

What's in a Word?

I am interested in the structure of .EXE program files. By reading explanations about the .EXE header layout in various books on DOS, I have come to understand all but one item, the *word checksum* at byte offsets 12-13 hexadecimal. I have experimented with it by plugging in a variety of arbitrary values in a couple of .EXE-format programs, but the programs have always loaded and run with no problems.

How is this value calculated, and how is it used when the program is loaded and running?

Ronald Rowley
Laurel, MD

The item you describe is the one's complement checksum of all the words in the .EXE file. This item is calculated by LINK (as LINK is creating the .EXE file), such that if you add together all the words of the .EXE file, the result (ignoring carries) is hexadecimal FFFF. The idea was that when you went to execute an .EXE file, DOS would calculate the file's checksum and refuse to run the program if the result was anything other than FFFF (indicating a possible corrupt file). To date, I haven't found a version of MS-DOS that pays heed to the checksum. It appears that you haven't, either.—R. G.

ing carries) is hexadecimal FFFF. The idea was that when you went to execute an .EXE file, DOS would calculate the file's checksum and refuse to run the program if the result was anything other than FFFF (indicating a possible corrupt file). To date, I haven't found a version of MS-DOS that pays heed to the checksum. It appears that you haven't, either.—R. G.

Multiple Monitors

I have an XT clone, a monochrome monitor, and a TV monitor. I also have an IBM monochrome card, a color graphics card, and a Hercules-compatible graphics card. Right now, I have the monochrome card and the color graphics card in the machine. I can output text on the monochrome monitor, but not graphics.

I'd like to do graphics on the monochrome monitor and play games on the TV monitor. I plan to replace the monochrome card with the Hercules graphics card, but a friend said that this would break my motherboard (two graphics cards can't be placed in the same motherboard). Can I output graphics to the monochrome card and play games on the color monitor?

Daniel Fu
Austin, TX

It is possible to combine Hercules and CGA graphics adapters in the same machine, but there are a few qualifications. First, you need an IBM CGA card or clone with composite output. This will let you connect your CGA card to the TV for the price of an RF modulator. Second, you'll need to configure your Hercules clone to run in half mode, so that it will be able to share the display segment with the CGA card. Most applications written for the Hercules graphics card require full mode, so you may have trouble with off-the-shelf software. One last caution: The composite output from the CGA card may be suitable for games only.—S. A.

FIX

In a June What's New item ("HyperPad Goes DOS") and a July Short Talk ("Desktop Manager with Hypertext Power") on HyperPAD from Brightbill-Roberts, we mistakenly referred to HyperPAD's scripting language as HyperScript. The actual name of the scripting language is PADtalk. HyperScript is a registered trademark for the programming language used in WingZ by Informix Software. ■

Here's the PC Voice Mail system that can increase your productivity by over 9 weeks.

The average business person *wastes* 5 to 7* hours each week on the telephone. That's over 9 weeks a year of wasted time and profits. That's why you need Watson.

What Is Watson?

It's the \$199 hardware and software system that turns your PC and telephone into an intelligent communications system that outperforms voice messaging systems costing thousands of dollars more.

Why Watson?

Because Watson invented the category of PC voice mail. Because PC Magazine selected Watson Version 1 as "Editor's Choice for Product of the Year in 1984." Because Watson Version 6.23 is a Hayes compatible modem (1200 or 2400 BPS) that runs completely in the background without interfering with other computing functions. Because Watson comes with a 60-day free support program. Because Watson has over 30,000 satisfied users. *And because over 45% of our sales come from user referrals!*

All This For Just \$199.

With basic Watson you'll get a single or multiple user system that answers the phone; forwards messages to any phone, even pagers; provides private and public voice mailboxes; gives you a personal calendar and programmable alarms plus a dictation system with full featured voice editing. You'll get auto dialing, remote access operation and message retrieval. Plus a sortable phone book based on a Rolodex™ file card structure in which you can enter free form notes and do key word searches. And it's all yours for just \$199.

*George Walther, *Phone Power* (New York: Berkley Books, 1986)

Watson—Voice Information System (VIS)™ Option.

An English-like command language that allows you to customize voice messages, control message sequences with touch tones for both inbound and outbound response applications.

Hear All About It.

To decide which Watson is right for you, call our *Demo Hotline*. You'll hear an actual demonstration and discover all the ways Watson can work for you.

Call Our Demo Hotline Now.

1-800-6-WATSON, EXT. 242. In MA 1-508-651-2186 EXT. 242. Or to order Watson directly, call 1-800-533-6120 EXT. 242 (in MA 1-508-655-6066 EXT. 242).

MasterCard, VISA, and American Express accepted.

30 Day Money-Back Guarantee.

Try Watson for 30 days. If you aren't completely satisfied, return it for a full refund.

FREE Copy Of Phone Power Just For Listening To Our Demo.

We'll send you a free copy of *Phone Power*, if you call before 10/31/89 and ask for extension 242. No order necessary. Over 200 pages of practical techniques for small business owners and company executives. Make your telephone and your time more profitable.



Call on the power of
Watson
from **Natural MicroSystems**
8 Erie Drive, Natick, MA 01760-1313

CHAOS MANOR MAIL

*Jerry Pournelle answers questions about his column
and related computer topics*

Unix Multitasking

Dear Jerry,

Your latest endeavors in Unix have caught my attention. I work in MS-DOS, the Mac operating system, and Unix, and I prefer Unix more each day. I'm afraid that your statement about Unix not doing multitasking is 100 percent wrong. The real problem is that the non-network version of Q&A Write was not designed to work in a true multitasking environment. It was designed to work in a single-user environment, and when it finds another copy of itself running, it assumes that you are trying to violate your copyright.

DESQview gets around this not by actively multitasking but by using an automated fast context-switching scheme. It's probably just a simple round-robin system without dynamic load balancing or any other optimization. Since you just have a context switch and only one active process at a time, Q&A cannot tell that it has been loaded more than once.

In Unix, multiple processes know who their user is, but Q&A isn't aware that the user of one process is the user of the other process, because it doesn't bother to check. You see, Unix processes are not special cases for certain situations; they are generalized and carry enough information to allow them to identify themselves, their owner, their environment, and more.

I applaud your looking into Unix, and I think that since we now have microcomputers powerful enough to support Unix properly, we will see more powerful applications. With you pointing to trouble spots in Unix, we may see a new level of refinement and performance for users. With the interprocess communication and networking abilities of Unix, we should see the visions of Mitch Kapor materialize. The types of things he wants to do may be impossible on an MS-DOS, CP/M, or Macintosh operating-system machine.

Tony Dean
Douglasville, GA

Clearly you know more about Unix than I do, but my point was then and is now that

Unix remains a guru-friendly system that requires wizardry to get and keep it running. If you have access to a wizard, it's probably wonderful.

I keep hearing about new Unix-based systems that won't have that problem. So far, I haven't had a chance to run one.

Steve Jobs once said that no one in his right mind would use Unix as the operating system for a new computer. He has clearly changed his mind. Perhaps new versions of Unix will change mine.

—Jerry

Under-the-Desktop Keyboard

Dear Jerry,

The usual low-budget recourse to lack of work space is to get a flush door and set it across a couple of sawhorses or small bookcases (and in cases of absolute necessity, cinder blocks), but usually either the keyboard or the table is at the wrong height. Enter the keyboard drawer, but, as you once remarked, these are not made long enough (or perhaps deep enough) for a mouse beside the keyboard.

My solution to this problem (actually, I needed space for a digitizing tablet rather than a mouse, but the principle is the same) was to buy a pair of keyboard drawer slides. These are full-extension slides like those on file drawers, but they have hanging brackets to screw onto the bottom of a table. They provide a drop of about 3 inches, which gives you a keyboard height of 26 inches or more under a standard 29-inch table. All you need then is a piece of 3/4-inch plywood—whatever size you want—and you're home free. My slides are made by Knappe & Vogt (Model #8100). The 14-inch size (the smallest) is about right for a keyboard, and a pair costs \$12.05. I hope this helps.

continued

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerry.p."

situation:

**Puzzled over
which Pascal
compiler is best
for you?**

solution:

**BLAISE
COMPUTING
INC.**

Our tools support both
QuickPascal and Turbo Pascal.

POWER TOOLS PLUS/5.0 \$149

Full featured function library

- ◆ Features context sensitive help screens
- ◆ window oriented pick lists
- ◆ multiple-line edit fields with fully configurable edit keys
- ◆ moving bar pull-down menus and windows
- ◆ in-memory sort routines
- ◆ EMS support
- ◆ TSRs and ISRs
- ◆ and much more!

ASYNCH PLUS \$129

Asynchronous communication manager

- ◆ Features speeds to 19.2K baud
- ◆ XON/XOFF protocol
- ◆ support for up to 4 comm ports
- ◆ hardware handshaking
- ◆ XModem file transfer
- ◆ I/O buffers up to 64K
- ◆ and much more!

POWER SCREEN \$129

Screen I/O manager

- ◆ Features screen painter
- ◆ virtual screens
- ◆ data validation
- ◆ context sensitive help
- ◆ unlimited screens
- ◆ definable keys
- ◆ and much more!

Fast, flexible and affordable!

Blaise Computing offers programming tools that are fast, flexible and affordable. Call now to order or to ask for a free brochure on our full line of products for C and Pascal.

FREE with these products!

Source code, complete sample programs, a comprehensive reference manual with extensive examples, the Norton Guides Instant Access Program, and a comprehensive online database.

Supports QuickPascal and Turbo Pascal!

All of these products support Turbo Pascal 4.0, 5.0, and 5.5 and QuickPascal 1.0.

Put Blaise tools to the test!

If at any time during the first 30 days you are not completely satisfied with their speed and flexibility, we'll refund your money.

Call (800) 333-8087 today!

FAX: (415) 540-1938

BLAISE COMPUTING INC.

2740 North Sycamore, Suite 710, Berkeley, CA 94705 (415) 540-1938

Turbo Pascal is a registered trademark of Borland International.
QuickPascal is a registered trademark of Microsoft Corporation.

On another subject, I have recently converted most of my computing operations from CP/M (and HDOS) to MS-DOS, and I miss some of the nice touches that I used to be able to write into the programs I used. So I'm looking for a disassembler that will let me do some customizing—particularly on dedicated application programs like AutoYACHT, which I use to fair up the lines of new designs. I have seen a program called The Sourcer reviewed with pretty favorable comments. Do you have any experience with it? Or do you know another, preferably reasonably priced, program?

Michael Porter
Chebeague Island, ME

That's a great idea. My present computer table is large enough and has a mouse platform, but the whole thing is 48 inches wide, which is larger than I like.

I'm contemplating rearranging the office—we're doing a CAD plan first, using Generic CAD (although we have AutoCAD, which is superb, I thought I'd try it with something more affordable for readers). I should have thought there would be hardware to let you do that, but somehow the idea hadn't sunk in. Thanks.

I've heard reasonable things about The Sourcer, but I have not used it. I fear I haven't disassembled a program for at least five years. Sigh. There's no better way to really learn what's going on.

—Jerry

Not Seeing Red

Dear Jerry,

I have a Zenith FTM display, model ZCM-1490, and I have experienced intermittent problems with the red gun. When I come to work in the morning and turn on my computer, there's about a 50 percent chance of no red for 15 minutes or so until the monitor warms up. I veri-

fied that the problem was in the monitor by putting a second monitor (a multisync type) on my desk and swapping the video cables (I have rewired the cable on my FTM to be the same 9-pin connector as the multisync). Lately, the red has also disappeared a few times in the afternoon. Unfortunately, intermittent problems don't tend to show up when you bring the item in for service, so I have resigned myself to occasionally lacking red until the problem worsens.

That's not the only problem I've had. When I got my first FTM, I showed it to some people in the office a couple of times. Then, after the accumulated "on" time was about 20 minutes, it got really bright and out of focus for a little while, and then it went blank. A trustworthy co-worker suggested the high-voltage section as the culprit. The local Heath/Zenith dealers swapped it for free with the one they had, which is the one that is now having the red problem. I'm lucky that those first 20 minutes of demos were done on a PS/2 VGA before I rewired the cable.

Despite these problems, I am enthralled with the image quality of the FTM. I am using it with the Pepper SGT board from Number Nine Computer Corp. While this board may be a bit pricey for most people (\$1995), devoted programmers may find it worthwhile. It contains two graphics coprocessors; the Intel 82786 provides hardware windowing support and "canned" graphics functions, and the TI 34010 provides programmable graphics functions. This is the only display board I know of that provides this absolutely essential combination of functions. Hardware windowing means that different regions on the screen have their own pointers to bit maps, so independent smooth scrolling of each region can be accomplished by

changing pointers rather than moving huge amounts of data. Programmable graphics functions are needed because it is impossible for the chip designers to think of all the graphics algorithms that you will need.

There is not much off-the-shelf software that can really take advantage of this board, other than AutoCAD and Lotus 1-2-3 with customized drivers. I suspect that Windows and Presentation Manager currently treat the screen as one big bit map rather than allow the graphics driver to maintain separate bit maps for each window; if this is true, I hope things will evolve.

The connector on the Pepper SGT board is a DE9 (common 9-pin) type. At the time I purchased the Zenith FTM, I wanted to make an adapter but could not find a female DE15 connector (15 pins in the space of 9) to mate with its video cable. Therefore, I cut off the FTM's factory DE15 and replaced it with a DA15 (normal 15-pin) and then used an adapter cable to get down to 9 pins. However, now Radio Shack sells male and female DE15 connectors.

Kevin C. Scott
Rochester, NY

Like you, I've had problems with the FTM, but the darned thing is so glorious—glare-free, under horrible lighting conditions—that it doesn't matter. It's wonderful.

It's also the only American-made monitor on the market, to the best of my knowledge.

Thanks for the tip. I've had a horrible problem finding proper cables. Nowadays I call the folks at Candy Cable of San Diego and let them worry about making the darned things up. They do it for not a lot more than I could do it myself, and theirs are much neater.—Jerry ■

Subscription Problems?

We want to help!

If you have a problem with your BYTE subscription, write us with the details. We'll do our best to set it right. But we must have the name, address, and zip of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.



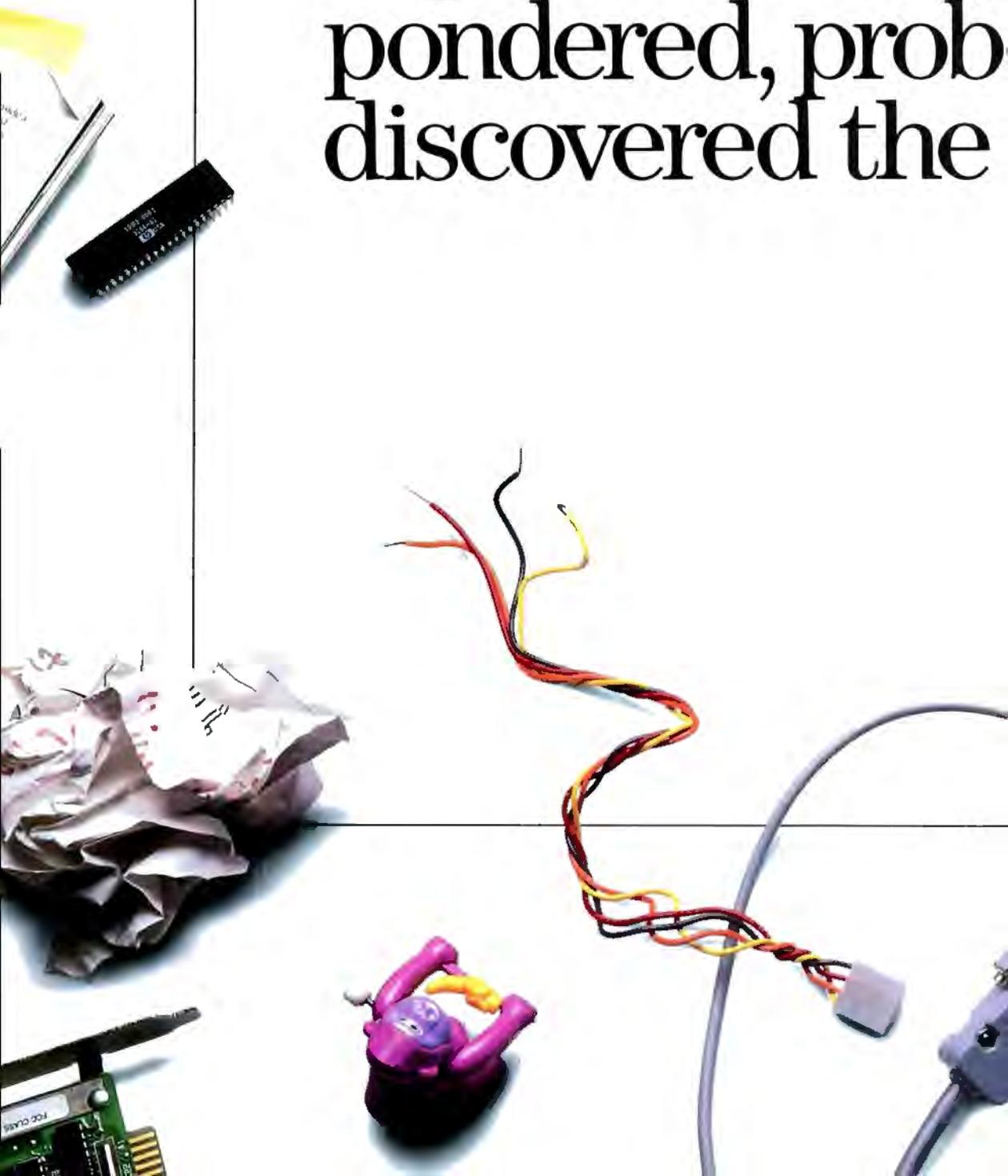
BYTE

Subscriber Service, P.O. Box 555, Hightstown, NJ 08520



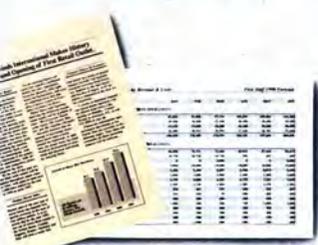
You've spent
the best years
of your life
searching for it.

You've analyzed
experimented,
pondered, prob
discovered the



scrutinized,
investigated, dissected,
and finally
the eternal truth.



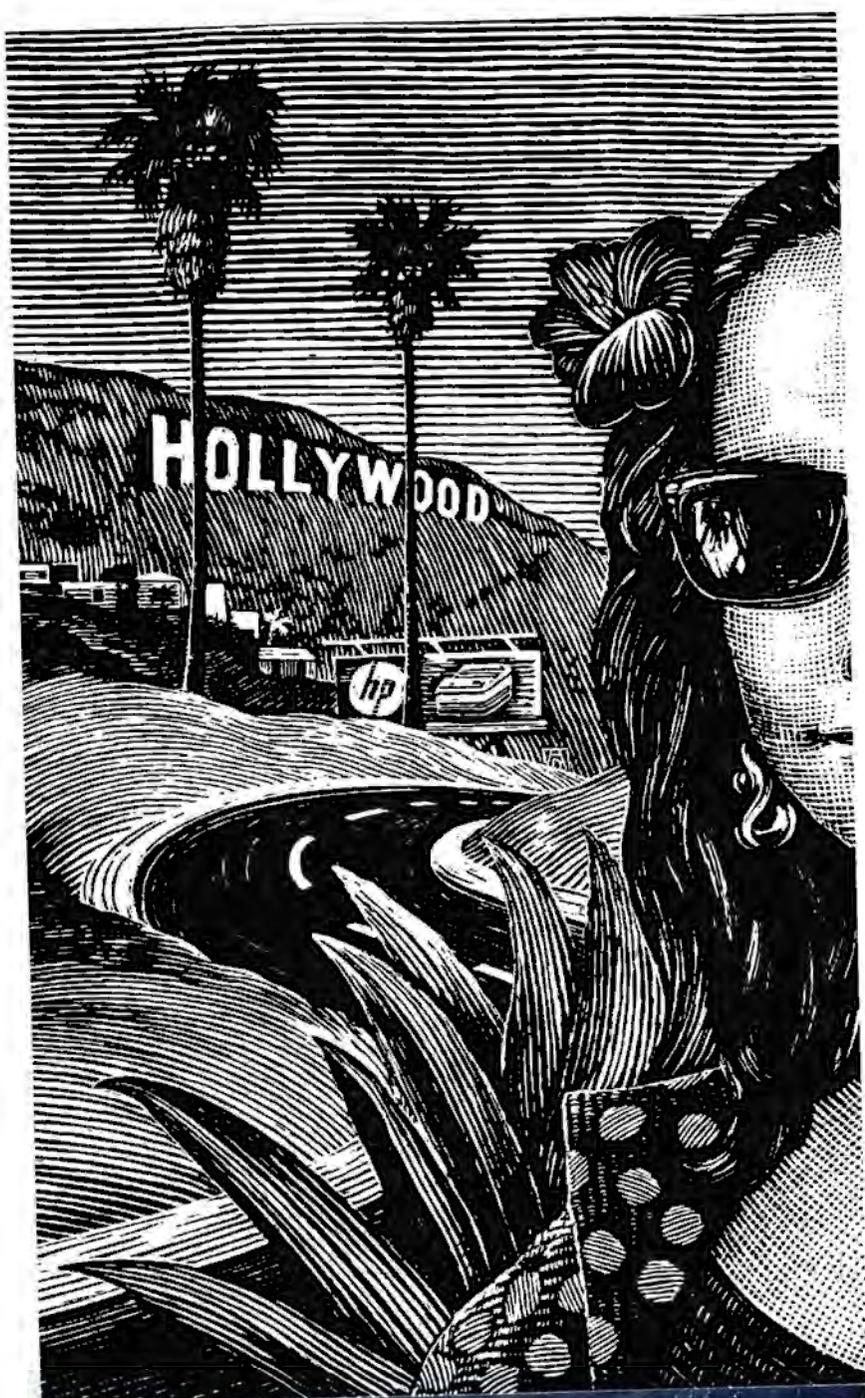


You already know about the HP LaserJet printer's razor-sharp text, saturated black tones and large selection of scalable typefaces. They've made LaserJet the most popular laser printer in history.

But we felt our equally fine graphics capability went unappreciated. So we commissioned this portrait of an old friend who moved to L.A. Notice her smooth curves, subtle gray shades and highly defined features.

There's a LaserJet to meet everyone's needs. Whether you need larger paper volume, duplexing or envelope feeding. So when it really counts, better do it on a LaserJet. The original, and still the best.

L A S E R J E T



S C A N J E T

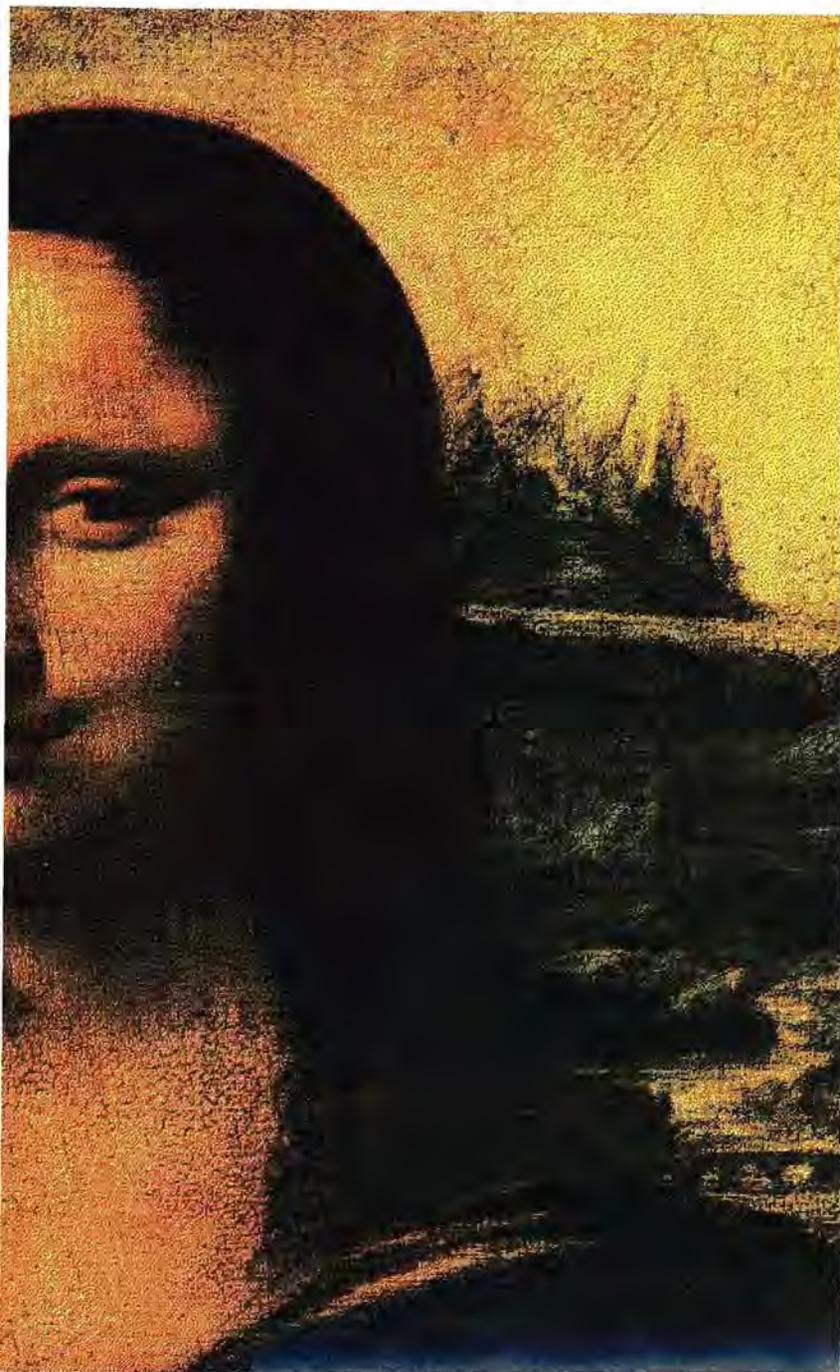
Pretty pictures, aren't they? Actually, the black and white images, right down to the brush strokes on Mona Lisa's hands, come unretouched from the HP ScanJet Plus scanner. It's the first affordable 8-bit scanner to bring photographic quality to your desktop.

At only \$2190,* ScanJet Plus provides the top image processing in its class. With 256 gray shades. Over 100 contrast settings. Even the widest range of scaling, from 4 to 200% in 1% increments.

And ScanJet Plus reads both bound and loose-leaf documents as well as it scans images. Just plug it into your IBM AT-compatible, PS/2 or Macintosh computer and experience the finest desktop reproduction available. A woman like Lisa deserves no less.



Looks are



everything.



Poor Leonardo. He didn't anticipate the HP PaintJet color printer with its thousands of brilliant colors. Now anyone with \$1395* (add \$125 for a Macintosh interface) can produce a masterpiece of fine art.

Or a masterpiece of business. Because the PaintJet works with nearly all of your favorite text and graphics software packages. On both IBM-compatible and Macintosh computers.

So whether you're making a presentation or sharing your vision with the world, you can't beat the PaintJet. It's what artists are starving for.

P A I N T J E T

D E S K J E T

Why settle for dot matrix when you can have laser quality? The HP DeskJet PLUS printer prints at 300 DPI, thanks to its advanced inkjet technology.

Think of it, laser-quality text and graphics for only \$995.* Apple users can get the same high quality on their desktops with the HP DeskWriter printer designed specifically for the Macintosh; it's only \$1195.* No more bulky dot matrix. No more jackhammer noise. No more of that connect-the-dots look that keeps your reports from being taken as seriously as they should be.

DeskJet PLUS works with the most popular software and with any IBM-compatible PC. So take a look at DeskJet PLUS. It may not be a laser printer but you don't have to tell.



HEWLETT
PACKARD

*Suggested U.S. list price.

Send us your most creative output*



and you could win something to smile about.

Announcing Hewlett-Packard's
"Looks Are Everything
Sweepstakes."

Here's a challenge that can
really put a smile on your face.
Send us an original printed
sample (no mechanical repro-
ductions, please) of your most
creative computer output—
business graphics, design work,
whatever—and you could win
a complete Hewlett-Packard
system or other valuable
Hewlett-Packard prizes.**

Show us your genius. We know
you've got a computer-generated
masterpiece—something you
created for your boss, your own
company, or even just for the
fun of it. Send it to us, along
with the attached entry form,

and you will be entered into a
random drawing.

See official rules on back of
entry card for complete details.

To receive another insert
and official entry form, prod-
uct literature or the name of
your nearest authorized
Hewlett-Packard dealer, call:
1-800-752-0900, Ext. 712H.
One entry form per request.
While supplies last. Entry form
request must be made no later
than September 30, 1989.

There is a better way.



**HEWLETT
PACKARD**



*In lieu of sending computer output, you may send completed sweepstakes entry form only (name, address, and phone # required).

****First Prize:** One Hewlett-Packard system, which will include one of each of the following: Vectra QS 20 PC, LaserJet Series II printer, PaintJet color printer, DeskJet PLUS printer, ScanJet Plus scanner and Graphics Gallery Collection software package (includes Drawing Gallery and Charting Gallery). **Second Prizes:** One (per winner from among eight randomly selected Hewlett-Packard peripheral products: two LaserJet Series II printers, two ScanJet Plus scanners, two PaintJet color printers, two DeskJet PLUS printers). **50 Third Prizes:** One Hewlett-Packard Graphics Gallery Collection software package (includes Drawing Gallery and Charting Gallery) (per winner).

WHAT'S NEW

HARDWARE • SYSTEMS

A 20-megabyte Laptop That Won't Weigh You Down

Even when configured with its rechargeable battery and an optional PrairieTek 2½-inch hard disk drive, the GRIDLite XL (extra light) weighs only 9½ pounds.

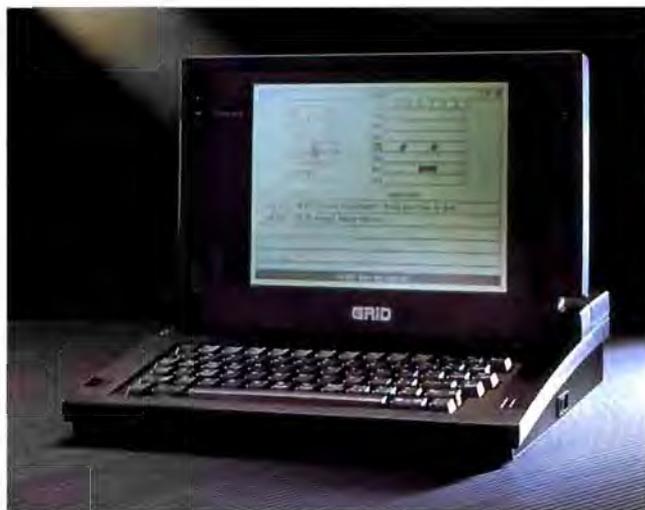
One reason it's so light is the compact hard disk drive. Another reason is the smaller and lighter battery afforded by the low power consumption of the PrairieTek drive and the LCD. Battery power lasts 3 to 4 hours.

The GRIDLite XL is based on an 8-MHz 80C86 CMOS CPU. A standard configuration includes 128K bytes of RAM (upgradable to 1 megabyte), a 1.44-megabyte 3½-inch floppy disk drive, and video (CGA, 9-pin), serial, and parallel ports. Options include the 20-megabyte hard disk drive (which replaces the floppy disk drive), an 8087 math coprocessor, and a 2400-hps internal modem. **Price:** \$1950; with 20-megabyte drive, \$3125.

Contact: GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537, (415) 656-4700. **Inquiry 1115.**

Dynabook Introduces Modular Notebook

A notebook-size computer called the Dynabook 286 has a modular design. There's a processor/keyboard/disk unit, a display unit, an optional battery, and an optional "docking station" for quick attachment to printers or



The GRIDLite XL, with a 20-megabyte drive, weighs 9½ pounds.

other peripherals.

The processor unit is based around a 16-MHz Harris 80C286 (with an optional 12-MHz 80287 math coprocessor). It includes 1 megabyte of one-wait-state, 100-ns RAM (expandable to 4 megabytes) and a full-size keyboard. A 1.44-megabyte 3½-inch floppy disk drive is standard, and built-in 20-megabyte or 40-megabyte hard disk drives can be ordered.

The detachable blue-tinted display, only ⅜-inch thick, uses electroluminescent backlit supertwist LCD technology and measures 11 inches diagonally.

For power, the Dynabook 286 uses either an unusual dry lead acid battery, which has the same dimensions as the computer and is only ½-inch thick, or a lightweight but bulky AC power adapter. The 2- to 4-hour battery does

not need to be "deep charged"; instead, it can be topped off like a gas tank. It also weighs 5 pounds, bringing the full weight for a mobile version of the Dynabook to more than 14 pounds (not including the hard disk drive). The company says the AC adapter includes built-in surge suppression.

The 2-pound docking station snaps onto the back of the computer with two big latches. On the back are a parallel port, two serial ports, and ports for an external keyboard, mouse, VGA monitor, and AT expansion bus. **Price:** \$4695; with 20-megabyte hard disk drive, \$5195; battery, \$249; docking station, \$299.

Contact: Dynabook Technologies, 6150 Stoneridge Mall Rd., Suite 225, Pleasanton, CA 94566, (415) 847-0660. **Inquiry 1116.**

SEND US YOUR NEW PRODUCT RELEASE

We'd like to consider your product for publication. Send us full information, including price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE has not formally reviewed each product mentioned. These items, along with additional new product announcements, are posted regularly on BIX in the microbytes.sw and microbytes.hw conferences.

From VCRs to Computers, Emerson Reaches Out

Emerson Radio charged into the personal computer business this month with three low-end, low-priced systems that offer something new.

For example, Emerson commissioned Microsoft for MS-DOS 3.3 in ROM. You can also order DOS on disks, but the company says it plans to upgrade all DOS-in-ROM models with talking capabilities sometime later this year. Spoken DOS, a company spokesperson said, will be possible with video-compression software technology licensed from UVC.

The company's first machine, the 8000EC, is a small-footprint 10-MHz 8088. It features a pop-up training and menu program designed to guide beginners through bundled word processor, spreadsheet, home accounting, and financial management packages. It's expandable, too, with four open 8-bit slots.

A new 16-MHz 80286 system and a 16-MHz 80386SX system feature SynOptics sound chips. For music synthesis within a range of eight octaves, models 8286EC and 8386EC feature 12 amplitude controllers, six mixers, six frequency generators, and two noise generators.

All systems include DOS, keyboards, and monitors. **Price:** 8000EC, under \$600; 8286EC, under \$900; 8386EC, under \$1000. **Contact:** Emerson Computer Corp., 5500 East Slauson Ave., Commerce, CA 90040, (213) 722-9800. **Inquiry 1114.**

continued

A 16-inch NuBus Monitor for Tall Applications

The TX SE/30 16-inch color monitor for the Mac SE/30 features the standard 1024-pixel width, but the display is slightly taller than normal, at 808 pixels. Resolution is 76 dpi, the refresh rate is 72 Hz, and dot pitch is 0.31 mm.

The included NuBus video controller features a 32-bit data path and a full megabyte of dedicated video memory, enough to easily display up to 256 colors. It operates at either 1 or 8 bits per pixel. Software included with the monitor lets you adjust brightness and contrast, and it also automatically dims the display to a preset level.

Outside dimensions are 19 by 19 by 21 inches, and it weighs 86 pounds.

Price: \$4495.

Contact: E-Machines, Inc., 9305 Southwest Gemini Dr., Beaverton, OR 97005, (503) 646-6699.

Inquiry 1120.

Tape Backup Runs off Floppy Disk Drive Controller

The Excel 40AT and Excel II 40fi are 40-megabyte cartridge-based tape backup systems that operate off your computer's floppy disk drive controller.

Both the 40AT, for AT-based systems, and the II 40fi, for most PS/2-based systems, fit in the open half-height floppy disk drive slot and back up data onto DC 2000 minicartridges. Data backup speed is rated at up to 3.8 megabytes per minute. Both subsystems use the QIC-40 recording format.

The subsystems also feature background formatting,



E-Machines' high-resolution NuBus monitor.

which lets you run applications during tape formatting, and 100-inch-per-second fast forward, seek, and rewind.

Price: 40AT, \$499; II 40fi, \$549.

Contact: Everex Systems, Inc., 48431 Milmont Dr., Fremont, CA 94538, (415) 498-1111.

Inquiry 1119.

Output Technology Speeds Up Dot Matrix

Output Technology's Model 2132 printer is an affordable alternative to today's laser printers, if blistering speed is of utmost importance.

High-speed draft mode is rated at 350 lines per minute, the company says, based on impact tri-matrix technology. You get three 9-wire print heads and four print modes: high-speed draft, draft, correspondence quality, and near-letter quality (two-pass printing).

The following printer emulations are included: Epson FX-286e, IBM Proprinter XL, and Printronix P6000.

The buffer size is 8K or 512 bytes, user-selectable. And you can get the 2132 to print in several additional print styles, like bold and superscript.

The 2132 weighs 70 pounds and measures 27 by 11 by 20 inches. Paper handling for forms and fault detection are included. Options include twin-axial and coaxial interface cards for networking.

Price: \$3995.

Contact: Output Technology Corp., East 9922 Montgomery, Spokane, WA 99206, (509) 926-3855.

Inquiry 1121.

Experience the Resolution

By increasing video amplifier bandwidth and scan frequencies, and by using a custom controller, Flanders Research has produced a 3300-by-2560-pixel monochrome monitor that's priced about the same as its 1024-by-768-pixel brethren.

Designed for high-precision CAD, desktop publishing, and other demanding applications, it's of the 300-dpi non-interlaced variety with a landscape display.

Both the 15- and the 19-

inch monitors have a video amplifier bandwidth of 750 MHz and a horizontal scan frequency of 210 kHz, the company claims. That compares to standard video amplifier bandwidths on other high-resolution monitors of 100 or 150 MHz. Standard horizontal scan frequencies for VGA monitors are 31.5 kHz and are 35.5 kHz for monitors adhering to the 8514/A specifications.

The high resolution is also the result of a new CRT concept, which involves mounting a high-precision electron gun to a glass bulb, Flanders says. Hughes Aircraft also contributed a new paper-white phosphor that's optimized to produce a flicker-free display. In cooperation with Discom, Flanders developed a yoke capable of handling more than 15 A of deflection current at the horizontal scan frequency of 210 kHz.

The custom controller will emulate EGA, which also makes it compatible with Hercules, Flanders says. But there won't be initial support for VGA or 8514/A standards.

You'll need to purchase your operating system (DOS) and your graphics environment (Microsoft Windows or GEM Ventura) separately; Flanders' first video controllers fit inside the monitor.

OEMs are developing proprietary controllers for both the IBM PC and Macintosh markets, the company says. Flanders also plans to release a SCSI-based controller and DOS-based software in October.

Price: \$3490; 19-inch, \$4490; controller, \$3000 to \$3500; total 19-inch system, under \$7000.

Contact: Flanders Research, Inc., 88 Bartley Sq., Suite C-6, Flanders, NJ 07836, (201) 584-0116.

Inquiry 1118.

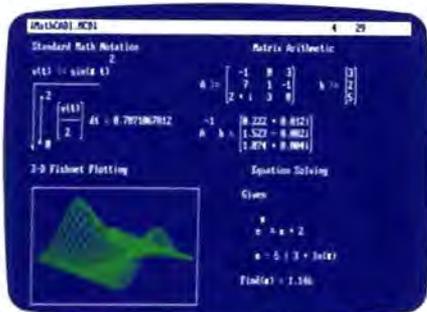
continued

After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell.

Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.

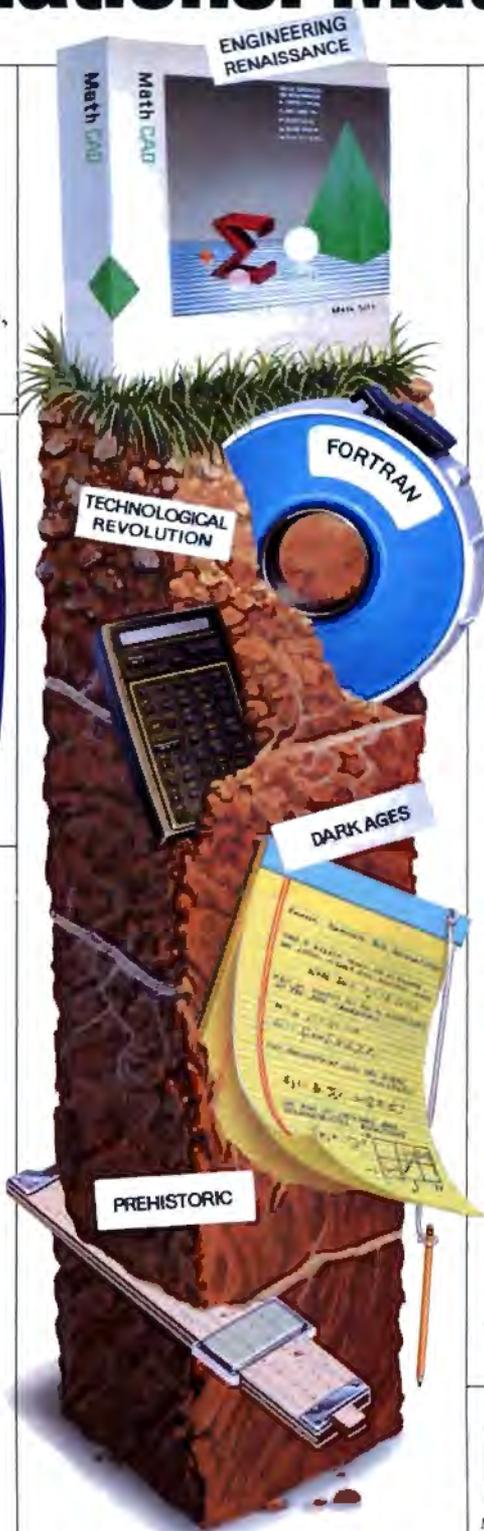


MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

And now we've made the best even better. MathCAD 2.5 is a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, and the ability to import HPGL files from most popular CAD programs, including AutoCAD.[®] And now you can print on PostScript[®] compatible printers.

And like before, MathCAD's live document interface™ lets you enter



equations anywhere on the screen, add text to support your work, and graph the results. Then print your analysis in presentation-quality documents.

It has over 120 commonly used functions built right in, for handling equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 50,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists, and economists.

But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."



March 14, 1989 issue.
Best of '88
Best of '87

And for Macintosh[®] users, we present MathCAD 2.0, rewritten to take full advantage of the Macintosh interface. Entering operators and Greek letters into equations is pure simplicity!

Look for MathCAD 2.5 at your local software dealer, or give us a call. For more information, a free demo disk, or upgrade information, dial 1-800-MATHCAD (in MA, 617-577-1017).

**If you purchased MathCAD 2.0 between 5/1/89 and 6/16/89, you can get a FREE upgrade to version 2.5 (otherwise, the upgrade cost is \$99.00 until June 30, 1989; afterwards, the cost will be \$149.00).*

MathCAD[®]

MathSoft, Inc. One Kendall Square, Cambridge, MA 02139

MFLOPS at RISC

The PL1250 32-bit Floating-Point Array Processor from Eighteen Eight Laboratories will give you 12.5 million floating-point operations per second, 50 percent more than the company's previous version.

The PL1250 also comes with software that will manage up to eight PL processors in a single system, which provides a capacity of 100 MFLOPS, Eighteen Eight claims.

Key to the board's performance is a 16-bit RISC processor. It has 21 16-bit registers and completes nearly all instructions in a single 160-ns cycle time. And because DRAM memory can't support the memory-access rates required by the RISC chip, each board has 60K bytes of on-board static memory.

To best use the board's parallel-processing capabilities, Eighteen Eight includes support software in the basic package. You write a FORTRAN, C, or Pascal control program that calls fundamental library routines supplied by the PL processor.

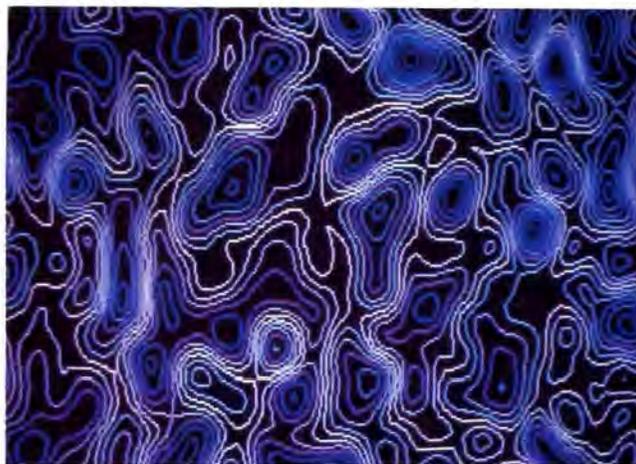
The library comprises 473 routines that perform logical and arithmetic operations on arrays, vectors, and matrices in PL memory. Typical control programs first transfer data to PL memory, make calls to operate on the data in PL memory, and finally transfer results to the host system for display or storage.

You can run the PL1250 on XT's, AT's, and compatibles through an 8-bit bus slot.

Price: \$2695.

Contact: Eighteen Eight Laboratories, 771 Gage Dr., San Diego, CA 92106, (619) 224-2158.

Inquiry 1129.



The PL1250 can provide one 100 MFLOPS for every XT.

Voice Processing Takes Two Steps

In separate developments, two companies recently introduced speaker-independent speech-recognition systems for personal computers. Voice Processing contributed an intelligent board that doesn't need to be taught and lets your AT hear better, even over noisy telephone lines. Meanwhile, Scott Instruments introduced a low-priced

traditional system (i.e., it needs to be taught) that can theoretically recognize 160 different words.

Voice Processing's VPC 1000 is a board for your IBM PC AT that works with your telephone to recognize up to 13 spoken words. And unlike most voice-recognition systems, the VPC 1000 doesn't need hours of programming with live voice samples.

It works even if the words are spoken without pause over noisy telecommunications

lines. Voice Processing claims that the VPC 1000 can recognize "all American English dialects by adult speakers."

The board comes with an 80386, 1 megabyte of memory, the TMS320C25 signal processor chip, and speech-recognition software. It installs in a single slot and has a standard RJ-11C connector.

It recognizes "yes," "no," and the words for the first 10 digits in our decimal system, including "oh" and "zero."

Price: \$5500.

Contact: Voice Processing Corp., One Main St., Cambridge, MA 02142, (617) 494-0100.

Inquiry 1123.

The need for sophisticated voice-recognition systems in both training and telephone applications spawned Scott's SIR Model 20 voice-recognition board.

It's a full-length 16-bit card with a TMS320C25 running at 40 MHz, an application-development software package, a microphone headset, and a reference manual.

Recognition speed is rated at 95 ms if it's loaded with a 40-word vocabulary. A 64,000-word vocabulary (including samples from all the dialects it needs to recognize) can be accessed in 120 ns, according to Scott.

There is, however, quite a long and steep learning curve to use this board. The company says it will take one person about two weeks to organize voice samples from 50 people. If organized correctly and with enough different types of samples, the accuracy rate can approach 95 percent, the company says. **Price:** \$2495; board only, \$1495.

Contact: Scott Instruments Corp., 1111 Willow Springs Dr., Denton, TX 76205, (817) 387-9514.

Inquiry 1124.

Audio F/X Creates Sound Effects

The Audio F/X is an 8-bit audio board for your XT or AT that inexpensively combines music, MIDI, and digital recording and playback.

Using special software drivers, you can create sound effects such as ocean waves, jet engines, footsteps, and almost anything imaginable, Forte claims. Or you can create music in stereo and teach the fundamentals of music theory, including pitch differentiation, note recognition, and attack, decay, sustain, and release.

You can play up to six voices simultaneously and support digital recording and playback at sampling

rates greater than 40 kHz. On-board amplifiers let you cable directly to stereo speakers.

Included with the board are three software packages. Sonata is a music software editor that helps you create and edit musical scores using as many as six independent instruments.

Sound Editor is a digital editor for direct manipulation of sound waveforms. Syncom is an interpretive language that lets you experiment directly with sound effects.

Price: \$299.

Contact: Forte, 72 Karenlee Dr., Rochester, NY 14618, (716) 427-8595.

Inquiry 1126.

continued

If You Want To Talk Fast DBMS Call 1-800-db_RAIMA And Start Screaming

You'll be screaming, all right. db_VISTA III from Raima Corporation combines the flexibility of a relational DBMS and the lightning speed of the network database model.

C db_VISTA III is written for C Programmers.

Source code available. The interactive database utilities and outstanding documentation make db_VISTA III easy to learn. All applications are portable to VMS, UNIX, OS/2, MS-DOS, even Macintosh. No royalties.

db_VISTA III is *Fast*. Using benchmarks originated at PC Tech Journal Laboratories, db_VISTA III measured *3 to 12 times faster than the average relational database!* Call us and we'll send you the results.

Relational and Network Model Technology for Programming Flexibility.

Retrieve a record fast using the relational keyed access method

db_VISTA III Database Development System		
Features	Yes	No
db_VISTA 3.1 High Performance DBMS:		
Single and Multi-User available	✓	
Relational B-tree Indexing	✓	
Network Database Model	✓	
Multiple database access	✓	
Referential integrity	✓	
Automatic recovery	✓	
Record & File locking	✓	
RAM resident		✓
db_QUERY 2.1 SQL-based Query:		
Relational Query & Report Writer	✓	
db_REVISE 1.0 Database Restructure Program:		
Total database redesign/restructuring	✓	
Operating Systems*: VMS, ULTRIX, UNIX	✓	
BSD 4.2, SunOS, XENIX, MS-DOS,	✓	
Macintosh and MS Windows, OS/2 compatible	✓	
C Compilers*: Most compilers supported	✓	
C++ compatible	✓	
LANs*: 3COM, Novell, Banyan, AppleShare	✓	
WKS Library:		
Read & Write WKS, WK1 & DBF files	✓	
SOURCE CODE AVAILABLE:	✓	
ROYALTIES: (Absolutely not!)		✓✓

*Other environments are supported; call for complete list.

and all related records can be immediately available using the network model. You decide how to combine these for best application performance.



SQL Support with SQL-based db_QUERY, db_VISTA III's relational query and report writer.

db_VISTA Puts You in Some Fast Company.

Thousands of C programmers in over 50 countries worldwide use db_VISTA III, including APPLE, ARCO, AT&T, EDS, Federal Express, Hewlett-Packard, IBM, NASA...

Don't wait. Call Raima for more information about how you can build applications that are *screaming-fast!*

Call 1-800-db_RAIMA
(That's 1-800-327-2462)

db_VISTA III™
Database Development System

RAIMA™
CORPORATION BY99



Smalltalk/V.®

Designed to blow the doors off the hybrid languages of the programming world.

Smalltalk/V does prototyping the same way Shelby prototyped the Cobra... using a blend of technical expertise and seat-of-the-

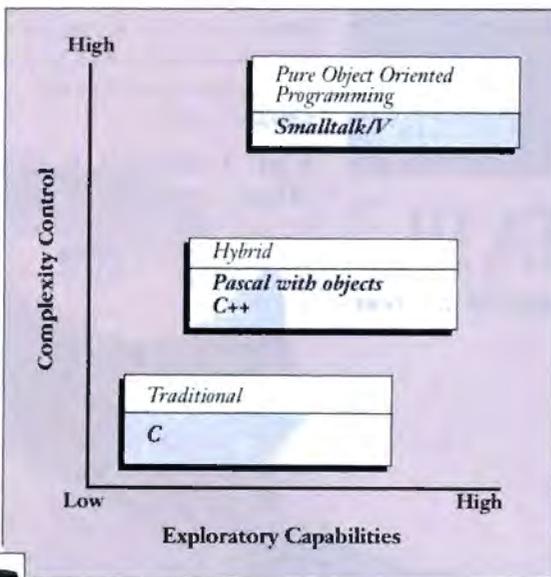


“Anyone can build a prototype by the seat of your pants.” — CARROLL SHELBY
Creator of the legendary Shelby Cobra

pants savvy that's startlingly sophisticated. First you doodle, design, dream. Then you explore the possibilities and begin to assemble the

prototype. You test. You tinker. You change. And you keep on changing and test-driving and refining until the prototype is just the way it was

achieve this feat without once having to go through the old “crash and burn” kind of programming so common with languages born in the age of mainframes.



meant to be. With no compromises... of any kind. But the most remarkable thing is this prototype is not just a prototype. It runs, it races, it performs like the real application. Because it is the real application. And you

COMPLEXITY CONTROL FOR THE 1990s AND BEYOND.

The concept behind an object-oriented programming system is relatively simple. You build more complex objects out of simpler ones. Much as you can build complicated designs with a Lego set. With Smalltalk/V a programmer can write a piece of code and then





C accents in the winner's circle. Cobra. His philosophy was simple and salty. Just the name of it struck fear into the hearts of race car drivers of the '60s. Le Mans. Sebring. Targa Florio. Suddenly a Texas drawl was replacing Italian matter whether you're building an outhouse or a cat. You don't compromise."

THE "AM I READY FOR SMALLTALK/V" CHECKLIST

- Does a lot of your work involve prototyping/exploratory programming?
- Are many of your problems difficult to define?
- Are external factors constantly changing?
- Do you like to make changes from insights gathered along the way?
- Do you feel torn between efficiency and conceptual clarity?
- Are you developing for Multi-Finder or Presentation Manager?
- Are you tired of needless crashing?
- Are team projects getting harder to manage and complete on time?
- Has your creativity been intimidated by the rigorous demands of the process?

"Traditional computer languages and interfaces with their structure and detail, have appealed to those of us who are left-brained (more logical and analytical). On the other hand, object-oriented languages and interfaces, with their emphasis on perception and the whole picture, invite those of us

who are right-brained (more artistic and intuitive) to join the computer revolution as well."

—Byte

"Object-oriented programming is the key to the next great transition in personal computing."

—NY Times

book. But you create a legend



With Smalltalk/V your mouse becomes a hot programming tool for either your Mac or your PC. You'll find that Smalltalk/V is souped up with lots of other high performance features, too. The Class Hierarchy Browser, Inspector, Debugger, Class Browser, Method Browser and Walkback window are all standard equipment.

Smalltalk/V you can write a fugue without having to build the piano."

OOPS! LOOK WHAT THE WORLD IS COMING TO.

"The software of the future, OOP promises not only to boost pro-

grammer productivity but also put powerful computing capabilities in the hands of non-techies."

re-use it again and again. The "inheritance" factor lets you create, enhance and refine your applications without constantly having to re-invent the wheel. Or, as one programmer put it, "With

grammer productivity but also put powerful computing capabilities in the hands of non-techies."

—Business Week

Smalltalk/V

AT THESE PRICES IT'S CERTAINLY NOT MONEY THAT'S HOLDING YOU BACK.

Smalltalk/V (DOS 512K RAM)	\$99.95
Smalltalk/V 286 (286 or 386 1.5 MB RAM)	199.95
Smalltalk/V Mac (Plus, SE, II 1.5 MB RAM)	199.95

Smalltalk/V. A product of Digitaltalk Inc., 9841 Airport Blvd., Los Angeles, CA 90045. For information or to find a dealer near you call:

1-800-922-8255
1-213-645-1082
CompuServe 71361,1636

MultiFinder is a trademark of Apple Computer. Smalltalk/V is a registered trademark of Digitaltalk Inc. Prices subject to change without notice.



An UnMouse for Unhappy Mouse Users

Touché, which is being promoted as the UnMouse, is a small touch tablet designed to replace the mouse on Macintosh and IBM-compatible systems (through the Apple Desktop Bus and serial ports, respectively).

The new tablet uses a small, clear glass surface (3 by 4½ inches). The entire tablet is smaller than a paperback book, which lets you place it conveniently near the system keyboard, where it takes up less space than a conventional mouse pad.

Despite its small size, the Touché tablet features a fairly high resolution (1024 by 1024 pixels). With it, you can quickly move the cursor across the screen, draw lines in a graphics program, or select options from a menu. For example, if you touch the top left corner of the touch tablet, the cursor will quickly emerge in the top left corner of your screen. You press a little harder to emulate the mouse-click.

At the flip of a switch, Touché can also execute macro commands. Because the tablet surface is made of clear glass, you can slide a keyboard template under the tablet and use it as an extended keypad, with as many as 70 keys.

Touché was designed in the Macintosh environment to



Touché, a touch tablet with a clear glass surface, provides absolute cursor control and mouse emulation.

take advantage of MacroMaker, the mouse-movement recording function of the Macintosh operating system, MicroTouch says. In conjunction with MacroMaker, for example, you can store a series of touches from Touché that activates a sequence of mouse-clicks triggering specific computer functions. Because of its high resolution and tracing function, Touché can also use MacroMaker to instantly recall your trace of an outline of a map of the U.S., for example.

Despite the lack of a simple MacroMaker equivalent, Touché is also available in an IBM-compatible version.

Both versions include a 5-V, 6- by 6- by 1-inch power supply that mounts on the back of your monitor, six

template pads for user-programmable functions in different applications, and a conductive stylus for drawing and tracing capabilities.

Touché uses the same analog capacitive technology found in MicroTouch's clear glass touchscreen monitors (which recently became available in snap-on versions for XTs, ATs, and Macintoshes). Electrodes on the sides of Touché place a linear voltage field across the screen so that the controller measures the position of a capacitive coupling from a finger or a conductive stylus.

Price: \$235.

Contact: MicroTouch Systems, Inc., 55 Jonspin Rd., Wilmington, MA 01887 (508) 694-9900.

Inquiry 1130.

Project Your Computer Screen Image

Kodak's Datashow 480 projects images from IBM- and Macintosh-compatible personal computers through bottom-lit overhead projectors.

The 14- by 14- by 3-inch unit sits atop the projector (where you previously placed the transparencies), and a separate cord plugs into your video port. The 10-foot cord includes a video port of its own for monitor connection, about 1 foot from the computer end of the Datashow cord. Each Datashow 480 weighs 7 pounds and ships with a 2-pound power transformer.

Whether your video card is color or black and white, the projection pad translates the CGA, EGA, VGA, MCGA, MDA, or Hercules signal into black-and-white images with eight shades of gray and resolution of up to 640 by 480 pixels.

With built-in microprocessors, the projection pad automatically recognizes and locks onto 14 different video signals.

You can also manipulate signals that aren't quite standard, whether by fault of the nearly compatible IBM clone or the nearly compatible graphics card, Kodak claims. Memory on the pad allows you to save this fine-tuning for future use, for up to three additional video signals.

Price: \$1895; cable, \$129.

Contact: Eastman Kodak Co., 343 State St., Rochester, NY 14650, (800) 445-6325, ext. 883.

Inquiry 1131.

continued

Arresdust Filters Your PC

With Arresdust—a three-part system that includes an intake filter, a keyboard cover, and a disk drive filter—there's no need to vacuum dust out of your PC, according to Arresdust Computer Products.

Each polyester foam filter

is ¾-inch thick, is static-resistant, and has adhesive on one side that sticks, peels off, and sticks again and again. Arresdust recommends you change the filters every six months.

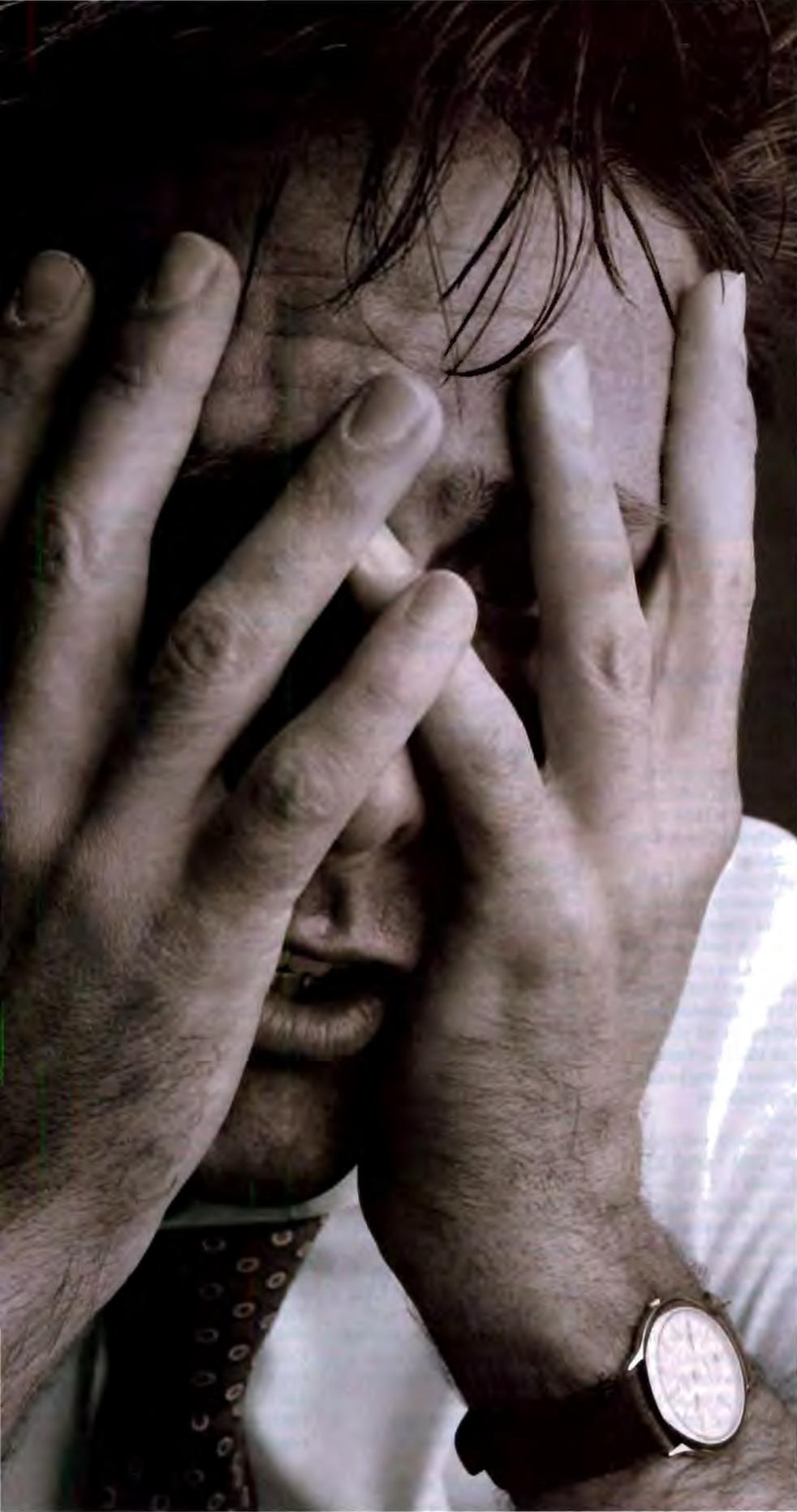
The only thing Arresdust doesn't cover is a bigger fan

to pull air through the filter, and wattage to power the bigger fan.

Price: \$14.95.

Contact: Arresdust Computer Products, 31 Black Horse Pike, Folsom, NJ 08094, (609) 561-4776.

Inquiry 1132.



Okay.

You're using dBASE. You're trying to develop a payroll application for the entire company, and you've just hit the wall. So the first thing you do is try a few workarounds, then some more. And ignore the fact that you don't have any decent back-up and recovery, data integrity, database security or multi-user concurrency.

No big deal. It's only the fate of the company, your closest friends, and their children.

dBASE[®] was the computing environment of the 80's. Back before businesses became dependent on LANs and multi-user applications.

ORACLE is the computing environment for the 90's. From the very beginning, Professional ORACLE[®] was designed for multi-user workgroup applications. Its SQL architecture is built in (not tacked on like dBASE) and includes all the fourth-generation development tools you need to develop applications that run on over 80 different platforms. And every major operating system, even OS/2.[™]

It's so reliable, in fact, that over 47 of the Fortune 50 rely on Professional ORACLE.

You can have Professional ORACLE for \$1,299. Or the Trial Version for \$199.

And if, after 30 days, you're not happy with it, return it for a full refund.

Call 1-800-ORACLE 1, Ext. 4956 to order. And enter the computing environment of the 90's.

ORACLE[®]
Compatibility • Portability • Connectivity

If it's that important, develop with ORACLE on the PC. Call 1-800-ORACLE 1, Ext. 4956.

Offer valid in U.S. only. Professional ORACLE requires: MS-DOS—486/386 PC with MS-DOS V3.1+ hard disk 4MB of memory and 2MB of extended memory required; 2 MB of extended memory is subdivided required for SQL*Report*Ware™ (SR) 2.0/2.02/2.03/2.04 PC or SR 2.1.1+ hard disk 2MB memory; SQL*Report*Ware™ not available for OS/2 and is replaced by SQL*Report*. Copyright © 1989 by Oracle Corporation. dBASE, dBASE IV and dBase III are registered trademarks of Ashton-Tate Corp. IBM, OS/2 and OS/2*Report are registered trademarks of International Business Machines Corp.

Fax Boards Double as Modems

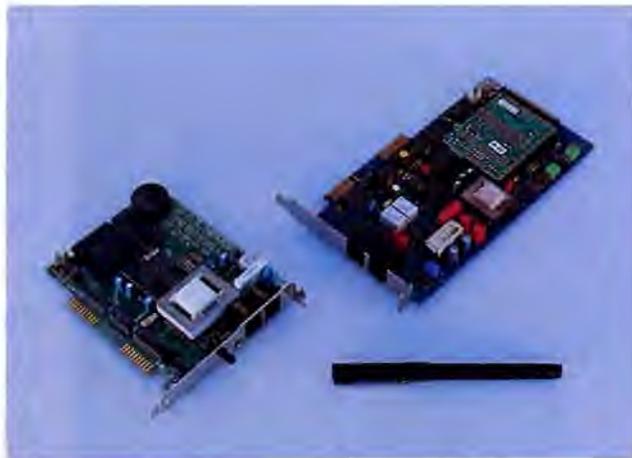
The ComFax is an inexpensive add-in that combines Group II (international) and III fax functions with 9600-bps modem functions. The EconoFax is an inexpensive 4800-bps send-only fax with V.22bis modem compatibility. Both boards fit XT- and AT-compatible slots.

The ComFax uses the less expensive V.29 "facsimile modem" standard as defined by the CCITT, instead of the V.32 modem standard used most often for 9600-bps modem communication. The V.29 standard has traditionally been used in fax machines because most interaction is one-way—they're either sending or receiving. For two-way communications at the V.29 standard, interaction is slowed to between 250 and 500 ms for one keystroke to make the transfer.

CompuCom uses a "fast-train" mode inherent in the V.29 specification, which limits this interaction time to 253 ms. That's a time segment that shouldn't greatly affect BBS communications, for example, the company claims. However, matching ComFaxes on both ends of the transmission are necessary.

Both products feature support for common graphics formats in addition to CompuCom's proprietary noise and data-error reduction algorithm, called Dynamic Impedance Stabilization. The ComFax also features scanner support, mouse support, deferred send and broadcast, and automatic reentry.

Price: EconoFax, \$199; ComFax, \$299.
Contact: CompuCom Corp., 1275 Palamos Ave., Sunnyvale, CA 94089, (408) 732-4500.
Inquiry 1142.



CompuCom's economy fax/modem boards, EconoFax and ComFax.

First OfficeVision Component Is for PCs

The personal computer version of OfficeVision, OfficeVision/2, is IBM's first networked office automation application.

OfficeVision/2 is an OS/2 integrated desktop application that runs in a client/server environment. It looks and acts like (and talks to) similar applications that will be available from IBM for minicomputers and mainframes, all in accordance with IBM's company-wide software strategy called Systems Application Architecture.

OfficeVision/2 will run only under IBM's OS/2 Extended Edition 1.2. A requestor workstation requires 7 megabytes of memory. A server workstation requires 10 megabytes.

Features include E-mail (to and from PS/2s on the same LAN, other IBM LANs, or larger IBM computers); an address book (with both private and public Rolodexes and links to other functions, such as E-mail); a correspondence processor, which is a word processor for writing letters; and

a telephone function for automatic dialing.

Price: \$750.
Contact: IBM Corp.; check your local telephone book's white pages or call (800) 426-2468.
Inquiry 1136.

Serial AIX Communications for the Distance

The PSCC Cluster Controller is a Micro Channel add-in card that supports up to 64 users at distances of up to 2550 feet.

Device drivers are available for several multiuser operating environments, including SCO Xenix, Unix System V, IBM's AIX, Interactive 386/ix, Concurrent DOS, PC-MOS, and others.

Each Cluster Controller includes an 8-MHz NEC V50 microprocessor, 64K bytes of PROM, 256K bytes of RAM, and, most important, a synchronous modem. The modem can support up to four C16 cluster boxes, which support up to 16 users each.

Price: Cluster Controller, \$1295; C16 cluster box, \$1195.
Contact: Computone Products, 1100 Northmeadow Pkwy., Suite 150, Roswell, GA 30076, (404) 475-2725.
Inquiry 1143.

LANalyzer Aims for Rings

A Token Ring version of Excelan's LANalyzer Network Troubleshooter (previously available only for Ethernet networks) has many of the same features.

It's designed to monitor Token Ring network activity, troubleshoot problems, and debug protocol and application software. The Token Ring kit includes LAN-analysis software and an add-in board with an Intel 80286 CPU and 2 megabytes of RAM.

LANalyzer is also available on a portable computer, the NEC PowerMate SX, which features an 80386SX chip, a VGA graphics display, and a 25-ms, 40-megabyte hard disk drive.

With the Token Ring LANalyzer, system administrators can check rotation time to monitor performance and count ring recoveries to spot potential problems. For planning Token Ring changes and additions, LANalyzer can simultaneously send and receive, Excelan says. This allows the user to simultaneously generate a load and monitor its impact.

Buffering packets allow LANalyzer's intelligent controllers to bypass the speed limitations of the AT bus, which will be important when addressing the emerging 16-Mbps Token Ring networks, Excelan said.

Price: \$9980; with PowerMate SX, \$19,995.
Contact: Excelan, Inc., 2180 Fortune Dr., San Jose, CA 95131, (800) 392-3526 or (408) 434-2300.
Inquiry 1139.

continued

Introducing Close-Up/LAN the remote that lets you control all PCs on your network

Call for
FREE
Working
Model!

Close-Up/LAN brings you a level of control never before possible. It connects PCs on your network giving you the versatility to instantly share screens and keyboards. With one PC, or simultaneously with all PCs up and down your network. Close-Up/LAN lets people work together.

Helping people

You're sitting at your PC on the 3rd floor working on a spreadsheet budget. Suddenly, a message appears on your screen: "Bob requests help". You press a hot key, and like magic you are looking at Bob's screen. Without moving an inch you see that Bob is working on the company database. A dialog window appears and Bob explains his problem. Since your keyboard is active you instantly solve the problem, on Bob's computer.

With another hot key you decide to look in on Sue's computer screen. She's new and you need to keep an eye on her work. You see that she is working on a letter using a word-processor. You monitor her for awhile without interfering with her work. In fact, Sue doesn't even know you're there!

Hot key again and off you go on your rounds of the company. Viewing one screen after another, helping some, watching others. All from the comfort of your chair. Finished, you hot key back to your spreadsheet and carry on with your budget. Amazed, you think that support has never been this easy before.

Workgroup Conferencing

As a workgroup problem solving tool, Close-Up/LAN is unsurpassed! Close-Up/LAN lets everyone in your workgroup work as a team. Your associates can chat in a conference, all linked together on screen, no matter how distant the locations. Bring up a spreadsheet, for example, and show your sales projections for all to see. With live keyboards and an instant screen

to screen connection, associates can adjust your figures (optionally at your discretion) for what-if scenarios.

On-Network Meetings?
Close-Up/LAN lets you conference your people over a single network, over bridged networks, or between networks thousands of miles apart. Only one program lets you have your meetings on your network, Close-Up/LAN.

Distributed Processing

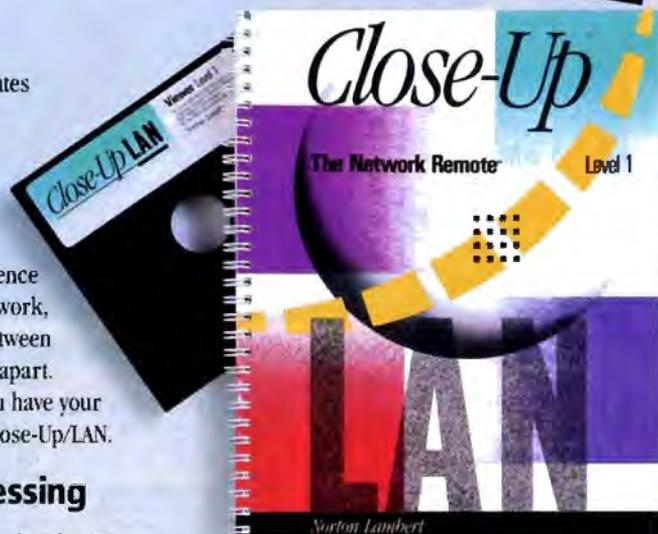
Close-Up/LAN distributes valuable LAN resources to all PCs on your network.

No matter where your PC is located you can access resources such as high speed processors (386's), CD ROM's, plotters, Irma type connections to mainframes, and modem equipped PCs that are connected to your LAN.

It's simple to think of ways to save money with Close-Up/LAN. Attach an inexpensive PC with a modem to your network. Instantly you have a shared communications server. Everyone on the LAN has access to that PC and modem, to run communication programs, terminal emulators, etc. Saving on modem and phone line costs.

Access is only a keystroke away. While working at your word processor, you decide to run a CPU intensive job on a 386 computer located somewhere on your network. Hot key to the 386 and control it as if it were your own. Close-Up/LAN connects your keyboard and screen to the 386. Start your CPU intensive job (like re-indexing a database). Then, hot key back to your wordprocessor. Toggle back, and you can view the 386.

Think of it. You can give everyone on your network the power of all peripherals at a fraction of the cost.



Training & Teaching

Close-Up/LAN lets your students watch on their PCs while you solve problems on your PC. Ideal for corporate and university classrooms. You can then reverse the process. Students work at their own pace while you, at the touch of a key, hop from screen to screen, monitoring their work.

There is only one program that fulfills the promise of your LAN's connectivity. Bringing people and PCs together... Close-Up/LAN.

Close-Up LAN

Call: 805/964-6767

Norton-Lambert

P.O. Box 4085, Santa Barbara, CA 93140 USA
Telex 709170

Programmer's Paradise - when you



WE'LL MATCH NATIONALLY ADVERTISED PRICES.

386 PRODUCTS

	LIST OURS	OURS
386 ASWLINK	495	409
386MAX	75	66
386MAX PROFESSIONAL	129	115
C Network 386 Compiler	995	799
Janus/Ada Pharlap 386 Ed Pak	595	559
Lahey F771-EM/32	895	795
NDP C-386	595	549
NDP FORTRAN-386	595	549
Paradox/386	895	625
VM/386	245	209

ADA

	LIST OURS	OURS
Meridian:		
AdaVantage Developer's Kit	1095	985
AdaVantage PC Prof. Dev. Kit	1780	1599
AdaGraduate	495	445
AdaStudent	50	45
Ada Tutor	150	135
Janus/Ada C Pak	129	115
Janus/Ada Ed Pak	395	369

ASSEMBLY LANGUAGE

	LIST OURS	OURS
Advantage Disassembler	295	279
Incra	180	159
MS Macro Assembler	150	105
MS QuickC w/Quick Assembler	199	139
OPTASM	125	105
SOURCER w/BIOS source	140	125
Turbo Assembler/Debugger	150	105
Visible Computer: 80286	100	89

BASIC LANGUAGE

	LIST OURS	OURS
dbLIB	139	121
Facelt	99	90
GraphPak Professional	149	129
MS BASIC/6.0	295	209
ProBas	135	125
ProScreen	99	94
QuickBASIC	99	69
QuickPak Professional	149	129
QuickWindows Advanced	139	125
True BASIC	100	69
Turbo Basic	100	69

C COMPILERS

	LIST OURS	OURS
C Network Compiler	695	559
Lattice C 6.0	250	199
Microsoft C	450	299
MS QuickC w/Quick Assembler	199	139
QuickC	99	69
Turbo C	150	105
Turbo C Professional	250	175
Zortech C	90	79

C++

	LIST OURS	OURS
Guidelines C++	295	269
M++	495	CALL
Zortech C++	150	129
w/ source	250	209
Zortech C++ Tools	100	89
Zortech C++ Video	CALL	CALL

C CODE GENERATORS

	LIST OURS	OURS
Logic Gem	198	179
Matrix Layout	150	129
PRO-C	675	569

C LIBRARIES/UTILITIES

	LIST OURS	OURS
C ASYNCH MANAGER	175	129
C TOOLS PLUS/5.0	129	99
C Utility Library	199	139
Codan	395	359
Essential Communications	CALL	CALL
Greenleaf Business MathLib	395	279
Greenleaf Comm. Library	299	209
Greenleaf Functions	229	165
Greenleaf SuperFunctions	299	209
Lattice Comm. Library	250	189
Multi-C	249	229
PCYACC	395	359
PC-lint	139	105
PhorCe	395	CALL
Power Search	149	109
TimeSlicer	295	279
w/ source code	1000	899
Turbo C TOOLS/2.0	149	109
vLIB	99	89
WKS Library	195	189
Zip	295	265

C SCREENS/WINDOWS

	LIST OURS	OURS
C-Worthy w/ forms and source	495	439
Greenleaf DataWindows	395	279
Greenleaf Makeform	125	95
HALO Window Toolkit	595	399
HI-SCREEN XL	149	129
HI-SCREEN XL Prof. Series	325	275
JAM	595	529
JAM/DBI	395	339
JYACC FORMAKER	395	339
Panel Plus	495	395
Vermont Views	395	CALL
w/ source code	790	CALL
Vitamin C 3.2	225	165
VCScreen	149	125

COBOL LANGUAGE

	LIST OURS	OURS
Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
COBOL/2 Toolset	900	749
Personal COBOL	149	129
MS COBOL	900	629
Realia COBOL	995	849
w/ RealMENU	1145	979
SCREENIO	400	375
XDB-COBOL (Realia)	595	549
XDB-DB2 Workbench	1500	1399

DATABASE DEVELOPMENT

	LIST OURS	OURS
Clarion	695	589
Clear +	200	175
Clipper	695	439
Codebase IV	295	265
dBASE IV	795	489
dBFAST/DOS	99	90
dGE	195	179
Flipper	195	169
FoxBASE+	395	249
FoxBASE+/386	595	399
Genifer	395	259
Magic PC	299	249
Paradox 3.0	725	509
QuickSilver	599	369

	LIST OURS	OURS
R&R	150	129
R-Base for DOS	725	529
SilverComm Library	189	165
Tom Rettig's Library	100	80
UI Programmer 2	595	CALL

DEBUGGERS

	LIST OURS	OURS
386 DEBUG	195	165
Perscope 1/0K	545	465
Perscope III 10 MHz	1395	1179
Perscope IV/16 MHz	1995	1695
Perscope IV/25 MHz	2595	2205
Sherlock	195	179
Softprobe II/IX	395	345

DOCUMENTATION

	LIST OURS	OURS
AutoFlow-C	299	269
C/Analyst	150	135
Clear + (C)	200	175
C.Lines/C.Tree	80	75
EasyFlow	150	125
FLOW CHARTING II+	229	189
PolyDoc	199	179
Source Print	99	89
Tree Diagrammer	99	89

DOS SHELLS

	LIST OURS	OURS
Magellan	195	CALL
Norton Commander	89	59
ViewLink	150	129

EDITORS

	LIST OURS	OURS
BRIEF	195	CALL
w/ dBRIEF	275	CALL
Epsilon	195	159
KEDIT	150	129
MKS VI	149	129
Multi-Edit	99	89
Norton Editor	75	59
NROFF/PC	99	85
PC/EDIT+	295	269
Pi Editor	149	129
SLICK Editor	195	175
SPF/PC	245	195
VEDIT PLUS	185	115

FILE MANAGEMENT

	LIST OURS	OURS
Brieve	245	185
Brieve for DOS 3.1 Networks	595	459
CBTREE	195	169
C-ISAM	225	209
c-tree	195	315
d-tree	495	399
r-tree	295	239
c-tree/r-tree	650	519
dbc III	250	215
dbc III PLUS	500	435
db FILE Bundle	295	CALL
Essential B-Tree	99	89
w/ source	198	149
FABS Plus	195	175
Informix Products	CALL	CALL
Netware SQL	595	459
pBase	149	135
Turbo Programmer/C	549	449
XDB-C	595	559
XQL	795	599
Xtrieve PLUS	595	459

FORTRAN LANGUAGE

	LIST OURS	OURS
GRAFLIB	175	159
Gratmatic	115	119
Gratmatic/Plomatric	240	219
Lahey F771	595	529
Lahey F771-EM/32	895	795
Lahey Personal FORTRAN 77	95	89
MS FORTRAN	450	299
PLOTHI	175	159
PLOTHP	175	159
Plomatric	115	119
Printmatic	115	119
RM/FORTRAN	595	499
SPINDRIFT Library	149	125
TEKMAR Graphics Library	195	169
WAITFOR FORTRAN	375	349

GRAPHICS LIBRARIES

	LIST OURS	OURS
Baby Driver	250	225
Essential Graphics	299	239
GraphiC	395	329
GSS Graphics Devel. Toolkit	595	509
HALO	395	279
HALO for MS Developers	595	419
PCX Effects	99	90
PCX Programmer's Toolkit	125	115
PCX Text	99	90
Turbo Geometry Library	150	135
XVT	595	509

LANGUAGE DEVELOPERS

	LIST OURS	OURS
LALR	99	90
MKS LEX & YACC	249	209
PCYACC	395	359

LINKERS/LIBRARIANS

	LIST OURS	OURS
LINK & LOCATE ++	395	349
OPTLIB	49	45
OPTLINK	125	115
Plink86plus	495	CALL
PolyLibrarian II	149	135
RTLlink	195	185

LIST OURS

	LIST OURS	OURS
MODULA-2		
LOGITECH Modula-2:		
Compiler Pack	99	75
Development System	249	199
Solid B+ Toolkit	100	90
TopSpeed Modula-2:		
Compiler Kit	100	89
DOS 3-Pack	200	159
TechKit	60	57
VID	60	57

OBJECT-ORIENTED PROGRAMMING

	LIST OURS	OURS
ACTOR	495	429
Language Extension I	99	95
C.talk	150	135
C.talk/Windows	450	379
Smalltalk/V	100	85
Communications	50	45
EGAVGA Color Extension	50	45
Goodies #1, #2 or #3	50	45
Smalltalk/V Mac	200	169
Smalltalk/V 286	200	169

OPERATING SYSTEMS/ CONTROL PROGRAMS

	LIST OURS	OURS
Concurrent DOS 386 (3 users)	395	335
10-User System	495	419
DESQview 386 (w/QEMM)	190	169
QEMM 386	60	55
MS Windows/386	195	136
PC-MOS 386 (single user)	195	179
5 Users	595	539
VM/386	245	209
VM/386 Multi-user	895	759
VM/386 NetPak	150	129
Vmos/3	99	90

PASCAL LANGUAGE

	LIST OURS	OURS
B-tree File	125	99
DATABOSS	399	359
MS Pascal	300	209
Pascal ASYNCH MANAGER	175	129
POWER SCREEN	129	99
Professional Pascal	595	549
QuickPASCAL	99	69
Turbo Analyst	99	79
TurboMAGIC	199	179
Turbo Pascal 5.0	150	105
Turbo Pascal 5.0 Professional	250	175
Turbo-Plus 5.0	150	129
Turbo Power Tools Plus	149	109
Turbo Professional 5.0	125	99

PROFILERS

	LIST OURS	OURS
Codesifter	119	85
Inside!	125	109
Pitersh	395	CALL
Turbo Analyst 5.0	99	79

PROTOTYPING

	LIST OURS	OURS
Dan Bricklin's Demo Program II	195	179
Instant Replay III	150	135
Proteus	149	125
Show Partner F/X	350	319
Soft Demo	69	59

NEW RELEASES

ADA STUDENT

Excellent product from Mendian for learning the Ada language. Includes a compiler and an interactive source level debugger allowing complete control over program execution in high level Ada terms.

List: \$50 Ours: \$45

BABY DRIVER

A linkable function library, from lthaca Street Software, for the graphics application developer. It allows access to over 175 dot matrix, ink-jet, and laser printers. Print screen, or in-memory bit-mapped images. Supports C, Pascal, Modula-2.

List: \$250 Ours: \$225

POWER SEARCH

A library of C functions by Blaise designed to search for character strings or regular expressions in large amounts of data. Critical operations in text editors, database accesses and file searches can be tuned for maximum speed with Power Search.

List: \$149 Ours: \$109

needed it yesterday! (800) 445-7899

OS/2 TOOLS
We're stocking everything the OS/2 Programmer needs, including:

	LIST OURS
Brief	195 CALL
Btrieve	595 459
Greenleaf DataWindows	395 309
HALO	695 489
MKS Toolkit	495 439
MS OS/2 Present. Mgr. Toolkit	500 349
MS OS/2 Present. Mgr. Softset	150 105
Paradox OS/2	725 543
Topspeed Modula-2	195 179
Vitamin C	345 279

UTILITIES

	LIST OURS
1 DIR Plus	95 75
BACK-IT	129 120
Copy II PC	40 35
Copy II PC Option Board	159 139
Disk Technician Advanced	190 159
Disk Technician Plus	130 109
Fast!	99 89
FASTBACK Plus	189 159
HELP ME	99 90
hTest.hFormat	90 80
MACE GOLD	149 129
MACE Utilities	99 85
MKS Toolkit	199 169
Norton Utilities	100 65
Norton Utilities Advanced	150 105
Pathfinder	70 65
PC Fullback	70 59
PC/Tools Deluxe	80 70
V OPT	60 55
Vieature Deluxe	120 109
Vtools	50 47
XENOCOPY-PC	80 70
XTree Pro	129 109

VERSION CONTROL SYS.

MKS RCS	189 159
PVCS (Corporate)	395 359
PVCS (Personal)	149 135
Seidl Version Manager	300 269
TLIB	100 90
TLIB 5 Station LAN	300 259

OTHER LANGUAGES

muLISP-B7 Interpreter	100 219
PC Scheme	95 79
PC/FORTH+	250 225
Personal Rexx	150 129

XENIX/UNIX SOFTWARE

APOGEE Prof. Developers Kit	2000 1799
Aspen Korn Shell	145 109
Basmark QuickKBASIC (186)	695 629
db FILE	CALL CALL
EDIX	275 222
Epsilon	195 159
Informax Products	CALL CALL
Interactive 386/IX	1095 989
IAM (186)	1950 1755
Micro Focus COBOL/2 (186)	1500 2995
Microport Sys. V/386 (comp.)	899 759
Microport Sys. V/AT (comp.)	649 549
MKS Trilogy	119 105
NDP C or FORTRAN	795 749
PANEL PLUS	795 675
SCO 386 XENIX Sys. V (comp.)	1495 1195
SCO XENIX System V (comp.)	1295 999
Terminal Control	995 879

BORLAND

Paradox 3.0	725 509
SideKick Plus	200 139
Sprint	200 139
Turbo Assembler/Debugger	150 105
Turbo Basic	100 69
Turbo C 2.0	150 105
Turbo C 2.0 Professional	250 175
Turbo Pascal 5.0	150 105
Turbo Pascal 5.0 Professional	250 175
Turbo Prolog	150 105
Turbo Prolog Toolbox	100 69

GREENLEAF

Greenleaf Bus. MathLib, DOS	395 279
Greenleaf Comm. Library	299 209
Greenleaf DataWindows, DOS	395 279
Greenleaf Functions	229 165
Greenleaf MakeForm	125 95
Greenleaf SuperFunctions	299 209
Greenleaf ViewComm	559 475

IGC

VM/386	245 209
VM/386 Multi-User	895 759
VM/386 NetPak	150 129

LAHEY

Lahey F77L	595 529
Lahey F77L-EM/16	695 649
Lahey F77L-EM/32	895 795
Lahey/Al OS/386	195 179
Lahey Personal FORTRAN w/ Toolkit	95 89
	119 105

MEDIA CYBERNETICS

Dr. HALO III	140 101
HALO	395 279
HALO for MS Developers	595 419
HALO for OS/2	695 489
HALO for two languages	545 389
HALO Programmer's Workbook	80 59
HALO Window Toolkit	419 359

MICROSOFT

MS BASIC/6.0	295 209
MS C	450 299
MS COBOL	900 629
MS Excel	495 299
MS FORTRAN	450 299
MS Macro Assembler	150 105
MS Mouse Bus or Serial w/ EasyCAD	175 125
w/ Paintbrush & Mouse Menus	150 105
w/ Paintbrush & Windows	200 139
MS OS/2 Present Mgr. Toolkit	500 349
MS OS/2 Softset	150 105
MS Pascal	300 209
MS QuickBASIC 4.5	99 69
MS QuickC 2.0	99 69
MS QuickPASCAL	99 69
MS Sort	195 139
MS Windows	99 69
MS Windows/386	195 136
MS Windows Development Kit	500 349
MS Word 5.0	450 285

MORTICE KERN SYSTEMS

MKS Awk	99 85
MKS Lex and Yacc	249 209
MKS Make	149 129
MKS Make for OS/2	249 219
MKS RCS	189 159
MKS SoftQuad Publishing Sys.	495 469
MKS Toolkit	199 169
MKS Toolkit for OS/2	495 439
MKS Vi	149 129
MKS Vi for OS/2	199 175

NOVELL

Btrieve Single-User	245 185
Btrieve for DOS 3.1 Networks	595 459
Btrieve for OS/2	595 459
Btrieve for XENIX	595 459
C Network Compiler	695 559
C Network 386 Compiler	995 799
NetWare C Interface for DOS	295 239
NetWare MHS	100 79
NetWare MHS Interface Guide	145 129
NetWare RPC	950 759
NetWare RPC for OS/2	1750 1399
NetWare SQT	595 459
NetWare System Calls for DOS	195 159
XQL	795 599
Xtrieve PLUS	595 459
Xtrieve PLUS for OS/2	595 459

PROGRAMMER'S POLICIES

Phone Orders

Hours 9 AM-7 PM EST. We accept MasterCard, Visa, American Express. Include \$4.00 per item for shipping and handling. All shipments by UPS ground. Rush service available.

Mail Orders

POs by mail or fax are welcome. Please include phone number.

International Service

Phone number required with order. Call or fax for additional information.

Dealers and Corporate Accounts Call for information.

Unbeatable Prices

We'll match nationally advertised prices. (Subject to same terms and conditions.)

Return Policy

30-day no-hassle return policy. Some manufacturer's products cannot be returned once disk seals are broken.

LIST OURS

VM/386

"VM/386 should be considered mandatory software as important as MS-DOS." ... Computer Language 10/88



VM/386, PC Magazine Technical Excellence Award Winner, lets you create "virtual machines," each running its own MS-DOS application so you save valuable time while maximizing the performance of your 386 PC. Time consuming tasks like compiling code and running bulletin boards no longer tie up your PC, because they run simultaneously. VM/386 offers the highest level of data integrity and software compatibility available in a multi-tasking operating environment. Order your copy today!

IGC

Special Price: \$209

LAHEY F77L FORTRAN

VERSION 4.0

Lahey's award winning F77L compiler just got better! The 4.0 release includes a new programming environment with an editor, profiler, linker, and make utility. F77L is the only real-mode FORTRAN compiler that has Weitek support and 32-bit 80386 code generation. F77L 4.0 also includes video graphics, DO WHILE and END DO statements, and additional VAX and IBM VS functions. For porting mainframe code or for development, F77L has the features professionals need. Full ANSI 77, debugger, fast compilation, Microsoft and Borland C interfaces, unbeatable diagnostics, and popular mainframe features.

Special Price: \$529



HALO WINDOW TOOLKIT

The first graphical interface tool for the DOS environment. This versatile tool allows software developers to concentrate on development of the application's function rather than on development of the interface itself.



- Object-oriented design lets you copy windows and place them in any size or color anywhere on the screen without additional code or data overhead
- Includes all HALO functions
- Practical time-saver for Microsoft C Programmers
- Provides a source code compatible development path to target both DOS and OS/2 operating environments

MEDIA CYBERNETICS

Special Price: \$359

C NETWORK COMPILER

Novell's C Network Compiler gives you a direct programming link into NetWare, the leading network operating system with the world's largest installed base of network application users. This complete development kit includes a powerful ANSI C optimizing compiler, the Express C Compiler, an enhanced text editor, a C graphics library, a high performance linker, a windowing debugger, and other utilities plus the whole library of NetWare application programming interfaces, including the Btrieve record manager.

Special Price: \$559



In NY: 914-332-4548
Customer Service: 914-332-0869
International Orders: 914-332-4548
Telex: 510-601-7602

Fax: 914-332-4021

Call or Write for Latest Free Catalog!

1-800-445-7899
Programmer's Paradise

A Division of Voyager Software Corp
55 South Broadway, Tarrytown, NY 10591

Circle 231 on Reader Service Card



Apple Branches Out to Token Ring and Ethernet

At the core of Apple Computer's "Phase 2" connectivity blitz are three products that allow communication between LocalTalk, Ethernet, and Token Ring LANs using new AppleTalk protocols and industry-standard cabling.

The TokenTalk NB (Nu-Bus) Card is a Token Ring-compatible (IEEE 802.5) card with the Texas Instruments 4-Mbps chip set for use with IBM's wiring scheme; thus, it supports shielded and unshielded twisted-pair cabling. It includes a TokenTalk software driver to support the new AppleTalk protocols and to provide a file transfer utility that will give the Mac II access to IBM PC LAN program Server Message Block (SMB) file servers.

The EtherTalk NB card is an Ethernet-compatible (802.3) Macintosh card for plug-and-play 10-Mbps communications over thin coaxial cabling. As with most Ethernet cards, you need to purchase separate transceivers if your installation involves thick coaxial or unshielded twisted-pair cabling. An Ethernet software driver ships with this card.

The AppleTalk Internet Router, a software bridge, ties it all together into a transparent network that can be theoretically larger than is realistically possible. EtherTalk for A/UX and Mac X.25 upgrades are scheduled to ship before year's end.

Price: AppleTalk Internet Router, \$399; TokenTalk NB Card, driver, and SMB, \$1250; EtherTalk NB Card, \$699.

Contact: Apple Computer, Inc., 20525 Mariani Ave., Cupertino, CA 95014, (408) 996-1010.
Inquiry 1135.

DCA's 10Net Goes Beyond Tempest

The first of four upgrades to take DCA's peer-to-peer Ethernet network beyond Tempest specifications allows any node to encrypt data on its individual disk subsystems. The end result, DCA says, will be the 10Net Secure LAN, a hardware-based data security and Data Encryption Standard encryption system for microcomputers.

The first phase provides "single-keyed" encryption and provides that the information is encrypted as it is written to the PC's hard disk drive and also as it is transmitted over the network. It features protection against browsing in private files, modifying and removing information and data, duplicating software, and unauthorized use of applications.
Price: \$1595.

Contact: Digital Communications Associates, Inc., 7887 Washington Village Dr., Dayton, OH 45459, (513) 433-2238.
Inquiry 1137.

Network Inspector Makes Hardware Installation Easier

The Network Inspector is a LAN analyzer and diagnostics software package. It provides network operating-system drivers and aids installation with a color graphics help screen before it performs simple node diagnostics. It's compatible with Ethernet, Token Ring, and ARCnet.

It includes such things as

cable break detection, single-node and multinode addressing tests, and dynamic performance measurement (such as network loading measurement) with graphics. One unusual feature is a software implementation of a time domain reflectometer.

Price: \$1000.

Contact: Tiara Computer Systems, Inc., 2700 Garcia Ave., Mountain View, CA 94043, (415) 965-1700.
Inquiry 1140.

Careful, Big Brother Is Watching

Close-Up/LAN is a TSR program that carries the benefits of "workgroup computing" to all the workstations on your LAN.

It's topology-independent, Norton-Lambert claims, and will work with either NetBIOS or IPX protocols.

Close-Up/LAN lets a single-host workstation connect to and remotely control any other single workstation on the LAN. (Optional versions transcend some bridges.) There's a "chat window" for two-way communications. Basically, Close-Up/LAN lets any number of workstations simultaneously work together on individual applications.

Close-Up/LAN also has a monitoring feature that allows a manager to "watch" what any workstation on the LAN is doing, without the operator's knowledge.

Price: Two-user, \$395; eight-user, \$795; 16-user, \$995; 32-user, \$1495; 64-user, \$1995.

Contact: Norton-Lambert Corp., P.O. Box 4085, Santa Barbara, CA 93140, (805) 964-6767.
Inquiry 1138.

GlobalView Lets You Configure Remote Modems

GlobalView is a PC-based network management system, similar to products found in LANs but applicable to modems and, therefore, wide-area networks. It provides much of the same functionality previously available only by leasing lines from the telephone companies.

What you see is Microsoft Windows-based network management software and an equipment rack for as many as 512 GlobalView-compatible modems. Initially, GlobalView software lets you remotely monitor and configure Universal Data Systems' V.22bis dial-up modems anywhere in the United States. Support for other modems is planned.

From your control station, you can determine if a particular modem is on-line, off-line, busy, ringing, dialing, in test mode, or under testing. You can also reconfigure remote modems for data rate and communications protocol, and you can run remote diagnostics. Of course, your results can be printed and manipulated for statistical analyses.

A user-friendly system map lets you examine your network configuration and organize it by address or by type of device. Universal Data Systems recommends an 80286 with a 20-megabyte hard disk drive, EGA graphics, and a mouse. The rack-mounted modem uses either an RS-422 or RS-232C interface.
Price: \$6000.
Contact: Universal Data Systems, 5000 Bradford Dr., Huntsville, AL 35805, (205) 721-8000.
Inquiry 1141.

continued

"SCO Sets UNIX Standard for PCs."
—COMPUTER DEALER NEWS (L.K.)

First, they built the
world's standard.

Then they added standards
no one else had.

And that was just
the beginning.

THE SANTA CRUZ OPERATION, INC. PRESENTS

UNIX NOW!

THE SCO LEGEND CONTINUES

AN SCO™ PRODUCTION IN EXCLUSIVE ASSOCIATION WITH MICROSOFT CORPORATION AND AT&T - SCO'S BLOCKBUSTER 3.2 RELEASE OF UNIX™ SYSTEM V/386 FOR ISA, EISA, AND MCA SYSTEMS "UNIX NOW!"

STARRING FIPS POSIX™ - X/OPEN™ - C2 TRUSTED SECURITY - MICROSOFT™ C, MASM, AND CODEVIEW™

CO-STARRING AT&T FILE SYSTEM SWITCH, STREAMS, SHARED LIBRARIES, PCC, AND SDB - BERKELEY SELECT - DOS, OS/2,™ AND XENIX™ CROSS-DEVELOPMENT - COMPUTER GRAPHICS INTERFACE
ONLINE MANUALS - EXTENSIBLE CONSOLE, MOUSE, AND SCSI DRIVERS - ALL SCO XENIX FEATURES INCLUDING MULTISCREEN™, SERIAL CONSOLE, AND AUTOMATIC POWER FAIL RECOVERY

AND INTRODUCING AUTOMATIC INSTALLATION - ACER™ FAST FILE SYSTEM - TRANSPARENT DOS FILE SYSTEM - DEVICE DRIVER WRITER'S GUIDE (WITH ANNOTATED SAMPLE SOURCE CODE)

SYSADM SHELL AS THE EASY-TO-USE SYSTEM MANAGER - MULTIPLE GROUPS, JOB CONTROL, AND RELIABLE SIGNALS AS THE FIPS POSIX EXTENSIONS - MMDF II AS THE MAIL DELIVERY AGENT

SUPPORTING CASE SCO EROFF™ - SCO MULTIVIEW™ - SCO XSIGHT™ X WINDOW SYSTEM™ - SCO NFS™ - SCO TCP/IP - SCO VP/ix™ - SCO uniPATH™ SNA-3270

PLUS HUNDREDS OF SUPPORTED PERIPHERALS INCLUDING TERMINALS, PRINTERS, SERIAL CARDS, TAPE DRIVES, AND ST506, RLL, ESDI, AND SCSI CONTROLLERS

PLUS THOUSANDS OF PROVEN APPLICATIONS SUPPORTED EXCLUSIVELY IN SCO SYSTEM V INCLUDING THE SCO PORTFOLIO™ FAMILY, SCO FOXBASE+™, MICROSOFT WORD, AND AutoCAD®

PRODUCED, DEVELOPED AND DIRECTED BY THE SANTA CRUZ OPERATION, INC. "UNIX" TRADEMARK CONFORMANCE SPECIFICATION BY AT&T

NOMINATED FOR MOST OPEN-SYSTEM STANDARDS! ★ EASIEST-TO-USE UNIX SYSTEM! ★ FASTEST 386/486 UNIX SYSTEM! ★ BEST XENIX COMPATIBILITY!
MOST APPLICATIONS SUPPORTED! ★ MOST PERIPHERALS SUPPORTED! ★ MOST COMPLETE DEVELOPMENT SYSTEM! ★ BEST INTERNATIONALIZATION!
BEST UNIX SYSTEM DOCUMENTATION! ★ BEST SUPPORT! ★ BEST TRAINING! ★ BEST WORLDWIDE DISTRIBUTION! ★ MOST WORLDWIDE OEM SUPPORT!

OS OPEN SYSTEM
RECOMMENDED FOR AUDIENCES
WITH STANDARDS

SCO
THE SANTA CRUZ OPERATION

**OPEN
DESKTOP.**
IS BASED ON SCO UNIX SYSTEM V/386

SCO, the SCO logo, MultiScreen, SCO MultiView, SCO Portfolio, Open Desktop, and the Open Desktop logo are trademarks of The Santa Cruz Operation, Inc. • UNIX is a registered trademark of AT&T in the USA and other countries. • POSIX is a trademark of The Institute of Electrical and Electronics Engineers (IEEE). • X/Open is a registered trademark of X/Open Company Ltd. • Microsoft, CodeView, and XENIX are registered trademarks of Microsoft Corporation. • OS/2 is a registered trademark of International Business Machines Corporation. • Acer is a registered trademark of Acer International. • Erolf is a trademark of Elan Computer Group, Inc. • Xsight is a registered trademark of Lotus Computing Corporation. • X Window System is a trademark of Massachusetts Institute of Technology. • NFS is a trademark of Sun Microsystems, Inc. • VP/ix is a trademark of Phoenix Technologies Ltd. and Interactive Systems Corporation. • uniPATH is a trademark of Pathway Design, Inc. • FoxBASE+ is a trademark of Fox Software, Inc. • AutoCAD is a registered trademark of Autodesk, Inc.
©MCMXXIX The Santa Cruz Operation, Inc. All Rights Reserved. The Santa Cruz Operation, Inc., 400 Encinal Street, P.O. Box 1900, Santa Cruz, California 95061 USA. The Santa Cruz Operation, Ltd., Croyley Centre, Hatters Lane, Watford WD1 8YN, Great Britain.
• 44(0)923 816344. FAX • 44(0)923 817781. TELEX • 917372 SCOLDN G

NOW SHOWING AT AUTHORIZED SCO RESELLERS!

(800) SCO-UNIX (726-8649)

(408)425-7222

FAX: (408)458-4227

E-MAIL: ...!uunet!sco!info info@sco.COM

Circle 257 on Reader Service Card

**OPEN
DESKTOP.**

**WORLDWIDE TECHNICAL SEMINARS FOR DEVELOPERS
CALL SCO'S OPEN DESKTOP™ SEMINAR HOTLINE TODAY!**

SuperCard: HyperCard with a Kick

Silicon Beach's SuperCard lets you create custom applications that are similar to HyperCard's but conform to the Macintosh user interface. Unlike HyperCard, which limits you to one image in a window that you can't modify, SuperCard lets you create applications with resizable windows and dialog boxes, multiple documents open simultaneously, and custom menus.

Because SuperCard uses a scripting language called SuperTalk, a superset of HyperTalk, you can open HyperCard stacks, HyperTalk scripts, XCMDs, and XFCNs and convert them to SuperCard projects. Once you've created a project, you can save it as a stand-alone application that doesn't need SuperCard to run.

SuperCard fields can contain mixed fonts and sizes. The program can import and export TIFF, PICT, PICS-format animations, and MacPaint files. SuperCard also supports sound and video and 256-color Paint and Draw graphics. SuperCard requires 1 megabyte on a Mac Plus or higher to run in black and white, and 2 megabytes on a Mac II or higher to run in color.

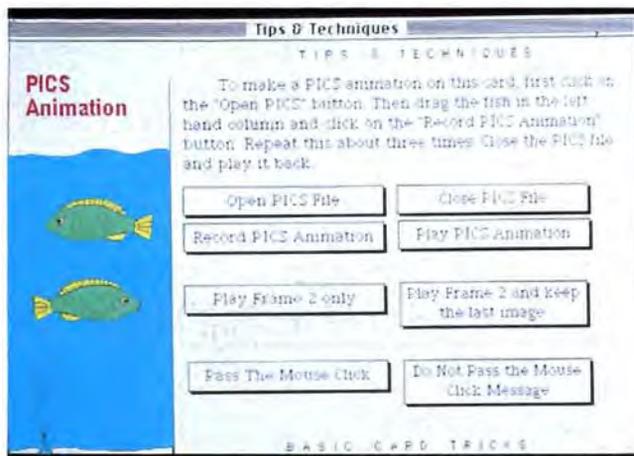
Price: \$199.

Contact: Silicon Beach Software, 9770 Carroll Center Rd., Suite J, San Diego, CA 92126, (619) 695-6956.

Inquiry 1148.

Build Your Own GUIs

The HALO Window Toolkit is based on Media Cybernetics' HALO and offers a set of windowing subroutines that help you design



Create multimedia presentations with SuperCard by mixing animation, sound, and video.

graphical user interfaces.

The Toolkit consists of a Window Manager and a Window Library. The Manager controls interactions between you and the windows, such as sizing, placing, and saving functions. The Library contains windowing tools, such as command bars, radio buttons, and icons.

The Toolkit has an object-oriented design, so you treat windows as objects, which enables you to copy and place them in any size or color anywhere on the screen without additional source code.

The memory manager has a look-ahead feature that automatically uses extended, expanded, or disk-cached virtual memory to maintain an image, so you don't have to keep a copy of the image to be redrawn after the interface removes a window.

Media Cybernetics reports that the HALO Window Toolkit runs under DOS and OS/2. All you need is the appropriate Microsoft C HALO (for DOS or for OS/2) to run in either environment.

Price: \$595.

Contact: Media Cybernetics, Inc., 8484 Georgia Ave., Silver Spring, MD 20910, (301) 495-3305.

Inquiry 1146.

Get to the Bottom of Your C

After spending all your time putting the finishing touches on a C program, the last thing you want to do is document the code. Clear+ for C is a program that will do it for you.

Clear+ for C reads your C source code and automatically generates a system tree chart, function flowchart, formatted source listing, function cross-references, and prototype files. The tree chart represents the hierarchical relationship between all functions in the system and shows structure of up to eight levels. The flowchart shows the logical structure and control flow of the program's statements.

The program uses a WYSIWYG approach. It also offers automatic paging, allows for background printing and portrait and landscape page orientation, and offers a variety of graphics options.

Clear+ for C runs on the IBM PC with DOS 2.0 or higher, 512K bytes of RAM, and Hercules, CGA, EGA, or VGA graphics.

Price: \$199.95.

Contact: Clear Software, Inc., 637 Washington St., Suite 105, Brookline, MA 02146, (617) 232-4720.

Inquiry 1145.

Object-Oriented C Programming on the Mac

Symantec developed Think C 4.0, a programming environment for the Macintosh, so that C programmers can get the benefits of object-oriented programming without having to learn a new language, such as C++ or Smalltalk.

Think C's object syntax is based on a subset of C++, and its object extensions are built on structures that any C programmer already knows.

With Think C's enhanced code resource support, you can write cdevs (control panel devices) and multisegmented code resources. The program includes an object-oriented shell that provides the basic code necessary to create a cdev, and a cdev Runner is included for debugging. The Runner provides a shell that lets you fake the system into thinking you have installed the cdev.

Think C 4.0 includes a full source-level debugger and a class library. Because the library implements the standard Mac user interface, including floating windows and tear-off menus, you don't have to waste time reinventing the wheel by re-creating common code. Symantec also rewrote the Think C libraries to conform to the ANSI standard.

Think C's in-line assembler, which lets you use assembly language within your source files, supports the instructions and addressing modes of the 68020 and 68881 coprocessor.

Price: \$249.

Contact: Symantec Corp., 135 South Rd., Bedford, MA 01730 (617) 275-4800.

Inquiry 1147.

continued

SEND AWAY FOR YOUR VERY OWN COMPUTER STORE.

When you buy a computer, about 35% of your money goes to the store.

But we'd much rather see your money go to somebody who deserves it a lot more.

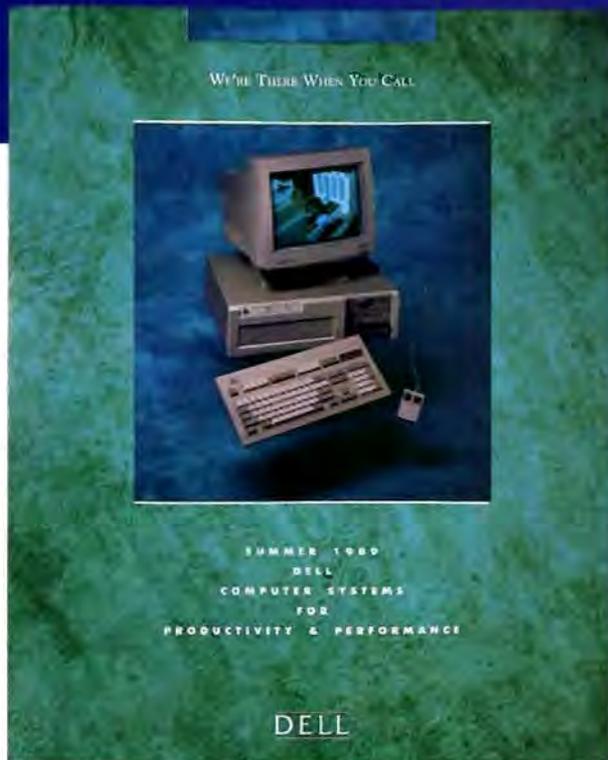
You.

So we give you a completely different kind of computer store.

The Dell Computer Store.

Instead of a crowded, high-overhead showroom, you get our brand new 44-page catalog. Which gives you a full line of 386™ and 286 systems, printers, peripherals, software, and accessories.

And since you buy direct from the manufacturer, you save about 35%.



But there's a lot more to it than saving money. We offer you the most complete service and support in the industry. Including a 30-day money-back guarantee. A toll-free technical support hotline. Self-diagnostic software. And next-day deside service from

Xerox Corporation. If you read our ad in the front of this magazine, it will tell you a lot more about the systems we offer. And the service we put behind them. So if you'd like a much more intelligent way to buy a personal computer, have a look at our ad. Or call us at 800-426-5150. Or send us the card on this page.

And we'll send the best computer store you've ever seen.

One you don't have to set foot in.



TO ORDER, CALL US.

800-426-5150.

FOR DELL IN CANADA, CALL 800-387-5752.



What can a ScanMan™ scan, man?

Virtually anything. Logos or photos. Digits or dingbats. Art or articles. A soda can. How can you get them into your PC? You could play cut and paste with the copier down the hall. Or use your own, do-it-in-a-flash, hand-held scanner. ScanMan.

Images. Select 1, 2, 3, or 400 d.p.i., then pop any image up to 4" x 14" into a file for your publishing program. Or into your Windows™ clipboard. Or use PaintShow Plus™—included with your ScanMan—for editing and coloring.

Text. Our Catchword™ software converts virtually any typeface into ASCII files for your word processor, desktop publisher, or spreadsheet. It reads horizontally or vertically, scans words or numbers from 6 to 20 point, and matches adjacently scanned columns perfectly.

Should you buy it? Once you've got it you'll wonder what you did without it. And it's only \$339.* Backed by our Customer Satisfaction Guarantee, and 7 Days-a-Week Support.

For information, call: 800-231-7717

In California:
800-552-8885
In Europe: ++41
-21-869-96-56

LOGITECH



*For IBM PC and compatibles. Includes Paintshow Plus. List price for the IBM Micro-Channel version is \$399. Catchword is an optional extra for \$199.

Circle 167 on Reader Service Card (DEALERS: 168)



Save that tiger.

Save face.

Scan the globe.

Take this job and shove it.

Catch a wave.

Save the day.

Can scan.

There goes the neighborhood.

Scan the horizon.

Get reel.

TODAY'S TIMES ONLY

- FIELD OF DREAMS (PG) THE MIRROR 12:25, 2:10, 4:20, 7:30, 9:55
- SCANDAL (R) 1:30, 3:45, 6:00, 8:15, 10:30
- BARON MUNCHHAUSEN (PG) 12:25, 2:10, 4:20, 7:30, 9:55
- RENEGADES (R) DOLBY 12:25, 2:10, 4:20, 7:30, 9:55
- NO HOLDS BARRED (PG-13) 12:25, 2:10, 4:20, 7:30, 9:55
- A FEW DAYS WITH ME (PG-13) 12:25, 2:10, 4:20, 7:30, 9:55
- BEACHES (PG-13) DOLBY 12:25, 2:10, 4:20, 7:30, 9:55
- 11 P.M. NIGHTS ON A SLOW (R) 12:25, 2:10, 4:20, 7:30, 9:55

WealthBuilder Helps You Plan Your Future

Unlike other financial programs designed to help manage your current finances and investments, WealthBuilder can help you plan your finances through retirement. You can use the program to balance your budget, but its expert-system techniques can also suggest specific investment strategies designed to meet your present and future financial objectives.

WealthBuilder's proprietary user interface looks like Windows and acts something like hypertext. Through colorful graphics and fill-in-the-blank menus, you are guided through inputting a personal financial profile and setting financial objectives, taking into account your tolerance for risk. You can tweak the strategies through what-if scenarios.

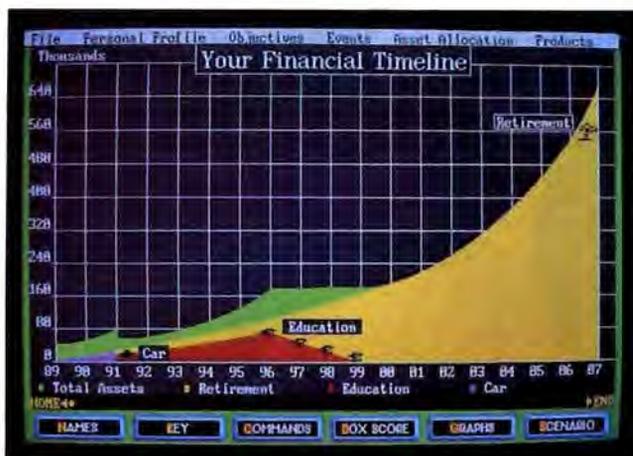
WealthBuilder includes 600 pages of context-sensitive tutorials, a dictionary of financial terms, and a guide to mutual funds, available through screen buttons. The package can examine your current financial situation, flagging expenditures that are out of line and advising ways to cut taxes and debt.

WealthBuilder can accept data from Andrew Tobias's *Managing Your Money* and *Intuit's Quicken*. It runs on the IBM PC with 512K bytes of RAM, DOS 2.0 or higher, and a hard disk drive. The program's developers report that a Macintosh version is in the works.

Price: \$249.95.

Contact: Reality Technologies, 3624 Market St., Philadelphia, PA 19104, (215) 387-6055.

Inquiry 1152.



WealthBuilder can help you with the business of life, especially in reaching financial objectives.

New Reflex Not Just Knee-Jerk Reaction

Reflex 2.0, an entry-level flat-file database management program, is Borland International's first program to support dynamic segment swapping. Borland says its programming technology, called VROOMM (for virtual real-time object-oriented memory manager) allows applications with more features and data capacity, but within 640K bytes of RAM.

Borland reports that Reflex 2.0 is a complete rewrite from the previous version (1.14). In addition to including VROOMM, which the company plans to incorporate into all its products over the next five years, Reflex 2.0 lets you view data in six different ways and print directly from within a file (previously, you had to run a separate program). It also supports databases of up to 32 megabytes. You can open five windows simultaneously, each with a different view, and enter text in memo fields of up to 8000 characters.

Reflex 2.0's capabilities

include Form View, which displays one record at a time; List View, for displaying data in a spreadsheet-like grid; Graph View; Crosstab View, for comparing and summarizing data; Report and Labels View, for reports and mailing labels; and Mail Merge View, which works as a text processor. All views are hot-linked—a change you make in one is reflected in the others.

Reflex 2.0 works on the IBM PC with 512K bytes of RAM and a hard disk drive. **Price:** \$249.95.

Contact: Borland International, Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95066, (408) 438-8400.

Inquiry 1150.

Sales Commission Tracker

Argonaut's Sales Commission Tracker lets you track your income and sales activity, including sales order status and distributor point-of-sale transaction status. With the program, you can enter sales orders, invoices, distributor transactions, and commission data.

You can print reports that show total commissions for each order, commissions due

on shipment, commissions paid to date, and the difference between commissions due and paid. You can display delinquent commission payments and the number of days late.

The program, written in FoxBASE, lets you sort reports by nine parameters. Sales Commission Tracker is a stand-alone program and requires an IBM PC with a hard disk drive, 512K bytes of RAM, and DOS 2.0 or higher. Argonaut is distributing it as a shareware program.

Price: \$45.

Contact: Argonaut Systems, 15466 Los Gatos Blvd., Suite 109-314, Los Gatos, CA 95030, (408) 867-5029.

Inquiry 1149.

1-2-3 Release 3.0 Add-in Solves What-If in Reverse

Frontline Systems introduced what it calls the first add-in for Lotus 1-2-3 release 3.0. What-If Analyst automatically determines the what-if value on your spreadsheet. You specify a desired result value (e.g., net profit) and a what-if variable. The program then automatically determines the what-if value that yields the desired result, solving the what-if problem in reverse.

A single What-If Analyst package includes the add-in versions for Lotus 1-2-3 release 2.01, 2.2, and 3.0, and for Symphony. The program requires 35K bytes of RAM on release 2.01 and 2.2, 45K bytes on Symphony, and between 15K and 55K bytes on release 3.0.

Price: \$49.95.

Contact: Frontline Systems 140 University Ave., Suite 100, Palo Alto, CA 94301 (415) 327-7297.

Inquiry 1153.

continued



QNX[®]

The OS for over-achievers[™]

QNX programmers have a decided advantage.

You see, people who use QNX enjoy the freedom that comes only with a flexible, modular OS. They appreciate the elegance of a **message-passing architecture**. And they marvel at the fact that QNX runs so lean — under 150K — yet out-performs any other PC operating system.

QNX users never worry about whether their applications will make it at runtime, because they know QNX has proven itself again and again in the real world.

It's no wonder that QNX users have achieved so much since the product was first released for the PC in 1982: over 80,000 systems installed in 47 countries world-wide, in all kinds of applications — from making cars to selling books to handling online credit card transactions.

One reviewer dubbed QNX "The multi-everything OS." Now, you might expect

multiuser and multitasking, but realtime? And integrated networking? And true distributed processing? Best of all, these terms take on a new meaning with QNX.

Multiuser, for instance, means up to 32 terminals per micro. **Multitasking** cashes out as 150 tasks per machine.

Realtime means not only priority-driven, preemptive task scheduling, but also speed: at 6,896 task switches/sec on a 16MHz 286, QNX is at least a full order of magnitude faster than a typical UNIX system. **Integrated networking** means you won't need yet another layer of software to set up a LAN, and you can use *any mix* of Intel-based micros — from vintage '81 PCs to PS/2s.

Distributed processing with QNX sounds too good to be true. But it is: *Any task can access any resource* — programs, files, devices, even CPUs — without going through the bottleneck of a central file server.

Besides the satisfaction that QNX developers get from using a fast, powerful, and flexible OS, did we mention that they also enjoy *free technical support*?

If you're wondering why you don't already know all about this great OS, you could try asking the over-achievers who are smugly guarding the secret of their success.

Better yet, give us a call. We'll tell you everything you need to know to become an over-achiever yourself.



Circle 242 on Reader Service Card

For more information or a free demo disk, please phone (613) 591-0931.

Microstat-II Now With Graphics
Interface and New Multivariate Module

2.0
Release

Now you can use YOUR favorite graphics package with Microstat-II.

Just some of the packages covered include *3-D Perspective Jr.*, *Harvard Graphics*, *Microsoft's Chart*, *Grapher*, and others.

Microstat-II also includes new procedures for:

- Canonical Correlation
- Factor Analysis
- MANOVA
- Discriminant Analysis
- Principal Components Analysis
- Cluster Analysis
- Covariance Analysis

While Release 1.0 was good:

"... one of the fastest IBM PC statistical packages we have tested... using Microstat-II is a breeze."

Infoworld

"Installation of Microstat-II is simple... The user interface is clean... a pleasant package to use..."

PC Magazine

Microstat-II Release 2.0 is even better!

For a limited time, you can purchase Microstat-II Release 2.0 for \$395.00. Microstat-II requires an IBM PC, XT, AT, PS2 or compatible with 512K memory or more with either a hard disk or two floppy drives. For more information, contact your local computer dealer or call:

Ecosoft, Inc.

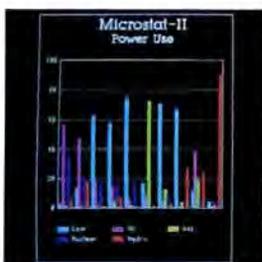
6413 N. College Ave.
Indianapolis, IN 46220
Orders: 1-800-952-0472
Info: 1-317-255-6476
FAX: 1-317-251-4604



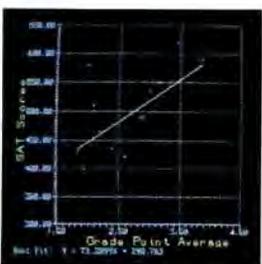
ECOSOFT



3-D Perspective Jr.



Harvard Graphics



Grapher

SCIENCE AND ENGINEERING



With Architriion II, you can study the effects of interior lighting.

Two Architectural Programs for the Mac

Architriion II, a design, drafting, and presentation program, lets you study the effects of light and color on your projects. You can define the colors of a building and its components and specify the light source's position and intensity to simulate shading and shadowing from interior lights or the sun.

With Architriion II, you can easily coordinate planes, sections, and elevations of a building so that you include a change in the three-dimensional database in its two-dimensional drawings. According to Gimeor, you can create and modify a building in section view and position and adjust openings in elevation while making real-time updates to the database.

Architriion II works on the Mac SE or higher with a minimum of 2 megabytes and a hard disk drive. A version that takes advantage of a math coprocessor is available.

Price: \$2495.
Contact: Gimeor, Inc., 420 10th St. SE, Washington, DC 20003. (202) 546-8775.
Inquiry 1155.

manage, and document the interior of plants and offices. The program uses independent overlays with references between them so that changes made in the facility are automatically updated for everyone. It also allows several people to work simultaneously using a common database.

MacBravo! Facilities includes a DBMS that lets you associate information with graphical representations of the facility. You can, for example, click on a symbol that represents a piece of machinery and get information on its initial service date, when it is scheduled next for maintenance, or how much it costs.

If you are drawing the top view of a wall, you can tell Facilities the height of the wall, and it can create a three-dimensional image from your two-dimensional drawing.

Facilities works on the Mac II or higher with 8 megabytes of memory and at least a 40-megabyte hard disk drive. It includes a library of about 1000 mechanical and architectural components.

Price: \$4900; PlanPrint components, \$495; IGES (Initial Graphics Exchange Standard), \$495.

Contact: Schlumberger Technologies, CAD/CAM Division, 4251 Plymouth Rd., P.O. Box 986, Ann Arbor, MI 48106. (313) 995-6000.

Inquiry 1156.

MacBravo! Facilities is a program for the Mac that lets facilities managers and industrial engineers plan,

continued

Intelligent Database Tools are Here!

Is your Database an Asset or just a File?

As your database grows, its potential value increases. Your challenge is to keep it error-free, understand it, and use it to make effective decisions. These are the tools you need:

S DATABASE **U** P E R V I S O R

Maintain data quality and data integrity. Keep your database error-free. Database/Supervisor analyzes your databases and identifies *suspicious data items*, and patterns which are out of the ordinary. It automatically detects errors which violate statistical or logical integrity constraints. *If your database is being corrupted, Database/Supervisor will show you where.*

IXL The Machine Learning S Y S T E M

Discover *hidden patterns and unexpected relationships* in your large database. IXL analyzes your database and generates easy-to-read rules using artificial intelligence and statistical techniques. While Database/Supervisor detects errors, IXL produces rules and decision-making insight. *The solutions you are looking for may already be in your database, waiting to be discovered.*

NEURAL/QUERY

Don't deny yourself inexact, but potentially valuable, answers to your database queries. Close matches are more valuable than *no response*. IXL and Neural/Query are perfect partners. IXL generates rules which can be exported. However, Neural/Query analyzes your large database, builds a network of partial matches, and provides the closest matching answer to your database queries. *Use the full informational content of your database.*

Intelligence **COMPILER**

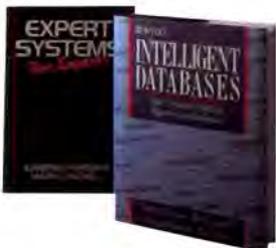
The highest-level, easiest-to-use intelligent database environment today. Build dialogs automatically, link them with rules, frames and hypertext *in minutes*. Develop your intelligent application quickly and efficiently, then run it on multiple operating systems. The built-in relational database combines expert system logic with SQL-based object oriented queries. *Accomplish in hours what would otherwise take weeks.*

Experts love our software:

The Intelligence/Compiler is a powerful state of the art system for real-world applications. Its intelligent editing and debugging facilities are a bonus. *AI/Expert Magazine*, February 1988.

Considering the variety of features that the Intelligence/Compiler provides, it is hard to believe that you can get better value for your money. *PC/AI Magazine*, June 1989.

Having used IXL on a large database of geological test data, we were surprised by the many relationships it found. This has greatly helped us to interpret our Oil Company database. *Mr. James Brown*, Oil Industry Consultant, July 1989.



Our leadership in this field of technology is unsurpassed. Ask for our books *Intelligent Databases* and *Expert Systems for Experts* by K. Parsaye, et al., published by John Wiley.



Will your database errors live forever?



Alone in a universe of data? Let IXL be your guide.



Are you sure you have no listing for the Vite House.



IntelligenceWare
The Next Level in Computing
Circle 140 on Reader Service Card

Yes, I want to win with your easy-to-use intelligent database tools.

- Send me your complete collection of intelligent database tools for \$1,490.
- Send me the three components: _____ for \$990.
- Send me the single component: _____ for \$490.

Computer system: IBM/PC PS/2 Macintosh

Also available on VMS, Unix and OS/2

Name _____

Check enclosed, Charge to: Visa MC AMX

Company: _____

Card No: _____ Expiration _____

Address: _____

Telephone: _____

For telephone orders call (800) 888-2996
Shipping and handling: US \$9, Canada and Hawaii \$20,
Overseas Air \$50. California residents please add 6.5% sales tax.



IntelligenceWare
9800 S Sepulveda Blvd.
Los Angeles, CA 90045-5228
Telephone: (213) 417-8896
Telefax: (213) 417-8897

Comput

Right Now. Guaranteed!*

Yes, we can ship your new ZEOS® '286 or '386 today! We've built up an extra supply of the hottest selling computers in America. The celebrated ZEOS 286-12 and PC Magazine's Editors Choice — the ultra fast ZEOS 386-20.

Take your pick now for immediate delivery. These are both *complete*, genuine ZEOS Zero-Wait state systems. Both include an ultra-fast Seagate hard drive and all the other goodies. And they're ready to ship. *Right Now.*

Here's how it works. We have these extra systems pre-built and ready to ship. They include both High Resolution Monochrome and VGA systems. While supplies last, we will ship either of these systems to you *the day you order* subject to these conditions:

1. Your order must be received by 1PM Central Time.
2. Credit Cards are subject to credit card authorization.
3. Orders must be for our standard 286-12MHz system or 386-20MHz system, either monochrome or VGA. Any other systems or upgrades are custom built and will take slightly longer.

*Our Guarantee to You:

If we fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready. All systems are fully burned in and tested. Each system includes our 30 day Money Back Guarantee and One Full Year Limited Warranty. Plus 24 Hour a day Toll Free technical support and Express Parts Replacement are included too!

This offer is good only as long as these pre-built

Complete ZEOS 12MHz '286 with 32MB Hard Drive!

Only \$1,395

For VGA color add \$595

*FREE Shareware Disks Too!
25 Software Programs Included
Every system will include 25 ready to run Shareware programs on free disks. Included are programs for Word Processing, Spread Sheets, Educational, Financial, Business, Games and more. With Shareware you can try the programs first before you register them with the author. What a great idea!*

Standard Features Include:

- 80286-12 CPU, 6/12MHz Dual Speed keyboard/hardware selectable. Reset and Turbo buttons right up front.
- Zero-Wait State DRAM, 512K expandable to 4MB on the mother board (16MB System Total). EMS Capability on board.



Performance Comparisons using PC Labs Benchmark Series Release 4:

	80286 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 286/12 Desktop	4.78	18.84	0.72
IBM PC AT (8MHz)	8.96	35.60	1.32
IBM PS/2 Model 50	7.20	28.34	1.05

- Fast 32MB Seagate 138R Hard Drive with auto-park, 1.2MB Floppy Drive.
- Ultra high speed Hard/Floppy controller. 1:1 interleave, 800 KB/sec transfer rate.
- Genuine Hercules® (Yes, Hercules!) Brand graphics card. High-Res Amber Display with Tilt/Swivel Base.
- ZEOS Enhanced 101 Key Keyboard with our Pleasant Tactile/Click Feel.
- Serial and Parallel Printer Ports.
- Clock/Calendar with Battery Backup.
- 6-16 and 2-8 bit expansion slots.
- 80287 support, up to 12 MHz.
- Heavy Duty Case Complete with Security Lock and LED indicators.

**Order Now Toll Free
800-423-5891**

ers Now! SM

systems remain in stock; please give us a call to verify availability. This offer does not apply to other ZEOS systems or custom configurations.

Immediate shipment is only part of the story.

ZEOS builds Rock Solid computers. That's why we offer you our 30 Day Money Back Guarantee, Toll Free technical support and Full One Year Limited Warranty. Compare that to the others. Then compare performance.

Performance is what ZEOS is all about. If you're buying a computer you may as well buy the fastest. The ZEOS 286-12 is *the fastest* in its class. It features true Zero-Wait state operation with speeds close to many 386 systems!

Or select the ZEOS 386-20. The Editors of *PC Magazine* did. In fact, they said "Out of 104 machines

from 58 companies... for overall excellence in both the 16- and 20MHz categories, we selected ZEOS International's 386-16 and 386-20." And ZEOS '386 systems have racked up *three PC Magazine Editor's Choice awards so far this year!*

PC Resource Magazine put it this way "ZEOS... provides quality comparable with the IBM or Compaq and does so for about 70% of the cost." *Personal Computing* simply says "The best value we've come across so far."

We couldn't have said it better ourselves.

And these are the machines that we have ready to ship to you *right now*. Rock solid block buster ZEOS machines with quality and performance that is, in a word, *Guaranteed*. Order now by calling 800-432-5891.

Complete ZEOS 20MHz '386 with 80MB 28ms SCSI Drive!

Only \$2,995

For VGA color add \$595



Standard Features Include:

- Genuine 32-bit Intel 80386-20MHz CPU.
- High speed Zero-Wait 64K SRAM CACHE.
- 1MB of Zero-Wait DRAM Expandable to 16MB system total.
- Fast 80MB, 28ms SCSI Seagate Hard Drive, 1.2MB Floppy Drive.
- Ultra high speed Hard/Floppy SCSI controller.
- Genuine Hercules® Brand graphics card. High-Res Amber Display with Tilt/Swivel Base.



Performance Comparisons using PC Labs Benchmark Series Release 4:

	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/20 Desktop	2.87	10.40	0.39
IBM PS/2 Model 70-121	3.24	12.72	0.61
Compaq Deskpro 386/20e	2.91	10.54	0.40

- 101 Key ZEOS Tactile/Click keyboard.
- High speed Serial and Parallel Ports.
- 1-32, 5-16 and 2-8 bit slots.
- 80387 math co-processor support.
- ZEOS 5-bay case with security lock and LED indicators.

Order Now Toll Free
800-423-5891

FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA, ZCard and COD
Open 24 Hours a day!
ZEOS International, Ltd.
530 5th Avenue, N.W.
St. Paul, MN 55112 USA



Protects while you type!



- **Remains In Place** while you use your computer.
- **Avoids Costly Repairs.** Protects delicate electronics from dust, spills, smoke, ashes, staples.
- **Soft, Flexible,** retains normal keyboard feel.
- **Washable, Durable High-Tech Polymer** lasts years.
- **Hundreds of Models.** SafeSkin is available for most PCs, laptops, workstations and clone keyboards.
- **Office • Home • Factory • Classroom • Laboratory**

List Price \$29.95. Please call or write for free color brochure. Dealer inquiries encouraged.

SafeSkin™

KEYBOARD PROTECTOR

Merritt Computer Products, Inc. 5565 Red Bird Center Drive
Suite 150, Dallas, Texas 75234/(214) 339-0753 • FAX (214) 339-1313
In Canada call 1-800-663-1061

NEW

AMX 386

REAL-TIME MULTI-TASKING KERNEL

for protected mode 80386

- | | |
|---|----------------------|
| ■ No royalties | ■ Intertask messages |
| ■ C language support | ■ Message exchanges |
| ■ Preemptive scheduler | ■ Dynamic operations |
| ■ Time slicing available | — task create/delete |
| ■ Configuration Builder | — task priorities |
| ■ List Manager | — memory allocation |
| ■ 20 us task switch
at 16 MHz (no waits) | ■ Event Manager |
| | ■ Semaphore Manager |

Source Code Included

Manual only \$75 US
AMX 386 \$3995 US
(shipping/handling extra)

KADAK Products Ltd.
206 - 1847 W. Broadway
Vancouver, B.C., Canada
V6J 1Y5

Also available for 8086 80286
6060 280, 68000



Telephone: (604) 734-2796
Fax: (604) 734-8114

WHAT'S NEW

SCIENCE AND ENGINEERING

Math for the Masses

MathCAD 2.5 is based on MathSoft's live document interface, which lets you use the computer as if it were a notebook, defining variables and entering text anywhere on the screen.

MathCAD formats equations in standard math notation and automatically calculates the results. As you make changes to the original equation, MathCAD automatically recalculates. The program generates each plot as soon as you specify the variables. According to MathSoft, MathCAD is capable of handling complex arithmetic, fast Fourier transforms, integrals, derivatives, Bessel functions, matrices, simultaneous linear and nonlinear equation solving, and statistics.

Unit conversion is another given with MathCAD. You specify what units you want the answers in, and that's what the program returns, according to MathSoft.

MathCAD also produces documents of any length and width. It offers cut, paste, and copy features, along with automatic word wrap.

One enhancement in version 2.5 is the ability to graph three-dimensional surface plots and manipulate their rotation viewpoint. Also added to the new version is HPGL sketch import capability, support for PostScript, sorting ability, multiple region cut and paste, and pop-up menus.

To run MathCAD 2.5, you need an IBM PC with DOS 2.0 or higher and 512K bytes of RAM. A math coprocessor is recommended.

Price: \$495.
Contact: MathSoft, Inc.,
One Kendall Square, Cam-

bridge, MA 02139. (617)
577-1017.
Inquiry 1158.

Structural Analysis Under Windows

Finesse/f is the first in a series of structural analysis and design programs from Cube Systems that run under Windows. Finesse/f solves two- and three-dimensional trusses and frames. In three-dimensional mode, when viewing a complex structure such as a bridge, you get a sensation of depth better than that produced by hidden line removal.

The system is written in optimized C, performs bandwidth minimization, and uses a math coprocessor and available EMS memory to reduce analysis time. With the Data Editor, you can build a materials database and define structural geometry, loads, and other data. Other databases are available for steel, timber, general shapes, and materials in Imperial, Canadian, and German metric formats.

You can view the structure in normal 2-D and deformed 2-D mode at the same time to see the effects of an applied force. Finesse/f (the *f* stands for wire-frame cases) can handle shear corrections for deep beams and shear walls, partial and full member releases, wide support corrections, variable and nonprismatic cross-section definitions, and inclined supports.

Finesse/f requires an IBM PC AT or higher with 640K bytes of RAM and Windows 2.0 or higher.

Price: \$995; four databases, \$245.

Contact: Cube Systems Consulting Services, Inc., 77 Metcalfe St., Suite 310, Ottawa, Ontario, Canada K1P 5L6. (613) 236-7067.

Inquiry 1157.

continued

What's even more amazing is its letter quality.



It may seem like a small thing. But it's nothing less than the first letter-quality, battery-powered, portable printer ever.

We call it the ExpressWriter 301. And you won't find a more convenient letter-quality printer anywhere. Especially if anywhere is precisely the place you need to use it.

The ExpressWriter301 is the perfect traveling companion to what is already the world's widest line of truly portable PCs. It operates on reuseable, rechargeable batteries and AC power. It's small enough to fit into the average briefcase. And it uses 24-dot technology to produce remarkably high resolution type. But most amazing of all, it weighs just four pounds.

Which means that now, anywhere you can take a portable PC, you can also print out a letter-quality hard copy.

And, to us, that's a big thing.



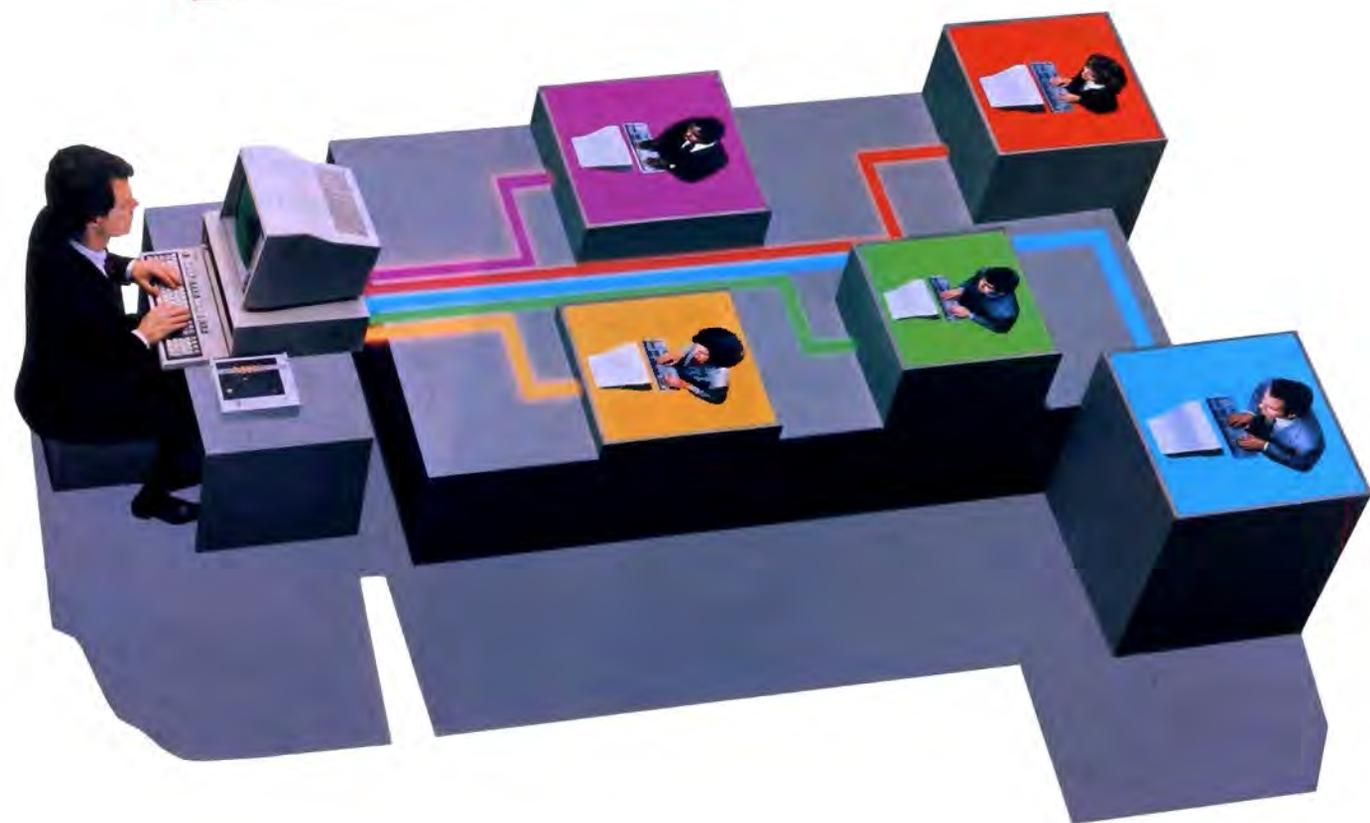
ExpressWriter301: 4 lbs., AC and battery-powered, letter-quality 24-dot print head, 60xps draft, Toshiba/Quone and Epson LQ emulations, 5 resident fonts, exceptional reliability, parallel interface.

In Touch with Tomorrow
TOSHIBA

Toshiba America Information Systems, Inc., Computer Systems Division

Circle 295 on Reader Service Card (DEALERS: 296)

How To Bring Minicomputer Power To Your PC



Introducing PC-MOS™ 3.0

A multiuser system no longer means only a mainframe or minicomputer. Today's 386- and 286-based PCs are more powerful than the minicomputers of just a few years ago. And they often provide more desktop power than one person can use effectively.

That's why you need PC-MOS 3.0. It harnesses the power of your 386- or 286-based PC and turns it into a powerful multiuser, multitasking computer. PC-MOS is the multiuser operating system that lets you run popular DOS applications such as Windows™, Lotus 1-2-3™, dBase IV™ or WordPerfect™—without modification.

PC-MOS is the perfect solution for a small business or a department of a large company that needs users to easily and affordably share programs, databases or peripherals. It takes full advantage of the hardware's power—and saves you money in the process! For example, instead of replicating PCs, each user can have an inexpensive terminal or monitor that acts like a PC.

DOS Compatibility Means Minimal Training And Support

Since PC-MOS is DOS compatible—unlike UNIX™ or OS/2™—there's no need for users to learn a "new" operating system or be retrained on the application programs they already know. And unlike most LANs, PC-MOS is easy to install and even easier to maintain. No hassle, no expensive wiring and no network management headaches.

There are now more than 100,000 users of PC-MOS worldwide, but if you haven't seen it lately, take another look. We've broadened our base of compatible applications and added multi-level security, faster

disk performance and larger task sizes. Version 3.0 also interfaces with Novell LANs, 3270 mainframe communications products and The Software Link's LANLink™ local area network.

Call us today for more information about PC-MOS 3.0 and the location of your nearest multiuser dealer. We'll show you how to easily and affordably turn your PC into a powerful multiuser system.

Terminals and Workstations Supported

Wyse 150™, Link MC5™, Kimtron KT-70™, IBM 3151™, AT&T 605 Business Communications Terminal™, Sun River Cygna/386™, Video Network Adapter™ and others.



THE SOFTWARE LINK

3577 Parkway Lane Norcross, GA 30092
1-800-451-LINK (404) 448-5465
Fax: (404) 263-6474 Telex: 4996147 SWLINK

PC-MOS and LANLink are trademarks of The Software Link, Inc.
All other products referenced are trademarks of their respective companies.

Dealer Inquiries Invited

GSA Scheduler/GSD0K 89 AGS6448

Your connection to advanced technology

Circle 263 on Reader Service Card (DEALERS: 264)

See Your Data



MapInfo software can find, display and analyze your data geographically. See your prospects, customers, facilities—anything in your database. Find addresses by street, ZIP code, city, etc. (We can even supply the maps.)



Any point or region on the map can have a complete record of data behind it. See your *actual* dBASE data in a window to view, edit, and print. Draw your own boundaries. Add titles and legends for high quality presentations.



Perform analyses on your data to sum, average, or count your database records by location. Color sales territories by volume of orders, ZIP codes by numbers of leads, countries by your demographic data.

From street-level to worldwide, MapInfo can merge your databases with maps. Play visual "what if" with your data. See patterns, trends, and opportunities you never knew existed. If you need to map your data, MapInfo can do it for as little as \$750.

MapInfo now includes a map of the world and the U.S. with all ZIP code locations. Runs on IBM PCs or compatibles with 640K memory, a hard disk drive, and graphics, and comes network-ready.

MapInfo Corp.

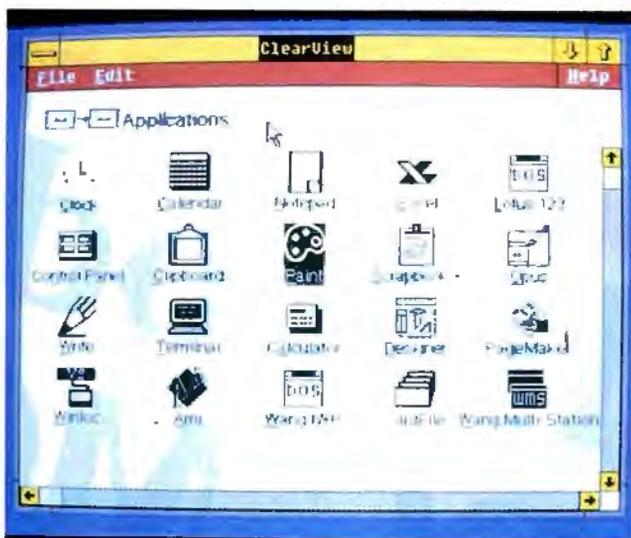
Changing The Way The World Looks At Information™

200 Broadway, Troy NY 12180
To order, call 1-518-274-8673
or 1-800-FASTMAP Toll free.

MapInfo is a trademark of MapInfo Corp. dBASE is a trademark of Ashton-Tate.

WHAT'S NEW

CAD AND GRAPHICS



ClearView lets you add true icons to the Windows desktop.

Customize and Enhance the Windows Desktop

Microsoft's Windows, while providing a consistent graphical user interface, isn't without its limitations. Two products, from Wang and hDC Computer, can make Windows easier to customize and manage.

Wang developed ClearView for Windows users who want to improve the graphics and functionality of the Windows desktop. ClearView's Window Organizer lets you customize the placement and size of the windows in which you run your applications so it's easier to find them. You can arrange open windows in an overlapping stack or move them into an aligned grid for viewing and access.

With ClearView, you can tell Windows which programs to load automatically and customize your desktop so a particular layout automatically appears when you activate the Windows environment.

ClearView replaces file-names with a menu system that lets you access Windows and non-Windows applications from the same menu. A List feature

of ClearView automates the opening, sizing, moving, and closing of windows.

ClearView works on the IBM PC AT or higher with Microsoft Windows 2.0 or higher, 512K bytes of RAM, and a hard disk drive.

Price: \$79.

Contact: Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851, (508) 459-5000.

Inquiry 1164.

Windows Manager from hDC Computer lets you install and manage desktop utilities for Windows. The program ships with seven utilities, and hDC says that more are on the way.

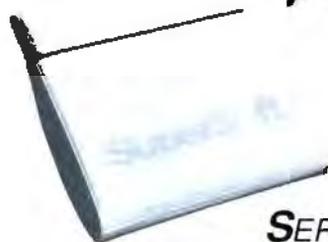
You can install Windows Manager in two ways: as a tear-off menu that you place anywhere on the screen or as a pull-down menu that becomes part of the Windows menu bar.

The System Enhancer utility's Run command lets you run any application from within any Windows program. Arrange lets you organize open windows by overlapping or tiling them, and the utility can also close all open Windows applications and exit Windows from any application.

The Work Sets utility lets you create sets of programs and files that you work with

continued

Want to save Time, Money,
& Headaches?



GET SUPERSOFT'S SERVICE DIAGNOSTICS

All the software, alignment diskettes, parallel/serial wrap-around plugs, ROM POSTs and extensive, professional documentation to provide the most comprehensive testing available for IBM PCs, XT's, AT's and *all compatibles* under DOS or Stand Alone. No other diagnostics offers such in-depth testing on as many different types of equipment by isolating problems to the board and chip level.

NEW: SuperSoft's **ROM POST** performs the most advanced **Power-on-Self-Test** available for system boards that are compatible with the IBM ROM BIOS. It works even in circumstances when the Service Diagnostics diskette cannot be loaded.

NEW: 386 diagnostics for hybrids and **PS/2s!**

For over nine years, major manufacturers have been relying on SuperSoft's diagnostics software to help them and their customers repair microcomputers. End users have been relying on SuperSoft's Diagnostics II for the most thorough hardware error isolation available. Now versions of Service Diagnostics are available to save everyone (including every serious repair technician) time, money, and headaches in fixing their computers, even non-IBM equipment.

All CPUs & Numeric Co-processors	All Color Graphics & Monochrome Monitors
System Expansion & Extended Memory	Parallel & Serial Ports
Floppy, Fixed & Non-standard Disk Drives	Mono, CGA, Hercules & EGA Adapters
Standard & Non-standard Printers	All Keyboards & the 8042 Controller
System Board: DMA, Timers, Interrupt, Real-time Clock & CMOS config. RAM	

Join the ranks of XEROX, NCR, CDC, SONY, PRIME, ... who have bundled SuperSoft's diagnostics with their microcomputers at no risk because of our 30 day money back guarantee.

Service Diagnostics for PC, PC/XT, and compatibles only	\$169
Alignment Diskette for PC, PC/XT and compatibles (48 tpi drives)	\$ 50
Wrap-around Plug for PC, PC/XT and compatibles (parallel and serial)	\$ 30
Service Diagnostics for AT and compatibles only	\$169
Alignment Diskette for AT and compatibles (96 tpi drives)	\$ 50
Wrap-around Plug for AT (serial)	\$ 15
ROM POST for PC, PC/XT and compatibles only	\$245
ROM POST for AT and compatibles only	\$245
Service Diagnostics: The KIT (includes all of the above—save \$502)	\$495
Service Diagnostics for 386 or V2, V30, or Harris, etc. (please specify)	\$195
Diagnostics II is the solution to the service problems of users of all	
CP/M-80, CP/M-86 and MS-DOS computers	\$126
ROM POST for PS/2 and compatibles only	\$245
Alignment Diskette for PS/2 and compatibles (3.5 inch)	\$ 50

To order, call 800-678-3600 or 408-745-0234
FAX 408-745-0231, or write SuperSoft.

your microcomputer repair solution

SuperSoft

FIRST IN SOFTWARE TECHNOLOGY P.O. Box 611328, San Jose, CA 95161-1328 (408) 745-0234 Telex 270385

SUPERSOFT is a registered trademark of SuperSoft, Inc. CDC of Control Data Corp. IBM PC, AT & XT of International Business Machines Corp. MS-DOS of MicroSoft Corp. NEC of NEC Information Systems, Inc. PRIME of PRIME INC. Sony of Sony Corp.

SOFTWARE • OTHER

and launch with one command. You can also use it to save the current state of any session when you quit.

Other utilities include Alarm Clock; Auto Save; Desktop, which lets you customize your start-up screen, customize your background, and add a screen saver; Font Viewer; and Memory Viewer, which displays a graph in pie chart form that shows how you're using conventional and expanded memory.

Windows Manager requires less than 10K bytes of RAM per utility and about 10K bytes for the manager itself. It works on the IBM PC AT or higher with Windows 2.0 or higher.

Price: \$79.95.

Contact: hDC Computer Corp., 15379 Northeast 90th St., Redmond, WA 98052, (206) 885-5550.

Inquiry 1165.

Software Brings PostScript to the Fax

GammaLink's GammaScript lets you create presentation-quality faxes with any application that uses the PostScript page-description language. Using an interpreter that GammaLink licensed from QMS, the program takes your PostScript application's output and translates it into a fax format file with output comparable to that of a 200-dpi PostScript printer.

GammaScript is available in two versions: GammaScript Plus is compatible with all 35 typefaces of the Apple LaserWriter NT; a less expensive package offers 13 typefaces. The program will work with GammaLink's line of PC-to-fax boards.

GammaScript works on the IBM PC AT or higher with a PC-to-fax board, 1 megabyte of RAM, and 4 megabytes of free memory on your hard disk drive.

Price: GammaScript, \$145; GammaScript Plus, \$440.
Contact: GammaLink, 2452 Embarcadero Way, Palo Alto, CA 94303, (415) 856-7421.
Inquiry 1161.

A Step up from Deluxe

The PC Tools DOS utilities package upgrade offers file viewers, LAN support, and a new application launch capability.

With version 5.5, you no longer need to know exactly where information is stored on your hard disk. Find and Locate functions let you identify and select files that match your search criteria. New file viewers let you view files in dBASE, Lotus 1-2-3, ASCII, and hexadecimal formats. The application launch capability links the selected data file with its associated application, and the program automatically loads them both.

LAN support added to version 5.5 lets you load the PC Tools DOS shell, desktop manager, and hard disk backup programs onto a Novell or IBM Token Ring network server. For security, the DOS shell will display only directories that the user is allowed to read, or you can run the PC Tools programs from a write-protected directory.

PC Backup, PC Tools Deluxe's hard disk backup program, includes new reporting capabilities, new verification and formatting options, and an automated installation procedure.

PC Tools Deluxe version 5.5 runs on the IBM PC with at least 512K bytes of RAM.

Price: \$129.

Contact: Central Point Software, Inc., 15220 Northwest Greenbrier Pkwy., Suite 200, Beaverton, OR 97006, (503) 690-8090.

Inquiry 1160.

12MHz 286 Mono with 40MB HD Complete System \$1190

- Monochrome Graphic Video Card
- Monochrome Monitor with Tilt & Swivel Base
- Clock Speeds: 8/12MHz 1/0 Wait State
- Intel 80286 Microprocessor with AMI BIOS
- 512K RAM (Up to 4MB)
- 16 Bit Dual Floppy and Hard Disk Controller
- 40MB Miniscribe Hard Disk

16MHz 286 VGA with 40MB HD Complete System \$1699

- VGA (Color Video Graphics Arrays) Card & Monitor
- Clock Speeds: 16MHz 0/1 Wait States
- 1.2 MB Fujitsu Floppy Drive
- 215 Watt Power Supply
- Reset/Speed Switches
- Enhanced 101-Keyboard
- 1 Year Warranty

TRAN 386 25MHz Complete Monochrome System \$1795

FEATURES:

- 32 Bit INTEL 80386 Microprocessor
- 6 Layer Motherboard
- 8 Chips & Tech Chips Sets Surface Mounted
- 1MB RAM (SIMM), up to 16 MB's
- Optional for 80287 & 80387
- Dual Hard Disk and Floppy Disk Controller
- 1.2MB Floppy Drive
- 220 Watt Power Supply
- Shadow RAM Supported
- Hi-Res Mono Monitor w/Swivel Base
- Parallel Port
- Enhanced 101 Keyboard
- 1 Year Warranty

Occasional Users TRAN XT - 10MHz

- With 1MB RAM 14" Monitor
- 360K Drive Keyboard

Complete Monochrome System **\$599**

PRINTERS

Narrow Carriage

ALPS Allegro	\$379
Star NX 1000 MultiFont	199
Star NX 2400, 24 pins	319
Panasonic 1124, 24 pins, 192 cps	855
Citizen MSP 50	Call

Wide Carriage

STAR NX15	\$329
Citizen MSP 15E, 160 cps	359
Citizen MSP 45	370
Citizen MSP 55	Call
Fujitsu DL3400, 288 cps	499
Hewlett Packard Laserjet Series II, Carriage and Toner Included	1690

NOVELL

AUTHORIZED DEALER

Novell ELS Software (4 User)	\$419
ARCNET Card	129
Passive Hub	69
25' Cable	19

HARD DISKS/ FLOPPY DISKS

20MB SEAGATE ST225	\$209
30MB SEAGATE ST238	225
42MB Mitsubishi 535	383
40MB Miniscribe	319
40MB Miniscribe 3053 (25ms)	429
71MB Maxtor 1085	595
360K Floppy Drive	65
1.2MB Floppy Drive	85

VIDEO ADAPTERS

Paradise VGA Plus	\$275
Paradise VGA Plus 16 Bit	345
Orchid VGA	395

MONITORS

VGA Monitor	\$390
Sony 1303	495
Mitsubishi 1381 (New)	495
NEC 2A (New)	519
Sony 1302	589
NEC 3 Dimensions (Newest)	690

MODEMS

1200B Everex Modem with Software	\$95
2400B Everex with Error Correction	185

SOFTWARE SHELF

Adobe Illustrator	\$450
Amortizer	49
dBase IV	465
Dollars & Sense V.3.1	119
Form Filler	99
Lotus: Freelance Plus	329
Lotus: Always (New)	129
Lotus: Hal	99
Lotus: Metro	69
MenuWorks PC Dynamics	24
Microsoft Quick C	95
Microsoft Word V.4.00	219
Microsoft Work	125
Microsoft Window 285	69
Office Writer	290
PageMaker V.3.0	515
PC Tool Deluxe with Word Processor V.5.0	65
Property Manager	195
PFS: First Choice (New)	89
PFS: First Publisher (New)	89
PFS: Professional File	130
PFS: Professional Write V.2.1	180
PFS: Professional Plan	72
Quattro Borland	159
Sidekick Plus	109
Timeline by Breakthrough	289
Turbo Tax	59
WordPerfect V.5.0	219
Wordstar 2000 V.3.0	214
386 Memory Manager	69

FAX: (619) 279-0572 24 hours
VISA/MC/AMEX accepted

Tran Computer Network, Inc.

(619) 279-6190

16580 Harbor Boulevard, Suite J • Fountain Valley, California 92708 • (714) 531-1786/FAX: (714) 531-1501

Business Hours:
Mon-Fri 9:30a.m. to 7p.m.
Sat. 10a.m. to 5p.m.

9353 CLAIREMONT MESA BLVD.
(Between Hwy 163 & 15)
New Showroom, Suite J • Service Center

WHAT'S NEW

PACIFIC

BMUG Wins Award, Starts Unix SIG

At the Second Intergalactic Users Group Meeting, held in New York City, users group officers held their first newsletter competition. The Berkeley Macintosh Users Group won top honors in the Best Columns or Columnist and Best Features categories for its newsletter, *BMUG*. Editors from *Folio*, *Home Office Computing*, and the *Mac-Street Journal* rated the newsletters. The meeting was sponsored by the New York Personal Computer Group for BBS sysops and newsletter editors and officers.

BMUG has also formed a Unix Workstation special-interest group for BMUG

members involved with A/UX, microVAX, Apollo, and the NeXT machine. The SIG meets every third Tuesday at one of the BMUG offices, 2150 Kittredge, Suite 3B, between Oxford and Shattuck.

The meetings will be free and open to the public.

Contact: The Berkeley Macintosh Users Group, 1442A Walnut St., Suite 62, Berkeley, CA 94709, (415) 549-2684.

Technology Conference Nanobytes

The Second Workshop on Workstation Operating Systems takes place at the Asilomar Conference Center in Pacific Grove, California,

on September 27-28.

Price: IEEE members, \$160; nonmembers, \$210.

Contact: Joseph Boykin, General Chairman, Encore Computer, 257 Cedar Hill St., Marlborough, MA 01752, (508) 460-0500.

The tenth annual Design Engineering Show and Conference/West will be held earlier than usual this year. Normally held in December, the conference will be held this year on September 26-28 at the Los Angeles Convention Center so that more engineers can attend.

Price: One session, \$115; four sessions, \$335. Show only, \$25.

Contact: Show Manager, Design West, 999 Summer St., Stamford, CT 06905, (203) 352-8372.

AmiEXPO, the conference for Amiga users and vendors, will take place in Santa Clara, California, on October 20-22. The conference will include master classes in animation, programming, video, graphics, and desktop publishing.

Price: To be announced.

Contact: AmiEXPO, 211 East 43rd St., Suite 301, New York, NY 10017, (800) 322-6442 or (212) 867-4663.

Supercomputing World, although mostly for mainframe computers, will also feature sessions on workstations. The expo will be held on October 17-20 at the Civic Auditorium in San Francisco.

Price: Full conference, \$475; one day, \$350; tutorials, \$300; exhibits only, \$20.

continued

The "Midas touch" for mailing lists

- Increases response & profit
- Cuts keying time & cost in half
- Greater accuracy & consistency
- Simple to use, blindingly fast

DataLift increases readership response and profitability of your mailings. It cleans up raw data by converting from ALL UPPER to U/L case, expanding your abbreviations, and correcting punctuation. \$149.

DynaKey cuts keying time in half. It offers "power-assisted" data entry (using DataLift's technology) as part of a complete list management program. \$199.

DynaKey.LIB adds "power-assisted" data entry to your Clipper programs. \$169.

Personator lets you make personalized mailings from a file where both first and last names are stored together. It splits each name and adds the gender prefix. \$169.

Convert this ...

D/M J MCHUE JR PHD
GM
GM
21ST & ST LOUIS ST
S SF CA 94080

Into this ...

Dr. & Mrs. J. McHue, Jr. Ph.D.
General Manager
General Motors
21st & St. Louis Street
South San Francisco, CA 94080

"This is the kind of product that can pay for itself after one session... Any company or individual concerned about the look of correspondence should try it out." - PC Magazine

Save 10% by phoning. If you work with name/address files on "PC compatitbles", please call today and ask about our 100% guarantee.

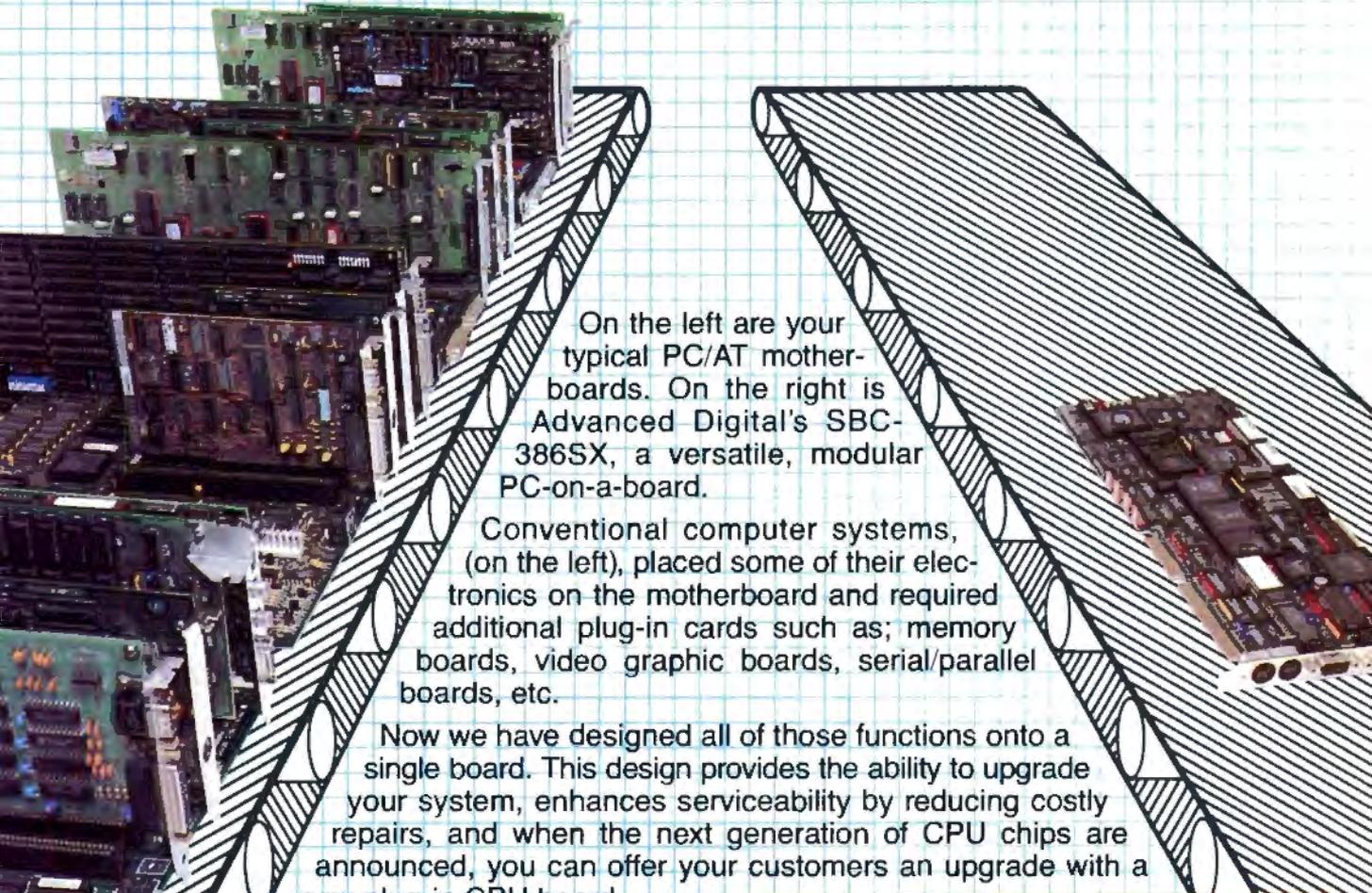
**Peoplesmith
Software**

800 777-2460

POB 384, N. Scituate, MA 02060

There are two ways to build PCs

Theirs OR Ours



On the left are your typical PC/AT motherboards. On the right is Advanced Digital's SBC-386SX, a versatile, modular PC-on-a-board.

Conventional computer systems, (on the left), placed some of their electronics on the motherboard and required additional plug-in cards such as; memory boards, video graphic boards, serial/parallel boards, etc.

Now we have designed all of those functions onto a single board. This design provides the ability to upgrade your system, enhances serviceability by reducing costly repairs, and when the next generation of CPU chips are announced, you can offer your customers an upgrade with a new plug-in CPU board.

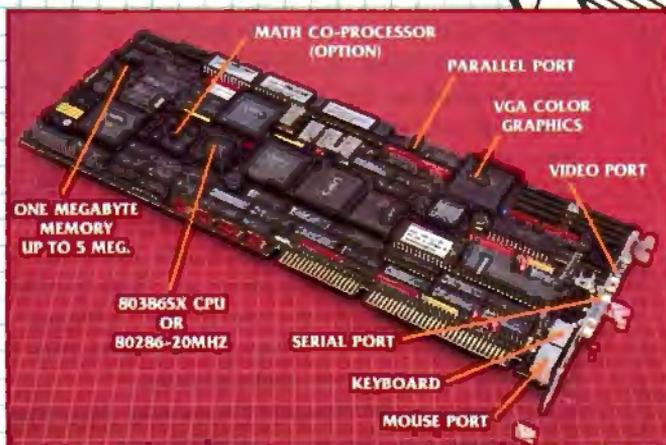
So, if you want to build the most powerful, versatile and modular system possible, give us a call.

ADC
ADVANCED DIGITAL CORPORATION

In the U.S.: Advanced Digital Corporation
5432 Production Drive, Huntington Beach, CA 92649
(714) 891-4004

In Europe: Advanced Digital (U.K.) Ltd.
21 Newman Street
London W1P3HB United Kingdom • (01) 323-1120

IBM and PC/AT are registered trademarks of International Business Machines.



The Choice is Yours.

Circle 517 on Reader Service Card (DEALERS: 518)

Contact: MG Expositions Group, 1050 Commonwealth Ave., Boston, MA 02215, (800) 223-7126 or (617) 232-3976.

INTEREX, the international Hewlett-Packard Users Group, is holding its North American Users Conference on September 11-14 at San Francisco's Civic Auditorium and Brooks Hall Complex.

Price: INTEREX members: \$650; nonmembers, \$750.

Contact: INTEREX San Francisco Conference, 680 Alhambra Ave., P.O. Box 3439, Sunnyvale, CA 94088, (408) 738-4848.

The Seventh Annual Pacific Northwest Software Quality Conference will be held on September 12-14 in

the Red Lion/Lloyd Center in Portland, Oregon. Half-day tutorials begin September 10.

Price: \$100.

Contact: Conference Management, Lawrence and Craig, Inc., 320 Southwest Stark, Room 411, Portland, OR 97204, (503) 222-2606.

A conference on the role of information systems in the global economy will be held on October 1-4 in San Francisco. Called "Information Systems Perspectives: Affecting the Global Market," the conference is sponsored by GUIDE International, an international association of IBM computer users.

Price: \$1495.

Contact: GUIDE International Corp., 111 East Wacker Dr., Suite 100, Chicago, IL 60601, (312) 644-6610.

The third annual AppleFest will be held at the Brooks Hall and Civic Auditorium in San Francisco on September 22-24.

Price: Exhibits only, \$10; half-day seminar, conference sessions, and exhibition, \$99.

Contact: Cambridge Marketing, Inc., One Forbes Rd., Lexington, MA 02173, (800) 262-3378 or (617) 860-7100.

NCGA C⁴ will be held on September 12-15 at the Santa Clara Convention Center.

Price: Full conference: NCGA members, \$475; nonmembers, \$525. Exposition only, \$10.

Contact: National Computer Graphics Association, 2722 Merrilee Dr., Suite 200, Fairfax, VA 22031, (703) 698-9600.

Technology and Its Consequences

A conference called Technics, Culture, and Consequences will cover the impact of technology on society. According to the IEEE Los Angeles Council, the conference serves as an interface between engineers and society, allowing both segments to exchange ideas.

The conference will be held at the California State University's Los Angeles campus on October 20-21.

Price: IEEE members, \$100; nonmembers, \$130.

Contact: Dr. C. Toporow, Society of the Social Impact of Technology (SSIT) LA, P.O. Box 328, Canoga Park, CA 91305, (213) 813-6194.

Quality In... Quality Out

No matter how well acquainted you are with making important personal computing decisions—decisions that may involve hundreds of thousands of dollars—the value of those decisions is only as good as the value of your information. Without quality information—it's hard to make quality decisions.

BYTEweek, McGraw-Hill's new weekly newsletter for professionals in the personal computer industry, is devoted to giving you that quality information through its timely and compact one-stop news format. And BYTEweek interprets this news with in-depth commentary and analysis.

Subscribe to BYTEweek for quality information. Remember, quality in... quality out.



Take advantage of the special one-year charter subscription rate of \$395 (\$495 outside the U.S. and Canada)—a savings of \$100 off the regular rate. Your subscription includes 50 issues plus a free three-month subscription to BIX—a \$49 value.

Don't miss this opportunity! In the U.S., call BYTEweek's toll-free number: **1-800-258-5485**, in N.H. and outside the U.S., call: 1-603-924-9281.

BYTEweek offers a *money-back guarantee* if you're not completely satisfied.

BYTEWEEK 

News and Analysis for Professionals in the
Personal Computing Industry
One Phoenix Mill Lane, Peterborough, NH 03458

FINALLY, ONE DISC DRIVE SOURCE

HARD DRIVES

ST506 Interface • 3 1/2" Half Height

Seagate ST125	20mb/28ms	\$249
Seagate ST138	30mb/28ms	299
Toshiba MK134FA	42mb/25ms	495

ST506 Interface • 5 1/4" Half Height

Seagate ST225	20mb/65ms	\$225
Seagate ST238	30mb/65ms	249
Miniscribe 3650	40mb/65ms	349
Seagate ST251-1	42mb/28ms	445
Seagate ST251	42mb/40ms	355
Mitsubishi MR535	42mb/22ms	525
Seagate ST277R	65mb/40ms	445
Rodime 5090*	74mb/28ms	895

ST506 Interface • 5 1/4" Full Height

Micropolis 1325	72mb/28ms	\$795
Seagate ST4096	80mb/28ms	599
Maxtor XT1140	120mb/28ms	1,625
Newbury Data 1140	120mb/25ms	1,295
Maxtor XT2190	150mb/28ms	1,895

FLOPPY DRIVES

3 1/2" Half Height

Teac	720k	\$110
Fujitsu/Toshiba	720k	105
Teac	1.44mb	120
Fujitsu/Toshiba	1.44mb	115

5 1/4" Half Height

YE-Data	360k	\$59
Alps IBM	360k	59
Teac FD55BR	360k	79
Teac FD55GFR	1.2mb	115

ATASI 3051
42 mb • 33 ms
\$295

SCSI Interface • 5 1/4" Full Height

Micropolis 1373A*	85mb/28ms	\$995
Newbury Data 3170S	147mb/19ms	1,595
Maxtor XT3280S	244mb/16ms	1,895
Newbury Data 3380S	320mb/19ms	2,495
Maxtor XT4380S	320mb/16ms	2,795
Maxtor XT8760S	676mb/16ms	4,250

SCSI Interface • 3 1/2" Half Height

HP97500-85620*	20mb	\$225
HP97500-85600*	20mb	225
Rodime 652*	20mb	245
Lapine LT4000*	40mb	295
Connor CP340*	40mb	375

SCSI Interface • 5 1/4" Half Height

Seagate ST225N*	20mb	\$225
Seagate ST251N*	42mb	395

HARD CARDS

10MB/85MS Hard Card*	\$185
20mb/65ms Hard Card*	225
20mb Tandon Hard Card*	245
30mb/65ms Hard Card*	295
48mb/36ms Hard Card*	395

1 year warranty except as noted
* 90 day warranty

MACINTOSH SCSI SUBSYSTEMS

HD/SCSI - 20*	\$395
HD/SCSI - 30*	495
HD/SCSI - 40*	595
HD/SCSI - 80*	895



FOR IBM & COMPATIBLES
10 mb Kit Includes Drive Cables
Controller and Instructions
Half Height \$179 Full Height \$159

ESDI Interface • 5 1/4" Full Height

Newbury Data 4175E	157mb/19ms	\$1,495
Siemens 1300	310mb/25ms	2,295
Newbury Data 4380E	320mb/19ms	2,295
Maxtor XT4380E	320mb/16ms	2,495
Siemens 4410	383mb/16ms	2,495
Maxtor XT8760E	676mb/16ms	4,250

IBM PS/2 KITS

360K Floppy w/Case & Cable	\$210
1.2mb Floppy w/case & Cable	250

CABLES

XT Cable Set	\$15
AT Cable Set	15

CONTROLLERS*

WD-FOX 360k/720k/1.2mb	\$69
1.44 mb Controller	79
WD-1002-WX1 Tandy	99
WD-WXT-GEN	79
WD1003-MM2 AT	149
ADAPTEC 2072A XT RLL	99
XEBEC 1210 XT 10-20mb only	59
DTC5287 AT RLL	195
Perstor/Sequel 200 Series AT (8 bit)	225
Perstor/Sequel 200 Series AT (16 bit)	325
Data Master 44-800 -- 3.5", 5.25", 8" floppy	79
SCSI Controller, Future Domain TMC841 (Kit)	265
WD1007-WA2, ESDI, AT (HD & FD)	325
WD1007-WAH, ESDI, AT (HD)	315
Omit 8620, ESDI Controller	295
WD1006-SR2 1:1 Inter. HD & FD RLL	195
WD1006-MM2 1:1 Inter. HD & FD	195

APPLE COMPATIBLE FLOPPY

11" HP	\$79
11" HD	\$89

HARD DRIVE REPAIR SPECIAL

Ampex, Atasi, CDC, CMI, Fujitsu, Hitachi, IBM, Lapine, Maxtor, Micropolis, Miniscribe, Microscience, NEC, Newbury Data, Priam, Quantum, Rodime, Seagate, Shugart, Tandon, Titan, Toshiba, Tulin and **Most Other Brands.**

FLOPPY DRIVE REPAIRS

5 1/4" FLAT RATE \$45

Seagate 4000 Series Servo-Writing Capability

CAPACITY	FLAT RATE	SPECIAL PRICE
10-19mb	\$99	\$89.10
20-29mb	\$125	\$112.50
30-39mb	\$150	\$135.00
40-49mb	\$175	\$157.50
50-85mb	\$210	\$189.00
86-120mb	\$275	\$247.50
121-150mb	\$325	\$292.50
151-275mb	\$425	\$382.50
276-380mb	\$495	\$445.50
Test & Evaluation		\$25

SHIPPING YOUR DRIVE FOR REPAIR

Call us for a repair order number.

Name _____

Street _____

City _____ State _____ Zip _____

Telephone No. () _____

COUPON MUST BE SENT WITH DRIVE

WE DO DATA RECOVERY. CALL FOR QUOTE.

VALID THROUGH SEPTEMBER 30, 1989

jb TECHNOLOGIES, INC.

21011 Itasca St., #F
Chatsworth, CA 91311
Telephone: (818) 709-6400
Telex: 678953
FAX: (818) 341-2935

TERMS AND CONDITIONS

- Corporate, Government and School PO's welcomed.
- Visa or Mastercard welcomed.
- COD, Cashier's Check or Money Order.
- Personal Checks - Shipment after Clearance.
- California residents must add applicable sales tax.
- All prices subject to change without notice.



Every thing

To Increase the Productivity of Your DEC System

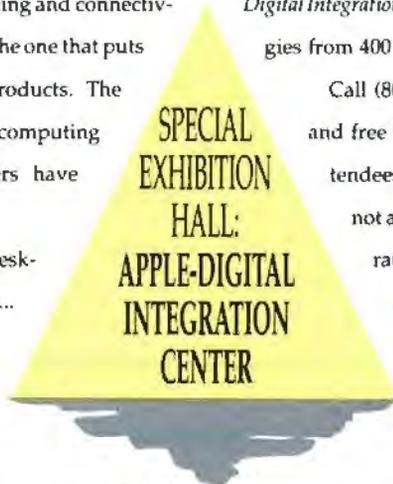
There's only one *biggest* DEC computing and connectivity show in the world. DEXPO West. The one that puts you in touch with more than 15,000 products. The one that provides you with more DEC computing solutions. The one 130,000+ DEC users have relied on since 1982.

Compare the latest VAX*, PDP* and desktop enhancements...connectivity tools... VMS & ULTRIX applications...Mac-to-VAX solutions at the *Apple-*

Digital Integration Center...productivity building technologies from 400 suppliers.

Call (800) 87-DEXPO for a free Show Preview and free V.I.P. Tickets. DECUS* Symposium attendees are always admitted FREE. (DECUS is not affiliated with DEXPO and requires separate registration.) Organized by Expoconsul International,

Inc., 3 Independence Way, Princeton, NJ 08540 *Registered trademarks of Digital Equipment Corp. Macintosh is a registered trademark of Apple Computer, Inc.



SPECIAL
EXHIBITION
HALL:
APPLE-DIGITAL
INTEGRATION
CENTER

DEXPO[®] 89 WEST

World's Largest DEC* Computing & Connectivity Exposition

Disneyland Hotel • Anaheim, CA • November 7-9, 1989

Register Toll-Free 1-800-87-DEXPO (8:30 A.M. TO 5:30 P.M. EST)

VGA



VGA

it's here! From the people who brings you the world's first color EGA portable computer, now proudly present the latest addition, PL286V and PL386V plasma VGA lunch-box portable.

The PL-386V based on the 386 architecture running at a speedy 25 Mhz with two built-in high density 3.5" and 5.25" floppy for data and program compatibility. It's standard 42MB hard drive retrieve and store your data at an astonishing speed of 28ms.

With its state-of-the-art gas plasma display you will be seeing a full 640 x 480 bit-mapped 16 shaded crispy clear VGA resolution; a built-in external VGA/Multisync monitor port for displaying simultaneously externally all in a 19.5 lbs.!

To find out more about PL386V and other Bi-Link portable computer, please call (213) 699-6684 ext. 212 (general orders and corporate account).

For OEM information, please call (213) 699-6684 ext. 322



MN286 and EGA-286 **

- 80286-12 0 wait state
- Standard 1MB/Maximum 4MB RAM
- Expanded Memory Specification (EMS)
- One 1.2MB 5.25" floppy
- One 1.44MB 3.5" floppy
- 44MB hard drive 28ms
- 4 AT-Expansion slots free
- One parallel, two serial
- Internal Modem 1200/2400 baud
- Dual frequency high resolution
- 9" amber monitor (MN286)
- 9" color EGA monitor (EGA-286)
- External monitor port

** Call for 386-20 machine specification



Projection Panel Now Supports Atari ST, DEC Terminals

NView Corp., which produces an LCD projection panel that lets you project your computer's screen onto an electronic transparency screen for presentations, has enhanced the panel to support the Atari ST and DEC's VT220 and VT340 terminals. Called ViewFrame II + 2, the panel also incorporates double-scanning circuitry, which increases the resolution on a CGA system from 640 by 200 pixels to 640 by 400 pixels.

To display your screen on the wall (the panel also supports IBM PCs and—with an adapter kit—the Mac), you connect the appropriate video interface cable to your system's video port and the ViewFrame display panel, place the panel on an overhead projector, and turn on the power. Your computer screen then appears on the projection screen. The DEC VT340 requires you to install an nView video interface board (which is supplied). A composite input jack lets you use VT220 and the Apple II.

Price: \$1995; Mac adapter kit, \$149.

Contact: nView Corp., 11835 Canon Blvd., Newport News, VA 23606, (804) 873-1354.

Inquiry 989.

Not Just the Fax

One of the benefits of fax boards is that you don't have to wait in line to send a fax. But if you create a document in a word processor and have to translate the document into an ASCII file, you lose the impact of fonts and format-



The ViewFrame II + 2 now supports a wide variety of personal computers and terminals.

ting. The Fax Group's FaxPro line of hardware/software and software-only products lets you send fax messages from your PC that retain the special formatting and graphics of your normal printed document.

According to The Fax Group, you can send a fax from any application by executing the Print command from the application program. The page prints to screen, giving a WYSIWYG display of the final faxed document. You can send the document to a fax or a printer or to both simultaneously. FaxPro lets you tag a signature, letterhead, or logo to the fax. You can also enlarge the document for viewing.

FaxPro is currently ship-

ping in two versions: a software-only version, and with a PC-to-fax board. The Modem FaxPro program works with a Hayes-compatible modem and lets several people in a workgroup share an internal FaxPro card. You can also use FaxPro with a fax service such as MCI Mail. For heavy-volume faxing, the Internal FaxPro gives you your own WYSIWYG fax capability. A network version of the product will be available soon.

FaxPro works on the IBM PC with 512K bytes of RAM, a hard disk drive, and a graphics board.

Price: Internal FaxPro, \$1295; Modem FaxPro, \$298; Network FaxPro, \$1795.

Contact: The Fax Group, 12526 High Bluff Dr., San Diego, CA 92130, (800) 426-7489 or (619) 456-0795.

Inquiry 982.

Math C Subroutines for CAD/CAM/CNC

With the QuickGeometry Library, a collection of math subroutines, you can perform geometric operations that formerly required you to write them yourself or use CAD/CAM interpreted macro languages. Developed by Building Block Software, the library is independent of any CAD/CAM environment, and you can use it for graphical and non-graphical programs.

Unlike other packages that support a wide range of geometry and require you to remember many routines, the library uses an object-oriented approach that lets you define one general object type, such as a curve, that can assume the form of any specific curve type. Building Block reports. Each geometric operation requires only one routine.

With the library, you can do parametric design and write CAD/CAM utilities for batch geometry processing, computer numeric control (CNC) postprocessing, mapping, medical imaging, and other engineering tasks. Routines are included for offsetting, breaking, trimming, rotating, scaling, translating, and reading and writing DXF files. Geometry types supported include lines, ellipses, arcs, nonuniform rational B-splines, and circles.

The QuickGeometry Library runs on the IBM PC with DOS 2.0 or higher.

Price: \$199.

Contact: Building Block Software, P.O. Box 1373, Somerville, MA 02144, (617) 628-5217.

Inquiry 985.

THE COMPUTER STORE THAT SERVICES ALL YOUR NEEDS

EVEREX
COMPUTER SYSTEMS DIVISION



Authorized Everex Step Dealer



CALL FOR 386/25, 386/20 AND ENTIRE LINE OF EVEREX STEP COMPUTERS

NEW
8086 Based LAN Workstation

AVAILABLE SOON:
33 MHz STEP System
88000 Based CAD Workstation

YOU DON'T HAVE TO BE RICH TO BE POWERFUL



AST
Authorized Personal Computer Dealer and Service Center

AST Premium 386/33
33MHz, state-of-the-art solution for ultimate LAN file service and CAD/CAM/CAE Upgradeable to 486

CALL FOR ENTIRE LINE OF AST COMPUTERS

AGI Computer, Inc.
Advanced Group Innovations
A Subsidiary of Everex Systems

MADE IN USA

AGI SYSTEM 1700/1800/3000 FEATURES

AGI 1700A 286/10MHz/1WS, 512K RAM	.....	\$825
AGI 1700C 286/12MHz/0WS, 1MB RAM	.....	\$1,125
AGI 1800A 286/10MHz/1WS, 512K RAM	.....	\$895
AGI 1800B 286/10MHz/0WS, 512K RAM	.....	\$1,045
AGI 1800C 286/12MHz/0WS, 512K RAM	.....	\$1,195
AGI 3000A 386/16MHz/0WS, 1MB RAM	.....	\$1,695
AGI 3000G 386/16MHz/0WS, 1MB RAM	.....	\$1,395
AGI 3000D 386/20MHz/0WS, 1MB RAM	.....	\$1,995
AGI 3000I 386/25MHz/0WS, 1MB RAM	.....	\$2,945

AUTHORIZED DEALER AND SERVICE CENTER
ALL 1700 SERIES ARE SMALL CHASSIS

Disk Drives by:
Seagate
Control Data
Miniscribe
Micropolis
Maxtor
Toshiba
Priam
Conner
Peripherals

Monitors by:
NEC
Mitsubishi
Sony
Everex
Seiko
Samsung
Relisys



2^{the} max VGA CARD

- ▶ 8-BIT W/256K RAM
- ▶ 800 x 600 16 COLORS
- ▶ REG LEVEL COMPATIBLE
- ▶ 1 YEAR SWAP WARRANTY
- ▶ VGA, EGA, CGA, MCGA, MDA & HERCULES COMPATIBLE
- ▶ MADE IN USA

\$199

Authorized Novell Dealer

LANtastic
LOCAL AREA NETWORK

MYLEX
MOTHERBOARDS

3F 3F Associates, Inc.
4508 Enterprise St.
Fremont, CA 94538

Call Us For Everex, AST, and other Peripheral Products

We Also Carry
Hard/Floppy Drives,
Monitors, Printers,
Tape Backups,
Macintosh™ IBM
PS/2™ Compatible
Products and All Major
Software, including
LAN & CAD

(415) 659-0403
FAX (415) 651-9190

Leasing and Financing ONSITE SERVICE AVAILABLE

EPSON HP



WIN YOUR TIME BY WINTIME pcTABLET



Wintime pcTablet KD series are designed for IBM personal computer family and compatibles, excellent performance in three sizes, compact and lightweight, suited for all popular CAD program and most application packages.

Especially the Tsoft(c) software from wintime provides a easy way to use pcTablet as a combined macro-keyboard, mouse and digitizer.

Specifications

Active area --

KD-1000	: 6" x 9"
KD-4000	: 11.7" x 11.7"
KD-5000	: 18" x 12"

Technology:

Electromagnetic

Resolution:

100-1016 lpi (auto selectable)

Accuracy:

+/- 0.025 (.625mm)

Proximity:

UP to 0.5"

Baud rate:

Auto Baud rate (75-19,200) or 9,600

Report rate:

Up to 200 reports/second (selectable)

Certification:

FCC class B.

Includes: Tablet, 4-button, cursor, power supply, RS-232C cable, 9 to 25-pin adaptor cable, Mylar template overlay, Utilities diskette.

Options: Two button Stylus pen, Tsoft(c) software.

Wintime Technology Inc.

RM 1004 10TH FL., NO. 166, SEC. 4, CHUNG HSIAO E. RD., TAIPEI, TAIWAN, R.O.C.
TEL: (02) 7318480-2 • 7766003-5
FAX: 886-2-7716403 • 886-2-7720380

Wintime Technology (U.S.A) Inc.

11621 Clark St #101 Arcadia, Ca 91006, U.S.A.
TEL: 818-3577154 • 818-3574256
FAX: 818-3596738

X-BANDIT

Break the 640K DOS barrier and utilize the Advanced Features of the LIM 4.0 standard while using only one motherboard slot!

"should be very useful for DOS users who are straining the limits of the 640K barrier"
—BYTEweek June 12, 1989

DESIGN PHILOSOPHY

- The Teletek X-Bandit was specifically designed to utilize the advanced features of the Lotus/Intel/Microsoft EMS 4.0 Specification. Further, the X-Bandit's Segmented Memory Mapping capability allows the user to extend DOS size beyond the 640K barrier. It is available in both 8 and 16 bit versions for use in the IBM XT, AT, and compatibles.

MEMORY

- Segmented Memory Mapping allows the user to fill out unused memory segments between 640K and 1024K. By "claiming" unused portions of memory in 16K increments, the user effectively increases TPA size. LAN or custom software modules, for example, can be loaded into these high memory areas thus relieving the lower 640K of TPA for other application programs.
- Split Memory Addressing allows the user to fill out conventional memory to 640K.
- Extended Memory Addressing is available for the PC/AT version.
- 2 MB capacity in a single slot. Up to 8 MB per system.
- Parity checking.

SOFTWARE

- Easy menu-driven auto configuration software.
- Device driver includes print spooler and RAM drive.
- Supports multitasking with the appropriate shell-resident software package.

SPEED

- 6/8/10 MHz speed with 0 wait states. 12 MHz speed with 1 wait state.

WARRANTY

- One year parts and labor.
- Now includes SYSTEM SLEUTH™ from DTG, Inc. A \$149.00 value.

TELETEK

4600 Pell Drive
Sacramento, CA 95838
(916) 920-4600
Fax (916) 927-7684

Circle 524 on Reader Service Card (DEALERS: 525)

Up to date. Down to earth.

Changing the world. UNIX is changing the world of computers, the world of business—quite simply, changing the world. It's revolutionizing office automation. It's required for U.S. government computer contracts. It's the backbone of information strategies worldwide.

The information you need. That's why you need *UNIXWORLD*—the magazine that keeps you up to date on the rapidly changing world of open systems computing. Each issue brings you the latest product trends and technical advances that can affect your business. The inside story on some of the world's

biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help you and your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

The whole UNIX-verse.

UNIXWORLD's in-depth features go beyond dry technical facts, to show how the pieces fit together—to tell you what's important about the advances and the strategies that are changing your world. And *UNIXWORLD* consistently offers the freshest, most down-to-earth writing you'll find in any computer publication.

Subscribe and Save. Subscribe today, and receive the next 12 issues of *UNIXWORLD* for just half the regular newsstand price. Save even more by ordering for two or three years. You can't lose—every subscription to *UNIXWORLD* comes with a no-risk guarantee*.

1 year \$18.00 (save 50%)
2 years \$32.00 (save 55%)
3 years \$42.00 (save 60%)

Subscribe now! Call toll-free

1-800-341-1522

UNIXWORLD

If you're into UNIX, you need *UNIXWORLD* MAGAZINE.

CDS - Advanced Computer Products / Custom Configured Systems & Upgrades

CDS AXT Model 10

Our Entry Level System won't stick you with a slow 8-bit 8088 CPU but give you the best low cost system that includes a High Performance 80286 Main board operating at 10 Mhz with full 16-bit zero wait state memory access. They system is 3 to 5 times faster than any XT and still provides for the use of lower cost XT peripherals. System includes:

- * 10 Mhz 80286 Main Board
- * 640K Bytes Memory
- * 30 Meg Byte Hard disk
- * Case and 150 W Power supply
- * 360k Floppy Disk (Optional 1.2)
- * M/IO Card, Serial, Game & Parallel
- * Hi-res amber monitor with controller
- * At style keyboard

\$ 949

CDS AT Model 12

We call this 12 Mhz Zero Wait state system our Entry level AT because of the Fabulous Price Performance Ratio with a relative AT speed rating of 15.7 Mhz. Special offer includes choice of Std AT case or Mini Tower case. Memory configuration options include 512k, 1 MB, 2 MB or 4 MB on the main board. This system includes:

- * 12 Mhz 80286 Main Board
- * 640K Bytes Memory
- * 30 MB Hard disk
- * Case and 200 W Power supply
- * 1.2MB Floppy Disk
- * Hi-res amber monitor
- * Graphics controller with printer port
- * AT style keyboard

\$ 1099

CDS 386SX Model 16/20

A low cost 16 Mhz system is a great solid entry level 80386 product. Overall cost is close to 16 Mhz & 20 Mhz 80286 systems and yet maintaining the ability to run all current and future 80386 Software. This 386SX system can run 16 Mhz or 20 Mhz as well as being fully OS/2 compatible. The system includes:

- * 16 Mhz 80386SX Main Board (See col 7 on table below)
- * 1 MB Memory
- * 40 MB Hard disk w/ 40 ms access
- * Mini tower Case / 200 W PS
- * 1.2 MB Floppy Disk
- * Hi-res amber monitor
- * Graphics controller with printer port
- * AT style keyboard

\$ 1599

CDS Model 25

This 25 Mhz system is a great 386 value based on our solid 80386 Chips and Tech main board. This system will give you the ability to run all 80386 Software or chose our 80386SX Model 16 and save \$200. (or custom configure any system from the Main board Table below. The system includes:

- * 25 Mhz 80386 Main Board (See col 9 on table below)
- * 1 MB Memory
- * 40 MB Hard disk w/ 40 ms access
- * Mini tower Case / 200 W PS
- * 1.2 MB Floppy Disk
- * Hi-res amber monitor
- * Graphics controller with printer port
- * AT style keyboard

\$ 1899

7.2 Mhz less \$50

Floppy Disks:

- 360K 5 1/4 * Fujitsu or Chison ... \$ 68
- 1.2MB 5 1/4 * Fuj or Chison ... \$ 79
- 720K 3.5" ... \$ 78
- 1.44MB 3.5" ... \$ 88

Controllers:

- XT/AT FD 2 Drive 360k,720k, 1.2M and 1.44M ... \$ 44
- XT H/Disk DTC MFM or RLL ... Call

- AT Floppy/Hard, MFM, 2:1 ... \$ 99
- AT F/Hard, MFM, DTC 1:1 ... \$ 149
- AT F/Hard, RLL Adaptec 1:1 ... \$ 189

Hard Disks:

- 20MB ST 225 ... \$ 199
- 30MB ST 238 ... \$ 239
- 40MB ST 251-0 ... \$ 339
- 40MB ST 251-1 ... \$ 369
- 80MB 4096 ... \$ 589

Monitors:

- 14" Amber Flat Screen ... \$ 109
- 14" CGA ... \$ 229
- 14" EGA / with cntr add \$148 ... \$ 359
- 14" VGA / with cntr add \$219 ... \$ 369
- 19" VGA only ... \$ 1449

Video Controllers

- CGA with printer port ... \$ 59
- EGA with or without p port ... \$ 149

- VGA (800 x 600) ... \$225
- VGA (1024 x 768) 16 bit ... \$399

Miscellaneous:

- Modems, 2400 Baud, Int. From ... \$88
- Modems, 2400 Baud, Ext. From ... \$119
- AT IO Card, Ser, Par & Game ... \$39
- Dot Matrix Printer...From ... \$145
- PC Mouse From ... \$48
- Power Strp ... \$16

PC, XT and AT Owners SAVE \$! Power Up with our Performance Solutions! CDS has the complete line of System upgrade products!

CDS has the performance upgrade solution to meet your computing needs and budget!

Current System AT Speed Comparison

- XT Turbo 4 Mhz
- Bullet 286-10 12.6 Mhz
- Bullet 286-12 15.4 Mhz

XT Solutions (Columns 1,2,3 & 6) Upgrade your XT system to a 12.5 Mhz 80286 AXT Main Bd. w/1 MB DRAM only ... \$ 449.

Add a 1.2 Meg Floppy drive kit for \$ 128 and your system performs like systems costing Twice as much. If you want to use existing 150 ns Memory we have AXT boards starting at ... \$ 179 for our 7.2 mhz XT replacement bd or \$ 199 for the 8 or 10 Mhz 80286 replacement for your PC or XT. This board is 100% compatible with existing XT boards and Keyboard resulting in the lowest total upgrade cost.

AT Solutions (Columns 3, 4 & 6) Replace your slower AT mother bd with our 12 Mhz Baby AT (fits original AT) for only...\$ 239! This board runs as fast as a 15.6 Mhz

AT with a Norton SI of 15.2 with existing 120 ns memory. Get out 16 Mhz version for \$ 329 or look at the 386SX as a solution to future 80386 software requirements.

80386SX Upgrade Solutions (Column 7) 16 and 20Mhz 80286 performance looks impressive but for just a little more you can have a 16 or 20Mhz 80386SX. All the performance benefits of running 386 software! From \$589

80386 Solutions (Columns 8 & 9) 80386 Upgrade with Baby sized or full size 386 is your solid, reliable 386 solution. Based on the Chips and Tech chip set and a 80386-20 pushed to 25.. (Add \$200 for -25 CPU) This Board is available in either baby or Full size. Full specs below. Special offer... 386 Board w/1meg \$1099 Cache Boards available 25 or 33 Mhz.

Compaq Portable Solution (Column 6) The Bridge 286/CP is the ideal Upgrade for that trusty Compaq. 12 Mhz Zero wait state performance with up to 6 MB of on board memory makes this a long term winner. Board with no memory...\$495

Bridge 286-12 (Column 6) This board is comparable to Transformer with a on board four floppy controller and brings full AT 12 Mhz performance to your PC or XT 5 Slot or 8 Slot. It provides full OS/2 capability with up to 6 MB of on board memory. Call for special memory pricing. board with no memory...\$495

Column	1 Bullet 286 286-7.2	2 Bullet 286 286-10	3 Bullet 286 286-12.5	4 VLSI AT 286-12	5 Precision AT 286-16	6 Bridge 286 286-12	7 CCI 386SX 386SX-16	8 CCI 386 386-20	9 X Golden 386 386-25
CPU	80286-8	80286-8/10	80286-10/12	80286-12	80286-16	80286-12	80386SX-16	80386-20	80386-20
Math Co-po	80287-2/3	80287	80287	80287	80287	80287	80387SX	80387	80287/80387
Cache Ram	N	N	N	N	N	N	N	N	N
Dram Type	64/256K	64/256K	64/256K	64/256/1024K	64/256/1024K	256K/1M SIMMS	256/1M SIMMS	256/1M DIP	256/1M Slp/DIP
Mem Speed	150ns	120ns	100ns	120/100 ns	100/80 ns	100ns	100 ns	100/80 ns	100/80 ns
Mem Config	512/640K/1M	512/640K/1M	512/640K/1M	512/640K/1/2/4M	512/640K/1/2/4M	512K/1M to 6M	512K to 8MB	1/2/4/6/8/10 MB	1/2/4/8/16/32MB
8 Bit Slots	8	8	8	2	2	(2) 5	2	2	1
16 Bit Slots	0	0	0	6	6	(3) 3	6	5	5
32 Bit Slots	0	0	0	0	0	0	0	1	2
BIOS	Quadtel	Quadtel	Quadtel	Award/AMI	Award/AMI	Phoenix	Phoenix	Award/Phoenix	AMI
Relative Speed	9	12.4	15.6	15.6	21.6	15.4	18.0	25.5	33.0
SI Raung	6.2	11.0	14.7	15.3	18.3	15.2	17.2	23.0	28.0
Price	\$189	\$199	\$225	\$229	\$299	\$495	\$599	\$799	\$849

Prices subject to change without notice!

Orders Only
800-548-2644



CDS Advanced Computer Products
1630 Oakland Rd. Suite A100
San Jose, Ca 95131
(408) 437-1003

Circle 520 on Reader Service Card

SEPTEMBER 1989 • B Y T E 80PC-13

DRAM Tester Includes SIMM/SIP Option

Fast RAMstar, a 64-, 128-, and 256-kilobit and 1-megabit DRAM tester, can test chips in the 45- to 110-ns range in 1-ns access-time resolution. Developed by the company Computer Doctors, the DRAM chip tester has an option that allows you to test 1-megabit single in-line memory modules (SIMMs) and single in-line pins (SIPs) with 8- or 9-bit configurations.

The company's 4-By adapter lets you test each bit of 4- by 64-kilobit and 4- by 256-kilobit DRAMs individually. The products are updates to Computer Doctors' original RAMstar tester, which has 16- and 18-pin zero-insertion-force sockets, auto-loop testing for long testing, and access-time control from 80 to 180 ns. RAMstar's test rate is 6.25 Mbps with continuous access speed set at 80 ns, and the tester can test all bits at every address.

Price: RAMstar, \$249; Fast RAMstar, \$349; SIMM/SIP adapter, \$189;

4-By adapter, \$89; 5-volt power supply, \$25.

Contact: Computer Doctors, 9204-B Baltimore Blvd., P.O. Box 470, College Park, MD 20740, (301) 474-3095.

Inquiry 1001.

Workgroup Editing and Review Software for the Mac

The old saying that the stoniest drive is to edit someone else's copy holds especially true when the edit and review process involves an entire workgroup. After 12 or so passes, the document or proposal can resemble some-



The SIMM/SIP and 4-By adapters plug into the 1-megabit test socket of the Fast RAMstar.

thing from Custer's Last Stand.

A program called MarkUp is designed to make workgroup review less painful and laborious. With it, members of a group can use a variety of editing tools to independently edit the same document at the same time, without having the application that created it. The program uses an overlay metaphor that lets you mark up, expand, annotate, and comment on an image of the document.

After all editing is complete, a master reviewer collects the comments from the overlays and incorporates them into the final version. A pop-up palette of proofreader's marks helps you add standard editing symbols.

MarkUp works on any AFP-compatible network, or you can use a personal version of the program that includes a run-time version of MarkUp with each distributed document. The program runs on a Mac Plus or higher.

Price: \$245; two-user version, \$495; five-user version, \$995.

Contact: Mainstay, 5311-B Derry Ave., Agoura Hills, CA 91301, (818) 991-6540.

Inquiry 1003.

New ScanLab Prevents the Washout Blues

Professional ScanLab 1.1, the 24-bit color-separation package, can make allowances for impurities in printer ink, so that your blues are blue and your yellows aren't orange. According to developer ASDG, impurities can exist in printer ink that corrupt the final printout.

For example, magenta has a slight touch of cyan. The program's utility software now accounts for that, using less cyan when mixing with magenta. The new program prevents blues that end up looking purplish, yellows that look too orange, and washed-out greens.

The package is a hardware/software combination that includes a board that fits into an Amiga expansion slot. It works with the Sharp JX-300 and JX-450 24-bit scanners and Gold Disk's Professional Page desktop publishing package. Pages can be converted to electronic color separations, saved in PostScript format, and sent to a bureau for film production for offset printing.

Professional ScanLab 1.1 requires an Amiga 2000 or 2500 with AmigaDOS 1.2 or higher and a minimum of 2 megabytes of memory.

Price: \$995.

Contact: ASDG, Inc., 925 Stewart St., Madison, WI 53713, (608) 273-6585.

Ntergaid Upgrades Hypertext System for the IBM PC

Black Magic 1.4, a hypertext authoring system for the IBM PC, now generates reports, supports the extended ASCII character set (with international characters), and allows you to grab VGA and multiple images from a screen without having to name each successive file. Ntergaid added a DOS shell that lets you access other DOS programs.

When you're moving through your application, Black Magic notes what you've read and remembers it when you want to generate a report. The report is then written to a text file when you activate the link. Because Black Magic now supports international characters, you could use it to create a language instruction tutorial. The program's TSR screen grabber lets you grab VGA and multiple images, which you can incorporate into your program. If you import a CAD image, you can link specific points of that image to explanatory text. Documents can be as large as your available RAM.

Black Magic 1.4 runs on the IBM PC with 384K bytes of RAM (640K bytes is recommended), DOS 2.1 or higher, and a monochrome, EGA, CGA, or VGA graphics adapter.

Price: \$89.95.

Contact: Ntergaid, Inc., 2490 Black Rock Tpk., Suite 337, Fairfield, CT 06430, (203) 368-0632.

Inquiry 994.

Plotters for people who want more, but can't afford expensive.

The truth is, some companies can buy any plotter they want. But most companies have to be concerned about budgets, as well as quality and performance. That's why Zericon's line of large format plotters are becoming so popular. They're made with exceptional craftsmanship utilizing advanced manufacturing techniques right here in the USA. Now you don't need a big budget to afford a great plotter.



most demanding application. And where scale is important, our X & Y calibration feature offers precision for critical applications like PCB artwork. "Installation is a Breeze" because we include a custom configured cable tailored to your software and hardware combination.

Call us today.

\$1695. - \$2995.

Starting at \$1695 for our ValueLine™ D size, to \$2995 for our Designer series A-E model, we make a large format plotter that's just right for your application.

Zericon plotters are compatible with all popular CAD software packages. They accept media sizes from 8½ x 11" to 36 x 48". With .002" repeatability, quality is assured for even the



We'll send you a free sample plot, provide full information about our entire line of large format plotters and outline our customer service program, which includes complete product satisfaction or your money back within 10 days of purchase. We'd like to win you over as a Zericon customer. And we've got the plotters to do it. Call

us today. Zericon, Inc.,
4049I Encyclopedia
Circle, Fremont,
CA 94538.

In CA (415) 490-8380.
FAX (415) 490-3906.

(800) 727-8380

ZERICON

More plotter. Not more money.

The Software Engineering Store

C

Borland Turbo C v2	\$105
Borland Turbo C v2 Prof.	\$175
Blaise C Tools Plus/5.0	\$99
Creative Vitamin C	\$169
Genus PCX Programmer's Toolkit ...	\$155
<small>read, write, modify & modify *.pcx graphics files</small>	
Gimpel PC Lint	\$99
Island Systems C Meta-Menu	\$165
Magna Carta C Windows Toolkit	\$89
Microsoft C v5.1	\$325
Microsoft Quick C	\$73
Novell Btrieve	\$199
Softfocus Btree/ISAM	\$99
<small>comprehensive file/index manager with all source</small>	
Wordcraft C Workshop	\$69
<small>C training manual & software</small>	
Zortech C++	\$129
<small>Optimizing C++ Compiler</small>	

Other Languages & Tools

Abraxas PCYACC	\$359
Digital Smalltalk/286	\$164
Borland Assembler & Debugger	\$105
Borland Turbo Pascal v5.5 Pro	\$175
Burton Tlib	\$89
<small>source code management system</small>	
Copy Tech Disk Duplicator Pro	\$129
Matrix Layout	\$129
Microsoft Macro Assembler	\$111
Microsoft Windows SDK v2.1	\$349
Mortice Kern MKS Toolkit v2.3	\$175
<small>KORN shell & 130 UNIX™ -like utilities</small>	
Periscope I 512K v4	\$599
Polytron Professional PVCS	\$359
Qualitas 386-Max	\$69
<small>80386 memory manager</small>	
Solution Systems Brief	\$call
Turbo Power Turbo Professional	\$99
Whitewater ACTOR	\$449
<small>High productivity development for MS Windows</small>	

Free Catalog & Newsletter

We carry hundreds of products from dozens of publishers. Call or write for your free subscription to our catalog and newsletter.

Returns

We want you to pay for only the tools you really use. If you order anything featured in this ad (or most of the products in our catalog) you can open and use the product for up to 30 days and still return it if it doesn't meet your needs.

386 Hardware

Hauppauge 386XT

replaces your XT motherboard to provide top 80386 performance with maximum compatibility. The 386XT works with virtually all 8-bit and 16-bit adapter cards and runs standard versions of 16-bit and 32-bit software including DESQview, OS/2, Windows/386 and UNIX. The board includes 16Mhz 32-bit CPU, 1MB zero wait state memory, 80387 socket and 8 slots (2 16-bit, 1 32-bit)

The 386XT is backed by a 30 day money-back guarantee and one year warranty.

386XT w/1MB RAM	\$1295
20Mhz AT w/1Mb	\$1645
33Mhz AT w/4MB	\$3875

Hauppauge!

The Software Engineering Store

1-800-443-7176

In Calif: 1-800-635-0969

(415)957-0111

Visa • MasterCard
COD • Check

- Most orders shipped within 24 hours
- Free shipping on orders over \$100

657 Mission Street, #300-BT
San Francisco, CA 94105

Programming Classes

The Software Engineering Store offers hands-on training classes in C, Pascal and other languages at our San Francisco store. Please call for a course outline and schedule.

C Windowing

Vitamin C	\$169
VC Screen	\$129
<small>top-notch code generator for Vitamin C</small>	
DESQview API Ref & C Lib ..	\$179
<small>use internal DESQview functions</small>	
Vermont Views	\$359
<small>complete functionality & great documentation</small>	
DataWindows	\$229
<small>easy-to-use with great documentation & full source</small>	
C Windows Toolkit	\$89
<small>high performance low level functions</small>	

Debugging

Periscope v4 by Periscope: The Periscope debuggers provide the combinations of hardware and software you need to solve really tough programming problems. Periscope includes all the debugging features you need, but with minimum overhead and maximum flexibility. With Periscope you can debug programs which need all memory, have real-time requirements and/or are picky about vector usage.

Periscope I w/512K \$599
0k memory overhead!

Periscope III \$1199
hardware breakpoints and trace-back for real-time applications

C Database

C-Tree	\$314
<small>highly portable file manager with full source</small>	
C-Tree / R-Tree Bundle	\$519
CQL	call
<small>SQL access to C-Tree files</small>	
Btrieve	\$199
Btrieve Network	\$469
<small>file manager with built-in error recovery & combined data/index files</small>	
B-Tree/ISAM	\$99
<small>highly portable with full source</small>	
C-Index for Microsoft C	\$179
C-Index for Turbo C	\$89
<small>combined data/index files with great performance and full source</small>	
pBase	\$179
<small>true relational database manager</small>	

SHORT TAKES

BYTE editors' hands-on views of new and developing products

Studio/1

DeScribe Word Publisher

SuperGluell

Ami Professional

POSTcard

Electronic Arts Decolorizes Studio/8

Last year, Electronic Arts brought out a color paint program for the Macintosh that is still the best in its class. The only problem with Studio/8 is the color. You can create some beautiful images with the program, but you need a Mac II with lots of memory, not to mention a color printer if you want to get the images off the screen.

Electronic Arts has now decolorized the program, added some capabilities, and released it as Studio/1. This monochrome paint package runs on anything from a Mac Plus on up. It's the most capable graphics program I've seen yet that will work on a system with just 1 megabyte of RAM.

Studio/1 has the same hefty toolbox as its colorful predecessor: freehand pencil, paintbrush, airbrush, text typer, filler, eraser, magnifier, selectors, a palette of 40 background/foreground patterns (including gradient fills), and tools for drawing straight lines, bent lines, rectangles, ellipses, polygons, triangles, freestyle shapes, and Bézier curves. Manipulating these shapes is easy; you can quickly rotate, distort, shrink,



or stretch just about anything you can draw.

The capabilities for drawing and editing are enough to make this an excellent program. But Studio/1 also has animation facilities.

Not everyone has a need to whip up animated graphics, but the developers have designed such a nice process that this part of the program will lure even people who have gotten no closer to animation than Mighty Mouse cartoons. If you have done any work with animation, the method for creating moving pictures with this program will seem (pardon the cliché) intuitive. If this is new to you, the manual will help make it clear.

You can paint/draw each frame yourself or create key frames and have the program make the transitions from frame to frame for you. The animation control panel is straightforward; so are most of the dialog boxes, although I have some nonintuitive trouble with the setup for doing some three-dimensional effects.

The rectangular control panel has buttons for moving backward and forward through the frames, for playing back the animation, and for setting the speed of the playback. One very handy feature is a simple thing: a line that tells you how much memory you have left for the rest of your animation. (I usually had about 160K bytes to start with and could comfortably fit in about 20 frames of fairly dense content.)

The Anim three-dimensional effects take some work to get used to, but they're worth the plotting if you like dissolves, zooms, and fades. By entering numbers for *x* and *y* axes, you can do some fancy visuals with this program. And with a folder of sounds, you can add sound effects (e.g., boing, warp, and bip) to the graphics. To really do much with Studio/1's animation functions, you'll need more than a megabyte of RAM, though.

The program works with most file formats, including PICT, TIFF, PICS, Mac-

THE FACTS

Studio/1
\$149.95

Requirements:
Mac Plus, SE, or II with at least 1 megabyte of RAM; it will run on a system with two 800K-byte floppy disk drives, but a hard disk drive is recommended.

Electronic Arts
1820 Gateway Dr.
San Mateo, CA 94404
(415) 571-7171
Inquiry 986.

Paint, Encapsulated PostScript, and Electronic Arts' own format for compressed animation files, SIAN. I had a chance to scan some images with the program but wasn't able to check out its ability to play animations in HyperCard stacks. The package comes with a HyperCard disk for installing the Animation Driver XCMD. This is a complex program that takes time to explore. I had less than a week with beta software, so I'm sure there are other things I haven't hit upon.

Companies like Electronic Arts, Silicon Beach Software, Cricket Software, and SuperMac Technology have developed some very capable color paint programs, but Electronic Arts deserves extra points for remembering the Mac owners who don't have the luxury of equipment for color graphics—or for those people who prefer to work in black and white. After all, some of the best things in life—*The Honeymooners* and the first third of *The Wizard of Oz*, for example—are black and white. □

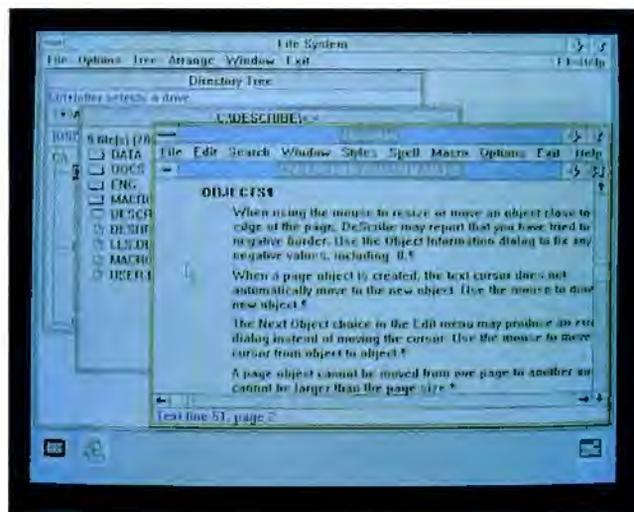
—D. Barker
continued

Word Publishing for OS/2

If you're looking for something just a bit different in IBM PC-based word manipulation, Lennane Advanced Products, a recently formed company whose entire mission in life is producing programs for the OS/2 Presentation Manager (PM), is developing what it calls the **DeScribe Word Publisher (DWP)**. The program is a real hybrid, lying somewhere between a word processor and a full-fledged desktop publishing package.

DWP is a true child of OS/2. Most of the under-development PM programs I've seen don't take full advantage of OS/2's very own graphical user interface. But it's evident that Lennane's designers are committed to PM. They started with a given (PM) and asked themselves how a word-manipulation program could take the best advantage of it. Despite some rough edges, they're well on their way.

My copy of DWP was an alpha version. Understandably, it had its bugs and shortcomings. But after only 15 minutes, I was happily producing multicolumn documents with a variety of fonts, type sizes, and styles. If you, like me, have ever spent hours attempting to get one of the leading desktop publishing programs to produce a simple multi-



THE FACTS	
DeScribe Word Publisher \$399	Lennane Advanced Products 4047 North Freeway Blvd. Sacramento, CA 95834 (916) 646-1111 Inquiry 987.
Requirements: An 80286- or 80386-based IBM PC or compatible running OS/2 1.1, with at least 2 megabytes of RAM and a hard disk drive.	

column page layout, DWP is a minor revelation.

Its user interface is remarkably intuitive. I rarely had to call up the extensive (800K-byte) help file. DWP uses

those ubiquitous style sheets to customize the look of a page or even a block of text. But unlike competitors, the program's style sheets are easy to fill out. And they're not set in stone

either. I found I could change the layout of a page on the fly with a couple of mouse-clicks.

But DWP's variable undo feature is absolutely unique among PC-based word processors. And it's almost worth the price of admission by itself. I've been frustrated by the so-called undo ability of most word processors. If you're lucky, you can undo just your last change and maybe a level or two back. But DWP's variable undo lets you undo any number of changes, all the way back to when you started working on the document. The last time I saw something like this was in my first word processor, which ran on a VAX.

Several high-end PC-based word processors come close to DWP. But none are anywhere near as easy to use. DWP does have one major shortcoming in its lack of graphics capabilities, which won't be available until next year. DWP was also molasses-slow on my 10-MHz AT clone. It's a bit more acceptable on a 20-MHz AT, and (as you might expect) it flies on a 33-MHz 80386. DWP isn't the be-all, end-all PM program, but it's a solid start, and it's the only program I've seen that's actually fine-tuned to PM. □

—Stan Miastkowski

Save and Annotate Your Mac Output

Two of the definitions in *Webster's Dictionary* for the word *utility* are, as a noun, "fitness for some purpose or worth to some end," and, as an adjective, "capable of serving as a substitute in various roles or positions." Solutions International's **SuperGlueII** is one of those versatile Macintosh utilities that assumes both roles.

Its fitness of purpose comes from providing the Mac with a "print to disk" capability. That is, it captures an application's printer output and re-

directs it to a disk file. Since printing operations are graphics-based on the Mac, the file becomes a copy of the document, down to the different fonts, embedded charts, and diagrams. SuperGlueII then serves as a substitute in that you can "print" your PageMaker newsletter and then send this file for evaluation to a graphics designer who doesn't have PageMaker.

SuperGlueII consists of two main files, ImageSaverII and SuperViewer, plus several support files. The ImageSav-

erII file masquerades as a Chooser-selectable printer driver, redirecting the application's printer I/O to a file. The SuperViewer file is the other half of the equation: It's the application you use to examine these files. Since there's no licensing fee for distributing SuperViewer, you're free to send a copy of it along with your output files.

You can adjust ImageSaverII to emulate either an ImageWriter or a LaserWriter from the Page Setup dialog box for those applications that

can deal with only these printers rather than ImageSaverII's generic printer (the default). When you're ready to print, you can select what format the output is to be saved in (Image, BackFAX cover page, PICT, Scrapbook, or text only) and optionally preview the output.

The SuperViewer application lets you look at and perform some slick operations on these captured files. You can extract portions of text or extract parts of captured images

continued



Embedded systems designers have already used CrossCode C in over 413 different applications.

CrossCode C comes with four powerful tools to help you program your 68000-based ROMable applications

From C source to final object, each tool takes you one step closer to your finished ROMable design

CrossCode C is designed specifically to help you write ROMable code for all members of the Motorola 68000 family. Four powerful tools take you from C source to object code:

1. COMPILER: To get truly ROMable code, you have to start with a truly ROMable compiler. Here are three **CrossCode C** features that you won't find in any ordinary C compiler:

- Compiler output code is split into five independent memory sections that you can assign into ROM or RAM as you please.
- You can optimize the code for your application because *you* control the sizes of data types. For example, you can optimize for speed by using two byte *ints*, or get maximum versatility by using four byte *ints*.
- You can easily write assembly language routines that call C functions and vice versa, because the compiler uses simple, well documented parameter passing conventions.

2. ASSEMBLER: **CrossCode C** comes with a Motorola-style assembler that has all the features that assembly language programmers require. In fact,

you could write your whole application with it:

- The assembler features an advanced macro language, conditional assembly, "include" files, and an unlimited size symbol table.
- Detailed cross references show you where you've defined and referenced your symbols.
- After a link, you can actually convert your "relocatable" assembler listings into "absolute" listings that contain absolute addresses and fully linked object code.

3. LINKER: The **CrossCode C** linker is designed to handle truly huge loads. There are no limits on the number of symbols in your load or on the size of your output file. And you can always count on full 32 bit target addressability, because the linker operates comfortably in the highest ranges of the 68030's address space.

4. DOWNLOADER: **CrossCode C** comes with a *downloader* that puts you in touch with all EPROM programmers and emulators. It can convert your load into Motorola S-Records, Intel Hex, Tek Hex, Extended Tek Hex, and Data I/O ASCII

Hex. You can also produce a binary image and convert that image into any format you might want. In all formats, bytes can be split into EPROMs for an 8, 16, or 32 bit data bus.

Why Wait

Once you start using **CrossCode C**, you may just wonder how you ever got the job done before! It's available under MS-DOS for just \$1595, and it runs on all IBM PCs and compatibles (640K memory and hard disk are required). Also available under UNIX, XENIX, and VMS.

CALL TODAY for more information:

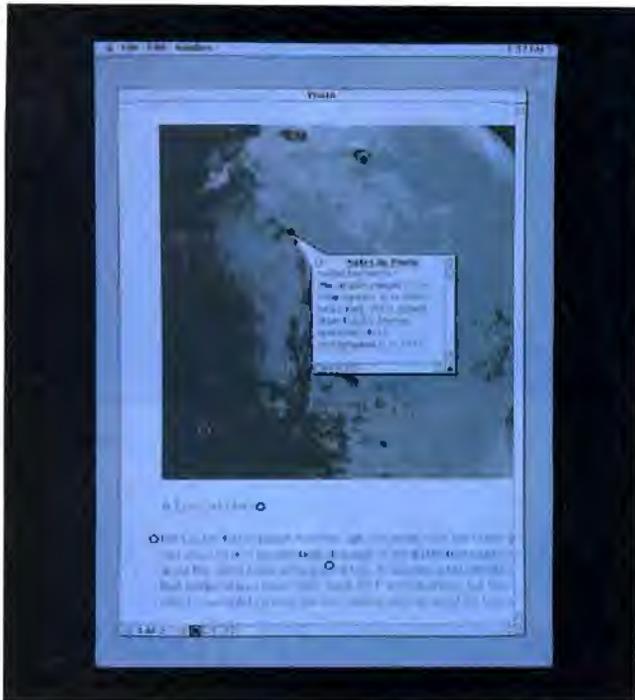
1-800-448-7733
(ask for extension 2002)

Outside the United States, please dial

PHONE: 1-312-971-8170
FAX: 1-312-971-8513

SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 51
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

CrossCode™ is a trademark of SOFTWARE DEVELOPMENT SYSTEMS, INC. MS-DOS® is a registered trademark of Microsoft. UNIX® is a registered trademark of AT&T. XENIX® is a registered trademark of Microsoft.



using either the built-in Marquee or Lasso tools. Where SuperViewer really shines is in its GlueNotes feature: You can annotate a document, both text or graphics, with the electronic equivalent of Post-it notes. This is similar to the Notes feature in MacDraw 1.1, but the advantage here is that you can annotate anything that can be printed, and the notes can hold text or an image

(but not both). SuperViewer can print these files, including their notes.

The printed output of files containing notes is handled elegantly. First, there's a thumbnail (miniature) view of the document, with each note's position marked on the image and assigned a number. Following this thumbnail view are, by number, the notes themselves. It's an effective

THE FACTS

SuperGlueII
\$119.95

Requirements:
Mac Plus, SE, SE/30,
or II running System 6.0.2
or higher with 1 megabyte
of RAM.

Solutions International
30 Commerce St.
Williston, VT 05495
(802) 658-5506
Inquiry 988.

way to keep what might be large amounts of disparate information organized.

I used a late beta version of SuperGlueII on a Mac II equipped with 5 megabytes of RAM and 32-Bit QuickDraw, and running System 6.0.3. ImageSaverII worked well with word processors (FullWrite Professional 1.0, MindWrite 2.1, and MacWrite 5.0) and graphics applications (MacDraw 1.1, PixelPaint 2.0, and SuperPaint 2.0). The Preview window worked well, even with PixelPaint, where it displayed a full-color view of an image before I committed the output to a file.

However, applications that emit special PostScript commands can cause problems or give you what looks like an empty file, but actually contains PostScript code. Offenders in this area are Adobe Illustrator, Aldus FreeHand,

and early versions of PageMaker. Some of these problems should go away with the improved printing drivers in System 7.0, but until then, check out the application carefully before attempting to save output to your Macintosh's hard disk. GlueNotes worked fine, but I wish that you could open all the notes at once, rather than just one at a time as you must do with the current implementation.

Despite these minor quirks, SuperGlueII's ingenious capture mechanism worked without a hitch, even with color graphics, and GlueNotes lets you comment on a document in a simple, intuitive way. If your work has you shipping information electronically across the country in a medley of formats and wishing there was an easier way, SuperGlueII is a must buy. □

—Tom Thompson

Text Marries Graphics under Windows

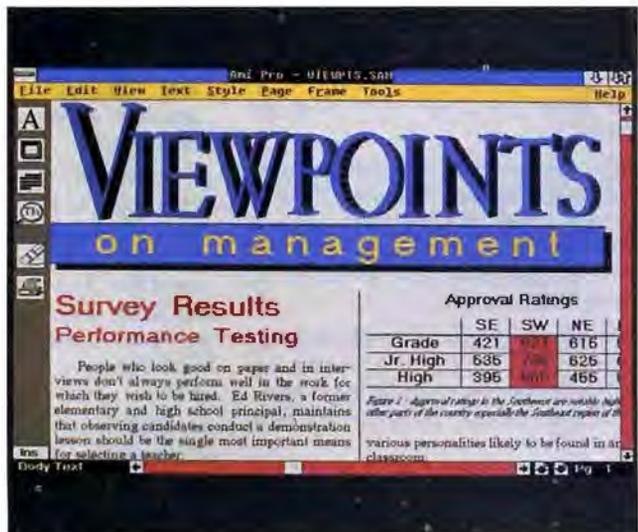
With **Ami Professional**, Samna adds a boatload of features and improvements to the original Ami, the company's inexpensive (\$199) program that combines word processing and basic desktop publishing under the Windows graphical user interface (GUI). Ami Professional lets you do fairly sophisticated graphing and drawing, use macro commands, and import TIFF, XLC, PIC, EPS, and PCX graphics files. At press time, Samna was working on supporting CGM files.

The new version also supports Dynamic Data Exchange, a protocol developed

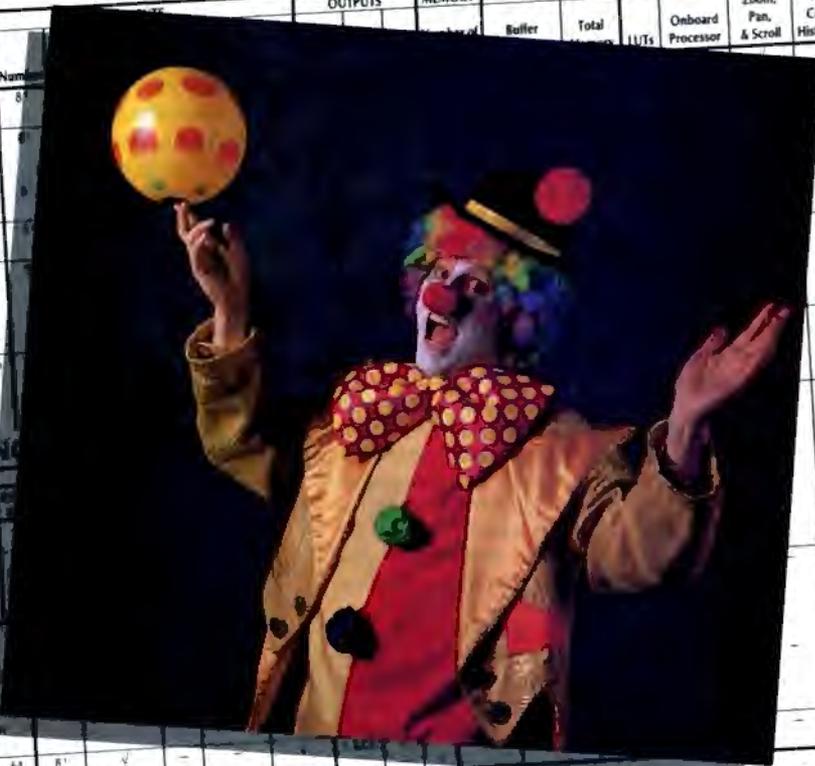
by Microsoft for message passing between applications. Using DDE, changes made to a spreadsheet would automatically update a related graph in Ami Professional. The program can also import data from non-DDE programs like Lotus 1-2-3.

But first things first: If word processing is your primary application, beautiful graphs and such aren't worth much if the program you're working with can't efficiently manage text. This program lets you work in two modes: draft, for high-speed text entry, and layout, which gives

continued



MODEL	DESCRIPTION	RESOLUTION		Number of Colors	Outputs	MEMORY		Onboard Processor	Zoom, Pan, & Scroll	N:M Conv., Histogram	Real-Time Frame Aver. Math & Logic	Hardw. Window
		Spatial	Gray Levels			Buffer	Total					
DT2862-60Hz*	Arithmetic Frame Grabber	512 x 512	256	8							8-bit	✓
DT2862-50Hz*	Frame Grabber & Frame Processor	512 x 512	256	8							8-bit or 16-bit ¹	✓
DT2861-60Hz* w/ DT2858*	Frame Grabber & Frame Processor	512 x 512	256	16.8 million							8-bit or 16-bit ¹	✓
DT2861-50Hz* w/ DT2858*	Frame Grabber & Frame Processor	512 x 512	256	16.8 million							8-bit or 16-bit ¹	✓
DT2861-60Hz*	Arithmetic Frame Grabber	512x512	256	16.8 million							8-bit or 16-bit ¹	✓
DT2861-50Hz* w/ DT2858*	Frame Grabber & Frame Processor	512x512	256	16.8 million							8-bit or 16-bit ¹	✓
DT2861-60Hz* w/ DT2858*	Frame Grabber & Frame Processor	512x512	256	16.8 million							8-bit or 16-bit ¹	✓
DT2851-60Hz*	High Resolution Frame Grabber	512 x 512	256	16.8 million							4-bit or 16-bit ¹	✓
DT2851-50Hz*	High Resolution Frame Grabber	512 x 512	256	16.8 million							4-bit or 16-bit ¹	✓
DT2853-SQ-60Hz*	Low Cost, Square Pixel Frame Grabber	512 x 512	256	16.8 million							4-bit	✓
DT2853-SQ-50Hz*	Low Cost, Square Pixel Frame Grabber	512 x 512	256	16.8 million							4-bit	✓
DT2803-60Hz	Low Cost Frame Grabber	256 x 256	64	8 ¹							4-bit	✓
DT2803-50Hz	Low Cost Frame Grabber	256 x 256	64	8 ¹							4-bit	✓



-Fred Molnar, President

COLOR IMAGE PROCESSING

MODEL	DESCRIPTION	RESOLUTION	Number of Colors
DT2871-60Hz	(HSI) Color™ Frame Grabber	512 x 512	16.8 million
DT2871-50Hz	Color Frame Grabber	512 x 512	16.8 million
DT2871-60Hz w/ DT2858	Color Frame Grabber and Frame Processor	512 x 512	16.8 million
DT2871-50Hz w/ DT2858	Color Frame Grabber and Frame Processor	512 x 512	16.8 million

Pages 6-7, New Products Handbook

Why clown around in black and white when you can do it in color...just as easily.

The DT2871 Frame Grabber.
The next logical step.

Now, moving from monochrome to color image processing is as easy as plugging our DT2871 (HSI) Color™ Frame Grabber into your IBM® PC AT®-compatible computer. The DT2871 features real-time 24-bit color capture and display. It also performs real-time RGB/HSI and HSI/RGB color-space conversion for processing captured images in either the red-green-blue or hue-saturation intensity domain . . . intensity being the link to

monochrome processing which performs gray scale operations.

The DT2871 connects directly to DT-Connect™ processor boards for faster compute-intensive color processing. And, is supported by our Aurora™ software for accelerated application development.

Now, color image processing can be much less complicated and quicker to execute.

So, add a little color to *your* act.
Call (508) 481-3700
In Canada, call (800) 268-0427

FREE 1989 Image Processing Handbook.



DATA TRANSLATION®

World Headquarters: Data Translation Inc., 100 Locke Drive, Marlboro MA 01752 1192 USA, (508) 481-3700 Tlx 951646
 United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG11 2QJ, U.K. (0734) 793838 Tlx 94011914
 West Germany Headquarters: Data Translation GmbH, Stuttgart-Strasse 66, 7120 Bietigheim-Bissingen, West Germany 01742 54025
 International Sales Offices: Australia (2) 662 4255; Belgium (2) 466-8199; Canada (416) 625 1907; China (1) 868 721 44017, (408) 727 8222; Denmark (2) 274511; Finland (0) 372144; France (1) 69077802; Greece (1) 951 4944, (31) 527 039 (1) 361 4300; Hong Kong (5) 448363; India (22) 23 1040; Israel (3) 5401524; Italy (2) 824701; Japan (3) 502 5550, (3) 348 8301, (3) 355 1111; Korea (2) 756-9954; Netherlands (70) 99 6360; New Zealand (64) 9 545313; Norway (2) 53 12 50; Portugal (1) 545313; Singapore (65) 7797621; South Africa (2) 8037680/93; Spain (1) 455-8112; Sweden (8) 761 7820; Switzerland (0) 723 1410; Taiwan (2) 7020405
 DT-Connect, (HSI) Color and Aurora are trademarks, and Data Translation is a registered trademark of Data Translation, Inc. All other trademarks and registered trademarks are the property of their respective holders.

THE SOLUTION

... to your data collection and data entry problems!

The Psion Organiser II & dCAPP

Psion Gives You the Answers!

With eight different Organiser II models to choose from, Psion lets you select the Organiser II that best meets your needs. Standard configurations are available with or without built-in software programs, and provide the options of either two or four lines of LCD display, several different keyboard designs, and from 32K to 96K of internal RAM memory.



All Organiser units can use our removable and interchangeable memory modules, allowing the Organiser II to be configured to meet your unique data and program memory requirements.

POWER

The Organiser II is a powerful hand held computer capable of running a broad range of pre-written programs. When an off the shelf program just won't do, you can custom program the Organiser II to the unique requirements of your application. From inventory control to remote sales order entry, the Organiser II has the power to do the job.

PERIPHERALS

For jobs ranging from simple data collection to an RS-485 factory floor network, the Organiser II has the right tools for the job. Peripherals include Bar Code Wands, Laser Scanners, Mag Card Readers, Portable Modems and Printers, Carrying Cases, all the way to a broad range of interfaces which include serial, parallel and multiple types of SPC devices.



dCAPP Gives You the Solution!!

• dCAPP data collection software is completely user configurable allowing even non-programmers the ability to create their own custom data collection program for the Organiser II in a matter of minutes, including its own operating instructions manual. • dCAPP data collection software is completely user configurable. Keyboard, Magnetic Card, or BAR CODE input. • Direct Interface to most Database and Spreadsheet programs; (dBASE 3, dBASE 4, Lotus 123, D.I.F., and many others).

TYPICAL APPLICATIONS: Inventory Control; Stock Taking; Tools and Equipment Control; Sales Route Accounting; Quality Control and Inspection Reporting; Tank Farm Gauging; Stores Accounting; Plant Inspection; and More . . .

For more information, contact:

XEC Products

13575 58th Street North, Suite #123
Clearwater, Florida 34620
(813) 538-4190

Lotus 123 is a registered trademark of Lotus Development Corp.
dBASE is a registered trademark of Ashton-Tate Corp.
IBM-PC is a registered trademark of International Business Machines Corp.

you a preview of the finished product as you type.

With Ami Professional, you can create a document with footnotes, a table of contents, and an index. Ami doesn't treat footnotes and your index as outcasts. They are included with the main copy, which allows you to edit them on the same page as the rest of your text. When generating the table of contents, all I had to do was tell the program the styles for titles and headings; Ami Professional collects them into a table of contents and adds the correct page number. When I double-clicked on an item in the table of contents, the program took me directly to the page. A similar approach is used for indexing.

Ami Professional lets you use DDE in two ways: You can link Ami with another Windows application where both applications are active on your screen, or you can use a file-importing function that updates the linked files when you load them.

Other features include complex headers and footers, mail merge with conditional statements, and a tables facility that lets you create and maintain tabular formats and bring in data from spreadsheets. The program lets you add hidden notes, which is handy when several people want to review a document and make comments to it. What I liked about Ami Professional's implementation of annotated notes is that if you anchor a note to a word and someone accidentally deletes that word, the note will remain intact, preventing accidental deletions of comments.

One common complaint against full-blown desktop publishing packages is the slow reaction when substantially editing a document in WYSIWYG mode. Sometimes, you have to get back in your word processor, make your edits, and repour the document into your desktop publishing program. Ami Professional also is not a speed demon. However, while draft

mode is best for text editing, you won't be twiddling your thumbs too often while editing in layout mode. The beta version I looked at was faster than the original Ami, but at press time, Samna was still tweaking the program's speed capabilities.

As for Ami Professional's page layout and drawing capabilities, the program is not (and is not meant to be) quite in the same league as full-featured desktop or drawing packages. But what it does, it does nicely, and the GUI made it easy. The program can do basic drawing (e.g., ellipses, lines, circles, and round-cornered boxes). I created a bar chart from text data I'd already entered by using the mouse and simply selecting the type of chart I wanted.

Ami Professional can wrap text around graphics frames, support multicolumn and variable-width column layout, and anchor defined text or graphics to the main body of text. You can also use the program to edit gray-scale images for qualities like contrast and brightness.

If you're looking for a program that can do desktop publishing and word processing for under \$500, I recommend that you look closely at Ami Professional. It bundles power with simplicity. □

—David L. Andrews
continued

THE FACTS

Ami Professional
\$495

Requirements:
IBM PC with 640K bytes of RAM and Windows 2.01 or higher (a runtime version is included); a Microsoft Mouse is recommended.

Samna Corp.
5600 Glenridge Dr.
Atlanta, GA 30342
(800) 831-9679
(404) 851-0007
Inquiry 989.

THE \$49 DISK SPACE SOLUTION — PACK MAGIC!



GUARANTEED.

Whether you're a hard disk user who is quickly running out of space, or a software developer whose program no longer fits on a single disk, PACK MAGIC is for you. PACK MAGIC works hard to solve these common disk space problems:

PROBLEM: You never dreamed it would happen, but your hard disk is now fast running out of room.

SOLUTION: Use PACK MAGIC to quickly compress directories when you're not using them. (They'll usually shrink by more than 50%!) When you're ready to use them, PACK MAGIC's rocket-fast algorithm expands any directory in record time.

The following savings are possible with PACK MAGIC:

Disk Size	Space Before PACK MAGIC	Space After PACK MAGIC
20 Megabytes	4 Megabytes	12 Megabytes
40 Megabytes	5 Megabytes	23 Megabytes

It's like getting a bigger hard disk!

PROBLEM: Backing up your hard disk takes forever, so you do it far less often than you should.

SOLUTION: Use PACK MAGIC to compress your directories before backing up. You'll cut the time and number of disks needed to back up by half or more.

PROBLEM: You'd like to reduce the amount of space occupied by the programs you use frequently, or you're a software developer and your program is too large to operate on a 360K floppy disk.

SOLUTION: Also use PACK MAGIC to compress your active program files (.com and .exe files). The average reduction for program files is 22%! Your programs will continue to function normally, but will occupy less disk space.

PACK MAGIC is easy-to-use, comes with a menu-driven interface, on-line help, free technical support and a printed manual.

Try PACK MAGIC for 30 days--if you're not completely satisfied, return it for a full refund (excluding shipping).

For Same Day Shipping

VISA, MASTERCARD & C.O.D. ORDERS CALL

1-800-223-6925

In Canada call: 319-395-7300
Mon.-Fri. 8:30 a.m. to 5:00 p.m. CST
FAX: 319-395-0217

Or send check or money order payable to Parsons Technology.



Dept.
375 Collins Road NE
Cedar Rapids, Iowa 52402



PACK MAGIC
\$49 + \$5 shipping
NOT COPY PROTECTED
INCLUDES PRINTED MANUAL

NAME _____
ADDRESS _____
CITY _____
STATE/ZIP _____ PHONE _____
CHECK MONEY ORDER VISA MASTERCARD
CARD # _____ EXP. DATE _____

PACK MAGIC requires an IBM*/Tandy*/Compaq* or compatible computer, 384K or more RAM and DOS 2.0 or higher. Add \$5 shipping/handling—\$10 outside North America. Iowa residents, please add 4% sales tax.

*IBM, Tandy and Compaq are registered trademarks of International Business Machines Corp., Tandy Corp., and Compaq Computer Corp. respectively.

NEW
FROM**NOVAS****The Leader in High Performance Since 1982****NOVAS NEAT 286-20MHz 40MB VGA SYSTEM**

- 1 MB SIMM Module RAM
- 1.2 MB or 1.44MB Diskette Drive
- High Speed 1:1 Dual Controller
- Enhanced 101 Tactile Keyboard
- 200W Power Supply
- Mini-Tower Case
- 40MB 28ms Hard Drive
- 16 Bit High Speed VGA Controller
- High Resolution VGA Monitor
- DOS 3.3 w/GW Basic
- 80286 Harris CMOS
- 16MHz CPU Running at 20MHz
- Chips & Technologies 286 Neat Chipset
- Interleave/Page Mode 0 Wait
- Shadow RAM, Clock, Battery, AMI BIOS
- 8 I/O Expansion slots, EMS 4.0 support
- Expandable to 8MB on Motherboard
- 287 Socket, 2 Serial, & 1 Parallel Port

POWER METER MIPS = 3.38**\$2595**

*Option: 80MB VGA System \$2775.

**NOVAS 386-25MHz W/CACHE 80MB VGA SYSTEM**

- 1 MB SIMM Module RAM
- 1.2 MB or 1.44MB Diskette Drive
- Chips & Technologies 82C307 Cache
- High Speed 1:1 Dual Controller
- Enhanced 101 Tactile Keyboard
- 200W Power Supply
- Tower Case
- 80MB 28ms Hard Drive
- 16 Bit High Speed VGA Controller
- High Resolution VGA Monitor
- DOS 3.3 w/GW Basic
- 80386 Intel 25MHz CPU
- Chips & Technologies 386 Chipset
- Interleave/Page Mode 0 Wait
- Shadow RAM, Clock, Battery, AMI BIOS
- 8 I/O Expansion slots, EMS 4.0 support
- Expandable to 16MB on Motherboard
- Socket for 287/387/Weitek
- 2 Serial, & 1 Parallel Port

POWER METER MIPS = 5.87**\$3995**

*Option: 150MB ESDI VGA System \$4795.



1. Baby Neat 286-14MHz (12MHz CPU) Motherboard W/OK **\$375**
2. Baby Neat 286-20MHz (16MHz CPU) Motherboard W/OK **\$475**
3. Baby 386-20MHz (20MHz CPU) W/OK **\$745**
4. AT 386-25MHz (25MHz CPU)
W/OK W/Chips 82C307 Cache Controller **\$1395**
5. NOVAS 4000 Super 16 Bit VGA
Expandable to 1 MB, 1024 x 768 Resolution **\$295**

"...FULLY LICENSED TO UTILIZE **IBM** PATENTS..."**NOVAS**Quality Products From
COMPUTRADE CO.
780 MONTAGUE EXPRESSWAY,
SUITE 501, SAN JOSE, CA 95131**SPECIAL PRICING FOR OEM, VAR, & DEALERS**
Corporate & University Discounts*VGA, XT, AT & IBM are trademarks of
International Business Machines
*Prices & specs subject to changeU.S. SALES: (408) 435-2662
U.S. FAX: (408) 435-5458**Send a POSTcard to Your PC**

Award Software's aptly named **POSTcard** is an add-in card that monitors your IBM PC during the POST (power-on self test) sequence that's run from the ROM BIOS every time you turn on your system. POSTcard has both a dual-digit LED display and a setup of 10 individual LEDs that tell you (in hexadecimal and binary, respectively) what tests are being performed. If your system locks up, it tells you exactly where the problem lies.

POSTcard's power lies in its ability to test a system without the need for an operating system, a monitor, or a disk drive. It's particularly useful for apparently dead and otherwise-undiagnosable systems. I borrowed an "unfixable" AT motherboard from a local computer store, plugged in POSTcard (into an 8-bit expansion slot), and within minutes found that its problem was a defective direct-memory-access controller chip.

Beyond the POST, POSTcard also automatically performs extensive diagnostics on major system components, including memory, disk drives, and communication ports. Its unique ability to continually loop through the same tests is particularly valuable for isolating those annoying intermittent problems. My AT was

THE FACTS**POSTcard**
\$399*Requirements:*
Any IBM PC or
compatible.Award Software, Inc.
130 Knowles Dr.
Los Gatos, CA 95030
(408) 370-7979
Inquiry 990.

occasionally locking up for no apparent reason, and diagnostic software told me nothing was wrong. But after nearly a full weekend of nonstop looping, POSTcard found a sticking memory chip.

POSTcard isn't designed for novices. You'll need a solid knowledge of PC hardware and your BIOS. Even with its well-written manual, I spent well over an hour puzzling over setting the card's two banks of DIP switches. Add its price tag, and it's clear that POSTcard isn't the type of add-in that's designed for everyone. But if you repair computers for a living or are responsible for a building full of corporate PCs, POSTcard can save scads of time and money—not to mention your sanity. ■

—Stan Miastkowski

More Powerful Than Ever ... Up To 5 KVA



STANDBY UPS MODELS

- 250 To 1600 Watt Output
- Synchronized Sinewave with 1 msec Switching Time
- Full One Year Warranty

ON-LINE UPS MODELS

- 1000 To 5000 VA Sinewave Output
- True On-Line — Total Isolation
- Static Bypass Switch Standard

SHUTDOWN SOFTWARE

- Auto Shutdown of Local Area Networks for Unattended Operation
- Compatible with SCO XENIX 2.2.3 and above
- Novell ELS 2.12 and above
Advanced Netware 2.11 & above
SFT Netware 2.11 and above

MINUTEMAN[®]
UNINTERRUPTIBLE POWER SUPPLIES



STANDBY UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
250 WATT	\$ 379.00	\$ 429.00
300 WATT	\$ 549.00	N/A
500 WATT	\$ 699.00	\$ 799.00
600 WATT	\$ 899.00	\$1049.00
900 WATT	\$1249.00	N/A
1200 WATT	\$1499.00	\$1749.00
1600 WATT	\$1999.00	\$2299.00

TRUE ON-LINE UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
1000 WATT	\$2249.00	Available
3000 WATT	\$5495.00	Available
5000 WATT	\$8950.00	Available



FOR L.A.N.
NOVELL LABS
TESTED AND
APPROVED
NetWare Compatible

PARA SYSTEMS, INC.

1455 LeMay Drive
Carrollton, TX 75007

Telephone:
(214) 446-7363

1-800-238-7272

FAX: (214) 446-9011

TELEX: 140275 OMEGA

Not Quite as Simple as 1-2-3

The new high-end release 3.0 of Lotus 1-2-3 finally arrived, endowed with a huge assortment of long-awaited features—but the features come at a price

Few software packages have ever been more anticipated than Lotus 1-2-3 release 3.0, the new three-dimensional spreadsheet application from Lotus Development. Now that release 3.0 is here, the news is decidedly mixed. The product adds dozens of new features and capabilities, and it addresses weaknesses that have plagued 1-2-3 for years. But release 3.0 is so big that it needs at least 1 megabyte of memory and an 80286 or higher CPU just to operate, and it's so slow that it runs at almost half the speed of release 2.01 on the same hardware.

Lotus originally announced release 3 back in 1987 as the next upgrade for 1-2-3 users. But early this year, the company abandoned its effort to bring out a single upgrade to 1-2-3 and instead divided the product into two versions, one for high-end PCs and the other for low-end PCs. Release 3.0 is the high-end product, a wholly rewritten 1-2-3 that runs under both DOS (with a built-in extended-memory manager) and OS/2 (in character mode, without Presentation Manager). For low-end users who are seeking an upgrade path, this fall Lotus will release a less-ambitious 2-D version of 1-2-

3 called release 2.2.

It's obvious with both of these new releases that Lotus has listened to its customers. Both are chockablock with the sort of new features that the user community has been clamoring for, ranging from the minor (e.g., 1-2-3 now warns you if you try to exit without saving your file) to the major, such as an undo function and a keystroke recorder for building macros.

Ironically, the new richness of features comes at the expense of simplicity, and Lotus's famous user interface, already showing signs of aging in the brave new world of Mac-like user interfaces, is stretched to its limit. This is the biggest drawback to 1-2-3 in today's market: Lotus has given users dozens of new features and functions, but the product just can't offer the user-configurability and graphical power available in newer packages like WingZ.

The Third Axis

The major improvements in release 3.0 are 3-D ability, background recalculation and printing, and improved graphics. By far the most significant is the addition of a third dimension. "Depth" is created by allowing spreadsheet files to consist of multiple pages, or "sheets," all of which are resident in memory at the same time. For the sake of simplicity, all these sheets can be referenced by a single filename, and operations familiar to 2-D denizens, such as range naming, copying, formatting, and summing, all work identically in 3-D. The only difference is that in front of the normal A1 cell address is a sheet designation (i.e., A:A1) that is used to reference any cell in sheet A. Each sheet can be large (up to 8192 rows long and 256 columns wide), and each file can have 256 sheets.

3-D spreadsheets are a useful way to organize large files, such as consolidated financial statements or regional sales reports, where a similar structure is repeated from one page to the next. Think-

ing in 3-D takes a little getting used to, but Lotus's implementation is straightforward. Moving between sheets is easy, and release 3.0 gives you a Perspective function that allows you to view up to three sheets of a spreadsheet file simultaneously (see the photo).

The major drawback to the Perspective function is that the configuration of the three windows is fixed: The three are arranged horizontally, each is the same size and shape, and the sheets they show must be contiguous (e.g., you can display sheets B, C, and D, but not B, D, and G). You can partially get around this problem by hiding sheets the same way you can hide rows or columns, but that's inconvenient. I don't understand why the user can't, as in Lucid 3-D, determine the size, shape, location, and contents of each window separately.

In addition to supporting worksheets with multiple pages, release 3.0 also permits you to load multiple worksheets into memory simultaneously and to establish hot links between them. Links between cells can also be made to "inactive" files—that is, files on the disk. These links are updated whenever the affected files are loaded into memory and recalculated. There's a big difference in performance between active and inactive links: If the linked file is in memory, updates are almost instantaneous, whereas from disk it takes much longer.

Saving Time with Foreground/Background

To save recalculation time, release 3.0 introduces two important enhancements: optimal and background recalculation. Optimal recalculation means that only those cells whose values have been, or will be, affected by a change get recalculated. With background recalculation, other activities can continue in the foreground while the spreadsheet recalculates. This is particularly important for power users whose massive recalculations sometimes tie up the computer for

several hours at a time.

Naturally, activity in the foreground does slow down background recalculations: One test that took 16 seconds to recalculate with no foreground activity took 22 seconds when I moved the cursor constantly during the recalculation. The background capability also applies only if all the spreadsheets in a linked group are memory-resident; if disk access is required to update cells across inactive linked files, the computer is locked up until the recalculation is finished.

One benefit of background recalculation is that it hides how much slower release 3.0 is than release 2.01. As long as you don't have to sit around waiting for the computer, you are not as likely to be annoyed by how slowly it is working. (Some of this slowness may be due to the overhead involved with background recalculation.) Unfortunately, with very large spreadsheets you'll still want to disable automatic recalculation when doing data entry, and if you're running what-if analyses (where knowing the answer is the rate-limiting factor), background recalculations won't help you get results faster.

Graphics Galore, Printing Aplenty

A virtual cottage industry has sprung up over the years to enhance the graphics capabilities of 1-2-3, and now Lotus has incorporated some of those features into the package itself. The most important improvement is that you can now view a graph and a spreadsheet on the screen simultaneously in two vertical windows with "live" updating. Also, an automatic graph generator lets you create a "best-guess" graph with a single keystroke, and it is easier to specify data ranges. In addition, release 3.0 includes six new graph types, new scaling options (including two y-axes), and a set of advanced options for controlling colors, hatch patterns, fonts, and text size.

Another nice change is that you no longer have to exit 1-2-3 and enter the separate PrintGraph module to output graphs. Also, you can store graphs in either .PIC or .CGM formats, and you can print both graphics and spreadsheets in background mode, which saves a lot of time. (Printing graphs is still slow, but at least you're not waiting for the computer.) Other print enhancements are long overdue: You can set print attributes and specify landscape mode from within 1-2-3, cancel and suspend print jobs, save your print settings for future sessions, and even print the worksheet frame.

Release 3.0 also includes a number of small but useful enhancements in the Range section. There is a new data format, Automatic, that allows you to enter data in its native format—dates as dates, percents as percents, and dollars as dol-

B107: (F2) 23

Sales Person	Car Expenses	Local Trans.	Plane Train	Meals	Misc.	Lodging	TOTAL
O'Malley		57.00		242.07		325.00	725.05
Friedman		134.54		134.21	3.00	123.50	395.25
Dawson		35.00	907.00			45.00	1525.50
Cohen		110.00		236.40		244.38	725.45

Research	Car Expenses	Local Trans.	Plane Train	Meals	Misc.	Lodging	TOTAL
Stoffer							
Harris	23.00						23.00
Humphrey		34.00	607.00	67.43		250.93	1049.16
Li				76.38			76.38
Total	23.00	34.00	607.00	143.73	0.00	250.93	1147.46

Division	Car Expenses	Local Trans.	Plane Train	Meals	Misc.	Lodging	TOTAL
Research	23.00	34.00	607.00	143.73	0.00	250.93	1147.46
Sales	0.00	345.04	907.00	758.48	3.00	1151.04	3246.26
Corporate	46.00	65.00	2367.00	965.32	0.00	457.07	3922.09
Total	69.00	446.04	4041.00	1067.53	3.00	1068.04	8315.01

PH012.WK3

With the Perspective function, you can view three pages or sheets of a spreadsheet file at once. You can also easily jump between them, zoom in on one, or create formulas that involve cells on multiple sheets.

lars. Lotus 1-2-3 will understand it and automatically format the range appropriately. A new search-and-replace function lets you locate strings in labels or formulas, and you can now use a range name in a formula before defining the range.

For macros, which are the richest and most flexible part of 1-2-3, Lotus has added a macro keyboard recorder, 10 new macro commands, and the ability to specify unlimited macro names. Macros developed in earlier versions of 1-2-3 are fully compatible. Other general improvements include 14 new @ functions, nine new function keys, 10 pointer-movement commands, four new filename extensions (including .BAK for automatic backups) and an easy-to-use install routine.

Auditing has been improved through the addition of a Map command that shows a pictorial representation of the spreadsheet with cells indicated as numbers, labels, and formulas, but, unfortunately, not links. Finally, at long last 1-2-3 includes an undo command, but in 3.0 it's a one-shot deal: Once you undo, you can't change your mind. (By contrast, the undo in 2.2 is a toggle.)

Performance

I extensively tested release 3.0 in both its beta and final versions and compared it to my trusty old copy of release 2.01. For hardware, I used both a high-end Compaq 33-MHz 80386 computer (with an 80387 math coprocessor and 4 megabytes of memory) and a much more modest 6-MHz 80286 with 2 megabytes of memory and no coprocessor. On the 80386, release 3.0 was approximately 41 percent slower than 2.01. (The complete suite of tests ran in 26.97 seconds under 2.01 and in 45.42 seconds under 3.0.) On the 80286, the situation was even worse. Release 3.0 was approximately 47 percent slower (409.94 seconds versus 215.04 seconds for 2.01).

My conclusion is that release 3.0 is

best suited to 80386 environments with large amounts of memory. Release 3.0 did better relative to 2.01 on the 80386 computer than on the 80286 machine, but it was still far slower. On a fast high-end system, that slowness will be less apparent.

As a point of comparison, release 3.0 was also considerably slower than our beta version of the forthcoming release 2.2. We'll have more coverage of release 2.2 when it becomes available, but from our early look it appears that 2.2 is an improvement for users of low-end machines in both features and performance, while 3.0 trades off performance for new capabilities.

Worth the Wait?

This article has just scratched the surface of the capabilities of Lotus 1-2-3 release 3.0. BYTE will soon follow up with a full review, where we will be able to give a more detailed and thorough evaluation of the product. For the time being, however, some points are immediately apparent.

Release 3.0 is a big step up from the older versions of 1-2-3 in both features and functions. But these improvements seem to come with a price in performance. If you have a very fast computer, release 3.0 will allow you to create new worlds of complex spreadsheets. However, if you have a slower system (e.g., an AT-class system), you may want to sit back and wait for the new release 2.2 or check out the many 2-D and 3-D alternatives to 1-2-3 now available on the market, such as Excel, Quattro, Lucid, or Twin.

Was release 3 worth the wait? On high-end systems and certain applications that lend themselves easily to 3-D, yes. But other users may just want to continue waiting. ■

Andrew Reinhardt is an associate news editor for BYTE. He can be reached on BIX as "areinhardt."

Automation For The 90's From The Heartland

CORPORATE COMPUTERS OF IOWA provides the nation's most aggressive prices on our entire line of state of the art 286 and 386 desktop computers as well as all TOSHIBA*, EPSON*, NEC* and PANASONIC* printers, FAX machines and laptops.

Call one of our account executives today and experience the performance and quality you'd expect for the "Heartland."

CCI AT 286/12 MHZ



80286 Processor Running at 6 to 12 MHZ

Phoenix Bios/Digital Speed Display

80287 Math Co-Processor Socket

8 Expansion Slots 6-16 Bit, 2-8 Bit

1 Meg of 0-Wait State Memory (Expandable to 4)

1.2 Meg Floppy

1.44 Meg Floppy

40 Meg Seagate ST 251-1 (28 MSEC.)
WD Controller (1-1 Interleave)

Norton SI 15.3

FCC Class B Approved

14" Multisynch Monitor 800 x 600 Tilt Swivel

Paradise 16 Bit Plus VGA Card

1-Parallel, 2-Serial, Game Port

101 Key at Keyboard with Dust Cover

DOS 4.01 with GW Basic or DOS 3.3 with
GW Basic

Surge Suppressor

1 Year Parts and Labor Warranty (FREE)

1 Year On-Site Service

30 Day Money Back Guarantee
(No Restocking Fee)

2nd Year Warranty (\$49.95)

Complete System Price \$2195.00

FREE

Free with the purchase of any CCI System . . . one year, on-site warranty through Data Access Systems Inc. Provides response time of 8 business hours and covers all parts, labor, travel and technical support. Extended warranty available.

CCI AT 286/20 MHZ



80286 Processor Running at 20, Switchable to 10

Phoenix Bios/Digital Speed Display

80287 Math Co-Processor Socket

8 Expansion Slots, 6-16 Bit, 2-8 Bit

1 Meg RAM 0-Wait State (Expandable to 8)

80 Meg Seagate ST 4096 (28 MSEC.)
WD Controller (1-1 Interleave)

Norton SI 22.5

FCC Class B Approved

14" Multisynch Monitor 800 x 600 Tilt Swivel

Paradise 16 Bit Plus VGA Card

1-Parallel, 2-Serial, Game Port

101 Key at Keyboard with Dust Cover

DOS 4.01 with GW Basic or DOS 3.3 with GW Basic

Surge Suppressor

1 Year Parts and Labor Warranty (FREE)

1 Year On-Site Service

30 Day Money Back Guarantee
(No Restocking Fee)

2nd Year Warranty (\$49.95)

Complete System Price \$2799.00

1-800-533-0948

FAX 712-277-8626

1-800-533-0948



CCI 386/25 MHZ CACHE

80386-25 MHZ Intel Processor 0-Wait State (32K Cache Memory)
 AMI 386 Bios with an in ROM Set-up Routine
 Socket Support for 80287, 80387 and Weitek Co-Processors
 One 32 Bit Slot, Five 16 Bit Slots, and Two 8 Bit Slots
 1 Meg Memory on Board, Expandable to 8MB, 1MB/2MB when using 256K D-RAM, 4MB/8MB when using 1 M Bit D-RAM, Expandable to 16MB
 1.2 Meg Floppy
 1.44 Meg Floppy
 80 Meg Seagate-4096 (28 MSEC.)
 WD Controller (1-1 Interleave)
 Norton SI 30.5

FCC Class B Approved
 Mitsubishi Diamond Scan 14" 800 x 600 Tilt Swivel
 Paradise 16-Bit VGA Card
 1-Parallel, 2-Serial, Game Port
 101 Key at Keyboard with Dust Cover
 DOS 4.01 with GW Basic or 3.3 DOS with GW Basic
 Surge Suppressor
 1 Year Parts and Labor Warranty (FREE)
 1 Year On-Site Service
 30 Day Money Back Guarantee (No Restocking Fee)
 2nd Year Warranty (\$49.95)

Complete System Price \$3999.00

EPSON PRINTERS

	RETAIL	CCI PRICE
LX-810	\$ 299.00	\$174.00
LQ-510	\$ 529.00	\$315.00
LQ-850	\$ 859.00	\$505.00
LQ-950	\$ 949.00	\$560.00
LQ-1050	\$1,199.00	\$695.00
LQ-2550	\$1,499.00	\$899.00

"FREE" Printer Cable

PANASONIC PRINTERS & FAX MACHINES

	RETAIL	CCI PRICE
KXP-1180	\$ 299.95	\$ 179.00
KXP-1191	\$ 399.95	\$ 230.00
KXP-1592	\$ 649.95	\$ 389.00
KXP-1595	\$ 729.95	\$ 429.00
KXP-1124	\$ 529.95	\$ 315.00
KXP-1524	\$ 899.95	\$ 539.00
UF-150 FAX	\$1,795.00	\$ 955.00
UF-260 FAX	\$2,795.00	\$1,479.00

"FREE" Printer Cable

NEC LAPTOPS

	RETAIL	CCI PRICE
PRO-SPEED 286-20 MB	\$5,099.00	\$3,025.00
PRO-SPEED 286-40 MB	\$5,599.00	\$3,189.00
PRO-SPEED 386-40 MB	\$7,699.00	\$4,299.00
PRO-SPEED 386-100 MB	\$8,999.00	\$5,275.00

TOSHIBA LAPTOPS

	RETAIL	CCI PRICE
T-1000	\$ 1,249.00	\$ 759.00
T-1200 F	\$ 2,099.00	\$1,279.00
T-1200 FB	\$ 2,199.00	\$1,350.00
T-1200 H	\$ 2,799.00	\$1,699.00
T-1200 HB	\$ 2,999.00	\$1,800.00
T-1600	\$ 4,999.00	\$3,025.00
T-3100 E	\$ 4,299.00	\$2,599.00
T-5100	\$ 7,199.00	\$4,295.00
T-5200 (40)	\$ 9,499.00	\$5,700.00
T-5200 (100)	\$10,999.00	\$6,699.00

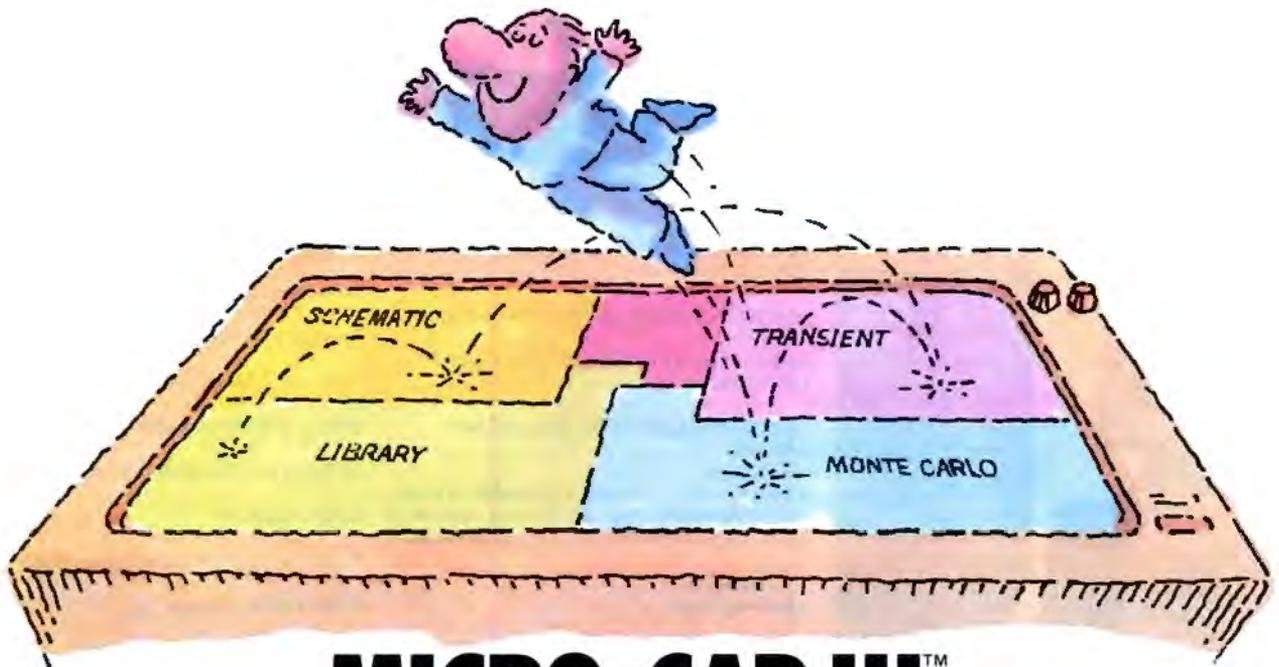
Corporate Computers of Iowa Policies

- Toll Free Number 1-800-533-0948 For Ordering And Post Sale Support
- Master Card, VISA, No Surcharge. American Express - Add 3%.
- C.O.D. Cashier Checks
- 30 Day, Money Back Guarantee
- Prices Subject To Change In Manufacturers Pricing
- Allow 10 Days For Personal Checks To Clear
- Call For Corporate Purchase Orders



P.O. Box 714
 Sioux City, Iowa 51102
 712/771-2100
 Toll Free: 1-800-533-0948
 Corporate Showroom
 609 5th Street
 Sioux City, Iowa 51101

Circle 83 on Reader Service Card (DEALERS: 84)



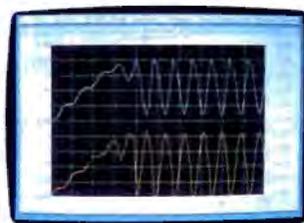
MICRO-CAP III.™

THIRD-GENERATION INTERACTIVE CIRCUIT ANALYSIS. MORE POWER. MORE SPEED. LESS WORK.

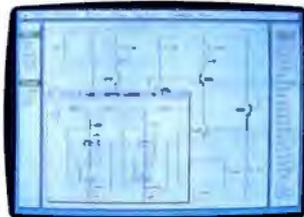
MICRO-CAP III,™ the third generation of the top selling IBM® PC-based interactive CAE tool, adds even more accuracy, speed, and simplicity to circuit design and simulation.

The program's window-based operation and schematic editor make circuit creation a breeze. And super-fast SPICE-like routines mean quick AC, DC, Fourier and transient analysis — right from schematics. You can combine simulations of digital and analog circuits via integrated switch models and macros. And, using stepped component values, rapidly generate multiple plots to fine-tune your circuits.

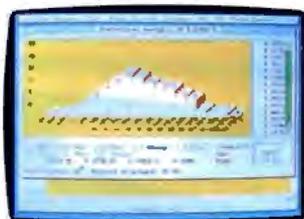
We've added routines for noise, impedance and conductance — even Monte Carlo routines for statistical analysis of production yield. Plus algebraic formula parsers for plotting almost any desired function.



Transient analysis



Schematic editor



Monte Carlo analysis

Modeling power leaps upward as well, to Gummel-Poon BJT and Level 3 MOS — supported, of course, by a built-in Parameter Estimation Program and extended standard parts library.

There's support for Hercules® CGA, MCGA, EGA and VGA displays. Output for laser plotters and printers. And a lot more.

The cost? Just \$1495. Evaluation versions are only \$150.

Naturally, you'll want to call or write for a free brochure and demo disk.

SPECTRUM

1021 S. Wolfe Road,
Sunnyvale, CA 94086
(408) 738-4387

MICRO-CAP III is a registered trademark of Spectrum Software.
Hercules is a registered trademark of Hercules Computer Technology.
IBM is a registered trademark of International Business Machines, Inc.

The 486s Are Here!

Apricot's VX FT Server
is the first announced PC
to use the new Intel
80486 CPU



While IBM and Compaq have been loudly engaged in a one-upmanship battle over who leads the market, Britain's Apricot has quietly introduced the first PC based on Intel's 80486 CPU. Unlike IBM's recently announced 80486 Power Platform upgrade for the PS/2 Model 70, the Apricot VX FT Server, based on the Micro Channel architecture (MCA), is an entirely new system with an external RAM cache. This cache memory provides a significant performance advantage over IBM's product.

Apricot has built an impressive machine. The prototype VX FT Server with a 25-MHz 80486 CPU is faster overall than any other 25-MHz PC and most 33-MHz PCs that BYTE has benchmarked. However, it is not cheap; prices range from \$18,000 to \$40,000. Designed as a high-performance file server, it could nonetheless prove economical for large network or multiuser installations.

Apricot configures the VX FT Server in two versions: the Series 400 for net-

work duties, and the Series 800 for multiuser Unix systems. They differ in RAM allotment and intelligent I/O ports (see table 1). Both versions provide multiple layers of data security. In Europe, an 80386 version is available in both series.

The Series 400 will be shipped with MS-DOS 4.01, although you can get the more powerful OS/2 Extended Edition as an option. The VX FT Server supports Novell NetWare, 3+Open, Microsoft LAN Manager, Torus Tapestry, and Apricot's own VXNet. SCO Unix System 3.2 is the chosen flavor for the Series 800. The 80486 machines will be available this month.

The model we tested was a Series 400/30 running MS-DOS 3.3. It had a 347-megabyte Maxtor SCSI hard disk drive, a 1.44-megabyte 3½-inch floppy disk drive, 12 megabytes of RAM, and, of course, an 80486 CPU.

The Box

Typical of Apricot PCs designed by Bob Cross, the VX FT Server is an unconven-

tional yet attractive box. It's also big, measuring 2 feet tall by 2 feet deep by 16 inches wide and weighing (in a typical configuration) 165 pounds. Two retractable handles at the top of the unit provide purchase for four strong hands. The VX FT Server stands on skids. Apricot thought that using casters would increase the chance of damage, even though the system would be easier to move. Gigabyte file servers should be bolted to the floor; the skids were a compromise.

A distinctive feature of the box's external design is a backlit LCD panel (handy during a power failure) above a row of buttons. Under software control, the buttons provide access status information about the VX FT Server and control the sliding door that conceals the drive bays below it. The monitor panel functions are under system security control.

There are removable panels on either side of the box that provide access to the

continued

inner workings of the VX FT Server. A physical case lock is backed up by an alarm that sounds if you remove the side panels without first establishing your access privileges.

The grill at the bottom of the system unit conceals an air filter and the fan for cooling the power module. Another fan in the rear panel takes heat from the motherboard and expansion bay. With all the noisily moving air, the VX FT Server is easier to live with in the corner of the room than under your desk.

The Power of the 80486

The VX FT Server's 6.7 CPU index bests IBM's 80486 Power Platform upgrade, which tested at 5.3, as well as all but two of the 33-MHz 80386 machines we've tested (for these results, see the upcoming *Inside the IBM PCs*, Fall 1989). Its 21.8 FPU index is unmatched; IBM's Power Platform scored a 21.4. The Apricot's disk index is a so-so 2.3, but its video index is a near-record 5.2 (see table 2).

But the real payoff is in the application area. Although we were unable to run all the BYTE application benchmarks, those we did run challenged or beat those of the

fastest 80386-based PCs. The only exception was the VX FT Server's subpar database index of 2.6. The database tests are disk-intensive. Apricot uses a SCSI hard disk drive rather than a faster ESDI unit for two reasons: The SCSI drive provides a greater throughput rate, and it lets you chain multiple drives off the same controller. If faster access times are needed, adding a hardware disk cache and a faster drive from a third party should be no problem.

The VX FT Server could not run all portions of the BYTE scientific/engineering tests, although the times for the tests it did complete suggest that it is significantly faster in this area than any other PC we've seen. An Apricot spokesperson said that some software would not run properly on the prototype 80486 CPUs from Intel and suggested that this could have been the cause of our benchmark problems.

The Qi to the VX FT Server

The VX FT Server is based on the MCA motherboard used in Apricot's Qi (pronounced "key") PC. The Qi has been sold primarily in Europe, although it and the VX FT Server are available in North

America through Apricot's Canadian distributor.

The company has integrated a number of I/O features on the Qi motherboard, including serial and parallel ports, a mouse port, Ethernet (both thick and thin wire), an analog VGA connector, and a bisynchronous communications port, which you can use as two additional serial ports (see photo 1). A second serial port is dedicated to the front LCD control panel. Additionally, Apricot has built security into the hardware by using a spare 8042 keyboard processor with its own CMOS RAM and real-time clock.

Chips & Technologies provides the MCA chip set that was developed with Apricot input. The BIOS is by Phoenix Technologies.

The motherboard, measuring 15 by 14 inches, fits comfortably into the system unit (see photo 2). It is the same one used in the other 80386 Qi models, but with an 80486 mounted on a daughtercard. (Unlike the IBM PS/2 designs, the 80386 CPU in the Apricot sits on the motherboard, not on a daughtercard.)

The daughtercard holds the 80486, the 82385, static RAM (SRAM), and associated programmable array logic (PAL)

Table 1: The VX FT Server model designations and respective base configurations.

Model	Cache memory (K bytes)	Standard RAM (megabytes)	Hard disk drive size (megabytes)	Serial channels	Maximum number of users
400/10	64	4	157	N/A	N/A
400/30	128	4	347	N/A	N/A
400/60	128	4	647	N/A	N/A
400/90	128	4	1047	N/A	N/A
800/10	64	8	157	32	64
800/30	128	8	347	32	96
800/60	128	16	647	64	128
800/90	128	16	1047	64	128

Note: N/A = Not available

Table 2: Indexes based on BYTE benchmark results. The VX FT Server is faster than the IBM Power Platform 486 and most of the 33-MHz 80386 PCs. (Indexes for the fastest 33-MHz PCs are not shown; only preliminary tests were run.) All tests were run on beta or prototype machines; times for shipping units might vary.

	CPU	FPU	Disk I/O	Video	Word processing	Spreadsheet	Database	Scientific/Engineering	Compilers
Apricot VX FT Server	6.7	21.8	2.3	5.2	5.5	4.6	2.6	N/A	5.0
IBM Power Platform 486	5.3	21.4	1.8	4.3	N/A	N/A	N/A	N/A	N/A
ALR 33/386	6.6	11.1	2.3	1.6	N/A	N/A	N/A	N/A	N/A
Zenith Z-386/33	4.8	N/A	3.1	3.0	N/A	N/A	N/A	N/A	N/A

Note: Indexes show relative performance. For all indexes, an 8-MHz IBM PC AT = 1. N/A = Not available. For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

Photo 1: The back of the VX FT Server sports numerous I/O ports and other outlets. The rugged handles on the top of the unit make carrying the system relatively easy for two or more people.

chips. It plugs into both the 80386 and 82385 sockets in the original Qi motherboard. Eventually, a revised 80486 motherboard will replace the daughter-board arrangement, but probably not until a 33-MHz version of the 80486 becomes available.

A bank of single in-line memory modules provides main system memory. The motherboard can accommodate up to 16 megabytes of RAM using Apricot-sourced double-decker SIMMs. Using the more readily obtainable 80-nanosecond parts, the motherboard holds 8 megabytes.

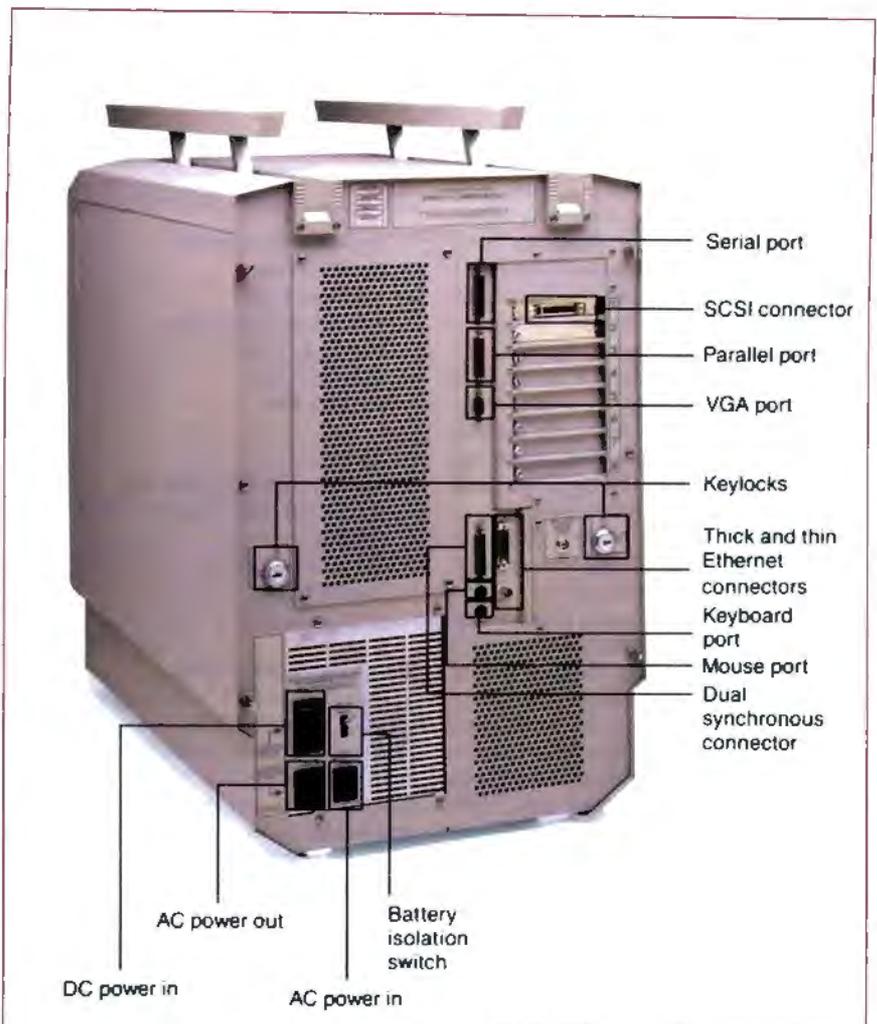
While the 80386 benefits from the 82385 cache controller and a 64K-byte bank of 35-ns SRAM, the 80486 itself has 8K bytes of four-way set-associative cache memory on-board. Apricot has added an external 128K-byte cache using 25-ns SRAM orchestrated by a 25-MHz 82385 and some custom PAL work. This arrangement has been christened Hyper-cache. The low-end versions of both series use a 64K-byte cache.

According to Apricot, Intel expected PC manufacturers to use the 80486 without any external caching, at least until both an "82485" and a 33-MHz version of the 80486 were in production. Rather than suffer the inevitable wait states or use faster, less-economical system memory, Apricot devised its own 82385 solution.

Apricot claims a 95 percent to 96 percent hit rate with its two-way set-associative cache system, depending on the code being run. The company thinks that the

continued

Photo 2: With only SCSI and run-length-limited disk drive controllers in two of the eight MCA slots, the inside of the VX FT Server looks empty. Note the large daughtercard on which the 80486 CPU sits. Apricot plans to integrate the CPU on the motherboard sometime in the future.



external cache is vital for multiuser performance; it unloads a good chunk of bus traffic and enables the 80486's burst mode. The BYTE benchmarks bear this out. IBM's 80486 Power Platform uses no external cache and suffers the consequences. For example, the VX FT Server was about 1.6 times faster than the IBM product on the string-move portion of the BYTE CPU tests. On the matrix, Sieve, and sort portions, there was virtually a tie. The string-move tests make extensive use of cache memory.

The 80486 has full floating-point capabilities built in. The 80486's computational abilities are alleged to exceed those of a Weitek 3167 math coprocessor while maintaining compatibility with 80287/80387 code. The BYTE FPU index supports that performance claim.

Courtesy of a plug-in bus extension, the VX FT Server has eight MCA expansion slots: four 32-bit and four 16-bit. The Chips & Technologies 452 VGA controller, a high-performance video extension, is available on one of the 16-bit slots, although it was not installed in our demonstration unit. In addition to the eight physical slots, two phantom slots let you configure the Ethernet and bisynchronous port options.

Making Your Data Secure

Given that the VX FT Server will hold a lot of valuable data, Apricot has gone to some length to provide more security than most PC-based file servers offer.

Two built-in 12-amp/hour solid electrolyte lead-acid batteries provide backup power. A lightly loaded VX FT Server could conceivably run for 1.5 to 2 hours on the batteries, but a fully configured machine, including a monitor, would get about 15 minutes—plenty of time for an orderly software-controlled shutdown. A switch on the back of the unit lets you disconnect the battery.

Temperature monitors are linked with sensors that detect electrical failure in the cooling fan. An alarm sounds if the machine runs too hot, and an automatic software-controlled shutdown occurs.

The keyed lock at the back of the system unit is only the first portion of the VX FT Server's access control. The company offers a \$450 security package called the Qi Environment. It includes a microprocessor-controlled infrared remote device and a master reference disk that guards access to all or part of the VX FT Server's services. You point the infrared card at the sensor on top of the unit, click, and then enter a code for access. Unauthorized attempts to access components or data sound an alarm that

COMPANY INFORMATION

Apricot Computers plc
Apricot House
111 Hagley Rd.
Edgbaston, Birmingham
B16 8LB, U.K.
021-456-1234
Inquiry 890.

Apricot
111 Granton Dr., Suite 401
Richmond Hill, Ontario L4B 1L5,
Canada
(416) 492-2777
Inquiry 891.

is specific to the offense.

The computer's security scheme is flexible enough for you to shut off the Ethernet link in the evening or on weekends but still allow system access for backup at preselected times. You can also enable or disable disk drives or any of the eight expansion slots. The security is menu-driven, and its configuration is stored on the master reference disk. If you lose or damage this master disk without having made a backup, you have to contact Apricot for a replacement. You can leave the security system inactive.

Mass Storage

As befits a well-designed file server, the VX FT Server has mass storage capacity to spare. The system box has space for six full-height devices, one of which must be fitted to provide mounting for two half-height drives. Three drives are inserted from the front, and three from the rear. Between the two stacks of drives is a plug-in partition holding two 4-inch-diameter cooling fans.

The standard VX FT Server has one 1.44-megabyte 3½-inch floppy disk drive and one of four hard disk drive options. The Series 400/10 and Series 800/10 have a 157-megabyte SCSI Maxtor drive. The other 80486-based models, the 30, 60, and 90 in each series, also use SCSI Maxtor drives run off an AHA 1640 Adaptec controller fitted into the MCA backplane. The drive capacities are 347, 647, and 1047 megabytes, respectively. Average access times are in the sub-16-millisecond range.

Apricot lacks a slick hardware-based mirroring system like that found in the DPT SmartCache controller, but the company has implemented one in software. This poor man's version of disk mirroring may be marginally slower in writes to disk, but it doesn't require the development of a special, low-volume

controller card. Although the SCSI controller can nominally have up to seven devices daisy-chained to it, Apricot suggests fitting a controller for each drive to get maximum performance.

With the potential for up to 5 gigabytes' worth of hard disk drives humming away inside the box, Apricot has not skimped on the power supply. It's a 465-watt monster with built-in surge protection.

The three tape backup options range from the ridiculous (in the server context) to the sublime. An 80-megabyte DC2000 tape streamer that runs off the floppy disk drive controller is at the leanest end of the tape options. A somewhat more useful 150-megabyte SCSI tape drive from Irwin Magnetics sits in the middle of the range. For the VX FT Server user with 1 or 2 gigabytes in the box, Apricot supplies a 1.2-gigabyte DAT/DDS (full-height) digital audio tape drive from Hewlett-Packard. No price has been set as of this writing for the DAT/DDS drive.

Microcomputer or Minicomputer?

With the 80486 VX FT Server prices starting at \$18,000, Apricot is competing with both PC-based workstations and low-end minicomputers. Considering its performance, its security features, and the number of users it can serve, the VX FT Server should be a cost-efficient alternative to those systems.

It's not perfect. The prototype unit we tested overheated easily and would not run some of our benchmark software. We expect that these problems will disappear in units with production CPUs, however.

Although the SCSI drives provide easy mass storage expandability—an important feature to consider for a growing network—some users will want hard disk drives with faster access times. Apricot should think about offering a hardware cache controller and faster ESDI drives as options.

The 80486 has popped up sooner than expected, and with it a new standard in the price/performance ratio. It is too soon to announce the death of the mini-computer again, but the power that the 80486 provides, as Apricot has demonstrated, will be giving many midsize-computer makers nightmares. The good news is all for the users. ■

Paul Lavin is a writer and consultant living in the U.K. Michael E. Nadeau is a BYTE associate managing editor. You can reach them on BIX as "plavin" and "miken," respectively.



THE FASTEST JUST GOT FASTER

Introducing the SOTA 386si
386SX Accelerator for 8088 / 8086 PC's

1987

MotherCard 5.0

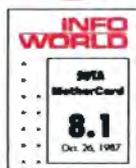


Nominated Technical Excellence

PC Magazine, 1987

"Card Excels in Speedup, Software and Hardware Compatibility"

InfoWorld, Oct. 26, 1987



"The SOTA MotherCard 5.0 is a well-engineered and elegant solution for running OS/2 on a PC."

BYTE, September 1988

1988

SOTA 286i

"SOTA 286i turns Dinosaur into Ripsnorting Demon"

BYTE, December 1988

"This fine performer upgrades a PC or XT-style computer to 50 percent faster than an IBM AT"

InfoWorld, December 5, 1988

"...the most flexible turbo board on the market is the SOTA 286i"

PC Magazine PC Advisor, May 16, 1989

1989

SOTA 386si

SOTA's 386si transforms your aging PC into a performance machine ready to meet the challenges of computing today and tomorrow. Using an 80386SX CPU at 16 MHz, the SOTA 386si benchmarks 19 times faster than an IBM PC. Install the optional 80387SX and get 5 times the numeric processing power of an AT with an 80287.

In fact, speed is just the beginning. The SOTA 386si offers compatibility with both the wide range of 8088/8086 machines and the large variety of add-on boards manufactured. Networks, video boards, tape systems, to name a few, all function flawlessly; whether installed in an IBM XT or an AT&T PC6300. This makes the 386si

the perfect solution for the corporate market where an extensive mixture of machines and add-on cards typically coexist.

More than just speed and compatibility, SOTA's 386si provides the flexibility to run today's powerful software. Add the Memory/16i option, and you can even use protected mode programs such as IBM OS/2 and Windows/386. No other manufacturer offers these features. So why buy half a solution when you can buy the fastest, most compatible, most expandable accelerator available. The complete solution — the SOTA 386si.

Options for SOTA 286i/386si:

Memory / 16i

Up to 8 MB of EMS 4.0 or extended memory

Floppy I/O Plus

Supports both 3 1/2" and 5 1/4" double and high density floppy drives

Math Coprocessor

For more information on SOTA's 286i and 386si call... **800-237-1713**.
In CA **408-745-1111**.

SOTATM
STATE OF THE ART TECHNOLOGYTM

559 Weddell Drive
Sunnyvale, CA 94089
408-745-1111

CMO... Your Guaranteed

ACCESS
VIDEO SYSTEMS

TURBO XT/10



- 10MHz Clock • 512K RAM Memory • Complete with 360K Mitsubishi Drive and 102-Key Enhanced Keyboard
- THE110

Standard System Features:

- Intel 8088-1 Processor Switchable From 477 to 10MHz
- 512K RAM Card Expandable to 8MB
- Four 1/2 Hr Drive Bays
- Dual Floppy Controller
- Real Time Clock Calendar
- High Capacity 150 Watt Power Supply
- IBM XT Compatible Eros Bios
- IBM XT Compatible I/O Card With One Serial, One Parallel and One Game Port
- 8 Slot Motherboard Design
- 102-Key Enhanced Keyboard
- Front Panel Security Lock
- 30 Day Money Back Guarantee
- 1 Year Warranty on Parts & Labor

Also Ask About Our Access XT And 386 Models

\$539

AMIGA

Anakin Research	
Easy1 Drawing/2000	\$349
Easy1 Drawing/500	319
C.LTD	
Keyboard w/Macros	99
Kronos 500	259
Kronos 2000	229
Kronos 1000	309
Digital Creations	
Supergen	709
Great Valley Products	
A2000 - 2/2	749
A2000 HC/40M	719
A2000 HC/40Q	829
A500 HD/30	799
A500 HD/40M	899
Megatronics	
3 1/2" External Air Drive	149
3 1/2" Internal Air Drive	119
Progressive Peripherals	
Pro-Gen Genlock	389

Frame Grabber	\$319
Spirit Technology	
1.5MB Bd. w/OK (A1000)	245
1.5MB Bd. w/OK (A500)	255

MACINTOSH

Olympia	
NP-30 Mac 150cps	249
Qume	
ScriptTen Laser	3395
Crystal Print Publisher	3299
Seikosha	
SP-1000AP Mac	239
Dolphin	
Integra 30 External	559
Integra 40 External	689
Everex	
EMAC 20 Deluxe 20MB	579
EMAC 60T 60MB Backup	799
Cornerstone	
SinglePage Display SE	759
DualPage Display SE	1259
Magnavox	
9CM080 14" VGA Display	499

TOPS	
Tops for Mac 2.1	\$149
Tops FlashCard	169
Tops NetPrint	125
Tops FlashBox	129
Practical Peripherals	
Mac 2400 Stand Alone	239

MONITORS

Amdel	
Video 210+ 12" Amber	99
Video 432 VGA Monochrome	149
Color 732 VGA Color	399
Cornerstone	
SinglePage Display	699
Magnavox	
7BM623 12" TTL Amber	89
CM8762 14" Comp/RGB	235
9CM053 14" HiRes EGA	339
9CM062 14" VGA Display	349
9CM082 14" VGA Display	399
Mitsubishi	
DiamondScan 13" Display	499
NEC	
JC-1403 Multisync IIA	489
Packard Bell	
PB-1272 12" TTL Mono	80
PB-1472 14" TTL 132 Col.	109
PB-1422EG 14" HiRes EGA	359



NEC
Multisync 3D
\$649

Polaroid	
Palette EGA Plus	2199
Seiko Instruments	
CM-1430 14" VGA	559
Taxan	
119 12" Composite Amber	89
Wyse Terminals	
WY-30, 50, 60	Call
Zenith	
ZFM-1490 14" VGA Analog	619

MULTIFUNCTION

ATD-ZuckerBoard	
Color Half Card	69
Monochrome Graphics Adpt.	79

AST	
Six Pak Plus Board	\$125
VGA Plus Adapter	389
Boca Research	
TopHat 128K Expansion	119
BocaRam/AT 0-4MB Board	149
Boca Dual Graphics Adapter	69
Boca MultiEGA	169
DCA	
Irma 3 Convertible	459



5TH GENERATION
Logical Connection
256K \$419

Emerald	
3XTwin 5251 Local Emulat.	549
Everex	
Magic I/O AT Par/Ser	59
Ram 3000 Deluxe 0-3MB Bd	89
Micro Enhancer EGA	169
5th Generation	
Logical Connection 256K	429
Hercules	
Graphics Card Plus	179
Intel	
AboveBoard 2 Plus w/OK	319
AboveBoard PS/286 w/512K	419
AboveBoard Plus w/512K	429
AboveBoard Plus I/O 512K	579
Inboard 386/PC 80386 CPU	589
8087 IBM PC/XT CoProc.	89
80287-8 IBM XT 8MHz CoP	209
80387-16 16MHz 80386	369
Orchid Technology	
ProDesigner VGA	319
TinyTurbo 286	229
Renaissance	
RVGA2 800x600 256K-PAL	259
Headland Technology	
FastWrite Video Adapter	319
V-RAM VGA Adapter	469

STORAGE DEVICES

American Power	
450AT + UPS Backup	439
Everex	
Floppy Stream 40 40MB Int.	359
Excel Stream 40T 40MB Int.	529

Your Source for Hardware, Software & Peripherals

Low Price Leader.

- Miniscribe**
 8425 20MB 3 1/2" 40Msec \$259
 3650 40MB 5 1/4" 61Msec 329
 3053 44MB 5 1/4" 25Msec 469
 3085 70MB 5 1/4" 18Msec 599
- Mountain Computer**
 TD-4340 40MB Int. Tape 319
 TD-8000 80MB Ext. Tape 445
- Plus Development**
 20MB Hardcard 529



SEAGATE
 ST-225 20MB w/Cont. \$239

- Seagate**
 ST-238 30MB w/cont 269
 ST251 40MB 1/2 Height 339
- Sysgen**
 Bridge-File 5 1/2" External 249
 Bridge-Tape 40MB External 479
 SmartImage 60MB Internal 479
 QIC-File 60MB External 599
 Omni Board Controller 80

COMPUTERS

- AST**
 Bravo 80286 Model 5 849
 Premium 286 Model 70 1299
- Compaq**
 Deskpro & Portable 286/386 Call
- IBM**
 PS/2 Model 30 w/20MB 1599
- NEC**
 Multimate Laptops Call
- Panasonic**
 Business Partner FX-1650 699
- Sysgen**
 ProSystem 12MHz w/40MB 1999
- Toshiba**
 T1000 Floppy Laptop 639
 T1200 Floppy/HrdD Lptp Call
 T1600 80c286 12MHz Lptp. Call
- Zenith**
 80286/386 Desktops Call
 SuperSport & Supersprt 286 Call



ZENITH
 Z-183 80c88 w/10MB \$1299

COMMUNICATIONS

- Anchor**
 2400 Baud External 169

- Atari**
 XMM301 XL/XE 300 Baud \$ 45
 SX-212 ST Modem 90
- Avatec**
 1200 HC External 99
 2400 Baud Internal 129
- Everex**
 Evercom 12 1200 Baud Int. 80
 Evercom 24 2400 Internal 149
- Hayes**
 Personal Modem 1200 Ext. 129
 SmartModem 1200 Baud 289
 SmartModem 2400 Baud 429
- Intel**
 2400EX External 299
- Murata**
 M1200 Facsimile 639
- Panasonic**
 UF-140 Panafax Facsimile 799
 FX-89 Fax Board 699
 FX-505 Hi-Res Scanner 1049
- Practical Peripherals**
 1200 Baud Internal 69
 1200 Baud Stand Alone 85
 2400 Baud Stand Alone 139
 2400 Baud Internal 189



EVERCOM
 2400 Baud External \$179

- Sharp**
 FO-220 Facsimile Machine 699
- Supra**
 2400AT 2400 Baud Atan 169
- The Complete PC**
 Complete FaxBoard 4800 269
 Complete Answ. Machine 239
 Complete HandScanner 149

PRINTERS

- Alps**
 ASP-1000 9-Pin Flatbed 159
 Allegro 24-Wire 329
- Brother**
 M-1709 240cps, 132 Col. 369
 M1724L 24-Wire, 132 Col. 569
 HR-20 20cps Daisywheel 329
 HR-40 40cps Daisywheel 589
- Epson**
 FX-850 264cps, 80 Col. Call
 FX-1050 264cps, 132 Col. Call
 LQ-510 180cps, 24-Wire 339
 LQ-850 330cps, 24-Wire Call
 LQ-950 264cps, 24-Wire Call
 LQ-1050 330cps, 132 Col. Call
 LQ-2550 500cps 132 Col. Call
- Hewlett-Packard**
 2225 Thinkjet 329
 Pacific Data 25-in-1 Font 279
- NEC**
 P2200 Pinwriter 24-Wire 359
 P5200 Pinwriter 265cps 549
- Okidata**
 ML-172 180cps, 80 Col. 199
 ML-182 Trbo 220cps, 80 Col. 245



EPSON
 LX-810 200cps, 80 Column \$179

- ML-320 300cps, 80 Col. \$359
 ML-390 270cps, 24-Wire 499
- Panasonic**
 KX-P1180 192cps, 80 Col. 185
 KX-P1191 280cps, 80 Col. 249
 KX-P1124 192cps, 24-Wire 339
 KX-P1524 24-Wire, 132 Col. 559
- Seikosha**
 SP1600AI 160cps, 9-pin 179
 SK3000AI 300cps, Color 349
- Star Micronics**
 NX-1000 144cps, 80 Col. 169
 NX-1000 Rainbow Color 229
 NX-2400 24-Wire, 80 Col. 369

PLOTTERS/DIGITIZERS

- Calcomp**
 2312 12x12 Digitizer 419
- Houston Instruments**
 9012 HIPAD+ 12"x12" Tblt 399
 PC695A 4-Pen A&B Plotter 599
- Seiko**
 DT-3503 11"x11" Digitizer 379
- Summagraphics**
 SummaSketch + 12"x12" 399

MS-DOS SOFTWARE

- Ashton-Tate dBase IV 459

- Ashton-Tate MultiMate II \$289
- Bloc** PopDrop 32
 Bloc Form Tools 55
- Borland** Paradox R-Database 439
 Borland Quattro 149
- Central Point** PC Tools 50
- DAC EASY** Accounting 60
- Delrina** Per FORM 159
- 5th Generation** FastBack Plus 99
- Fox Base +** Development 199
- IMSI** OptiMous w/Dr Halo III 79
- IMSI** Turbo CAD 59
- Intuit** Quicken 33
- Logitech** PS/2 2-button 59
- Lotus** Lotus 1-2-3 V3-0 299
- MECA** Managing Your \$ 119
- Meridian** CarbonCopy + 119
- MicroPro** Wordstar Pro 5.0 199
- Microsoft** Mouse 109
- MSC** OmniMouse 35
- Nolo** Press WillMaker 35
- Peter Norton** Adv. Utilities 80
- Peachtree** Accounting 169
- Quarterdeck** DESQView 80
- Server Technology** EasyLan 179
- SPC** 1st Choice 3.0 90
- SPC** 1st Publisher 2.0 80
- SPC** Professional Write 2.0 179
- TOPS** for DOS 125
- Traveling** Lap-Link + 85
- WordPerfect** 5.0 219
- Xerox** Ventura Publishing 2.0 479



CHINON
 DS-3000 Flatbed Scanner \$539



Your Source for Hardware, Software & Peripherals

In U.S.A.

800-233-8950

In Canada call: 800-233-8949

All Other Areas call: 717-327-9575 Fax call: 717-327-1217

Educational, Governmental and Corporate Organizations

Call toll-free: 1-800-221-4283

CMO, 101 Reighard Ave., Dept. A1, Williamsport, PA 17701

Over 400,000 SATISFIED CUSTOMERS • MAJOR CREDIT CARDS ACCEPTED

POLICY: Add 3% (minimum \$7.00) shipping and handling. Larger shipments may require additional charges. Personal and company checks require 3 weeks to clear. For faster delivery, use your credit card or send cashier's check or bank money order. Credit cards are not charged until we ship. Pennsylvania and Maryland residents add appropriate sales tax. All prices are U.S.A. prices and are subject to change. All items are subject to availability. Defective software will be replaced with the same item only. Hardware will be replaced or repaired at our discretion within the terms and limits of the manufacturer's warranty. We cannot guarantee compatibility. All sales are final and returned shipments are subject to a restocking fee. We are not responsible for typographic or photographic errors.

CMO
 MICROCOMPUTER
 MARKETING COUNCIL

The Only Character Recognition System



That Outperforms Ours

Nature's character recognition system can be trained to read any language. Flagstaff Engineering's **SPOT OCR Text Reader** is also trainable. It has read text printed in thousands of typefaces in over 130 different languages!

The SPOT OCR Text Reader works just like a typist who reads a page, then uses a keyboard to transfer the information on the page into a computer file—except SPOT uses a scanner for eyes and outputs the text directly into standard text files. SPOT is also faster. It can read up to 35 characters per second on a 16MHz AT, and up to 65 characters per second on a 25MHz machine (that's 780 words per minute). SPOT supports most major makes of scanners.

Using sophisticated statistical techniques, SPOT recognizes characters like the brain does: by examining their shape and context. Like nature's original, SPOT is very flexible. It can glance over an entire page or zoom in on a few lines of text. SPOT can read newspapers,

magazines, books, manuals, invoices, contracts, government documents, columns, tables . . . just about any printed text. And SPOT keeps getting better. The **new Version 3.0** is faster, more accurate, easier to use, and better documented than its predecessors.

Since 1982, Flagstaff Engineering has provided visionary data conversion solutions for thousands of companies worldwide. SPOT is already increasing productivity and making life easier for many publishers and researchers, accountants and telemarketers, medical and legal offices, archival and transcription services.

Wouldn't *your* business benefit from fast, accurate, and low-cost OCR software? Give us a call and let our application specialists explain how you can save time and money with SPOT, *the* OCR text-entry solution.



Join Flagstaff Engineering's
BIX conference: flageng

Circle 109 on Reader Service Card for
S.P.O.T. 3.0 Version
110 for 9 Track Tape
111 for Disk Conversion Systems Up-Date
112 for DEALERS only



**FLAGSTAFF
ENGINEERING**

Helping People Read a World of Information

1120 Kaibab Lane • Flagstaff, AZ 86001
602-779-3341 • FAX 602-779-5998



THE WORLD ON CD-ROMS

Jerry looks at current CD-ROMs, WORM drives, and UPSes

I am supposed to be hard at work on *Wrath of God*, a sort of sequel to *Lucifer's Hammer*, but it's hard to concentrate while they're shooting students on the Avenue of Eternal Peace in Beijing. A civilized army will fight and die to prevent the massacre of its nation's citizens. I keep hoping the Chinese People's Liberation Army will remember that. I also keep hearing a line from Robinson Jeffers, "Long live freedom, and damn the ideologies."

ERRMON

You may recall that a few months ago I had, or thought I had, hard disk drive problems, particularly on the Zenith Z-386; but after exhaustive disk media analysis, I wasn't able to find anything wrong. After I wrote that column, BYTE's editor in chief Fred Langa sent me a small program that actually solved the problem. (He sent it over BIX; the "attach" command in BIXmail is a very convenient way to send any kind of file, including binary files in ARC format.)

It's a freeware program written by Robert J. Newton, called ERRMON. This is a small TSR program that sits there waiting for DOS to detect a drive error; when an error is detected, ERRMON tries to figure out what it was and then posts a message on the screen. This message is generally considerably more helpful than the ones DOS puts up. Besides, it works inside other programs. In particular, it works inside Coretest; and Coretest was the only program that thought I had a problem with the Z-386 hard disk drive. Coretest, you may recall, kept reporting a READ ERROR on that disk, although no other program

could find a thing.

ERRMON saw what the trouble was immediately. While Coretest was reporting a READ ERROR, ERRMON printed out its strange error message number, which, being interpreted by referring to the table in the ERRMON.DOC file, translates to: "Direct-memory-access boundary crossed. This indicates a software problem. DMA cannot operate across 64K-byte segment boundaries."

Presumably, there is some odd interaction between Coretest, DOS, and the Z-386 BIOS, which is why this happens only when you run Coretest on that particular machine. I expect I could find out more if I took the trouble, but the fact is I'm just relieved to know there's no real difficulty with the Zenith hard disk drive—and there never had been. My files are safe.

ERRMON is available on BIX and other BBSes, and it's copyrighted freeware, meaning you can use it and give it away, but you can't sell it.

Just after I wrote that, I got a note from Doug McFadyen ("doug" on BIX), who reports that if you upgrade to the 2.5A version of the Z-386 ROMs, Coretest no longer reports a problem. I'll try that and let you know.

Golden Bow Strikes Again

John Carr has been using the AT&T PC 6300 Plus, an older IBM PC AT compatible, to enter the introductory essays for the next volume of my anthology series on the future of conflict (*There Will Be War*, Tor Books). We've had that machine quite a while. First it was my main text system; then Mrs. Pournelle inherited it and named it Attila the Honey. She kept it until we got her an 80386. Now John uses it for general office work.

A couple of days ago he had a problem: the AT&T PC 6300 Plus was taking several retries to save files. John is a science fiction editor; he knows nothing about computers, and problems are definitely not his department.

It took me about 2 minutes to discover there was a flaky sector somewhere on Attila's hard disk. We did a quick backup of John's work onto a floppy disk and invoked Golden Bow's Vmarkbad, a program that comes with their Vopt disk optimizer program. As the name implies, Vmarkbad finds and marks bad sectors on a hard disk, examining the disk at about 2 megabytes a minute. It found eight or nine bad sectors, making me wonder if Attila hasn't suffered some unreported traumatic injury.

Unlike SpinRite and some other "disk repair" programs, when Vmarkbad finds a bad sector in a currently active file, it reports the filename. In our case, there were bad sectors in seven files. Three of those were .BAK files, and one more was in a file we'd just copied onto a floppy disk. The other three were Q&A auxiliary files, including the one that handles text saves. It was no trick to get the original Q&A disks and recopy those files.

Then we used Norton Commander to go through all the directories and eliminate needless files, something John just won't do. There were a bunch of tutorial files, .BAK files by the score, and just a lot of general garbage. After that cleanup, I used Vopt to compact the disk, ran Vmarkbad again, and just for luck ran Norton Disk Doctor. No new bad sectors found, and Attila hums along as if nothing had ever happened. There's a dance or two in that old boy yet.

I received my version of Vopt and Vmarkbad in January 1988. There may or may not be updates. I have a number of programs that are supposed to do the same job as the Golden Bow tools, but I've never seen any good reason to change; Vopt and its auxiliary programs are a lot more than good enough.

A Study in CD-ROM

At the West Coast Computer Faire, I was given two copies of the entire Sherlock

continued

Holmes canon, one on floppy disks, the other on a CD-ROM. The CD-ROM version is called *Sherlock Holmes on Disk!* and also has *The Medical Casebook of Dr. Arthur Conan Doyle* by Alvin E. Rodin and Jack D. Key; linoleum block prints by Dr. George Wells; medical poetry by Dr. George Bascom; and all kinds of indexing and retrieval software. The publisher is CMC ReSearch.

There are no documents, but none are needed. Simply log onto the CD-ROM and type DP; the rest is pretty automatic. After a few questions about your system configuration, you're at the main command screen. This has pull-down menus that work about as you'd expect them to, including menu items for text searches. Once I was clear on how that worked, the first thing I did was use word search to look for any story with the words: dog .AND. curious .AND. nighttime. (The program uses .AND., .OR., .NOT., and so forth as commands for Boolean searches.) It took about 10 seconds for it to tell me there was only one match, "Silver Blaze," which is the story involving the curious incident of the dog in the nighttime: "'The dog did nothing in the nighttime.' 'That was the curious incident,' remarked Sherlock Holmes."

Pressing Return put that story on the screen. It puts the text in black letters on a soft white background, quite easy to read, and next thing I knew I'd read it all instead of working on the column. Then I looked up Persian .AND. slipper, expecting that there would be a dozen matches, but in fact there were only three: "The Adventure of the Empty House," "The Musgrave Ritual," and "The Naval Treaty." That slipper is so famous I was sure there was some mistake and tried again, this time using "persian," but I got the same result; the search isn't case-sensitive.

There are nine matches on Moriarty but only seven on Moriarty .AND. Professor. I haven't had a chance to look at the differences.

I'm sad to say I have not seen the linoleum block illustrations that are supposed to be on the disk. When I try to access any of the graphics (including the chart in "The Naval Treaty"), the CD-ROM drive light blinks, and something obviously is read from it, but then the screen goes blank; all I can do from there is escape back to the story. The program documents say you must have a 640- by 480-pixel VGA board and monitor capable of 256 colors, but that's a generic description of VGA. The program itself offers you a menu of two VGA boards, the Orchid Designer VGA and the STB VGA

Extra/EM. I've tried invoking the program under each option, but neither lets my Video Seven V-RAM VGA show the pictures.

I've often thought CD-ROM was an ideal medium for presenting not only the Sherlock Homes canon, but just about every word written about England's greatest detective, including all the issues of *The Journal of the Baker Street Irregulars*. It could also have maps of London in Victorian times, illustrations from contemporary newspapers, and all that sort of thing, possibly linked by hypertext.

Most of the CD-ROMs I have are disappointing given the potential of the medium.

Sherlock Holmes on Disk! doesn't have all that, but it is fun; it's another of those programs that you probably wouldn't buy a CD-ROM drive for, but if you already have the drive, it's a neat thing to have around. It's amazing what you can find out about the Holmes stories with the proper Boolean searches.

Geography Lesson

I have a whole bunch of CD-ROMs I collected at the Microsoft CD-ROM conference last spring. Most are a bit like *Sherlock Holmes on Disk!*: not bad, but disappointing given the potential of the medium. An example is the *World Atlas* by Electromap. This gives a pretty good high school-level atlas, which starts with two views of the world, physical and political; if you use a mouse or arrow keys to go to a region of interest and press Return, up comes a more detailed map of that area. You can then go down one further level to maps of individual countries.

Alas, that's as far down as it goes, and at the country level there isn't a lot of detail. For example, the U.S. map has perhaps 40 cities and half a dozen rivers. The USSR map has even less information.

The geographical maps aren't the real point, though. There are numerous statistical maps, each accompanied by pull-down menus of information on econom-

ics, population, languages, population density and growth rate, infant mortality, life expectancy, and a whole bunch of other stuff from the *World Almanac*, all given for each country and listed both alphabetically and by parameter order.

If you're interested in inflation rates, you bring up that map and then go to the menus. If you want to find the country with the smallest inflation rate (Equatorial Guinea with a rate of -18 percent) or the largest (Nicaragua, 1800 percent; next is Vietnam with 700 percent), it's simple enough. Ditto for population growth (Hungary, -0.2 percent, Brunei +8.6 percent annual) and a raft of other stuff. You can spend a couple of hours playing about with this with no trouble at all.

Access is reasonably fast, but it seems slow compared to a hard disk drive. Of course, I have a very fast hard disk drive. In any event, it's quicker to find specific information on this CD-ROM than it would be to go look it up in your atlas or almanac.

Once again, you wouldn't buy a CD-ROM drive for this, but if you've got students in the house, it would be worth letting them browse through this.

I do wish there were more detail. Electromap says they're doing a U.S. atlas that will have both political and topographic maps of each state, plus a great many more statistical maps.

A second atlas-type CD-ROM comes from the CIA. The *World Factbook* is available from Quanta Press. This has a directory of maps, one outline for each country or territory, at 300-dot-per-inch resolution in TIFF format suitable for desktop publishing. The *World Factbook* consists of 248 data cards much like the 5- by 8-inch paper index cards you used to make up in the library (although there's a bit more information on many countries than you could conveniently put on even two or three cards). There's form of government, religion, population, currency, literacy rate, economic trends, recent history, diplomatic problems, and a whole raft of other stuff—more details than you got on the *World Atlas* disk, but not as well organized.

The cards are indexed on 22,987 keywords, and you can do Boolean searches with or without wild cards. Searching on the word *atheist* gives you four countries, Albania, Hungary, USSR, and China. You can then examine cards for each or all of those. Searching on *OPEC* yields 16 cards, one of them

continued

NEW! TOPSPEED TOOLKITS



"Everything about this product exudes quality...it is one of the most complete and powerful development systems available today."

Scott Robert Ladd
Computer Language

"...TopSpeed* is surely one of the finest new products introduced to date in the PC arena...DDJ doesn't give unqualified raves very often, but there's no question about it in this case; JPI's TopSpeed Modula-2 is first-rate."

Kent Porter
Dr. Dobbs Journal

"JPI Modula-2 looks like another classic in the making. It generates code as good as or better than leading C compilers and the programming environment is a genuine pleasure to use."

Dick Pountain
BYTE Magazine

In England and Europe contact:

Jensen & Partners UK Ltd., 63 Clerkenwell Road, London EC1M 5NP. Phone (01)253-4333. FAX (01)251-0141. Each Toolkit £49.95*
DOS Compiler £59.95, TechKit £34.95*
VID £34.95, DOS 3-Pack £119.95*
OS/2 Compiler £124.95* (*Prices effective through Oct. 1, 1989)

Handling charges: In UK please phone for VAT & P&P. In Europe, add £6 for each com-

TopSpeed* Modula-2 is a high-speed optimizing compiler (3,000-5,000 lines/min. on a PC AT 8MHz), integrated menu-driven environment with multi-window/multi-file editor, automatic *make*, fast smart linker. All Modula-2 sources to libraries included. Available for DOS or OS/2.

Communications Toolkit is designed to help you write applications that use IBM PC serial port hardware. Features include an interrupt driven low-level driver; VT100 and ANSI terminal emulation; XModem, YModem, and Kermit support; compiled script language; and full source for all modules. The same version supports both DOS and OS/2.

B-tree Toolkit provides you with the tools you need to write powerful database applications. Store multiple tables and indexes in one or more physical files (no record count limit; each physical file up to 4 gigabytes). Automatic network support allows opening of sharable or private physical files and full control of file locking. Indexes can be linked to tables so that index updates are automatic. The same version supports both DOS and OS/2.

VID (Visual Interactive Debugger): A source-level, multi-window symbolic debugger. (DOS only)

TechKit*: Includes assembler, assembler source for start-up code, TSR module, error handlers, communications driver, dynamic overlays, and PROM locator. (DOS only)

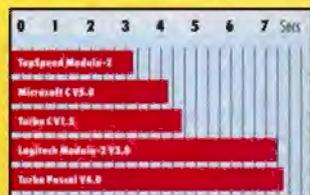
System Requirements: IBM PC or compatible, 384K available RAM, two floppy drives (hard disk recommended).



TopSpeed's seamlessly integrated environment.



VID (Visual Interactive Debugger): power without complexity.



Steve benchmark measured by the British Standards Institution (BSI) - 25 iterations on an 8MHz AT.

Each Toolkit \$79.95*
DOS Compiler \$99.95
TechKit \$59.95*
VID \$59.95

DOS 3-Pack \$199.95*
(Compiler, TechKit & VID)

OS/2 Compiler \$195.00*
*Prices effective through 10/1/89

To Order:

In the US, call:
1-800-543-5202

In Canada, call:
1-800-543-8452

Or mail us your order with a check, money order, or VISA/MC information. 30-day unconditional money-back guarantee.

Shipping & handling charges:

In North America: add \$5 for each product ordered. CA residents please add applicable sales tax. Overseas: Add \$20 for EACH compiler and \$8 for each other product. 3-pack s & h is \$36.00.



Jensen &
Partners
International

1101 San Antonio Rd.
Suite 301
Mountain View, CA 94043
Phone: (415)967-3200

TopSpeed and TechKit are trademarks of Jensen & Partners International. Other brand and product names are trademarks or registered trademarks of their respective holders.

Austria, which isn't an OPEC member (OPEC is mentioned in another context). This is another of those disks well worth having if you have a CD-ROM drive.

Programmer's Library

If you're a professional programmer, the Microsoft Programmer's Library is valuable enough to make it worth buying a CD-ROM drive just to have it. The disk contains the reference manuals to QuickBASIC 4.0, C, FORTRAN, Assembler,

Pascal, Windows 2.0, and OS/2 Programmer and User Reference. All these can be popped up inside the compiler environment or in an external editor like BRIEF. The newest versions have the reference manuals to Windows/386 and QuickPascal.

I'm not spending a lot of time on this because there's no need to: if you do much programming and your time is worth anything at all, get a CD-ROM drive and Microsoft Programmer's Li-

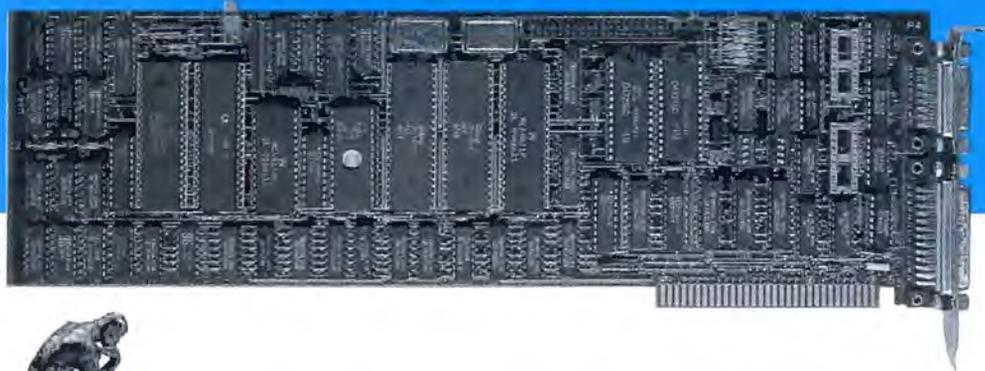
brary. You won't regret it.
Highly recommended.

The Coming Scene

Microsoft has done an admirable job of pushing CD-ROM, so much so that the number of installed CD-ROM drives out there has gone from zip to perhaps 100,000 in the last three years; and a good half of those, perhaps more, are due to Microsoft products.

continued

PC XNET THE CARD THAT BRINGS X.25 PERFORMANCE TO YOUR PERSONAL COMPUTER THINK ABOUT IT!



And think about OST, the European leader in the field of private X.25 networks!

Our PC XNET card, an option/adaptor card for personal computers, provides two channels, each supporting 128 virtual circuits and speeds to 64 kbps. The PC XNET card provides a level of performance never before reached in a personal computer.

Easy access via MS DOS, XENIX and NETBIOS makes the PC XNET card the perfect tool for emulating terminals and file servers or providing a gateway to Local Area Networks. Fully compatible with many protocols such as X.25, X.32 and X.21, the PC XNET card enables computers to be connected to any type of network.

Furthermore, applications programs you develop on the PC XNET card can be transferred to the PC SNET card, OST's ISDN interface card.

So, if you are thinking of X.25 capability for your computer think about OST.

OST, SA

Rue du Bas-Village. Z.I. Sud-Est
35515 Cesson-Sévigné Cedex
Tel. : (33) 99.32.50.50
Fax : (33) 99.41.71.75. Telex : 730839



OST, Inc

14225 - F Sullyfield Circle
Chantilly, VA 22021
Tel. : (1) 703 817 0400
Fax : (1) 703 817 0402

Networking Intelligence

Our MAJOR ADVANTAGE-Supplying you with the Broadest Range of Software Ammunition.



LIST OURS

APPLICATION SOFTWARE

COMMUNICATIONS

Carbon Copy plus	195	118
Close-Up		
Customer	195	130
Support	245	165
Co/Session	249	182
Crosstalk XVI	195	99
Mirror III	100	67
PC Anywhere III	145	79
Procomm Plus	75	50

DATABASE

Clarion	695	589
Clipper	695	439
dBASE IV	795	489
dBXL	249	159
FoxBASE+	395	214
FoxBASE+/MAC	395	214
Paradox 3.0	725	479
PFS:Professional File	299	189
Q&A	349	230
R&R	149	109
R:Base for DOS	725	521

DESKTOP PUBLISHING

Adobe Illustrator '88	695	CALL
Adobe Illustrator '88 (MAC)	495	300
Corel Draw	495	299
Draw Applause	495	315
First Publisher	99	75
First Publisher Art Gallery	129	82
GEM Artline	495	299
GEM Desktop Publisher	299	183
PageMaker	795	489
PageMaker (MAC)	595	395
Ready, Set, Go (MAC)	495	320
Springboard Publisher	139	80
Ventura Publisher	895	539

GRAPHICS

Chart-Master	375	239
Freelance Plus	495	CALL
GEM Graph Present. Team	495	305
Graph Plus	495	332
GraphWriter II	495	CALL
Graph-in-the-Box	140	75
Harvard Graphics	495	313
Micrografx Designer	695	460
Microsoft Chart	395	270
Perspective Junior	149	88
Pinstripe Presenter	200	CALL
PIXIE	195	117
Powerpoint (MAC)	395	265
Xerox Presents	495	326

INFORMATION ORGANIZERS

Agenda	395	CALL
askSam	295	209
GOfer	80	45
GrandView	295	205
Memory Mate	70	43
SideKick Plus	200	135
Tornado	100	73
Who-What-When	190	140
Zyindex Professional	295	159

PROJECT MANAGEMENT

Harvard Project Manager	695	445
InstaPlan 2.0	99	95
Microsoft Project	495	333
SuperProject Plus	395	263
Time Line v. 3.0	595	349
Time Line Graphics	195	135

SPREADSHEETS

Legend Twin Level III	249	CALL
Lotus 1-2-3	CALL	CALL
Lucid 3-D	100	71
Microsoft Excel	495	CALL
Microsoft Excel (MAC)	395	270
Microsoft Multiplan 4.0	195	134
Microsoft Multiplan (MAC)	195	140
PFS:Professional Plan	249	161
PlanPerfect	395	196
Quattro	248	171
SuperCalc5	495	328
Symphony	695	465
Wingz (MAC)	495	296

SPREADSHEET UTILITIES

3-D Graphics	145	129
4Views	150	119
4Word	100	61
@BASE	195	119
@ Liberty	295	199
Allways	150	90
Baler	495	449
Graph-in-the-Box	140	75
Hal	150	107
Impress	140	CALL
Inword	100	59
Lock & Link	100	60
Note-It Plus	80	53
Noteworthy	80	49
PanaView	145	129
See More	80	49
Sideways	70	43
SmartNotes	80	48
SpellIt!	80	49
SGZ Plus	100	63

WORD PROCESSING

AmI	199	CALL
DisplayWrite 4	495	342
Grammatik III	99	61
Manuscript	495	CALL
MaxThink 89	89	71
Microsoft Word	450	249
Microsoft Word (MAC)	395	293
MultiMate Advantage II	565	CALL
Office Writer 6.0	495	302
PFS:Professional Write	199	129
Q & A Write	199	135
RightWriter	95	53
Samna Word IV	595	316
Sprint	200	144
WordPerfect 5.0	495	249
WordPerfect (MAC)	395	231
WordPerfect Executive	249	127
WordPerfect Library	129	69
WordStar 2000+ Personal	495	302
WordStar Professional Rel 5	495	262
XyWrite III Plus	445	256

OPERATING SYSTEMS / CONTROL PROGRAMS

DESeqview 386 (w/GEMM)	190	169
Interactive 386/IX	1095	989
MS Windows/386	195	136
PC-MOS 386 (single user)	195	179
PC-MOS 386 (five users)	595	539
SCO 386 UNIX Sys V (comp)	1495	1195
SCO UNIX Sys V (comp)	1295	999
VM/386	245	199
VM/386 Multi-User	895	759
VM/386 NetPak	150	129

LIST OURS

SCIENCE/ENGINEERING

CAD		
AutoCAD Release 10	3000	CALL
AutoShade	500	475
AutoSketch	150	102
DesignCAD	CALL	CALL
DesignCAD 3-D	399	219
Drafix CAD Ultra	395	259
Generic CADD Level 3	300	189
Generic 3-D Solids Modeling	349	195

PCB ARTWORK/SCHEMATICS

HiWIRE Plus	895	805
Micro-CAP III	1495	1269
Schema II	495	450
smARTWORK	895	805
Tango-CAD Pack	995	949
Tango-PCB Series II	595	559

DATA ACQUISITION/ANALYSIS

Asystant Plus	995	849
DADISP	795	719
LABTECH Notebook	995	799

MATHEMATICAL TOOLBOXES

Derive	200	164
Eureka: The Solver	167	115
Eureka: The Solver (MAC)	195	134
Gauss Math & Stat System	395	350
Mathematica 386	695	CALL
AT 386/7	995	CALL
Mathematica (MAC)	795	CALL
PC MathCAD 2.5	495	315
Appl. Packs (for MathCAD)	99	89
PC-Matlab	695	559
Control System Toolbox	495	399
System ID Box	495	399
TKI Solver Plus	395	319

PLOTTING AND GRAPHING

Dataplot Graph	299	259
Grapher	199	149
Grapher/Surfer Bundle	600	499
Surfer	499	379
TECH*GRAPH*PAD	395	313

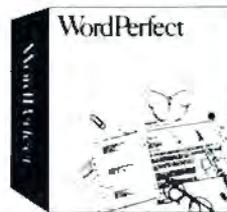
WordPerfect

WordPerfect 5.0 integrates text and graphics to let you create professional looking newsletters, reports, and documents—without neglecting the features that made it number one in the first place!

Graphic images can be placed anywhere on the page, scaled, moved, and can include a caption and border. 5.0 also has enhanced print capabilities, and a WYSIWYG preview mode. Master Document combines files to generate tables of contents, indexes, etc.

WordPerfect 5.0 succeeds 4.2 as the world's best word processor. Once you've tried it, you'll never go back!

List: \$495 **Ours: \$249**



WordPerfect CORPORATION

Laplank (MAC)	140	89
MACE GOLD	150	88
MACE Utilities	100	54
Magellan	195	CALL
MKS Toolkit	199	155
Norton Commander	89	52
Norton Utilities	100	59
Norton Utilities Advanced	150	89
PC Tools Deluxe	79	55
PC Tools (MAC)	79	55
Q-DOS II	80	47
Software Carousel	80	46
Spinrite	59	47
Symantec Utilities (MAC)	100	67
V feature Deluxe	120	95
Vopt	60	46
XTree	70	39
XTreePro	129	70

SCIENTIFIC TEXT PROCESSING

ChiWriter	150	128
EXP	150	129
PC TEX	249	226
T!	595	479

STATISTICS

CSS	495	469
Microstat II	395	336
NWA StatPak	495	366
P-Stat	695	639
SPSS/PC+	795	727
StatGraphics	895	601
StatPac Gold	595	544
StatView II (MAC)	495	345
SYSTAT	595	449
SYSTAT (MAC)	595	449
SYSTAT (w/ SYGRAPH)	795	595

Terms & Policies

All prices subject to change without notice. We accept Visa, MC, AMEX (2% surcharge on AMEX). Shipping \$4 per item sent UPS Ground. Allow 14 days for personal/company check clearance. Returns subject to 15% restocking fee. RA # required. PO's welcome from Fortune 1000 and other qualified organizations.



ADVANTAGE SOFTWARE

A Division of Voyager Software Corp

In the U.S. call:

1-800-333-3141

N.Y. / International 914-332-0756

Fax: 914-332-4021

55 South Broadway, Suite B, Tarrytown, NY 10591



Introducing OS/RAM4™.

- ✓ 4 megabytes of memory.
- ✓ Extended and expanded memory. LIM 4.0.
- ✓ Works with all of your programs.
- ✓ Run DOS or OS/2 effortlessly.
- ✓ Fast and simple switchless installation.
- ✓ Auto-configuration for all operating systems.
- ✓ Works in all Micro Channel™ computers.
- ✓ Expanded memory 10 times faster than Intel.
- ✓ Risk free guarantee. Two year warranty.
- ✓ IBM approved ID. \$349 0K.

Call today 1-800-234-4232 or 617-273-1818



Capital Equipment Corp.
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

Meanwhile, the number of CD-ROMs available continues to grow. Some, like McGraw-Hill's wonderful Encyclopedia of Science and Technology, haven't been done all that well; that is, the information in that Encyclopedia is more than worth it (except it's a time trap: you start browsing through that thing and the next you know it's dawn), but the CD-ROM software isn't as good as it could be. It also wants some pretty specialized graphics board equipment. Now that VGA is getting common, we can hope that McGraw-Hill will revamp the Encyclopedia.

There are the various NASA CD-ROMs with planetary data. Grolier's has much improved their access software for the original Grolier's Encyclopedia on CD-ROM. We see new CD-ROMs here every day.

Moreover, we can expect a lot more CD-ROM drives in the future: not only will Microsoft continue with excellent products like Microsoft Bookshelf and Programmer's Library, but IBM will, in about 18 months, have a low-cost home computer with a built-in CD-ROM drive. Microsoft is writing the code for it even as you read this, and IBM expects to sell a lot of those machines at \$1995 or thereabouts. The machine will also have a MIDI interface.

IBM will then very aggressively go

after both the home and educational markets. One supposes Apple will have some sort of response, since they certainly wouldn't want to abandon the educational field to Big Blue without a hard fight.

Whatever the outcome of that, it should be beneficial to users. Right now CD-ROM is about where small computers were before the IBM PC. CD-ROM is a wonderful way to organize and distribute information; you'll see a lot more of it as time goes on. The potential is nearly unlimited.

WORMs and DESQview

In my judgment, the 8086, 8088, 80186, and 80286 chips will disappear in the next few years. Their place will be taken by chips that can execute the 80386 instruction set. Probably one of those replacement chips will be the 80386SX, although I don't think there's any real reason to prefer the SX to a real 80386. Even more important will be the 80486; there are definite indications that you can build a fully operational system with the 80486 cheaper than you could build the same system with an 80386 and 80387.

This is going to have a large effect on both the bus and operating-system wars. Most volume buyers won't care much about the details; all 80386 systems, regardless of bus and operating system, are

a great deal faster and more powerful than most businesses think their "standard" user—a secretary or junior executive—will need. The decision factors will be total workstation cost, hardware and software, including both applications and operating-system software. There's also training and support, which aren't trivial, especially when changing systems. The bottom line is, what can Bertram and Susie accomplish, and what's it going to cost?

Which is to say that while OS/2 with Presentation Manager can be pretty nifty (I've just got OS/2 PM running on a fast 80386 system, and I confess I like what I'm seeing), the fact is that right now, at least, you can get a lot more done with MS-DOS 3.3 and DESQview.

We have, for instance, tuned our Big Cheetah 80386 so that we can have a number of 530K-byte windows open all at once, and every one of those windows has a mouse, various keyboard fix programs, and the Maximum Storage WORM (write once, read many times) drive built in. Every bit of the 530K bytes is available to application programs.

All this is accomplished with carefully arranged CONFIG.SYS and AUTOEXEC.BAT files. (Listings of these files are available on BIX in the CHAOS-MANOR conference.) We use a SHELL command to increase the program environment to 512 bytes to support a larger PATH statement. And we use LOADHI.SYS and the LOADHI program (they come with Quarterdeck's QEMM) to load various TSR programs into the area between 640K bytes and 1 megabyte. In this particular case, we do more than that: we also load some 15 buffers up there. The result is that we can have pretty big DESQview windows, and inside each of those windows the software thinks the WORM drive is just one more disk drive.

CD-ROM

All this was very well, but there's something missing. There's no CD-ROM driver. In order to use the CD-ROM, I used to have files called CONFIG.CDR and AUTOEXEC.CDR. A batch file would make them the current CONFIG.SYS and AUTOEXEC.BAT, and then I'd reboot. Those files omitted the WORM drivers. Thus, I could have a CD-ROM in every window or a WORM in every window.

I could even have both, but if I loaded both CD-ROM and WORM drivers, even using LOADHI.SYS, I'd end up with a maximum window of about 480K bytes; and while this isn't tiny, it's not quite

CHAOS MANOR

large enough, either. I have programs that want a full 512K bytes before they'll run properly. I don't need both WORM and CD-ROM in every window; indeed, I don't really need both in any single window.

DESQview has no problem with the kind of TSR program that's loaded with a command file. The problem comes with drivers that must be loaded with CONFIG.SYS. They have to go in on boot-up; there's no way to put them inside a DESQview window. Both the WORM and CD-ROM drivers have to be loaded with CONFIG.SYS, and if you load both, you use too much system memory.

The obvious solution, I thought, was either to get Quarterdeck to change DESQview so that it *can* bring .SYS drivers into DESQview windows, or to get Maximum Storage to change its drivers so they can be loaded with a command. Alas, so far neither of these has happened.

I continued to brood, and suddenly I was struck with inspiration.

The purpose of buffers is to speed disk operations by giving the disk drive controller a place to stash stuff prior to putting it where it belongs. My Big Cheetah uses a Distributed Processing Technology hard disk drive controller. This controller has 500K bytes of on-board memory. Why, then, would it want or need file buffers? Maybe I could eliminate the buffers.

That wasn't hard to do: just remove the LOADHI buffers statement in AUTOEXEC.BAT and reboot. I tried that. If there was any effect on disk operations, I sure couldn't detect it; time for a real test.

The sure test of whether your system needs more buffers is to make up a sub-directory with a *lot* of filenames in it. The test is to get a directory: if you need more buffers, the directory information will scroll smoothly at first; then, as the buffers are filled, it will get jerky until you start getting one or two filenames put to screen, and then there is a noticeable hesitation as the machine goes to disk.

I went to one of the unused logical areas on Cheetah's Priam 330-megabyte hard disk drive and transferred every short file on the system to it. I ended up with something like 450 filenames. Then I looked at the directory. No hesitation. OK, next try a *big* file transfer. Again no loss of speed. Clearly, Big Cheetah with the DPT controller doesn't need any stinking buffers.

Alas, while that gave LOADHI some extra room, it still wasn't enough to let



PS/2[®] MEMORY

Introducing OS/RAM8™.

- ✓ 8 Mbytes of memory + 2 serial ports.
- ✓ Extended and expanded memory. LIM 4.0.
- ✓ Works with all of your programs.
- ✓ Run DOS or OS/2 effortlessly.
- ✓ Fast and simple switchless installation.
- ✓ Auto-configuration for all operating systems.
- ✓ Works in all Micro Channel™ computers.
- ✓ Expanded memory 10 times faster than Intel.
- ✓ Risk free guarantee. Two year warranty.
- ✓ IBM approved ID. Best price. Fast delivery.

Call today 1-800-234-4232 or 617-273-1818

cec Capital Equipment Corp.
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

me have WORM, CD-ROM, and windows bigger than 512K bytes. Time for more thought.

Of course, the solution was obvious. Access to CD-ROM drives requires two actions. First, you have to load the CD-ROM driver with CONFIG.SYS. Then you have to execute the MSCDEX.EXE program, which loads Microsoft DOS extensions that allow DOS to recognize disk drives larger than 33 megabytes. All I had to do, then, was use LOADHI to install the Amdek Laserdek driver with CONFIG.SYS and, when I wanted to access the CD-ROM drive, open a window and execute the MSCDEX.EXE command *inside the window*.

That worked fine. I can now open a window; do MSCDEX.EXE; load SideKick; go to the CD-ROM drive and set it up to use its software complete with memory-resident software; load Procomm; and log onto BIX with, say, both SideKick and Grolier's Encyclopedia available in the communications window. I can also download files directly from BIX into the WORM drive. Meanwhile, I can have a 525K-byte program going in other windows that can't access the CD-ROM.

Of course, not everyone has or needs both CD-ROMs and WORM drives; but it's nice to know you can have both and still use DESQview.

WORMS and UPSes

I'm going to make this a flat statement that you can accept or not as you choose.

If you're seriously in the software development business, either your company is large enough that you've got all your expensive people's systems networked and a systems manager sees to it that daily backups are made, or you need at least one WORM drive for every expensive programmer you employ, including yourself. True, there are a lot of arguments for tape backup systems; but my experience has been that they don't tend to be used routinely. If there's someone whose job is to see that backups are made, they probably will be made; but leaving that task to individual programmers—or writers, or financial analysts, or CAD engineers—is risky.

WORMS are different: since they look to the user like just another disk drive, it's very easy to save stuff to WORM, and just as easy to recover lost data from a WORM; and unlike most other backup systems, WORM drives save every version. When we were working on Mrs. Pournelle's Reading Program, I had several opportunities to bless that feature.

The other thing that you can't afford not to have is an uninterruptible power supply, which is commonly called an UPS. Indeed, given that you can buy a

continued

decent UPS for a few hundred bucks, you can make the case that not having one, even on a system with a WORM drive, is plain stupid.

I now have several UPS systems. Two of them are Clary systems: there's the big one we had when the Great Power Spike hit (see my August column) and a smaller desktop model. The big one will run more equipment, including the laser printer, but be warned, it really is big—a couple of cubic feet—and heavy. It also

has a fan that, while reasonably quiet, does add a bit to the background noise. The smaller model does just fine taking care of your computer, and the Clary people tell me it has the same surge-protection capability as the large unit.

My other UPS is a TSi UPS-3160P. This is a handsome little unit that will sit nicely under a computer or its monitor; it can also stand on the floor, which is where I have mine. It has three conditioned power outlets, labeled Computer,

Monitor, and Printer, each with its own switch. There are also two non-UPS outlets, also switched. The TSi has been running Big Cheetah and his monitor and, instead of a printer, an outlet box that powers the Maximum Storage WORM, the Amdek CD-ROM drive, and the USRobotics modem. There have been no problems in over a month.

I've no great competence in evaluating an UPS. I have tested both the Clary and the TSi, subjecting them to such cruel and unusual punishment as yanking the power cords and hooking them to a Variac variable transformer on which I steadily reduce the input voltage to simulate a brownout. Both cut in well before I got worried about what low voltage would do to my computer.

Most UPS systems will work; but some deliver a much better quality of power than others. Your computer power supply probably won't care about that, but your printer will, and so can other auxiliary equipment. There's more to learn about UPS systems than I thought. (See "Curing the Brownout Blues," April BYTE.)

Pournelle's Law: If you don't know what you're doing, deal with people who do. I'm pretty sure there are a lot of companies that make good UPSes; one thing I'm quite sure of, both the Clary and TSi people know what they're doing. They both independently tell me the same story regarding power quality and the dangers and advantages of different ways to do power conditioning.

Get yourself some good advice on what *kind* of UPS to get; but take it from me, if your work is worth anything at all, get an UPS. It's darned cheap insurance.

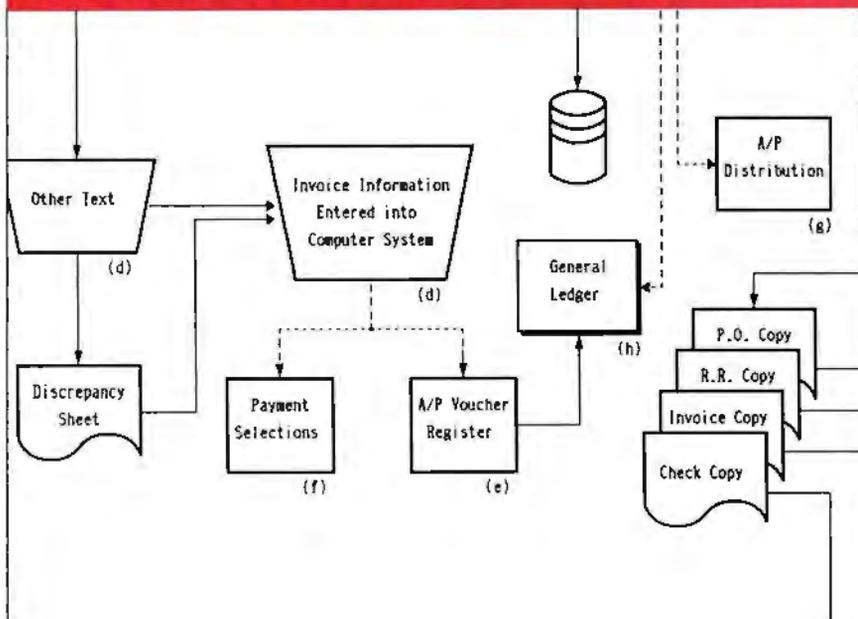
Bringing Up OS/2

Recent visitors to Chaos Manor include Pierluigi Zappacosta, president of Logitech, and Logitech programming engineer Mansour Safai. They wanted to demonstrate the new Logitech Modula-2 Compiler and the Logitech Debugger on OS/2 PM. The only problem was I didn't have OS/2 up and running on anything here. They offered to install it.

Although you can set up your system so that you've a choice between DOS or OS/2 on start-up, I wasn't quite ready to change operating systems on my main machine. On the other hand, I wanted to have PM handy, not off in a back room. That left two candidate machines, the Zenith Z-386 and the new Northgate 386. The Zenith has a Maximum Storage WORM drive installed already. That made it easy to back up the Zenith files.

continued

ARE YOU STILL DRAWING FLOWCHARTS BY HAND?



FLOW CHARTING II+

Flow Charting II+ will *amaze* you with its speed, power and simplicity.

- Update and print charts as fast as the situation changes
- See your revisions right away—no long wait for charts to be hand drawn
- Select 26 standard shapes; 10 text fonts
- Tutorial manual makes learning easy
- Runs on IBM or compatibles
- Produces excellent organizational charts!
- Only \$229!

PATTON & PATTON

Software Corporation

Excellence in charting the flow of ideas

For more information, see your local retailer or call
 1-800-525-0082, ext. 47 (outside Calif.) 408-629-5376 (Calif./Int'l.)
 81 Great Oaks Blvd., San Jose, CA 95119

THE NEW STANDARD FOR HIGH PERFORMANCE STATISTICAL SOFTWARE

CSS

**COMPLETE STATISTICAL SYSTEM
WITH DATA BASE MANAGEMENT
AND GRAPHICS**

A powerful, comprehensive, elegant, and super-fast statistical package for IBM (PC, AT, PS/2) and compatible computers. ■ The CSS optimized user interface with fast hierarchical menus incorporates elements of artificial intelligence; even complex analyses require only a few keystrokes (batch processing is also supported). ■ CSS features comprehensive, state of the art implementations of: *Basic statistics, Multi-way frequency tables, Nonparametric statistics, Exploratory data analysis with analytic graphs, Multiple regression methods, Time series analysis with modeling and forecasting (incl. full ARIMA), General ANOVA/ANCOVA/MANOVA, Contrast analysis, Discriminant function analysis, Factor analysis, Principal components, Multidimensional scaling, Item analysis/Reliability, Log-linear analysis, Cluster analysis, Non-linear estimation, Logit/Probit analysis, Canonical analysis, Survival and Failure Time analysis (Censored data), Quality Control analysis, and much more.* ■ All statistical procedures are integrated with fast data base management and instant, presentation quality graphics (over 100 types); full support for all mono and color graphics boards (incl. VGA) and over 100 plotters and printers (incl. the HP and Postscript standards). ■ All CSS screen output is displayed via customized Scrollsheets™ (i.e., dynamic, user controlled, multi-layered tables with cells expandable into pop-up windows); all numbers in a Scrollsheet™ can be instantly converted into a variety of presentation quality graphs; contents of different Scrollsheets™ can be instantly aggregated, combined, compared, plotted, printed, or saved. ■ The flexibility of the CSS input/output is practically unlimited: CSS offers an intelligent interface (read/write) to all common file formats (Lotus, Symphony, dBase, dBase III+, dBase IV, SYLK, ...) and special utilities to easily access data from incompatible programs; graphics can be saved in files compatible with desktop publishing programs (Aldus, Ventura). ■ CSS data files can be as large as your operating system (DOS) allows; OS/2 version coming soon. ■ CSS precision exceeds the standards of all common precision benchmarks. ■ *Technical note: The CSS user interface and all I/O were written in Assembler and bypass DOS; graphics and data management were written in Assembler and C; the computational algorithms were written in Assembler and optimized Fortran.* ■ \$495 (plus \$5 sh/h); 14-day money back guarantee.

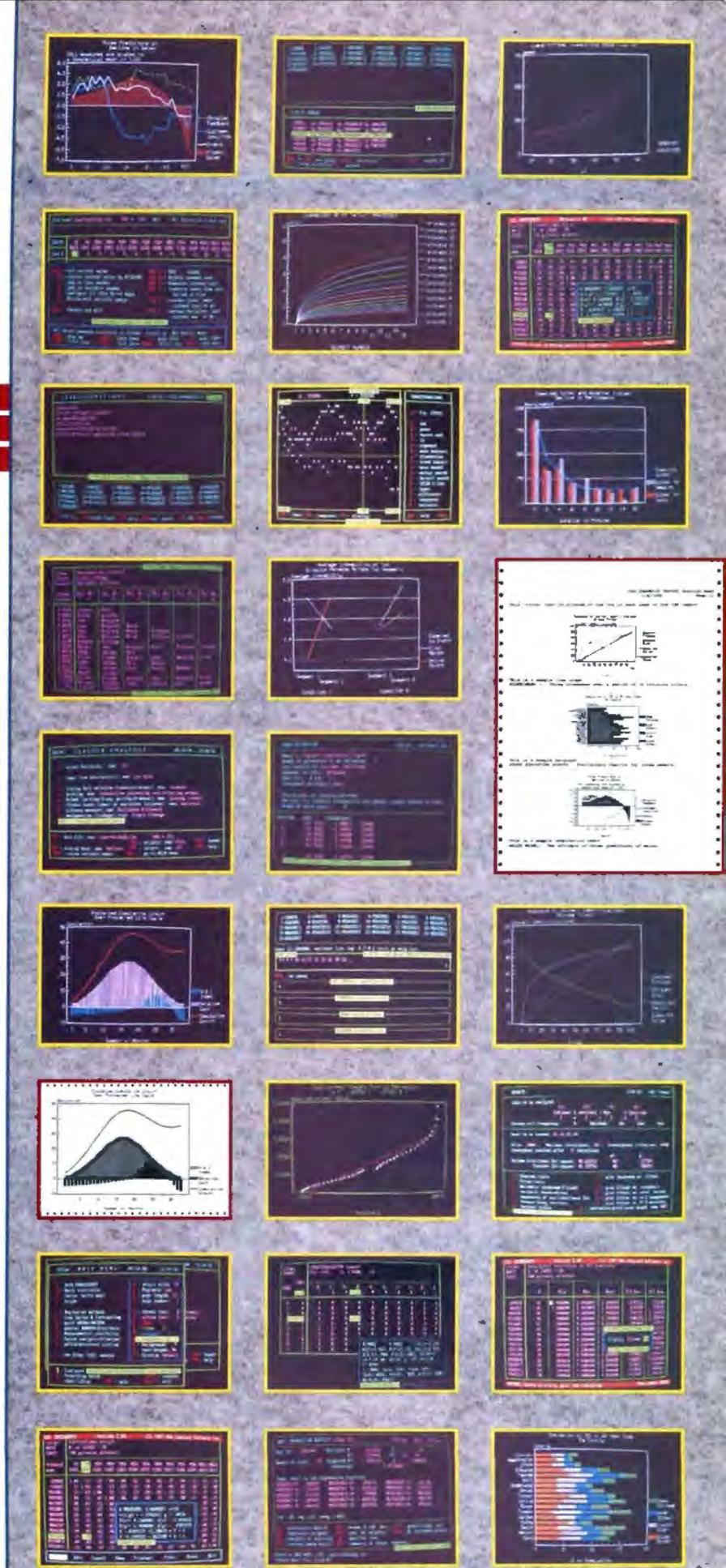
Circle 270 on Reader Service Card



StatSoft

2325 East 13th Street ■ Tulsa, OK 74104 ■ (918) 583-4149
Fax: (918) 583-4376

Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph: 040/4200347, fax: 040/4208724, StatSoft UK (London, UK), ph: 0438/310056 or 316561, fax: 0438/310001, StatSoft Pacific (Melbourne, Australia), ph: 613-663-8580, fax: 613-663-6117, StatSoft Canada-CCO (Ontario), ph: 416-849-0737, fax: 416-849-0918 Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: Lemax BV 02968-94210; France: Conceptel (1) 45669700; Sweden: AkademiData 018-696201; Korea: Geul Bang (02) 272-1973



ITEMS DISCUSSED

LapLink 3.....\$139.95 Traveling Software, Inc. 18702 North Creek Pkwy. Bothell, WA 98011 (206) 483-8088 Inquiry 1105.	SimCity Amiga..... \$44.95 Mac..... \$49.95 Broderbund Software 17 Paul Dr. San Rafael, CA 94903 (415) 492-3200 Inquiry 1109.
Logitech Modula-2 Compiler ....\$249 MultiScope.....\$299 Logitech, Inc. 6505 Kaiser Dr. Fremont, CA 94555 (800) 231-7717 (415) 795-8500 Inquiry 1106.	TSi UPS-3160P.....\$395 Taesung Industries, Inc. 2001 Westside Pkwy., Suite 240 Alpharetta, GA 30201 (404) 664-8944 Inquiry 1110.
Microsoft Programmer's Library CD-ROM.....\$395 Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073 (800) 426-9400 (206) 882-8080 Inquiry 1107.	Vopt disk optimizer program \$59.95 Golden Bow Systems 2665 Ariane Dr., Suite 207 P.O. Box 3039 San Diego, CA 92117 (800) 284-3269 (619) 298-9349 Inquiry 1111.
Sherlock Holmes on Disk! CD-ROM \$79 CMC ReSearch, Inc. 7150 Southwest Hampton, Suite 120 Portland, OR 97223 (503) 639-3395 Inquiry 1108.	World Atlas CD-ROM.....\$159 Electromap, Inc. P.O. Box 1153 Fayetteville, AR 72702 (501) 442-2309 Inquiry 1112.
	World Factbook CD-ROM \$99 Quanta Press, Inc. 2239 Carter Ave. St. Paul, MN 55108 (612) 641-0741 Inquiry 1113.

And just at the moment, the Zenith has the 19-inch Electrohome monitor running off a Video Seven 16-bit VGA board. I thought PM would look pretty good on that.

Alas, OS/2 PM won't install on the Zenith. It doesn't like the Zenith's disk drive controller. Microsoft says that OS/2 is "very picky" about disk drives. They're also working on the code to make it less so; OS/2 won't install on something like half the systems it's tried on, which cuts down the market potential something fierce.

LapLink 3

It was time, then, to back up the Northgate 386. That was simple enough because, being a recent arrival, it didn't yet have many files. I'd just received a new version of Traveling Software's LapLink

3; this one came with a six-headed cable and a new option to send files through the parallel port. We hooked the Northgate to the Zenith, printer port to printer port, put LapLink on the Zenith, and turned on the system.

LapLink trundled for a moment, noticed that the remote computer wasn't running LapLink, and offered to send itself to the Northgate. This is a new feature of LapLink: you don't need a copy on both machines. Just follow instructions. We did that, and in about a minute we had the two machines linked. I initialized a new WORM disk cartridge, put LapLink in turbo mode, and told it to send all the files from the Northgate to the Zenith's Maximum Storage WORM drive. The result was startling: LapLink 3 in turbo parallel mode sends files about as fast as the WORM drive can write

them. The whole process was completed in about a minute or so.

The new LapLink is awesome. Highly recommended.

Logitech and PM

The good news is that OS/2 went on the Northgate 386 without a hitch. We did have to repartition the hard disk; the Northgate comes with 5 megabytes on the C partition and 75 megabytes on the D, but OS/2 wants more C disk space. Once that was done, though, OS/2 went up smoothly enough.

Then Mansour put up Logitech Modula-2 and the new Modula Debugger and did a quick demonstration. It works.

Logitech Modula-2 is one of the first highly structured programming languages (other than C) available for OS/2 PM. This could be important for both the language and the operating system. More next month.

MultiScope

Meanwhile, MultiScope, Logitech's newest debugger, works so well I can hardly believe it. There's a version for DOS as well, and it simply blows everything else out of the water.

Like Borland's (excellent) debugger, MultiScope can be run remotely from another machine. Like Microsoft's CodeView, it works with a whole bunch of different languages. It also has features you won't find in any other debugger I ever heard of. You'll be seeing a lot more on MultiScope, all good.

FRACTINT

The shareware of the month is actually freeware: FRACTINT, which you can find on BIX and a number of other places. On BIX, look for FRACTINT-ARC. The .ARC file extension denotes software that uses a shareware file compression and archiving utility that you can also find on BIX and elsewhere. I've been using it to compress Empire war game moves so they can be uploaded to BIX.

FRACTINT was formerly FRACT-386, but now there's an 80286 version as well. It's an integer program, but very fast, about the fastest fractal program I'm aware of. There are all the standard features, including the Mandelbrot set. It runs under DESQview, and as my son Alex says, the program is a sponge for any time and CPU cycles you have left over from something else. You can find out more from the program's inventor, Bert Tyler ("btyler" on BIX), who says he doesn't want money but he does ap-

continued

How an upside down idea made the mouse obsolete.



Frankly, we thought any input device that operated by dragging it across an already cluttered desk was great technology misapplied. We took a different approach.

Now RollerMouse makes the conventional mouse obsolete.

Control Without Bending Your Elbow

All the pointing accuracy and speed you only hoped for from your old mouse is right at your fingertips. Moving from point to point with our oversized trackball is fluid, effortless and fast at 200 CPI resolution.

Using our exclusive four-button control, you have maximum click and click lock versatility. With programmable pop-up menus, RollerMouse works with software written with or without a mouse in mind. And RollerMouse technology means you never need to disassemble it for cleaning.

More Application Productivity

If you work with the latest graphics-based applications, such as desktop publishing, CAD/CAM/CAE or any object-oriented PS/2, PC or Mac operating system, don't be held back by old mouse technology.

Buy from the leader in precision pointing devices. CH Products perfected computer control technology more than 25 years ago. And the latest technology is at a dealer near you.

For more information, call
(619) 744-8546

8:00 a.m. - 4:30 p.m. PST

For credit card orders, call

USA (800) 624-5804

CA (800) 262-2004

8:00 a.m. - 4:30 p.m. PST



A Division of Joystick Technologies, Inc.
1225 Stone Drive, San Marcos, CA 92069

All product names are registered trademarks of their respective owners. All rights reserved.

Circle 59 on Reader Service Card
(DEALERS: 60)

RollerMouse™

The other kind of mouse.



File Manager

For **C**

C Programmers choose db_FILE because it's fast and flexible.

The combination of relational B-tree indexing and network model database technology delivers better performance than file managers using relational technology alone. Build simple B-tree/ISAM applications or complex database applications. You decide how to optimize runtime performance.

SQL Support included.

db_RETRIEVE - the SQL-based relational Query and Report Writer is now included in this special offer.

Applications completely portable.

Free lifetime phone support.

C source code is now included!

No royalties.

SPECIAL LIMITED OFFER

db_FILE, db_RETRIEVE and source code for each - at one low price!

Single-User Package \$295.00

A \$1780 value.

Multi-User Package \$595.00

A \$2890 value.

db_FILE™

File Manager 2.2

File Structure: Relational B-tree indexing and network database model. Use independently or in combination for real power.

Transaction processing supported

Not RAM resident

Operating Systems: MS-DOS, UNIX, XENIX

C Compilers: UNIX, XENIX, Microsoft,

Lattice, TurboC

Major LANs Supported

For your nearest distributor call:

1-800-db_RAIMA (1-800-327-2462).

RAIMA™

CORPORATION

BY99FM

Raima reserves the right to discontinue this promotion at any time without notice. See price book pricing when you call.

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA

606/747-5570 Telex: 6583018237 MCTUW FAX: (206)747-1991

telex: (214) 231-3131 International Distributors: L.K. (0992) 500919

Germany: 07127-8244 Switzerland: (01) 725 0410 France: (14669)2628

Denmark: 31(02)5946814 Sweden: (0131)24780 Italy: 045/584711

Norway: 47 244 88 55 Denmark: (288)7249 Singapore: 468 3888

Australia: (02)959 5122 Japan: (03)473 7432 Taiwan: (02)511 3277

Mexico: (83) 57 35 94 Brazil: (0192) 52 9770 Colombia: 57 1 218 9245

Argentina: 54 1 313 5371 Chile: 56 2 696-4308 Uruguay: 92 19 37

Caribbean: (809) 834 4069 Central America: (506) 28 07 64

© Copyright Raima Corporation 1989

preciate acknowledgment. If you're at all interested in fractals, find a BBS that has this. You won't regret it.

Some Corrections

I generally send an early draft of my column to the people I'm talking about. Because Penny and Giles is an English company, their reply to my remarks about their TrackerMouse trackball/mouse substitute didn't get back here in time to be incorporated into the July column. What they said didn't make sense to me anyway: they insisted that their gadget worked fine with Microsoft Windows, and I continued to insist that it sure didn't work with my machine. Meanwhile, the Microsoft Windows people said the same thing, that the Penny and Giles TrackerMouse worked fine with Windows; which was all very well, but it sure didn't work with the version of Windows running on my Northgate 386. Finally, I got a call from the Microsoft Windows technical-support people.

One solution: you have to tell Windows you're using a Mouse Systems mouse. Then the Penny and Giles TrackerMouse will work fine. Indeed, according to Microsoft, when dealing with a foreign mouse, the first thing you ought to try is telling Windows you have a Mouse Systems mouse, because that will usually work.

I also discovered that the original Northgate 386 I got had a bad serial port. It affected the TrackerMouse when running with Windows, but it had little effect when running some games such as Empire. The TrackerMouse indeed works fine with Windows, and you don't need to use the Mouse Systems (highly generic) option.

About the time you read this, there will be another trackball system designed much better than the Penny and Giles TrackerMouse, or indeed anything else I've seen. More on that next month. Anyway, whatever strange mouse or mouse substitute you've got, if you have trouble installing Windows, try saying you have a Mouse Systems mouse. That may save you having to reload Windows yet again.

Winding Down

There are several books this month. First, I'm often asked how one gets to be a writer. The answer to that is simple: you write. For more details, *Techniques of the Selling Writer* (University of Oklahoma Press) is the single best work I'm aware of. *Film Scriptwriting: A Practical Manual* (Focal Press, 80 Montvale Ave., Stoneham, MA 02180) is the best intro-

duction to that subject I've ever seen. Both are by a good friend, Dwight Swain, sometime professor at the University of Oklahoma and longtime selling writer.

Cosmic Catastrophies (Plenum, 233 Spring St., New York, NY 10013) by astronomers Clark Chapman and David Morrison is a highly readable but serious discussion of catastrophes in earth's history: dinosaur extinction, greenhouse effect, nuclear winter—all presented without sensationalism. This is well worth reading.

The program of the month is, of course, Mrs. Pournelle's Reading Program. I don't normally pay much attention to advertising—I consider my responsibility is to the readers—but I have to say I'm impressed with the number of inquiries we've got from the BYTE product information cards. One of these days I expect we'll turn the program over to a regular publisher. Meanwhile, Roberta is shipping copies all over the world, to schools and home study groups and even a Roman university.

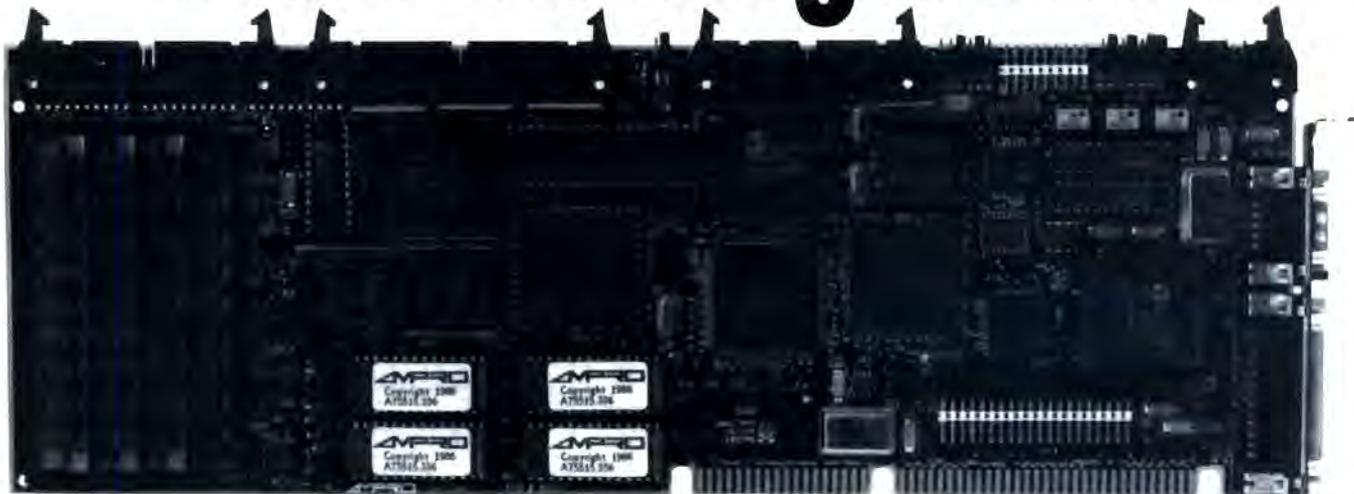
The game of the month is Broderbund's SimCity. The monochrome Mac version is fun; the color version for the Amiga is even more so, especially if you have a MicroWay FlickerFixer board and a really good color monitor. Do note I call it a game: while it's jolly fun to play city planner, the real world is much more complex than this game implies. SimCity is highly sensitive to the prejudices of its designers, including their extreme preference for rail over road transport. Still, it's fun to outwit them.

Alex is in the other room installing OS/2 application programs. So far we have SideKick and Paradox, as well as the Logitech Modula-2 and MultiScope. He's been working with it for half an hour and it hasn't crashed yet; given the Murphy field he carries around with him, that's pretty encouraging.

Now back to *Wrath of God*. It's very quiet in Beijing. They create a desolation and call it peace. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryyp."

All the advantages of Ampro's Little Board/286. Now in a single slot.



Slot Board/286.

One philosophy. Two systems. Ampro's new Slot Board/286, like the Little Board/286, is a complete AT-compatible single board system. Each is equivalent to an AT motherboard and four expansion cards. Now, you can choose between stackable systems with the Little Board/286 or passive backplane systems with the Slot Board/286. Both are based on the popular 80C286 processor. Both utilize highly integrated CMOS parts to lower parts count, increase reliability and reduce power consumption. Both are available in prototyping and production quantities.



PC/AT Software compatible. Ampro single board systems are compatible with MS-DOS, DR-DOS, UNIX and XENIX operating systems, plus high level languages and applications software. DR-DOS is included with each board.

Everything you need. StackPlane™ or backplane. 512K to 4 MB on-board DRAM. Bootable Solid State Disk. Disk controllers. Display controllers. A selection of I/O ports. All this, stackable with Little Board/286; or, a

complete system in a single slot with Slot Board/286. Ampro also supplies Slot Board/286 card cages and passive backplanes for easier system implementation.

Better answers for embedded systems. Bolt-in or plug-in. Little Board/PC and Little Board/286 with their compact, easy to build-in StackPlane architecture. Slot Board/286 with its passive backplane for I/O and peripheral intensive applications.

Available worldwide. Call Ampro or any of the distributors listed below for complete details on Ampro Little Boards or Slot Board/286.

Slot Board/286 Features

- IBM PC/AT compatible
- 12 or 16 MHz 80C286 CMOS CPU
- Up to 4MB DRAM on-board
- On-board Bootable Solid State Disk
- 2 serial ports (RS232C/RS422/RS485)
- Parallel printer port
- AT Bus hard disk interface
- Floppy disk controller
- SCSI controller
- Enhanced Award ROM BIOS
- Math co-processor support
- Real time clock & watch dog timer
- Low power (approx. 8 Watts)
- Wide operating temp. range: 0 to 60° C
- Low parts count. High reliability
- Optional On-board MiniModules: EGA/CGA/MDA/Hercules compatible controllers
- LCD Display Driver. Serial/Parallel expansion
- 2400 baud modem ... and more

All trademarks are the property of their respective owners

(408) 734-2800

AMPRO
SINGLE BOARD SYSTEMS

Ampro Computers, Inc., 1150 Mountain View/Alviso Road,
Sunnyvale, CA 94089. Telex: 4940302 FAX: (408) 734-2939

Reps: USA - contact AMPRO for the name of your nearest rep. **Australia** - 61 3 720-3298; **Austria** - 43-1/45 4510-0; **Canada** - (604) 438-0028; **Denmark** - 45 3 66 20 30; **Finland** - 358 0 585-322; **France** - 331 4502-1800; **Germany, West** - 49 89 611-6151; **Hong Kong/PRC** - 5 8613118; **Israel** - 972 3 49-16-95; **Italy** - 39 6 811-9406; **Japan** - 81 3 257-2630; **Netherlands** - 31-10-411 8521; **Sweden** - 46 8 55-00-65; **Switzerland** - 41 1 740-41-05; **United Kingdom** - 0296-435511

MONTGOMERY GRANT

BYTE
9 88

OUTSIDE USACALL
(718)692-0790

For Customer Service
Call Mon-Fri: 9:30am-4:30pm
(718) 692-1148

Retail Outlet: Penn Station, Main Concourse
(Beneath Madison Square Garden) New York City, NY, 10001
Store Hours: Mon-Thurs, 8:30am-8pm/ Fri, 8:30am-5:00pm/ Sat, Closed /Sun, 9:30am-7pm
FOR ORDERS & INFORMATION CALL TOLL FREE

1-800-759-6565

OR WRITE TO:
Montgomery-Grant Mail Order
Department, P.O. Box 58,
Brooklyn, N.Y., 11230

FAX NO. 7186923372
TELEX 422-132 MGRANT

ORDER HOURS: Mon-Thur 9am-7pm/Fri 9am-6:00pm/Saturday CLOSED/ Sunday, 9:30am-6:00pm
NO SURCHARGE FOR CREDIT CARD ORDERS / WE INVITE CORPORATE AND EDUCATIONAL CUSTOMERS

CORPORATE LEASING & PERSONAL FINANCING AVAILABLE / DISCOUNTS FOR QUANTITY ORDERS/TOLL FREE TECHNICAL SUPPORT



EPSON EQUITY 1+
IBM XT COMPATIBLE
640K RAM w/Clock Calendar - 4.77-
10 MHz - 380K Drive - Serial &
Parallel Ports - MS DOS 3.3 - GW Basic
SAME w/SEAGATE 20MB HARD DRIVE.....\$919
SAME w/SEAGATE 30MB HARD DRIVE.....\$949
SAME w/SEAGATE 40MB HARD DRIVE.....\$1019
SAME w/TWO 380K FLOPPIES.....\$719
EPSON EQUITY 1+.....\$729



EPSON EQUITY II+
IBM AT COMPATIBLE
640K RAM - 80286 Microprocessor
1.2MB Floppy Drive - Serial & Parallel
Ports - MS DOS 3.3 - GW Basic
SAME w/SEAGATE 20MB HARD DRIVE.....\$1299
SAME w/SEAGATE 30MB HARD DRIVE.....\$1339
SAME w/SEAGATE 40MB HARD DRIVE.....\$1399

EPSON EQUITY 386/20
60386 Microprocessor - 20MHz - 1MB RAM Expandable
1616MB - 1.2MB Floppy Drive - MS DOS 3.3 - GW Basic
\$2599

WE CAN RECONFIGURE ANY OF OUR COMPUTER PACKAGES TO FIT YOUR SPECIFICATIONS. CALL FOR INFORMATION. ALL COMPUTER SYSTEMS SUPPORT VGA, CGA, EGA, VEGA & MULTISCAN. WE CARRY MODEMS, DRIVES, CARDS, MONITORS, MEMORY UPGRADES & ALL OTHER ACCESSORIES FOR YOUR COMPUTER.



LEADING EDGE MODEL D2
IBM AT COMPATIBLE
640K RAM Expandable to 1MB - 80286
Microprocessor - 101 Keyboard - 1.2MB
Floppy Drive - Serial & Parallel
Ports - MS DOS 3.3 - GW Basic
SAME w/SEAGATE 20MB HARD DRIVE.....\$1099
SAME w/SEAGATE 30MB HARD DRIVE.....\$1139
SAME w/SEAGATE 40MB HARD DRIVE.....\$1199



LEADING EDGE MODEL D
IBM XT COMPATIBLE PKG.
512K RAM Expandable to 1MB - 8086-2
Microprocessor - 360K Floppy Drive - 4.77/7.16
MHz - MS DOS 3.3 & GW Basic - 12" Monitor
SAME w/SEAGATE 20MB HARD DRIVE.....\$829
SAME w/SEAGATE 30MB HARD DRIVE.....\$869
SAME w/SEAGATE 40MB HARD DRIVE.....\$929



AST 286 IBM AT COMPATIBLE
80286 Processor - 512K Expandable to 4MB - 1.2MB
Floppy Drive - Serial & Parallel Ports - Video Card
SAME w/SEAGATE 20MB HARD DRIVE.....\$1049
SAME w/SEAGATE 30MB HARD DRIVE.....\$1079
SAME w/SEAGATE 40MB HARD DRIVE.....\$1149
AST PREMIUM 386 16 MHz.....\$2199
AST 386/25 MHz.....\$3495
AST 386/33 MHz.....\$4199

LAPTOP COMPUTERS

AMSTRAD PPC-512 512K 1 FLOPPY	\$490
AMSTRAD PPC-640 640K 2 DRIVES, MODEM	\$600
TOSHIBA 1000	\$630
TOSHIBA 1600	\$719
TOSHIBA 3100	\$769
TOSHIBA 1200H	\$1040
TOSHIBA 3200	\$1300
TOSHIBA 5100	\$4100
w/10MB	\$4700
TOSHIBA 5200	\$4600
TOSHIBA 5200 w/10MB	\$5200

NEC MULTISPEED HD	\$1940
NEC ULTRALITE 2MB	\$2300
NEC PROSPEED 386 w/40MB	\$4490
ZENITH 184 w/2 FLOPPIES	\$1460
ZENITH 184-2 w/20MB	\$2100
ZENITH 286 w/20MB	\$2900
SPARK II	\$600
COMPAQ SLT 286-20	\$3790
COMPAQ SLT 286-40	\$4100
EPSON LT 20MB (Backlit)	\$1740
BONDWELL 286 w/20MB	\$2290

MODEMS, EXTERNAL DRIVES,
& ACCESSORIES AVAILABLE

500 • 2000 •
2500 • COMPUTERS



Amiga 500 w/ Built-in 5.25" Drive **\$529**
Amiga 500 w/1064S Monitor **\$799**
Amiga 2000 H.D. **\$1999**
Amiga 2000 w/ Built-in 3.5" Drive **\$1429**
Amiga 2500 **\$3199**
Amiga 1064S RGB Monitor **\$279**
Amiga 1010 Disk Drive **\$159**

PRINTERS



STAR
NX-1000.....\$164.95
NX-1000
RAINBOW.....\$214.95
NX-2400.....\$294.95

CITIZEN
120-D.....\$134.95
180-D.....\$149.95

DICONIX
150+.....\$329.95

OKIDATA
OKIMATE 20.....\$139.95
OKIDATA 180+.....\$219.95
OKIDATA 183.....\$249.95
OKIDATA 320.....\$329.95
OKIDATA 321.....\$459.95
OKIDATA 390.....\$454.95
OKIDATA 391.....\$629.95

EPSON
FX-1050.....\$429.95
FX-850.....\$334.95
LQ-500.....\$277.95
LQ-510.....\$329.95
LQ-850.....\$519.95
LQ-950.....\$569.95
LQ-1050.....\$719.95
LQ-2550.....\$699.95
LX-810.....\$179.95

NEC
P-2200.....\$319.95
P-5200.....\$489.95
P-5300.....\$649.95

PANASONIC
KXP-1092L.....\$289.95
KXP-1524.....\$519.95
KXP-1595.....\$409.95
KXP-1124.....\$319.95
KXP-1180.....\$177.95
KXP-1181.....\$229.95
KXP-3131.....\$294.95

TOSHIBA
301.....\$329.95
311.....\$369.95

SANYO PR-3000A
DAISY WHEEL.....\$59.95
HP DESKJET.....\$599
HP DESKJET PLUS.....\$689
HP PAINTJET.....\$1029

LASER PRINTERS

HP LASERJET
SERIES II
\$1629
1MB EXPANDER.....\$299
2MB EXPANDER FOR
LASERJET II.....\$499
HP LASERJET HD.....\$2829
PANASONIC KXP-4450.....\$1349
BROTHER HL-6.....\$1859

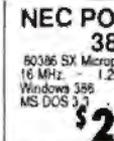
NEC



NEC POWERMATE 1
IBM AT COMPATIBLE
60286 Microprocessor - 10 MHz - 640K RAM
Expandable to 10.6MB - 1.2MB Floppy
Serial & Parallel Ports - MS DOS 3.3 & GW Basic
SAME w/SEAGATE 20MB HARD DRIVE.....\$1249
SAME w/SEAGATE 30MB HARD DRIVE.....\$1279
SAME w/SEAGATE 40MB HARD DRIVE.....\$1349



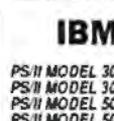
NEC POWERMATE 1+
IBM AT COMPATIBLE
640K RAM Expandable to 16MB - Zero
Wait State - 8-12 MHz - 1.2MB Floppy
Drive - Serial & Parallel Ports - MS DOS 3.3
GW Basic - 80286 Processor
SAME w/SEAGATE 20MB HARD DRIVE.....\$1499
SAME w/SEAGATE 30MB HARD DRIVE.....\$1539
SAME w/SEAGATE 40MB HARD DRIVE.....\$1599



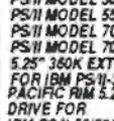
NEC POWERMATE 386 SX
80386 SX Microprocessor - 2MB RAM
16 MHz - 1.2MB Floppy Drive
Windows 386 - Serial & Parallel Ports
MS DOS 3.3 - NEC 42MB Hard Drive
\$2299



NEC POWERMATE 386 20
80386 SX Microprocessor - 2MB RAM
16 MHz - 1.2MB Floppy Drive
Windows 386 - Serial & Parallel Ports
MS DOS 3.3 - NEC 42MB Hard Drive
\$3599



IBM XT
256K RAM Expandable to 640K -
360K Disk Drive
\$699
IBM XT w/TWO FLOPPIES.....\$799
IBM XT w/1 FLOPPY & SEAGATE 20MB H.D.....\$949



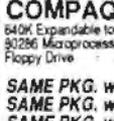
IBM PERSONAL SYSTEM 2
ALL OTHER PS/II MODELS
AVAILABLE
**IBM PERSONAL SYSTEM II
MONITORS**
8503 MONOCHROME.....\$199
8512 COLOR.....\$439
8513 COLOR.....\$529



EVEREX
EVEREX STEP 386 IS
386 SX Microprocessor - 16MHz - 1MB RAM
40MB Hard Drive - 1.2MB Floppy Drive - 12"
Monitor
EVEREX 386/20 MHz.....\$2999
EVEREX 386/25 MHz.....\$3499



APPLE IIGS COMPUTER PKG.
Apple IIGS Computer - 512K Upgrade -
RGB Color Monitor - 3.5" Disk Drive
\$1299



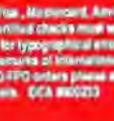
IMAGewriter II PRINTER.....\$439
ALL OTHER APPLE MODELS.....CALL



COMPAQ DESKPRO 286
640K Expandable to 2.1MB - 8-12MHz -
80286 Microprocessor - 1.2MB -
Floppy Drive - Serial/Parallel Ports
\$1629
SAME PKG. w/SEAGATE 20MB.....\$1879
SAME PKG. w/SEAGATE 30MB.....\$1919
SAME PKG. w/SEAGATE 40MB.....\$1979



COMPAQ 286e **\$1849**



DESKPRO 386S
80386 SX Microprocessor - 1MB
RAM Expandable to 13MB - Serial/
Parallel Ports - 16 MHz - 1.2 MB
Floppy Drive
\$2399
COMPAQ 386/33 w/84MB
\$7499



DESKPRO 386-20e
80386 SX Microprocessor - 1MB
RAM Expandable to 16MB - Serial/
Parallel Ports - 20 MHz - 1.2 MB
Floppy Drive
\$3699
CUSTOM CONFIGURATIONS
AVAILABLE FOR ALL
COMPUTERS

RUSH SERVICE AVAILABLE-CALL FOR DETAILS

Defined Check Bank Check, Money Order, Approved P.O., Visa, Mastercard, AmEx, Discover's Club, Carte Blanche, & C.O.G. accepted. Please call before submitting P.O.s. An additional surcharge for Credit Card orders. Non-certified checks must wait 48 hours for clearance. N.Y. residents add applicable sales tax. Prices and availability subject to change without notice. Not responsible for typographical errors. Return of defective merchandise must have prior return authorization number or labels will not be accepted. IBM & A.T. are registered trademarks of International Business Machines Corp. Please add the shipping & handling. Volume orders over \$2500 are processed for 3% shipping and handling. AFO/FPD orders please add 10% shipping and handling. All AFO/FPD orders are shipped first class priority air. All other orders ship standard A3 Express. Call for details. CCA #00233



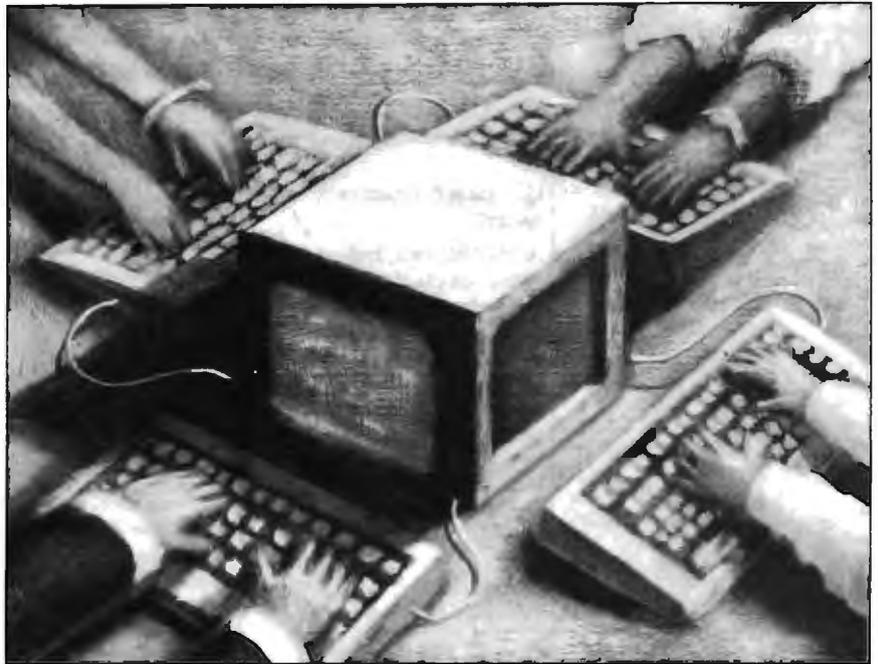
UNIX ON PERSONAL COMPUTERS: WHY AND HOW

Installing Unix on a personal computer isn't always easy, but it's well worth the effort

There are many reasons why you might want to run Unix on your personal computer, but making your life simpler wouldn't be one of them. It's true that learning Unix isn't done overnight. Just the idea of installing it frightens many people unnecessarily.

There are advantages, though, to having a small but well-managed Unix system:

- No more worrying about spooler programs, manually switching printers, or waiting for a print job to finish.
- If someone else wants to use the computer, he or she can log in at a terminal. You won't have to stop what you're doing.
- Background communications? Of course. You can dial up another machine manually or put the UUCP (for Unix-to-Unix copy) system to use for unattended E-mail and file transfer.
- The ability to run DOS programs (once a major stumbling block for Unix acceptance) is becoming less of an issue with the emergence of DOS running in 8086-compatibility mode on 80386-based machines, or DOS emulators on other platforms. You won't have to give up much if you're coming from the MS-DOS world.
- You'll finally appreciate how incredibly primitive the whole concept of loading TSR programs really is. For the most part, you can also forget any concerns about available memory. The "swap partition" on your hard disk will take care of things for you invisibly.
- Perhaps best of all, you will be able to



work the way you want. Did you just start up a long batch job and now need the computer for something else? Switch to another window or screen and do as you like. No kludge programs that sit on top of your operating system here: This is the way it was designed to be. For example, in the middle of writing this paragraph under The Santa Cruz Operation's (SCO) Xenix, I wanted to make a note to myself, so I switched to "virtual screen 2" by pressing Alt-F2, mailed myself a message, and switched back to the editor on "virtual screen 3" with Alt-F3. It took less time than typing the last sentence, and I was able to do it before the thought slipped my mind. No mousing around, either.

Not All Good News

There are disadvantages to Unix, too. Using your operating system becomes more complicated. You can't just turn the machine on and off whenever the mood

strikes. It takes a minute or three to boot up. If you're not the only user on the system, shutting it down without warning can be hazardous to your health, depending on how heavy the nearest manuals are and how good your officemate's aim is. But you generally don't have to go into a long, involved ritual for shutting down, either. (On Xenix, at least, you just run the `haltsys` program, and it comes down safely and instantly.)

Another drawback is that you'll have to do more administrative work with the system. On DOS, this generally refers to things like editing the `AUTOEXEC.BAT` and `CONFIG.SYS` files, so you get the default behavior you want from your system. On Unix or Xenix, you might end up editing the `/etc/profile` and `.profile` files (to customize default behavior), changing the `/etc/inittab` file (to tell the system which ports are active), perhaps reconfiguring the kernel (to add

continued

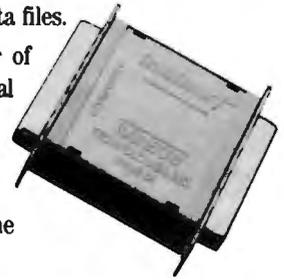
Ask The Doctor Your Most Important Questions About PC Data Security.



Escalating instances of PC data theft and misuse affecting both government and industry have shown the need for an effective yet easy-to-use data security product. U.S. Public law 100-235 now mandates that government agencies protect sensitive data files.

In response, Dr. Alan K. Jennings, Ph.D., inventor and co-founder of Rainbow Technologies, has designed the DataSentry™, an external hardware key that provides data file security without the problems associated with internal hardware and software-based protection.

In this first of a series of informational bulletins, Dr. Jennings answers some of the more frequently asked questions on PC data security and the DataSentry system from Rainbow Technologies.



DataSentry™

- Completely user-installable
- Pocket-sized external device
- Menu-driven, user-friendly interface
- Single- or multi-user security system
- Audit trail, log-on identifiers and automatic encryption/decryption of entire directories
- Secures data transmitted by modems
- Prevents recovery of data by utility programs

Dealer Inquiries Welcome.

Q. What is the DataSentry system?

A. The DataSentry protection system consists of a combination of a hardware encryption device - Personal Access Key - and associated software that runs on an IBM or compatible PC having a parallel printer port and a floppy disk drive. The DataSentry provides three types of security: mandatory use of the access key to open a file, encryption and password protection.

Q. What is inside the Personal Access Key?

A. Inside each pocket-sized Personal Access Key is a proprietary custom-designed integrated circuit, often referred to as an Application Specific Integrated Circuit (ASIC). This ASIC was designed by engineers at Rainbow Technologies specifically for the DataSentry system. The full capabilities of the ASIC are known only to Rainbow. In operation, the proprietary ASIC implements a special function called an algorithm, chosen from many thousands of possible algorithms when the key is being manufactured at the Rainbow factory.

Q. What is the disadvantage of password-only software protection?

A. The main disadvantage of password-only protection is that users find it difficult to remember a password unless it is something quite familiar to them - like their spouse's name, their dog or the street they live on. It was recently estimated that about 75% of ARPANET passwords could be discovered by trying these three choices. Choosing a less familiar name requires that it be written down. This, of course, is a security risk. As a result, password-only protection is fairly easy to defeat.

Q. What is the advantage of external hardware keys over internal security boards?

A. Some protection systems depend on circuit boards being installed inside the PC. In addition to objection to the expense of installation and training, many users are reluctant to open their PCs. IBM PS/2s and laptop PCs do not accept the standard add-in boards. As a result, nearly all PC users have a strong preference to the addition of low-cost external hardware to achieve the desired protection.

Q. Is the DES (Data Encryption Standard) government-specified algorithm available with the DataSentry system?

A. Yes. The DES algorithm as defined by U.S. government standard FIPS 46 is implemented in the DataSentry system.

Q. Can the DataSentry system be used on local area networks?

A. Yes. It can be used on LANS as long as the automatically protected files are stored on a local computer. It does not matter if the application is stored on the local PC, on a shared file server or on any other PC.

Q. Can a DataSentry system be used to secure mainframe data files?

A. Yes. The mainframe could send files to the PC for encrypting or decrypting.

Q. What are some of the new special features of the DataSentry system?

A. Audit trail, log-on identifiers, and automatic encryption/decryption of entire directories.

To consult Dr. Jennings and the DataSentry sales staff about your personal data security questions, call Rainbow Technologies today.



RAINBOW TECHNOLOGIES

18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY, U.K., Tel: 0753-41512, Fax: 0753-43610

© 1989 Rainbow Technologies. All product names are trademarks of their respective manufacturers.

THE UNIX /bin

special device drivers), modifying the line printer spooler system (to get spooled printer output), adding systems to UUCP (for electronic communications), and specifying backup schedules (to ensure that you won't forget to run backups).

Very little mandatory work is necessary, in most cases, to just get the system running on a minimal DOS-equivalent level. It's only when you want to start taking advantage of all the things Unix can do that you have to start reading manuals.

First-time users should skip the swap space calculations and use defaults.

What about those backups? Backups on Unix are no more critical or difficult than on any other operating system, which means that if you fail to run them consistently, you will get yourself into trouble one day.

Then there's the issue of money. Unix costs quite a bit more than DOS. There are lots of manuals and disks, not to mention a certain amount of learning (which is an expense, even if it's just taking the time to read the manuals). And although there are versions (or look-alikes) of Unix around that will technically run on machines as small as an 8086, that's not realistic. You can't really run Unix with less than 2 megabytes of RAM and 40 megabytes of hard disk space. This means you'll be spending more money on hardware, too.

Be Honest with Yourself

So the choice really has to do with what you use your machine for. For instance, are you using your computer for personal development, recreation, and intellectual stimulation? If so, and if you're the kind of person who has to have the newest, most exotic hardware and software, you can dazzle your friends by buying Unix. Otherwise, it might not be such a wise investment.

But suppose you're a home- or office-based programmer who needs to develop programs for several markets. Or maybe you're the "power user" in a small but

growing office or department, with other people who need access to the same data. Or you're just a lone user who has to work with machines from DOS to mainframes, perhaps on multiple databases. In these cases, Unix starts making sense, both logically and financially.

Setting Up Xenix

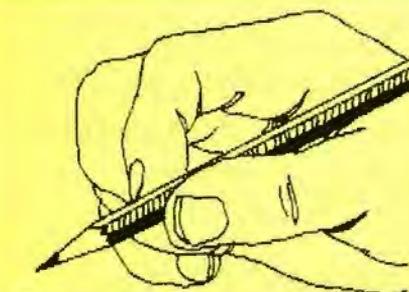
Say you've decided to at least think about it. What is physically involved in turning a running DOS system into a Unix system? I'll use the example of an 80386-based IBM PC AT clone and SCO Xenix. I chose this setup partly because that's what I run on my machine, but more because that's probably the most popular scenario in the industry right now.

To install Xenix, you'll need at least 1 megabyte of RAM and 20 megabytes of hard disk space (80286-based systems can get away with as little as 512K bytes of RAM). SCO recommends a minimum of 2 megabytes of RAM, with which I heartily concur, and I add my own recommendation of at least 40 megabytes of hard disk space (hopefully with a 28-millisecond average access time). Multiuser systems, especially those running database systems or VP/ix (which runs DOS under Xenix), will need a minimum of 4 megabytes of RAM to prevent swapping and excess paging. You'll want to avoid these conditions, as they signify that memory is being used inefficiently (e.g., by excess paging) or that processes are being saved to a special area of the disk due to lack of sufficient RAM (known as swapping). Both will slow the system down, though swapping is far worse.

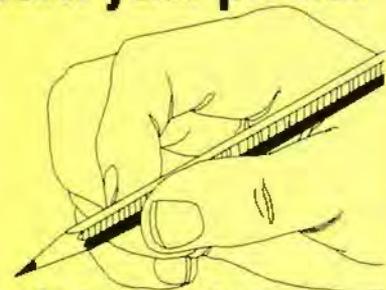
The swap partition is a separate area of the disk that is reserved for those times when the system is running out of RAM, so it *swaps out*, or writes to the swap area, the process data for a program that is not running. When it's time for that program to run again, it is swapped back in: The system reads the data from the swap area back into RAM and runs the program again. Naturally, this takes some time, but it's the way a small system handles large programs. It's also the way virtual memory works—the swap area of the disk takes up the overflow when RAM runs out.

Even the relatively straightforward procedure outlined in current Xenix documentation can be confusing, since it tries to give as much information as possible. First-time users should essentially skip the swap space calculations and use defaults whenever possible. I understand that SCO has taken this into account for its new release of SCO Unix System

continued



Turn your printer



into a plotter

Imagine your present printer turning out crisp, high resolution plots while you continue to work, *without interruption*, at your PC.

The EOgraph Plus add-on board lets you do that, and more.

You have total control over eight different line widths, and as many colors as your printer offers.

You can produce drawings 15 feet long, and longer, in any carriage width.

How about multiple plots, or automatic queuing of text and plots? Yes, the EOgraph Plus lets you do that, too—with ease.

Think of it! Using virtually *any* CAD or graphics program, you can work at your PC while your printer generates plotter-quality drawings with nearly incredible detail.

Best of all, you get all of this without the headaches, or expense, of baby sitting a plotter.

Thousands of users agree: No other PC add-on can increase your productivity, or pay for itself so quickly, as the EOgraph Plus.

It may sound too good to be true, until you call for the facts, toll-free, at 1-800-548-5780.

DEALER INQUIRIES WELCOME

EOgraph Plus™

Eotron Corp / 121 Westpark Road / Dayton, OH 45459

Please send information and independent test reports to:

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

BYT

MEGA-Link™

The universal transputer system

Demanding applications such as

- CAD / CAM
- molecular design
- aerodynamics
- image processing
- simulations
- signal processing
- robotics
- artificial intelligence

have a growing need for computing power!

Our MEGA-Link series offers all the computing power you need, combining high flexibility and very reasonable prices.

MEGA-Link01 plus:

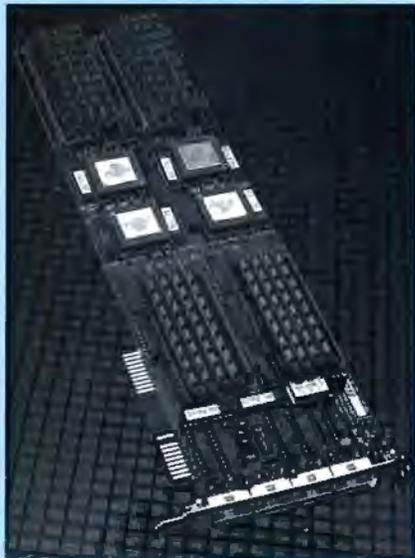
- Multi-transputer system with 4 transputers T425/T800
- 1, 2, 4 or 8 megabytes DRAM per transputer
- Up to 60 MIPS / 9 MFLOPS computing power per board
- High performance DMA-interface

MEGA-Link02:

- High performance graphics system with T425/T800 + G300
- 1-8 megabytes main memory, 1-2 megabytes video RAM
- Selectable resolutions reaching from 512*512 (50 Hz interlaced) up to 1280*1024 (67 Hz non-interlaced) pixels
- 16 million colors simultaneously or 256 out of 16 million colors with the INMOS G300 color video controller
- 10 MHz up to 110 MHz video dot clock selectable freely
- U_MATIK® + VCR-interfaces available (video applications)
- supporting graphics libraries, written in C and assembler
- X-windows® server for Helios users being developed
- High performance DMA-interface

MEGA-Link03:

- Single-transputer system for large amounts of data
- 1 T425/T800 and 1-32 megabytes of RAM
- High performance DMA-interface



All systems of the MEGA-Link series

- work with each PC/AT compatible, Amiga 2000® or Atari ST™
- are fully compatible in between and to INMOS® boards
- can be connected to build up high performance networks
- are supported by a wide spectrum of software (e.g. Parallel C, Fortran, Pascal, Helios, TDS, TASM 2)
- come with T425/T800 in the 20-, 25- or 30 MHz versions
- are 'Made in Germany' with a 3 year limited warranty

CALL US IMMEDIATELY FOR MORE INFORMATION!

WE ARE LOOKING FOR WORLDWIDE DISTRIBUTORS!

SANG

SANG-Computersysteme GmbH
Am Wuennesberg 13 • D-4300 Essen 1
West Germany
phone +49-201-7101191 • FAX +49-201-710410

THE UNIX /bin

V/386, which will have a single prompt that's something like "Do you want the system to install itself?" This will go over a lot better for new users.

About DOS

There are two ways to run MS-DOS with Xenix. One is to keep a DOS partition on your disk: a logically separate area that Xenix doesn't even know about. You can then boot up your system (from the hard disk) into either DOS or Xenix, but not both at once. This might be a good plan during a DOS-to-Unix transition, since you will still have the security of having all your DOS files and procedures intact.

A few
programs will balk
at living in
the Xenix partition.

Another method is to purchase either VP/ix, which is a separate product that runs under Xenix on the 80386, or SCO's new Open Desktop product, which uses Merge 386 (a different product than VP/ix, but it performs about the same functions). Using one of these DOS migration packages allows you to essentially run the entire DOS operating system as a task or a program under Xenix. You can enter DOS, run your DOS programs, and then exit back to Xenix. Or you can set things up so you can type the name of your DOS application and run it, automatically entering and leaving DOS with no additional effort on your part. The advantage is that the DOS programs and files can be stored on the Xenix file system (transparently to DOS), so they can be manipulated, copied, and backed up like any other Xenix files. You still have access to your DOS partition, if there is one.

If you already have DOS, you are warned to back up all your DOS files before installing Xenix and to leave at least a 6-megabyte partition free for Xenix. I recommend 10 megabytes if you can afford the space. Even if you're planning to run VP/ix, I suggest setting up a small DOS partition anyway, because a few programs will balk at living in the Xenix partition or running on anything but native DOS.

Rolling Up Your Sleeves

Basic Xenix takes up eight floppy disks and will install on any normal IBM-compatible hardware, including Intel Inboards. Most video and serial cards will work, and both standard and nonstandard hard disk drives (including RLL [run length limited] or a second drive controller) are supported, although you should contact SCO for a complete list.

To get started, you simply insert a boot floppy disk, which brings up the Xenix kernel. The installation procedure leads you through a hard disk parameter menu, which you should be able to skip if your disk has already been installed under DOS. Then it shows you the partition table, where you allocate as much space to Xenix as you want, and allows you to specify any bad blocks on your disk (it can also scan the disk for bad blocks; any bad blocks are automatically remapped).

You're almost done with the hard part by now. The installation menu then runs a program that figures out how much swap space you'll need. After another few questions, the new file systems are created, you're prompted for your software serial number, and you reboot the system from the hard disk. At this point, it gets boring because you just keep inserting floppy disks in response to prompts.

Finally, you tell Xenix which time zone you are in, and you're up and running for real. You can log in, run background commands, and all that other good stuff.

It's Alive!

Yes, you now have a live Unix system. But before setting off in full stride, you should be sure that it is tuned to your special needs (which I'll cover in next month's column). You will see the flexibility (and some of the complexity) that I have been talking about.

So, now the exciting part begins: getting the system configured to your hardware and learning how to make Xenix work the way you want it to. As the months go by, you will be seeing more and more gems for the Unix veterans as well. ■

David Fiedler is editor and publisher of the Unix newsletters Unique and Root and coauthor of the book Unix System Administration. He can be reached on BIX as "fiedler."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

THE COMPUSTAR[®] THEORY OF SENSIBILITY

$$C = at + mca^2 + eisa$$

Okay, we admit it may not be as profound as Einstein's Theory of Relativity. But, if you're a computer user, we bet it's a bit more, shall we say, "relative" — not to mention a whole lot more sensible.

The "C" stands for CompuStar[®] — the world's first and only multi-processor, convertible bus™ microcomputer. And, as the theory states, CompuStar means AT, MCA and EISA compatibility — all in a single system.

A CONVERTIBLE BUS?

Each CompuStar features snap-in bus "modules" that let you convert from one bus standard to another — a PC/AT¹ bus, a PS/2 (MCA) bus... or both!



SNAP-IN PS/2
AND AT BUS MODULES.

Depending on configuration, you can have up to 13 AT and/or PS/2 bus expansion slots. Plus, when the new EISA bus becomes popular, we're licensed to offer it as well.

THREE COMPUTERS IN ONE.

Busess are not the only thing you can reconfigure in a CompuStar. Each system can be equipped with any of three CPU Modules — an 8086, an 80286 or an 80386. Since the modules are interchangeable, you won't have to worry about buying the *wrong* computer system. We'll even let you trade-in your CPU Module toward the purchase of any of



the other more powerful modules.* But that's not all. CompuStar features an incredible seven disk/tape compartments that we'll gladly custom configure for you at the factory. No matter what your application, we can tailor fit a CompuStar to match it precisely.



CPU MODULES ARE INTERCHANGEABLE.

IT'S NUMBER ONE RATED.

If you're thinking a computer with as much flexibility as CompuStar would have to compromise *something*, like performance — think again. With a MIPS³ rating of 6.1, the CompuStar is one of the fastest, most powerful systems available. In fact, CompuStar's performance and flexibility so impressed *InfoWorld* magazine they gave it the highest rating of all hardware products tested in 1988! That's astonishing when you consider you can buy a CompuStar for *thousands* of dollars less than a comparably equipped system from IBM or Compaq.

If you're shopping for the next generation in personal computers, why not call us today at 803/796-7800 to arrange an on-site no obligation 30 day CompuStar[®] trial in your office.* Relatively speaking, it's the only *sensible* thing to do.



Wells American

Circle 315 on Reader Service Card (DEALERS: 316)

Corporate Headquarters: 3243 Sunset Boulevard • West Columbia, SC 29169 • 803/796-7800 • FAX 803/796-7029

The Cool Machine Cometh



OKIDATA introduces a line of PC modems that run so cool they're guaranteed for 5 years.

Our new 1200, 2400 and 2400 *Plus* PC modems are built around a very simple fact: the cooler they run, the longer they last.

That's important in any modem, and it's vital in the case of an internal board. That's why we engineered a special chip that does the work of three ordinary chips. It also generates less heat—and consumes 50% less power—than the leading brand. Which is why we back our modems twice as long as they do.

But reliability on the inside comes as no surprise when the OKIDATA name is on the outside.

We have over a century of experience in telecommunications all over the world. And you'll see it in everything we make, from tank-tough printers to award-winning PC modems to a full line of high-speed modems.

To see our new "cool machines" in person, visit your OKIDATA dealer. Or call 1-800-OKIDATA for the name of the dealer nearest you.

Circle 216 on Reader Service Card

PC DIGEST

... gave five stars to our 1200 bps modem and top-rated our 2400 bps modem.

PC WORLD

... gave our 2400 their coveted "Best Buy" title.

Registered Trademarks: OKIDATA, Oki America, Inc.,
Marque déposée de Oki America, Inc.
Trademarks: PC Digest, National Software Testing
Laboratories, Inc.; PC World, PC World Communi-
cations, Inc.

OKIDATA[®]
an OKI AMERICA company

We put business on paper.

?!


ON THE ROAD AGAIN

These days, you can take plenty of computer power on your business trips—but don't forget the screwdriver

As this is being written, I'm on assignment in Honolulu, seeing to the final stages of a LAN installation. I'm carrying a Zenith SupersPort 286 equipped with a hard disk drive, LAN diagnostic software, an Ethernet card, and a Diconix 150 Plus printer. (Who says portables have limited capabilities?)

I've carried other computers on trips throughout the world, to points as remote as the jungles of the South Pacific. Indeed, without a laptop, I'd be hard pressed to do my work, and it would be impossible to file my columns for *BYTE* and *BYTEweek*.

Practical Concerns

Air travel has a number of perils for the computer user. Chief among them can be the security check, especially in these days of heightened concern about electronic devices. If you're traveling with a portable, be prepared to turn the machine on to prove that it *is* a computer and not some other kind of device. A battery-powered computer will be a lifesaver here. I watched a Compaq owner miss his plane from Washington-Dulles because his computer required a power cord to run and he had packed the cord in his checked luggage. My Zenith, with its battery, powered right up, and I was through the checkpoint in seconds.

These security hassles may be replaced by something worse—an outright ban on all electronic equipment on commercial airlines. At this writing, the Federal Aviation Administration is con-



sidering such a move. This ban would include carry-on and checked luggage. If it goes into effect, you will have to ship your laptop ahead of you. Of course, you could also take the train and avoid these problems entirely.

Some airlines operate special executive lounges for their business travelers. United's Red Carpet Clubs even go so far as to include a modem connector on each phone. Now, if they'd only put the power outlet close enough to the phone. . . . It's a common inconvenience in hotel rooms, as well.

One of your greatest challenges in working from your hotel room is simply attaching your computer to the telephone system. While many hotels, including Embassy Suites and Hyatt, have started providing telephones with modem ports, the majority of them do not. Fortunately, many do use the same RJ-11 modular connector your home phone uses. In either case, it's easy to plug your computer into the phone system.

There are always a few hotels that make it hard for the business traveler, though. Not only do they have no modem ports, their phones are hard-wired into the wall. In these hotels, you have no choice but to use your screwdriver (you *did* bring a screwdriver, didn't you?) to remove the wall plate for a look. Interestingly, many hotels have their modular connectors hidden behind a wall plate. Once you have access to the connector, you can use your modem to call BIX or other important services.

There are, of course, the hard cases—the ones that really *are* hard-wired, rather than simply disguised. If you are lucky, there will be a connection block behind the wall plate. Otherwise, you will have to dismantle the phone itself. In either case, you use a cable that has spade connectors on one end and a modular plug on the other. The leads are color-coded, and you will find screw terminals inside most phones. Simply connect the

continued

color-coded wires to their like colors and reassemble the phone. Then connect the modular connector to use the modem.

But remember, when the hotel manager asks you what you're doing with that screwdriver, you're on your own. . . .

Business Uses

There are as many uses for traveling computers as there are travelers with computers. When the FDIC shows up at a bank closing, it arrives with computers in hand. Likewise, many of today's auditors bring a computer along, as do lawyers and consultants. These computers run Lotus 1-2-3, dBASE, WordStar, or any of a thousand applications that people need in their work.

Some get even more exotic. Because I work with LANs a great deal, I am currently using a Xircom Pocket Ethernet Adapter. This is a slim box that attaches to the parallel printer port on the rear of the Zenith and allows me to connect to an Ethernet LAN. Xircom includes a disk containing Novell software, so you can configure your laptop computer either as a workstation or as a file server. I can use it to perform diagnostics and tests of a LAN without having to first transfer any software to another workstation.

At this point, unfortunately, most of the diagnostic software doesn't know about the Xircom, so those packages, including Brightwork Development's E-monitor, can't be used with it just yet. This is especially too bad with E-monitor, which is a very useful tool and would be even more so if it supported the Xircom Pocket Ethernet Adapter.

Having the Xircom adapter saves some time, of course, but it also gives me a known quantity with which to work. If need be, I can carry the SupersPort over to another LAN to confirm its proper operation. That way, LAN testing becomes somewhat less of a black art than is usually the case.

Portable Printing

If there is a portable printer designed with the business traveler in mind, it is the Diconix 150. This is a tiny ink-jet printer that runs on C cells, emulates either an IBM or Epson printer, and fits into the Zenith's carrying case, right along with the Zenith.

There are other portable printers, of course, and some that can be made portable. The Hewlett-Packard ThinkJet has been around for years. Like the Diconix, it's small and easy to carry. Unlike the Diconix, it doesn't come with built-in batteries. Some dot-matrix printers are small enough to be portable, although

ITEMS DISCUSSED

Diconix 150 Plus\$499
Eastman Kodak Co.
343 State St.
Rochester, NY 14650
(800) 342-6649
Inquiry 1101.

SupersPort 286 Model 20.... \$4999
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(312) 699-4800
Inquiry 1102.

T-1000.....\$999
Toshiba America, Inc.
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
Inquiry 1103.

Xircom Pocket Ethernet Adapter.....\$695
Xircom
22231 Mulholland Hwy.,
Suite 114
Woodland Hills, CA 91364
(818) 884-8755
Inquiry 1104.

most of them are simply small desktop printers and aren't designed for the rigors of travel.

Portable Pointers

Here are some ideas that will help you decide whether you want to do computing on the road, and if so, what to use. First, I'll consider the computer itself:

- Unless there is an overwhelming reason to do otherwise, consider a battery-powered computer. It will let you work along the way, and it will assure you that you will be able to operate your computer once you reach your destination.
- Unless you know you will never have to carry the computer through an airport on a tight connection, opt for something light. A 30-pound transportable is simply too heavy for most air travelers.
- A backlit screen is vital for marginal lighting conditions—as in all airplanes, most airline terminals, and nearly all conference rooms. If you don't have a backlit screen in these conditions, you may not be able to see it at all.
- A carrying case is usually expensive, but it will save your computer when nothing else will. The case also gives you somewhere to put chargers, cables, software, and even Diconix printers.

- An internal modem, portable fax cards, and network cards are invaluable if you need them. If you don't, they only add weight and take power.
- If you can get an extra battery for your computer, consider doing so. Batteries usually run out when you need them the most.
- A hard disk drive can make a portable computer seem just like your desktop model; without one, you may feel handicapped. So many of today's programs require enormous amounts of disk real estate. WordStar and WordPerfect, for instance, require a couple of megabytes to run properly, and they need to access additional files during operation.

While there is an additional battery drain with a hard disk drive, the Conner Peripherals hard disk drives used by Zenith and others use a mere 2 watts, which has very little impact on battery life. Most likely, doing without the software you are accustomed to would have a much greater impact on your work habits.

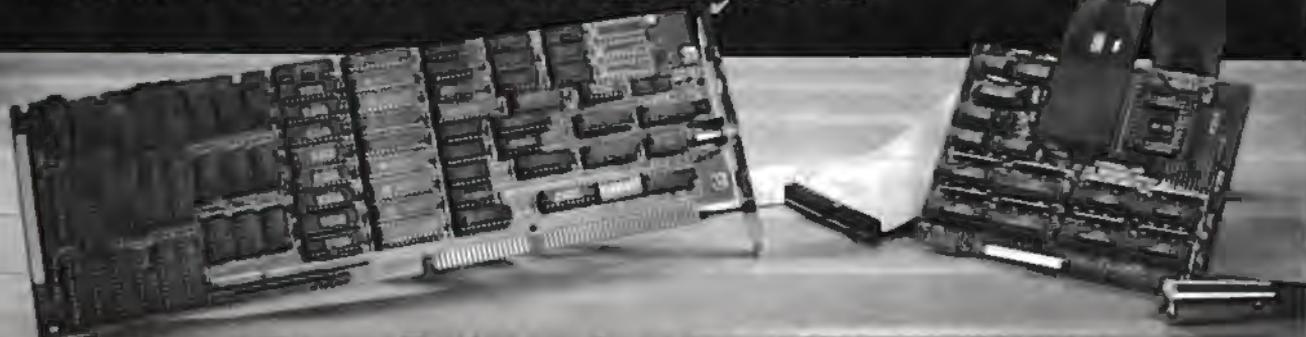
Finally, there's the question of survivability. No computer (except, perhaps, one designed for the military) is rugged enough to be checked as baggage. Nevertheless, some laptops, notably Zeniths, are awfully strong. In the course of my travels, I dropped a Zenith laptop on the railroad tracks beneath a train in Brussels. I also had one rained on while using it at Waikiki. Then there was the one that fell down the steps on a London double-deck bus. And of course, we can't forget the time the porter slammed it into a wall in Guam. In each case, the laptop survived with no ill effects. I suppose that Zenith's laptop contract with the military has had something to do with this.

Travel with a computer can be highly productive. It allows you to use time that would be wasted otherwise. It also allows you to be more effective once you reach your destination. In some cases, it makes jobs possible that weren't possible before. At the very least, it gives you the same level of support you were used to back at the office. ■

Wayne Rash Jr. is a contributing editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

NEW FROM PERISCOPE



Real-Time Debugging for 386s and 286s

User Jeff Garbers, Crosstalk Communications' Director of Software Development, has been debugging with Periscope® Model IV and says, "The hardware really makes Periscope shine, especially when you've got timing-related problems. I can now track down changing pointers and altered buffers on my 386. I've been using it to debug Crosstalk® Mk. 4 and there's just no better way to do it."

Periscope IV gives you the ability to debug time-sensitive programs, hardware-interrupt routines, and programs with intermittent errors. You can run your program at full speed while tracking down unwanted memory overwrites. You can use the information captured in Periscope IV's real-time trace buffer to see EXACTLY what the system is doing, and to improve its performance.

Periscope manual, disk, quick reference card, and 512K Plus board that provides write-protected RAM for Periscope Models I, III, and IV.



A New Generation of Hardware-Assisted Debugging

Compatible with virtually any 286 or 386 with an AT-style bus, Periscope IV works on machines running up to 25MHz with any number of wait states. Because it gets information directly from the CPU, instead of from the system bus, Model IV is not sensitive to bus compatibility issues.

Periscope IV collects CPU information in its hardware trace buffer while the CPU runs at full speed. Whether you tell Periscope IV to capture just selected information or to capture everything, you can use its powerful trace buffer commands to search for and display the execution history the way you need to see it. And you can use the CPU cycle count information to get the last bit of performance out of your code.

With Periscope IV you can set hardware breakpoints on memory accesses (within the first 16MB), I/O ports, and data. You can also set breakpoints on the occurrence of specific sequences of events, such as "watch for the routine FOO to begin executing, then while it is, watch for the variable BAR to be written." This capability, called sequential triggering, enables you to define complex conditions, then stop your program and examine what has happened when these conditions occur.

If you're developing a large application that needs all of the lower 640K, you can use the optional Plus board to keep Periscope totally out of normal DOS memory. The Plus board requires the use of a second slot.

The Periscope IV software is an extension of the software that comes with all models of Periscope. So, along with Periscope IV's powerful hardware, you get a full-function software debugger with source and symbol support for most popular PC compilers and linkers, Microsoft® Windows support, PLINK overlay support, dual monitor support, support for debugging device drivers and TSRs as well as regular programs, DOS independence, crash recovery, ease-of-use, and much more.

Prices on Periscope range from \$145 for software-only Model II-X to \$2,995 for a 25MHz 386 hardware-assisted Model IV. Call 800/722-7006 for pricing details, free information, to talk about your debugging needs, or to order your Periscope.

**Order Your Periscope, Toll-Free,
Today! 800-722-7006**

MAJOR CREDIT CARDS AND QUALIFIED
COMPANY PURCHASE ORDERS ACCEPTED



"No matter what your debugging needs, a single call to the Periscope Company has always sufficed..."

Ross Greenberg
"Best of 1988" (Development Tools)
PC Magazine, January 17, 1989

The
Periscope
Company, Inc.

1197 PEACHTREE ST.
PLAZA LEVEL
ATLANTA, GA 30361
404/875-8080
FAX 404/872-1973



- ② Sales
- ② Services/Support
- ② Product Knowledge
- ② On Time Delivery
- ② Frequent Buyers Program



ZENITH data systems

Supersport 88, 2 drive	CALL
Supersport 88, 20 Meg	CDW™
Supersport 286, 20 Meg	FOR
Supersport 286, 40 Meg	LOWEST
Turboport 386, 40 Meg	ZENITH
Turboport 386, 40 Meg w/modem	PRICING

WHY PAY RETAIL?

CDW Sells For Less

AND SERVICES YOU BETTER

8-330 4.77/10 MHz, 640K, 6 Slots, Built-in CGA, DOS 3.3, Enhanced Keyboard	\$745.50
8-330, 1 Floppy	\$745.50
8-330, 20 Meg/40 Meg	994.95/1019.52
8-450 AT Compatible 9/12 MHz, 8 Slots, 256K, Built-in EGA, DOS 3.3, Enh. Keyboard	\$1220.45
8-550, 1 2M Floppy	\$1220.45
8-550, 20 Meg/40 Meg	1569.80/1695.45
8-600, 386 20 MHz, 8 Slots, 1 Meg, 1.2 & 720 Floppies	\$2570.89
8-800, 40 Meg/80 Meg	2990.01/3280.00
8-800, 40 Meg (26 ms)	3050.50

SAMSUNG



NOVELL



Entry-level 286 Starter Kit, 4 Users	\$427
Entry-level 286 Starter Kit, 8 Users	\$617
NOVELL 286 Software V. 2.15	\$109
NOVELL SFT Netware V2.16	\$296
NOVELL NETPRO	\$127

HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

COMPUTERS

AST SPECIALS

MDL 100	CALL CDW™	MDL 390C	IN STOCK
MDL 140	FOR ALL	MDL 3150C	& READY
MDL 300C	AST	MDL 386/25	TO SHIP
MDL 340C	PRICING	MDL 386/33	CALL

PRINTERS

EPSON

L8K10	CALL	L0510	ALL EPSON
E8200	CDW™	L0550/L0950	MODELS
F8550	FOR BEST	L01050	READY
FX100	PRICE EVER	L02550	TO SHIP

CDW™ stocks all cut sheet feeders and ribbons

NOVELL NETWORKING

SOFTWARE & STARTER KITS

Entry-level 286 Starter Kit, 4 Users	\$429.99
Entry-level 286 Starter Kit, 8 Users	\$699.99
NOVELL 286 Software V. 2.15	\$109.65
NOVELL SFT Netware V2.15	\$296.60
NOVELL NETPRO	\$120.50

SOFTWARE

WORDPERFECT 5.0 5 1/4" 3 1/2"	\$229.50 / \$238
ASHTON/TATE Office III - 7.0 IBM PC	424.00 / 428
ASHTON/TATE Multimedia Advantage II	270.00
LOTUS 1-2-3 5.0/3.1	209.95 / 205
LOTUS 1-2-3 Version 3	337
ANSA Paradox 3.0	429
BORLAND Quattro/Write Kick	149.52 / 121
MICROSOFT EXCELLENT WINDOWS 3.11	252.50 / 257
MERIDIAN Carbon Copy	119
SYMANTEC OS/2	212
KEROL Ventura Software Version 2.0	479

WORKSTATIONS

AST 105X	ALL AST
AST 386SX Model 5/ Model 45	WORKSTATIONS
AST Bravo	IN STOCK
SAMSUNG PC TERMINAL 286	\$1050.50
EARTHSTATION V40 w/ 286 Arcnet Ethernet	CALL

NEC

P2200	\$344.83	PS300	\$585.63
PS200	\$509.12	PS604	\$1039.24

15/20" by Kodak \$309.17 / \$17.17

INTERFACE CARDS

3COM ETHERLINK	\$417.29
ARCNET PC110 LANboard PS2	\$530.49
ARCNET PC130 LANboard	164.27
ARCNET PC220 LANboard	189.50
ARCNET SMC 16-Bit File Server Bd	437.55
ARCNET SMC 16-Bit Workstation Bd	359.25
ETHERNET Interface Connector (NE1000)	298.90
ETHERNET Plus Board (No 286) (NP600)	635.35
G-NET Interface Card w/cable	289.52
NOVELL NE2000	384.15
THOMAS CONRAD 6042	129.22
THOMAS CONRAD 6045	299.88
WESTERN DIGITAL Ethernet Cards	249.10

MONO MONITORS & CARDS

CDW™ color / mono stands w/c	\$90.00 / \$3
HERCULES™ color / mono stands w/c	146.14 / 179
AT&T Monochrome Monitor	149.99 / 179
AMDEK 4104/1280	145.99 / 679
COMPAQ Mono/VGA Mono	177.00 / 209
IBM PS2 8503	209
GOLDSTAR Amber	84
NEC Monograph	129
PS2 MAX 128/AMX II	136.40 / 87
PACKARD BELL Green or Amber	289

IBM PS2

MDL 30, 20 Meg	\$1655.17	MDL 555X, 30 Meg	\$2099.59
MDL 80, 40 Meg	\$346.15	MDL 555X, 60 Meg	\$178.30
MDL 90, 70 Meg	\$644.52	MDL 70, 60 Meg	\$370.20
MDL 30286, 1 dr.	\$412.10	MDL 70, 121 Meg	\$329.84
MDL 30286, 20 Meg	\$823.50	MDL 80, 40 Meg	\$474.40
MDL 50Z, 30 Meg	\$276.75	MDL 80, 70 Meg	\$509.37

TOSHIBA

3215L	\$468.95	Expresswriter 311	\$377.16
3415L	\$62.84	Expresswriter 301	\$328.84
3515X	\$48.95	CALL FOR ACCESSORIES	

ACCESSORIES

ARCNET Passive Hub	\$74.00
ARCNET Active Hub	\$95.10
ARCNET SMC Turbo Kit	49.95
ARCNET SMC Active Link	264.70
THOMAS CONRAD 16 Port Hub	814.25
THOMAS CONRAD 8 Port Hub	\$78.65
Ethernet Terminator	39.50

COLOR GRAPHIC MONITORS

IBM PS2 8512/8513	\$449.40 / 249
SAMSUNG RGB Color	224
TAGAN 720	289
MAGN-A-VIX 8572	295

IBM PS2

286, MDL 1	\$1548.95	386, 25 MHz, MDL 30	\$899.99
286E, MDL 1	1899.50	386, 20E, 40 Meg	4583.12
286E, MDL 20	2172.45	386, 20E, 100 Meg	\$504.22
286E, MDL 40	2453.41	Port II, MDL 2	1838.10
386, 20 MHz, 130	\$718.33	Port II, MDL 4	2987.42
386, 25 MHz, 60	\$683.90	Port III, MDL 20	3495.85
386E, MDL 1	2324.49	Port III, MDL 40	3998.33
386E, MDL 20	2783.12	Port 386 MDL 40	\$426.24
386E, MDL 40	3882.34	Port 386 MDL 100	\$689.74
386, 25 MHz, MDL 10	6905.05		

PANASONIC

1124	\$338.18	1592	\$412.34
1585	453.45	3131	318.20
1190	783.95	3524	562.10
1191	732.12	CALL FOR ACCESSORIES	

MODEMS & COMMUNICATIONS

EVEREX 1200B/2400B	\$97.90 / \$14.10
EVEREX 2400 Ext/2400 PS/2	\$99.80 / \$205.45
INTEL 2400 Int./2400 Ext.	148.75 / \$78.34
PACKARD BELL 2400 Int./2400 Ext.	169.95 / \$69.22

VGA & EGA PRODUCTS

VGA & EGA MONITORS

COMPAQ VGA monitor	\$348
MAGN-A-VIX 943EG4/93CM882	365.40 / 371
MITSUBISHI 1409/1410	287.44 / 385
MITSUBISHI 1381 Diamond Scan	\$19
NEC Multisync II PLUS	200
NEC Multisync III 19 inch	680
NEC Multisync 2A/Multisync 30	495.85 / 349
PACKARD BELL 8541 VGA	379
PACKARD BELL 8524 Enhanced VGA	479
PACKARD BELL 8526 Multisync	379
PS2 Ultrisync 12	518.00 / 487
PS2 Ultrisync 14/18	618.00 / 487
SONY Multisync 1002/1063	629
ZENITH 2-M999	629

TOSHIBA

T1000	\$657.95	T1800	\$3237.80
T1200 2 Drive	1455.74	T5100	4238.70
T1200 20 Meg	1956.80	T5200, 40 Meg	4943.82
T3100e	2688.78	T5200, 100 Meg	\$375.50
T3200	\$393.25	CALL FOR ACCESSORIES	

ALPS

Alegro 24	\$342.50
-----------	----------

MEGAHERTZ CORPORATION

2400 for ZENITH	\$187.10	2400 for COMPAQ S/LT	\$258.80
2400 for NEC	225.80	2400 for TOSHIBA	183.74

VGA DISPLAY CARDS

ATI VGA Vendor 256	\$298
ATI VGA VIP	289
GENOA 5200/3300	330.55 / 289
RENAISSANCE SVGA II/VGA II	208.00 / 218
PARADISE VGA/VGA + 16	282.80 / 289
VIDEO 7 VGA	239
VIDEO 7 Fast Video / VRAM	372.15 / 489

MINISCRIBE

MIN-8425	\$239.40	MIN-3065	\$779.40
MIN-8438	298.85	MIN-6085	899.52
MIN-3053	468.52	MIN-3380	1859.34

TERMINALS

WISE 50 Amber or Green	\$373.40
WISE 50 Amber or Green	360.16
WISE 85/20 Amber	375.90 / 234.10
WISE 990T	394.82

BATTERY BACKUP & SURGE

AMERICAN

AME-1200VX	\$329.45	AME-520EX	\$449.40
AME-330AT	278.72	AME-800RT	696.19
AME-450AT	394.82		

EGSA DISPLAY CARDS

GENOA Super EGA II Res 800 x 600	\$704
NEC MVA 1024	1790
PARADISE Auto Switch EGA 480	189
VIDEO 7 Vega Deluxe	218

SEAGATE

SEAGATE 20 Meg	\$208.99	SEAGATE ST-251-G	\$344.56
SEAGATE 30 Meg	287.32	SEAGATE ST-251-1	378.23
SEAGATE 4096 80	599.95		

PLOTTERS, DIGITIZERS & SCANNERS

CALCOMP

1023	\$3745.38	12 x 12	\$358.12
1043	6477.15	12 x 18	718.10
1044	9915.06	36 x 48	\$238.15

DURANT TECHNOLOGIES

BPS-300	\$336.10	BPS-550	\$498.85
BPS-500	485.11	BPS-1200	710.85

CAD MONITORS & CARDS

MITSUBISHI 8905, 19 inch	\$2320
MITSUBISHI 3905LBK	1835
MITSUBISHI 3905BOK	1790
SIGMA LaserView	1887
VERMONT Cobra	2977
METHUEN 1104	1039

STORAGE DIMENSION

AT 155E	\$1850.52	AT-650E	\$590.00
AT-335E	2420.26		

TRIPLETE

BC-450	\$348.50	4 outlet	\$ 44.25
BC-1200	648.56	LC-1200	158.85
BC-2000	1179.80	LC-1800	198.80

MISC. & ACCESSORIES

A/B Switching Box (par or serial)	\$29.95
BAF 5 Pack of 10 OS/2 disks	39.00
INTELLICOM Long Link	129.70
KENSINGTON Masterpiece	99.99
KENSINGTON Masterpiece Plus	123.40
KEYTRONICS 5151 IBM or AT&T	148.99
KEYTRONICS 101	92.99
5TH Gen Logical Connection 256K/812K	447.72 / \$14.36
Electronic 4-Way Switchbox	94.85
XT Power Supply 150 Watt	59.00

MICE

LOGITECH C9 Serial/PS2	\$89
LOGITECH BUS	94
MICROSOFT Mouse (Bus Version)	109
MICROSOFT Mouse (Serial Version)	117
MICROSOFT MOUSE w/windows	130
MOUSE SYSTEMS (Serial Version)	99
MOUSE SYSTEMS (Bus Version)	108

HARD DRIVE CARDS

PLUS DEVELOPMENT 20 Meg	\$539.28
PLUS DEVELOPMENT 40 Meg	677.80
WESTERN DIGITAL 30 Meg	399.37

HP FACSIMILES AND BOARDS

COMPLETE Fax 9600	\$399.50	SHARP FO-220	\$554.48
QUADRAM J1-Fax 9600 Int	\$27.65	SHARP FO-330	1199.10
QUADRAM J1-Fax Portable	\$283.35	SHARP FO-330	1085.70

NEWLETT PACKARD

HPT440A	\$964.30
HPT475A	1389.89
HPT550	2926.56
HPT570	LOWEST PRICE
HPT576-EXL	CALL
HP SCANJET	SAVE

HOUSTON INSTRUMENTS

HI DMP-52/DMP-52MP	
HI DMP-56A	
HI DMP-61	
HI DMP-62	
Image Maker	

MOST ORDERS RECEIVED BY 4:00 P.M. C.D.T. SHIP SAME DAY

HIGH VOLUME BIDS INVITED
2840 Maria, Northbrook, IL 60062 FAX (312) 291-1737

PC Magazine says... "You may find a better deal here than anywhere else."

WHY WAIT? CALL COMPUTER DISCOUNT WAREHOUSE™ NOW!

Open terms available to approved credit

(800) 233-4426

In Illinois FAX (312) 498-1426 (312) 291-1737

NEW AREA CODE 708 - Effective 1/1/90

SPECIAL EXTENDED HOURS
Sales 7:30-7:30 CDT Mon-Fri
9:00-3:30 CDT Sat
Tech Support 9:00-5:00 CDT Mon-Fri





DISASTER RECOVERY

After you crash and burn, getting back to work shouldn't be this hard

I am angry. Not a little bit, but a lot. Why? I just spent the better part of my evening trying to recover a crashed Jasmine DirectDrive 140 hard disk drive. You probably know that horrible warning dialogue by heart: "This disk is damaged. Do you want to initialize it?" Initialize it! Are they kidding? I had 128 megabytes of data on that disk! And you're given two pretty extreme options: Yes or Cancel. That's it.

If you say Yes, you also say yes to wiping the disk of all your files. Good-bye years of work. See you later. If you say Cancel, you can never mount and use the disk in its current shape, because somehow the directory structure has been scrambled. In both cases, you can't get to your files, which makes the disk useless, unless you need a paperweight.

Now you might say that this sort of thing goes with the territory, and in a calmer and more rational moment I'd agree. But I'm tired of being calm and rational when it comes to drive crashes, tape backups, and file recovery programs. So, even if it won't help me fix my sick drive, at least I'll feel better once I tell you what's wrong with all this hard disk drive backup and recovery business. And maybe it will save you from the same fate.

I do a full save to DC-2000 tape once a week, and daily incremental backups, also to DC-2000 tape. However, the problem is that no matter how religious you are in doing backups, restoring backed-up data is a pain. And backed-up data is *never* as fresh as the stuff that's on your disk, so you'll always lose a few



files. Often, the few files you do lose are the most critical ones at the time the drive fails. Backups keep you from a catastrophic loss of data, but they just don't keep you from wasting time rebuilding a failed disk or recreating critical files.

A Solution?

If backups aren't going to save you from the drudgery of rebuilding a disk, what can? Symantec Utilities for Macintosh is supposed to. Unfortunately, I haven't had much luck with it. SUM is a package of several different disk management and recovery utilities. The important part for preventing hard disk drive losses is called the Guardian INIT.

Guardian installs on all your hard disks and records a separate hidden directory of the disk whenever you shut down or restart your Mac normally. Guardian can also save the directory information for deleted files into a hidden file so that you can recover them later (or at least until the files are overwritten).

The hidden disk and file directories can also be backed up to floppy disks, tape, or another hard disk, in case the versions saved on the disk in question get trashed when it fails.

That's all fine in theory, but the practice leaves much to be desired. First of all, the only time the Guardian lists get updated is when you *normally* shut down or restart the Mac. If you've created or edited a bunch of files since your last normal shutdown/restart and your Mac disk fails, those files are not recorded on the Guardian lists. And if the Mac dies while writing the Guardian files, they're usually scrambled and unusable.

Second, the Guardian lists tend to be large. For example, on my hard disk drive, with 128 megabytes of files (over 4600 files in 600 folders), the Guardian disk record was more than a megabyte in size, so it wouldn't fit on an 800K-byte floppy disk.

Third, the Guardian files are no more

continued

resistant to damage caused by a software disk failure than any other files. If the disk sector that carries these hidden files was creamed during the failure, SUM can't use them to recover the disk's directory. And, unfortunately, SUM does a poor job of deciding whether or not the Guardian files on the crashed disk should be trusted or not.

I tried restoring my failed DirectDrive 140 over a dozen times using the Guardian files on that disk. Every time, the SUM Disk Clinic application told me that the disk had been fully recovered. Every time I quit that application and rebooted (as instructed), the Finder said that the disk was damaged and unreadable. I finally had to use a day-old set of Guardian files that I had backed up to tape to recover the disk. That recovery mostly worked, although so far I've found that about 10 percent of the files I try to launch have been damaged and need bit-tinkering.

The problem is even worse if you've failed to install Guardian or if none of your Guardian files can be read. Then you must use SUM's file-by-file disk recovery utility. This utility works. It will pull everything off your damaged disk (of course, you have to have another hard disk for copying). But your directory structure will be history: Files will be in and out of folders, and folders will be listed, but empty. Basically, you'll recover your files and little else. If you've got the amount of data that I have, it can take months to recreate some semblance of order from this chaos.

Although I'm annoyed that SUM doesn't do more in its current incarnation and doesn't make recovery easier, I have to give Symantec kudos for at least letting me salvage an otherwise dead disk. That's an important bottom line, and one to remember when you get that sickening "disk damaged" message. I've tried plenty of other disk recovery programs that don't come close to the sophistication and success rate of SUM.

Apple's Omissions

The basic problem, however, is not Symantec's. It's Apple's. Like many of you, I pored over the previewed specifications for System 7.0 that Apple released at the May Developer's Conference. I was impressed by the Finder enhancements, outline fonts, virtual memory, interapplication communications, improved print management, Communications Toolbox, and the rest of the goodies. But I wasn't impressed by the omissions—obvious ones from my point of view.

ITEMS DISCUSSED

DirectDrive 140 \$1499

Jasmine Technologies, Inc.
1740 Army St.
San Francisco, CA 94124
(800) 347-3228
(415) 282-1111
Inquiry 981.

Symantec Utilities for Macintosh 1.1 \$99.95

Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
(800) 228-4122
(408) 253-9600
Inquiry 982.

Where was built-in scripting and a script editor, so that I can build an auto-backup script that would create shadow directories on other drives? Where were Apple's built-in disk recovery utilities? In short, where were the built-ins that will make disk crashes less frequent and less disastrous? Nowhere in the System 7.0 specifications that I saw.

Of all the suggestions that I've made to Apple in the past year about what needs to be in future operating systems, file integrity is the most important. If you can't trust your hard disk drive, using your Mac becomes a scary scenario. Apple must address this problem quickly. While I applaud the third-party efforts of Symantec and others, it's not their job to fix deficiencies in Apple's operating system. And let's be clear here: These are major deficiencies. Anytime that 128 megabytes of data can vanish without warning, you've got an operating-system problem.

We shouldn't have to waste our time running recovery programs. The Finder should have an entire menu just for disk integrity. This menu should include every manner of disk recovery utility that Apple can think of, and it should be transparent to the user. It should also include options for setting "reliability factors," so that users with large disks could opt for slower performance if it means their disks will be better protected (either by shadow directories, parallel structures on other disks, or the like) from software crashes.

Also on the menu should be disk analysis and modification tools for the technically sophisticated, who need to examine their disks and perform surgery on them. This menu should also include backup dialog boxes, for doing every kind of backup (e.g., tape, floppy disk,

WORM [write once, read many times] drives, or erasable CD-ROM drives) in every kind of way (e.g., unattended, timed, or parallel structure).

Apple's Responsibilities

The point is that Apple should take the lead in making its operating system more robust, and not leave that to third-party vendors. Apple should take the lead in preventing drive crashes and making backups transparent, not third-party vendors. Apple should take the lead in making disk errors and failures easily recoverable, not third-party vendors.

Apple has often said that the Mac operating system is its competitive advantage, its intellectual property. That's one of the reasons that Apple has defended it with the suits against Microsoft and Hewlett-Packard. But intellectual property is a double-edged sword: It implies responsibilities on Apple's part that go way beyond the ownership of the system. These are Apple's responsibilities to its customers, to the MacFolk who have made Apple a 4-billion-dollar-a-year company. For them, disk and file-system integrity should be a given, and not something that they have to seek with outside utility programs and other kinds of baling wire and spit.

With System 7.0, Apple has shown us a solid view of what the 1990s will bring in personal computer operating systems. The distinction between personal computers and larger ones will become even more inconsequential as the small machines are given all the features that users of big machines have enjoyed for years. With the advent of OS/2, Apple has some serious competition with its vision and an even bigger reason to concentrate on the basics of file and disk integrity.

As small computers do more and more of the work of computing, the reliability of file systems may make the difference in the success or failure of an operating system and its computers. Apple needs to keep this thought at the forefront as System 7.0 and future Macintosh operating systems start to roll out of the Cupertino labs and into the disk-duplication factories. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

CompuServe is offering inside information on these companies.

**CROSSTALK • SUN MICROSYSTEMS
SOFTWARE PUBLISHING • ENABLE
ADOBE • NOVELL • WORDPERFECT
MICROPRO • JAVELIN • MICROSOFT
BUTTONWARE • MONOGRAM • INTEL
DIGITAL RESEARCH • ASHTON-TATE
MANSFIELD SOFTWARE • BORLAND
AUTODESK • ALDUS • BRODERBUND
LOTUS • NANTUCKET • DATASTORM
SYMANTEC • FOX • AND MANY MORE**

Product support for your IBM and compatible.

Access CompuServe's forums, and you'll find invaluable product support maintained by all these companies. Often, company decision makers are online to discuss the next generation of products, or to put software updates on CompuServe before they hit the market.

When you run into a problem, there's a

good chance you can quickly find the solution online in one of CompuServe's many forums. Or, you can leave a message. You'll get answers fast, often from the person who actually developed the product you are using. Either way, you save yourself time and frustration finding the answers you need when you need them.

To join CompuServe, see your computer dealer. To order direct or for more information, call 800 848-8199.

CompuServe®

The names listed here are proprietary trademarks of their respective corporations.

Circle 68 on Reader Service Card

Aw...What the Heck!

EXTREMELY POWERFUL

DesignCAD 3-D version 2.0 is as powerful as most CAD systems costing \$5000 - \$10,000! Features like: Complex Extrusions-linear, scalar, and circular, Blending of Surfaces, Shading, Cross Sectioning, Complex Sweeps and Translations, and Boolean operations make DesignCAD 3-D one of the most powerful 3-D CAD systems available... at any price! Engineers, Architects and Consultants constantly tell us that they use CAD systems costing thousands of dollars which are not as powerful as DesignCAD 3-D.



VERY EASY TO USE

Just because DesignCAD 3-D is powerful doesn't mean it is difficult to use. Single keystroke commands and side-bar menus which give short directions on how to proceed make DesignCAD 3-D a snap to use! While not required, DesignCAD 3-D supports all popular digitizers and mice.

Many of the older, more cumbersome CAD systems require weeks of training before a user can be productive. DesignCAD 3-D users find they can be producing useful drawings in a matter of minutes! In a recent CAD contest only one contestant was able to match our drawing time. The package sold for \$3000.00. The other CAD packages took up to twice as long to perform the same drawing and cost up to \$5000.00!

Still don't believe us? The goblet pictured below required only 16 keystrokes and 3 commands to create! The top, front, side, and isometric views were created simultaneously... in less than one minute!

DesignCAD 3-D only \$399!

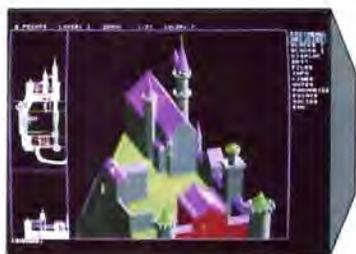
VERY LOW PRICED

The first question asked by many people is, "Why is DesignCAD 3-D priced so low?" The answer? After developing DesignCAD 3-D version 2.0, we were unable to decide how the product should be priced. We consulted experts. We used the finest spreadsheets on the market. We took employee polls. Finally, in the great American Tradition, we said, "Aw... What the Heck! Let's see the other guys beat this price!" DesignCAD 3-D version 2.0 sells for \$399.



WHY BUY THIS ONE?

There is a very important reason to buy DesignCAD 3-D. **PERFORMANCE.** No other CAD system can match our price/performance ratio. Many people make the serious mistake of thinking that it is necessary to spend thousands of dollars to obtain "a good 3-D CAD system." This is not true! We talk to people everyday that are sadly disappointed with their "expensive" CAD systems. Don't be one of them! Call us and we will send you a complete set of literature and a free slide show demo disk. Once you compare DesignCAD 3-D version 2.0 with other CAD systems we know you will choose DesignCAD 3-D.



DON'T TAKE OUR WORD FOR IT

Here is what other people have to say about DesignCAD 3-D:

"After you've worked with DesignCAD, the single keystroke commands are simple to remember and it becomes easy to "flick one key" to execute a command. An extremely ergonomically designed program."

HENRY LEVET, Level 5 Daigle Architects - New Orleans, LA
Designed a 65,000 sq. ft. nursing home using DesignCAD

"Recently I worked with a firm that builds decks. They purchased your product on my recommendation. I sat down with them and in two hours they were very proficient in DesignCAD. Now they are more effective; and we can communicate... it's wonderful to be able to do a block repeat 42 times and there are 42 2x4's to make the deck!"

J. TURNER, Architect, TAO Ltd. - The Woodlands, Texas

"Allows scientists and engineers to expend minimum time learning and using CAD software so that their time can be expended on the project at hand. It also allows scientists and engineers to quickly present to management all views of a subject (3-D)."

DR. STEVENS, NASA Space Scientist/Engineer



HOW DO I GET ONE?

DesignCAD 3-D version 2.0 is available from most retail computer stores, or you may order directly from us. DesignCAD 3-D is available in a number of foreign languages from distributors throughout the world. All you need to run DesignCAD 3-D is an IBM PC Compatible and 640K RAM. DesignCAD 3-D supports most graphics cards, printers, plotters and digitizers. Free information and a demo diskette are available by contacting us at:

American
Small Business Computers, Inc.

327 South Mill Street
Pryor, OK 74361
918/825-4844
FAX: 01-918-825-8359
TELEX: 9102400302



TALKING TO OS/2 DEVELOPERS

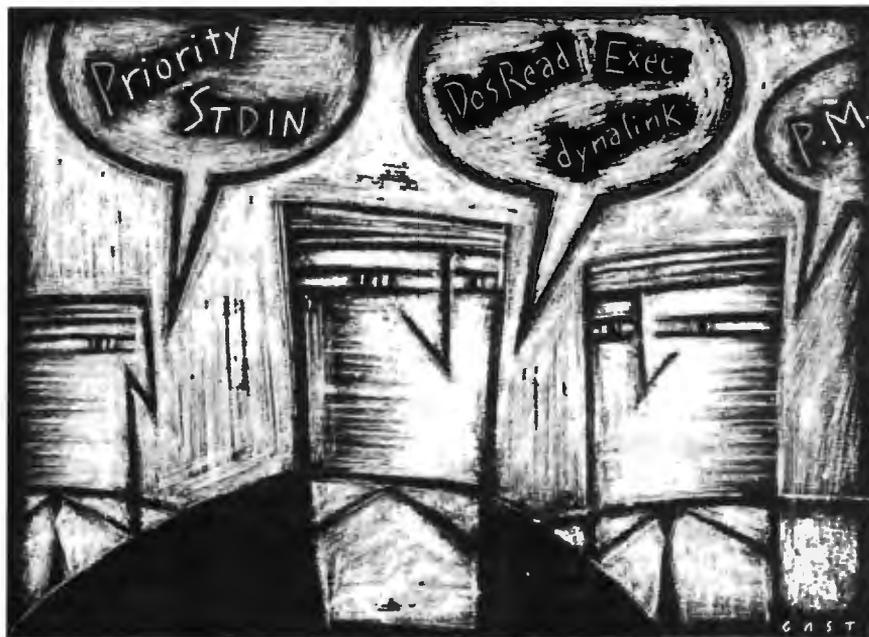
Pluses and minuses
of OS/2 from
those working with it

Last month, I talked about the latest developments in OS/2 programs. This month, I'll be talking to three of the people who are developing those programs: Dave Nanian, Doug Hamilton, and Martin Heller.

Nanian's text editor, BRIEF, needs no introduction. Ever since it appeared several years ago, BRIEF has accumulated a fair-size following in the programming community. That's no mean feat, because text editors are like favorite easy chairs to programmers. Nanian converted BRIEF to OS/2 because "I got tired of switching to the compatibility box [the DOS mode session] to run my editor when writing code."

Doug Hamilton doesn't come to OS/2 from DOS, but rather from an extensive Unix background. He worked until recently for Prime Computers. Prior to that, he worked for IBM. The Hamilton C Shell implements the popular Unix C shell under OS/2. OS/2's optional command-line interface looks like the DOS CLI, with many of the DOS limitations. The Hamilton C Shell will appeal to those who prefer Unix system commands—the Unix `ls` directory command works, for example—but the DOS commands also work, so you can use either `ls` or `DIR`. Unlike DOS commands, most of the C shell commands are self-documenting: If you just invoke them with the `-h` switch, you get help on the command.

Martin Heller has wide experience with several computer environments. He is now converting two packages to run under OS/2; they'll probably be on the market by the time you read this. The



first product is an engineering application called MATDB, which provides metallurgical characteristics of hordes of materials. For each metal, MATDB gives data for 40 properties at 20 temperatures under 20 conditions. (*Conditions* refers to whether the material was cold-rolled, annealed, or the like.) The second product is ENPLOT, an engineering graphics program that is undergoing beta testing for Windows under DOS.

The programs that these developers work on provide an interesting cross section of genealogies: BRIEF started out life as a standard DOS application, the Hamilton C Shell is a new application first developed under OS/2, and MATDB was originally a Windows application.

Developers on OS/2 Acceptance

Despite the differences in the programs and the markets that they appeal to, all three developers agreed that OS/2 will be successful, even though it will take some

time to become established.

Nanian says, "Debugging is far easier under OS/2, and OS/2 applications can be built to work under DOS. I do like OS/2, I hope it succeeds, but DOS will be around for a long while. Developers must make sure that their OS/2-inspired programs run well under DOS. An application can't work well and stink under DOS. Ignoring either DOS or OS/2 people is foolish. Virtual memory is an example. Just because DOS doesn't have that feature doesn't mean you can't add it to your application, if it's important."

While Hamilton agrees that OS/2 acceptance is going slower than he thought it would, he thinks that DOS-to-OS/2 conversion will be swift once it starts. "At some point, people will see just what OS/2 can do; then there'll be a flood of applications. Lots of new computers are being sold today. Lots of new machines mean lots of new people who haven't invested in DOS." He adds, "In 1992

continued

OS/2

and
~~or~~

DOS?

MultiBoot
is the answer.

BYTE May 1989

*MultiBoot Brings OS/2
Back to Earth*

Bolt Systems has come to the rescue with a program called **MultiBoot**, which does away with the dual-boot problem for good.

MultiBoot is simple, inexpensive, and foolproof, and it works flawlessly. It's a good example of a utility that fills a much-needed niche.

—Stan Miastkowski

OS/2 NOTEBOOK

Once you've spent thousands of dollars on OS/2 and an OS/2-ready work station, what's another \$49.95 to have easy access to DOS? Highly recommended.

—Mark Minasi

Not all DOS programs work in the OS/2 compatibility box. **MultiBoot** lets you install both systems in your computer. **MultiBoot** works with DOS versions 3.0-4.01 up. And OS/2 versions 1.0 and 1.1.

TO ORDER:

Send \$49.95* + \$3.00 shipping and handling (check or money order) to:

MultiBoot, Bolt Systems, Inc.
4340 East-West Highway
Bethesda, Maryland 20814
or call 1-301-656-7133

FAX: 1-301-907-8736 to order
by Visa/Mastercard. Specify 3.5"
or 5.25" diskettes.

*Maryland residents add 5% sales tax.
Ask about our volume discounts

A Product of **BOLT** Systems Inc.

we'll chuckle about all those folks who wondered if DOS would really be replaced."

Should you convert to OS/2 today? "Not unless you're a developer," says Heller, although he notes, "That will

The three agreed on the question of OS/2's value as a development platform, saying that OS/2 made development much easier.

change this summer." Heller predicts that a "killer application" will be out soon. What would a killer application for OS/2 be?

"PageMaker," says Heller. "PageMaker really shines with more memory, and Presentation Manager applications have access to lots of memory. The PM version of PageMaker is at least three times better than the Windows version."

OS/2 as a Development Environment

The three agreed again on the question of OS/2's value as a development platform, saying that OS/2 made development much easier. Nanian and Heller commented that the virtual memory feature of OS/2 simplified their code. In both cases, they'd been forced to implement virtual memory under DOS, no picnic of a task.

Heller's MATDB program organizes data into folders. Under DOS, such folders must be limited to 200 materials. Under OS/2, there is virtually no limit. Another example comes from the database side. Under OS/2, the database's tables are built up in the background.

"OS/2 has some powerful debugging tools," says Heller, so that the conversion to OS/2 was really not a big investment. "It's actually easier to debug the OS/2 code than the DOS code. At this point, I make changes to the OS/2 version, then move the changes back to DOS. I found bugs in the OS/2 version that had eluded me for two years under DOS."

For much of the debugging, Heller is using Logitech's MultiScope debugger. "It's better than CodeView. It gives you more views of the application. Features like the postmortem debugger can be incorporated into your ordinary version."

Unlike CodeView, MultiScope will analyze after the fact why a program crashed. CodeView can do this only if the application was being run under CodeView at the time.

Hamilton likes OS/2's threads. "It's much faster to create a thread than to spawn a separate process. You can spawn and kill threads very quickly. The bad part about threads is, of course, there aren't fire walls between threads." In other words, threads (unlike processes) share memory and can therefore damage one another's data.

Nanian appreciates OS/2 stability and its debugging features. "They make development a lot easier. The virtual memory code that we had to write and maintain under DOS is not required under OS/2. It's nice to code to a platform that's fairly mature, compared to something like DOS 2.x."

What Developers Would Change

I asked the three developers what they would change about OS/2 if they could. What do they hate most?

Hamilton dislikes the way that text windows work. "Microsoft thinks we're going to go 100 percent to bit-mapped screens, and that just doesn't make any sense. There are plenty of uses for text-based screens, and the support of text windows under PM is awful, both in terms of speed and features."

Nor is he fond of the way icons work. "There aren't enough pixels for icons, so I'm afraid my icon turned out kind of hard to read. You can't control icon colors directly, so it limits your ability to design a nice icon."

Heller says that OS/2 is slow, compared to running DOS with various speedup aids. But he notes that the Hamilton C Shell actually solves some of those problems. "Also, I'd like to be able to develop for Windows under OS/2 and use other tools like On-Line and the Programmer's Library without going back to DOS to use them."

One of Nanian's gripes regards the High Performance File System, a feature of the upcoming OS/2 1.2. "There are no operating-system-level functions to parse and qualify filenames," says Nanian. "I can't just pass OS/2 a filename and say, 'Here's a filename—what part

continued

Compuclassics

ACCOLADE	
Test Drive	26.00
ADOBE	
Illustrator/Windows	409.00
ALDUS	
Pagemaker 3.0	499.00
ALPHA	
Alpha/4	329.00
AMERICAN SMALL BUSINESS	
Design Cad	159.00
Design Cad 3D	209.00
APPLAUSE	
Perfect Addition	39.00
APPLICATION TECHNIQUES	
Pizazz Plus	69.00
ASHTON-TATE	
DBase IV	485.00
Framework III	455.00
DBase III Plus	455.00
Mastergraphics	295.00
Multimate Advantage II	295.00
ASK SAM	
Ask Sam 4.0	179.00
AUTODESK	
Autosketch Enhanced 2.0	95.00
BANNER BLUE	
Org Plus	52.00
BLOC PUBLISHING	
Formtool	55.00
BLAISE	
Turbo C Tools	92.00
Turbo Power Tools Plus	92.00
BORLAND	
Turbo C	99.00
Turbo Pascal	99.00
Turbo C Pro	169.00
Turbo Pascal Pro	169.00
Quattro	165.00
Sidekick Plus	135.00
Sprint	135.00
Paradox	439.00
BOURBAKI	
1 Dir Plus	49.00
BRIDGEWAY	
Fast Trax	35.00
BRODERBUND	
Print Shop	39.00
Memory Mate	45.00
BUMBLEBEE	
DB Fast/DOS	60.00
BUTTONWARE	
PC File DB	69.00
CALIFORNIA SCIENTIFIC	
Brainmaker	79.00
CENTRAL POINT	
PC Tools Deluxe	79.00
Copy II PC	24.00
POWER-UP	
Quick Schedule Plus	49.00
CHRONOS	
Who-What-When	115.00
CLARION	
Professional Developer	409.00
COMPUTER ASSOCIATES	
Supercalc 5	319.00
Superproject Expert	449.00
CONCENTRIC DATA	
R & R Report Writer	109.00
CORE	
Corefast	69.00
CROSTALK	
Crosstalk Mark 4	124.00
Remote 2	95.00
DAC	
Lucid 3D	80.00
DAC Easy Bonus Pack	115.00
DAC Easy Accounting	59.00
DATAEASE	
Dataease 4.0	499.00
DATASTORM	
Procomm Plus	49.00
DELFINA	
Perform	172.00
DELTA TECHNOLOGY	
Direct Access	55.00
DIGITAL RESEARCH	
Gem Artline	285.00
Gem Draw Plus	179.00
DIGITALK	
Smalltalk V286	139.00
DYNAMIC MICROPROCESSOR	
PC Anywhere III	72.00
ELECTRONIC ARTS	
Mavis Beacon Teaches Typing	32.00
Deluxe Paint II	65.00
EPYX	
California Games	25.00
FIFTH GENERATION	
Fastback Plus	109.00
FORMWORX	
Formworx w/Fill & File	89.00
FOX	
Foxbase Plus	195.00

FUNK	
Sideways	42.00
Allways	65.00
GAZELLE	
ODOS II	39.00
GENERIC	
Generic CADD Level 3	169.00
GIBSON	
Spirrite	49.00
GOLDEN BOW	
V Cache	45.00
HAVENTREE	
Interactive Easy Flow	115.00
IBM	
ODS 4.01	125.00
Displaywrite IV	289.00
INDIVIDUAL	
101 Macros for WordPerfect	45.00
INSET	
Inset Plus	139.00
INSIGHT DEVELOPMENT	
Laser Control	85.00
Print-A-Plot	105.00
INTUIT	
Quickan	40.00
LASERGO	
Go Script	139.00
Go Script Plus	269.00
LEARNING COMPANY	
Reader Rabbit	25.00
LOTUS	
Agenda	275.00
Other Products	Call
MATHSOFT	
Mathcad	305.00
MECA	
Managing Your Money	119.00
MERIDIAN	
Carbon Copy Plus	109.00
MICROGRAFX	
Windows Graph Plus	329.00
Designer	449.00
MICROLOGIC	
Tornado	52.00
MICROLYTICS	
Gofor	45.00
MICROPRO	
Wordstar 5.5	209.00
MICROPROSE	
F19 Stealth Fighter	45.00
MICROROM	
RBase for DOS	489.00
MINDSCAPE	
Balance of Power 1990	29.00
MULTISOFT	
Super PC Kwik	49.00
MICROSOFT	
Quickbasic	67.00
Quick C	67.00
Windows 286	67.00
Windows 386	129.00
Excel	239.00
Macro Assembler	99.00
C Compiler	299.00
Word	209.00
Flight Simulator	35.00
MICROTEK	
Softbytes 286	35.00
NANTUCKET	
Clipper	429.00
NEW ENGLAND	
Graph-In-The-Box	75.00
NOLO	
Willmaker	35.00
NORTH EDGE	
Timeslips III	169.00
NOVELL	
Advanced Net 2.15	1850.00
Other Products	Call
OWL	
Guide	169.00
PAPERBACK	
VP Planner Plus	129.00
PATTON & PATTON	
Flowcharting II Plus	139.00
PAUL MACE	
Mace Utilities	55.00
PEACHTREE	
Crmpite Accting W/Data Query	235.00
PERSOFT	
tz	259.00
Smarterm 240	205.00
PERSONICS	
Ultrasivision	79.00
See More 1-2-3	49.00
PETER NORTON	
Norton Utilities	59.00
Norton Commander	52.00
Norton Utilities Advanced	89.00
POLARIS	
Packrat	259.00
PRECISION SOFTWARE	
Superbase 4	409.00
PRIME SOLUTIONS	
Disk Technician Advanced	119.00
PROXIMITY TECHNOLOGY	
Choice Words	59.00

PUBTECH	
File Organizer	145.00
QUAD	
Copywrite	59.00
QUALITAS	
386 To The Max	60.00
QUARTERDECK	
Desqview	79.00
QEMM 385	37.00
REFERENCE	
Grammatik II	52.00
RIGHTSOFT	
Rightwriter	52.00
RIX	
Colorix VGA Paint	105.00
ROYKORE	
Opus One	275.00
SAMNA	
AMI	129.00
SANTA CRUZ OPERATIONS	
SCD Operating System 286	439.00
SCITOR	
Project Scheduler 4	429.00
SIERRA ON-LINE	
Leisure Suit Larry #2	32.00
Kings Quest IV	32.00
Space Quest III	39.00
SIMON & SCHUSTER	
Webster Prof Thesaurus	79.00
SOFTKLONE	
Mirror III	55.00
SOFTLOGIC	
Disk Optimizer	45.00
SOFTWARE DIRECTIONS	
Print Q	65.00
SOFTWARE MASTERS	
Flash	49.00
SOFTWARE PUBLISHING	
Harvard Graphics	279.00
PFS 1st Publisher	79.00
PFS 1st Choice	99.00
PFS 1st Graphics	89.00
Professional Write	139.00
SOLUTION SYSTEMS	
Brief	165.00
SPECTRUM HOLOBYTE	
Tetris	24.00
Falcon-AT	32.00
STSC	
Statgraphics	579.00
STORAGE DIMENSIONS	
Speedstar	35.00
SUBLOGIC	
Jet	32.00
Scenery Disks	Call
SYMANTEC	
Q & A	219.00
Timeline	369.00
Grandview	189.00
SYMSOFT	
Hotshot Graphics	149.00
SYSTEMS COMPATIBILITY	
Software Bridge	79.00
THREE D GRAPHICS	
Perspective Jr	99.00
TIMWORKS	
Publish It!	115.00
TRAVELING SOFTWARE	
Laplank III	65.00
Viewlink	89.00
TURBO POWER	
Turbo Bitree Filer	79.00
Turbo Professional	79.00
UNISON WORLD	
Printmaster Plus	32.00
VERSASOFT	
DB Man V	219.00
WHITE CRANE	
Brooklyn Bridge	75.00
PRIMETIME	
Primetime	65.00
WOLFRAM RESEARCH	
Mathematica 386	599.00
WORDPERFECT	
Word Perfect	239.00
Word Perfect Library	65.00
Word Perfect Network	349.00

WORDTECH	
Quicksilver Diamond	349.00
DBXL Diamond	145.00
XEROX	
Ventura Publisher	499.00
Xerox Presents	319.00
XOR	
NFL Challenge	59.00
XTREE	
Xtree Pro	69.00
ZSOFT	
Publishers Paintbrush	159.00

HARDWARE	
ACER	
Computers	Call
AST RESEARCH	
525/11 Enhanced	599.00
Six Pak Plus 64K	129.00
ATI	
VGA Wonder 256	335.00
BELKIN/DATASPEC	
Cables/Switchboxes	Call
CENTRAL POINT	
Copy II Option Deluxe	119.00
CURTIS	
Ruby Plus	65.00
ELGAR	
IPS 1100 Power Backup	979.00
EVEREX	
Internal 2400 Modem	149.00
Computers	Call
FIFTH GENERATION	
Logical Connection 512K	579.00
HAYES	
Smartmodem 2400	449.00
HEWLETT PACKARD	
Font Cartridges	Call
IBC	
AT Replacement Battery	19.50
INTEL	
Above Board Plus 512K	449.00
Coprocessors	Call
KENSINGTON	
Masterpiece Plus	109.00
KEYTRONIC	
KB101 Plus Keyboard	99.00
KYE	
Genius Mouse	54.00
LOGITECH	
Scanman PC	199.00
New Logimouse	89.00
MICROSOFT	
Bus or Serial Mouse w/Paint	109.00
MICROSPEED	
Fast Trap Serial	95.00
MOUSE SYSTEMS	
Bus or Serial PC Mouse II	89.00
NEC HOME	
Multisync 3D	699.00
ORCHID	
Pro Designer VGA Plus	409.00
PANASONIC	
KXP 1124 Printer	365.00
PARADISE	
VGA Plus	265.00
POLAROID	
EGA Palette	2399.00
PLUS	
Handcard 40	699.00
PRACTICAL PERIPHERALS	
2400 External Modem	179.00
SEAGATE	
Hard Disks	Call
SUMMAGRAPHICS	
Summasketch Plus 12x12	399.00
SYSGEN	
Bridge File w/adaptor	289.00
TOSHIBA	
Printers	Call
TOUCHBASE	
Worldport 2400 Modem	255.00
Worldport 2496 Fax Modem	499.00
VIDEO 7	
Vram VGA 256K	459.00

We ship to APO & FPO PO Boxes

WE WELCOME CORPORATE ACCOUNTS AND INTERNATIONAL ORDERS

FAX YOUR ORDER!
(818) 347-9977

► IMMEDIATE SHIPMENT ON PURCHASE ORDERS FROM GOVERNMENT AND STATE AGENCIES, CITIES, COUNTIES, SCHOOL AND UNIVERSITIES.

► Prices subject to change without notice and while stocks last. ► We Ship the latest versions. ► We accept Visa, Master card, American Express. ► 2% Surcharge on American Express. ► Please call (818) 347-9400 for an Authorization # for defective goods or your return will not be accepted. ► Due to copyright laws we cannot take back any software where the seal has been broken. ► \$5 minimum shipping per item, less on bulk orders. ► \$9 Blue Label shipping, \$3.50 C.O.D. charge. ► Heavier items are charged accordingly. ► We do not guarantee compatibility. ► Call for prices for any software item not included in this ad. ► Order desk open 7 a.m. to 5 p.m. (PST), Saturday 10 a.m. - 2 p.m. (PST). ► P.O. Box 10598, Canoga Park, CA 91309. Showroom: 7959 Deering Ave., Canoga Park, CA 91304. ► Customer Service 818 347 9400. General Office 347 7500.

ORDERS CALL 800 733 3888

Microcomputer News On-Line

In this fast paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE magazine, BYTE-week, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983
In NH 603-924-7681

ITEMS DISCUSSED

BRIEF 2.11\$195

UnderWare, Inc.
321 Columbus Ave.
Boston, MA 02116
(617) 267-9743
Inquiry 983.

ENPLOT MATDB

(not yet released)
Martin Heller & Co.
89 North Main St.
Andover, MA 01810
(508) 475-8088
Inquiry 984.

Hamilton C Shell 1.03\$395

Hamilton Laboratories
13 Old Farm Rd.
Wayland, MA 01778
(508) 358-5715
Inquiry 985.

is the extension?' A developer has to write these routines. Once we've got alternate installed file systems, we'll have to write a routine for each system. That's just not reasonable."

Nanian would also like a better debugger, something along the lines of the Borland Turbo Debugger with a mouse interface added. "Also, a version control program and a good profiler. Better printing utilities, also, like a spooler that works."

OS/2 Hardware

Finally, I asked the developers what hardware the average person needs to do real work with OS/2? Generally, they agreed that the more powerful, the better, but you don't need a 20-MHz 80386 to make headway. Hamilton uses a PS/2 Model 80 and insists that 8514 video is the only way to go. Heller also uses an 80386, a 20-MHz clone. On the other hand, Nanian used an 8-MHz AT to develop the first version of BRIEF for OS/2. ■

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

PC BRAND Chosen # 1 For Customer Service and Support.

"PC BRAND is the LL Bean of the personal computer mail order.

PC BRAND wants no unhappy customers, and it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies, Feb, 1989



PC BRAND

PC BRAND offers you more...

Welcome to PC Brand. Your *first* place to shop. Your *best* place to shop for top quality IBM compatible systems, custom configured to your exact specifications, and thousands of quality name brand peripherals and accessories.

Choose from over 10,000 items in stock... all at unbeatable prices!

Free Freight, Toll-Free Support, 5-Year Warranty and more...

Everyone promises you great service. We deliver the tangibles.

- Free freight • Fast delivery
- No credit card surcharges
- A 30-day Money-Back Guarantee on every system we sell
- Toll-Free Customer Service and Technical Support that will stay with you until your questions are answered and your problem is solved
- And our exclusive 5-Year Warranty on all PC Brand products, call for details.

Call PC Brand today.

For the best selection... the best products...at the best price, you can't do better than PC Brand.

Call PC Brand today!

TURN PAGE
FOR PC BRAND SYSTEMS
...AND NAME BRAND
PERIPHERALS

Circle 234 on Reader Service Card

Outstanding Quality

PC BRAND Chosen #1 For Customer Service and Support.

"PC BRAND is the LL Bean of the personal computer mail order...PC BRAND wants no unhappy customers, and it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies, Feb, 1989

PC BRAND

Your Best Choice
for Quality Systems
Toll-Free Support
Toll-Free Service
Free Freight
5-Year Warranty



PCV20 AD-II \$539

15 MHz Throughput in an XT. Norton SI 4.0
512K, 360K Drive, 84-Key Keyboard

Standard System Features:

- 10MHz Nec V20 CPU with 1.5 times the power of the 8088!
- 512K RAM standard. Expandable to 640KB
- One 360K Floppy Drive • 84-key AT Style Keyboard
- 8 Slots. Serial, Parallel, Game Ports, and Clock Standard
- AT Style Case with Keylock, Turbo, Power and Hard Drive LEDs.
- Accommodates up to 4 HH Mass Storage devices
- Set-up & Operating instructions.

Standard Pre-Built Configurations:

PCV20 AD-II With 512K, Hard Disk Drive, Monitor & Video Card						
Video	Drive	1 Floppy	2 Floppy	20MB	40MB-46MS	40MB-28MS
Mono		\$669	\$749	\$924	\$944	\$1077
RGB		\$819	\$899	\$1074	\$1094	\$1227
EGA		\$1024	\$1104	\$1279	\$1299	\$1432
VGA/Mono		\$859	\$939	\$1114	\$1134	\$1267

PC BRAND 286/12 \$845



Now Using C & T
"Neat" Chip Set

12 MHz Clock, Zero Wait Operation,
Norton SI 15.3 • Landmark™ Speed 15.1MHz
512K, 1.2MB or 1.44MB Drive, 101- Keyboard

Standard System Features:

- 80286-12 Processor Operating at 12MHz with Zero Wait States delivering 15.1MHz Effective Throughput
- 512K RAM expandable to 4MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller
- Enhanced 101-key AT Style Keyboard
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS with full MS/DOCS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full size 5 drive case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable
- Full or Mini Size Tower® Case

Standard Pre-Built Configurations:

286/12 With 512K, Hard Disk Drive, Monitor & Video Card					
Video	Drives	40MB-46MS 1:1 RLL	40MB-28MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-25MS 1:1 RLL
Mono		\$1295	\$1399	\$1625	\$1745
EGA		\$1644	\$1750	\$1985	\$2100
VGA 16bit		\$1759	\$1860	\$2095	\$2210
VGA/Mono		\$1526	\$1625	\$1860	\$1975

Unbelievable Price

PC BRAND 286/20 \$999

PC BRAND 386/SX-16 \$1099



Ideal Novell Server!

20 MHz Clock, Zero Wait Operation
NortonSI 23.0 • Landmark™ 26.7MHz
512K, 1.2MB or 1.44MB Drive, 101-Key-board

Standard System Features:

- 80286 Processor Operating at 20MHz w/Zero Wait States in interleave mode delivering 27MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full or Mini Size Tower * Case
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

286/20 w/512K, Hard Disk Drive, Monitor & Video Card							
Drives	40MB-40MS 1:1 RLL	40MB-28MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-28MS 1:1 RLL	150-17MS 1:1 ESDI	320-16MS 1:1 ESDI	
Mono	\$1455	\$1530	\$1730	\$1890	\$2496	\$2890	
EGA	\$1810	\$1885	\$2110	\$2245	\$2890	\$3245	
VGA 16 bit	\$1920	\$1995	\$2220	\$2355	\$3061	\$3355	
VGA/Mono	\$1685	\$1760	\$1960	\$2120	\$2726	\$3120	



16 MHz Clock, Zero Wait Operation
NortonSI 18.7 • Landmark™ 18.3MHz
512K, 1.2MB or 1.44MB Drive, 101-Key-board

Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 80ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays (Shown with optional Mini Size Tower * Case)

Options:

- Full or Mini Size Tower * Case
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

386SX-16 w/512K, Hard Disk Drive, Monitor & Video Card							
Drives	40MB-40MS 1:1 RLL	40MB-28MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-28MS 1:1 RLL	150-17MS 1:1 ESDI	320-16MS 1:1 ESDI	
Mono	\$1555	\$1630	\$1830	\$1990	\$2596	\$2990	
EGA	\$1910	\$1985	\$2210	\$2345	\$2990	\$3345	
VGA 16 bit	\$2020	\$2095	\$2320	\$2455	\$3161	\$3455	
VGA/Mono	\$1785	\$1860	\$2060	\$2220	\$2826	\$3220	

TURN PAGE FOR MORE PC BRAND SYSTEMS...
FOR NAME BRAND PERIPHERALS SEE OUR AD ON FOLLOWING PAGES...

To Order Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL. 60607 Int'l Fax# 312-226-6841 Int'l Voice# 312-226-5200. Open Mon thru Fri.: 8am to 6pm Central. MasterCard, VISA, Discover, Checks, & Approved P.O.s Accepted. Prices and specifications subject to change. Customer Service Inquiries Call: 1-800-662-SERV BYTE 14-9

Amazing Performance

"Faster Than a Speeding Bullet!"

Computer Shopper Cover Story Nov, 1988

"PC Brand offers the best low cost alternative around"

-PC Magazine Feb.14, 1989

PC BRAND 386/20 \$1649



20 MHz Clock, Zero Wait Operation
Norton SI 23.0 • Landmark Speed 26.1MHz
1024K, 1.2MB or 1.44MB Drive, 101-Keyboards

Standard System Features:

- Intel 80386 Processor Operating at 20MHz with Zero Wait States in interleave mode delivering 26.1MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 1 8Bit & 2 32/8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full or Mini Size Tower Case • 8MB 32Bit RAM Card Upgrade
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • Weitek Co-processor

Standard Pre-Built Configuration:

386/20 With 1024K, Hard Disk Drive, Monitor & Video Card						
Drives	40MB-28MS 1:1 MEM	71MB-18MS 1:1 MEM	110-28MS 1:1 RLL	150-17MS 1:1 ESDI	320-16MS 1:1 ESDI	
Video						
Mono	\$2155	\$2343	\$2464	\$3014	\$3564	
EGA	\$2458	\$2567	\$2757	\$3307	\$3919	
VGA16bit	\$2599	\$2708	\$2908	\$3458	\$4029	
VGA/Mono	\$2353	\$2463	\$2662	\$3212	\$3795	

PC BRAND 386/25 \$1899



25 MHz Clock, Zero Wait Operation
Norton SI 28.2 • Landmark Speed 33.6MHz
Norton SI 31.6 • Landmark Speed 43.5 w/Cache
1024K, 1.2MB or 1.44MB Drive, 101-Keyboards

Standard System Features:

- Intel 80386 Processor Operating at 25MHz with Zero Wait States in interleave mode delivering 34 to 44 MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 or Weitek Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit & 2 32Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- 32KB or 64KB Cache Processor • Weitek Co-processor • Tower Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • 8MB 32Bit RAM Card

Standard Pre-Built Configurations:

386/25 With Hard Disk Drive, Monitor & Video Card						
Drives	40MB-28MS 1:1 MEM	71MB-18MS 1:1 MEM	110MB-28MS 1:1 RLL	150-17MS 1:1 ESDI	320-16MS 1:1 ESDI	
Video						
Mono	\$2404	\$2679	\$2804	\$3459	\$3814	
EGA	\$2809	\$3034	\$3159	\$3814	\$4169	
VGA 16bit	\$2919	\$3144	\$3269	\$3924	\$4279	
VGA/Mono	\$2684	\$2909	\$3034	\$3669	\$4044	

CRT display is courtesy of RIX Softworks, Inc. Irvine, CA

Exceptional Support

386/33 CACHE \$2799

*Worlds Fastest
Personal Computer!*



33 MHz Clock, Zero Wait Operation
Norton SI 45.9 • Landmark 58.7 MHz w/32K or 64K Cache
1024K, 1.2MB or 1.44MB Drive, 101-Key Keyboard

Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating with Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385-33 Cache Processor with 32K 25NS Static RAM Standard, Field Upgradable to 64K
- 1024K RAM Standard Expandable to 16MB
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS With Full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design
- Full size case with 5 Disk Drive bays
(Shown with Optional Full Size Tower Case)

Options:

- Custom configurations w/Name Brand peripherals of your choice
- Weitek Co-Processor • Tower Case • Factory Ram Upgrades

Standard Pre-Built Configuration:

386/33 With Hard Disk Drive, Monitor & Video Card						
Drives	40MB-25MS 1:1 MEM	71MB-18MS 1:1 MFM	110MB-25MS 1:1 RLL	150MB-17MS 1:1 ESDI	320MB-16MS 1:1 ESDI	640MB-17MS 1:1 ESDI
Vides						
Mono	\$3354	\$3579	\$3694	\$4359	\$4714	\$6399
EGA	\$3709	\$3934	\$4049	\$4714	\$5069	\$6754
VGA 16 bit	\$3819	\$4044	\$4159	\$4824	\$5179	\$6864
VGA/Mono	\$3584	\$3809	\$3924	\$4589	\$4944	\$6629

+ Norton SI 3.0

CRT display is courtesy of RIX Software, Inc. Irvine, CA

PC BRAND

Your Best Choice
for Quality Systems
Toll-Free Support
Toll-Free Service
Free Freight
5-Year Warranty

LCD PORTABLES from \$1745

286 & 386 Systems
• 512K, 1.2MB Drive,
Combo Controller,
LCD Backlit Display
Optional EGA
Plasma Display



All feature:

- 640 x 400 Backlit Supertwist LCD by TOSHIBA (EGA Plasma version Available)
- Monographic & Color operating modes, EGA Optional
- External Monitor Support, External Keyboard Port.
- 5 expansion slots (3 long, 3 short) • 86-key keyboard.
- Accommodates two 5.25" or 3.5" Floppy/Hard Disk Drives
- 200 Watt 112/220 Autoswitch Power
- Serial, Parallel, Game Port, Clock/Calendar Standard

Standard Pre-Built Configuration:

Portable System Processor and Drive Options					
Drive \ CPU	286-12	286-20	386/SX-16	386-20	386-25
1 Floppy	\$1745	\$1950	\$2100	\$2600	\$2900
20MB	\$2055	\$2240	\$2390	\$2890	\$3190
40MB	\$2175	\$2380	\$2530	\$3030	\$3330
71MB	\$2375	\$2580	\$2730	\$3190	\$3530
150MB	\$3125	\$3330	\$3480	\$3960	\$4280

*386/20 and 386/25 Systems come with 1024K.

SAVE ON NAME BRAND PERIPHERALS... SEE OUR AD ON FOLLOWING PAGES...

To Order Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392



PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Int'l Fax# 312-226-6841 Int'l Voice# 312-226-5200. Open Mon thru Fri.: 8am to 6pm Central. MasterCard, VISA, Discover, Checks, & Approved P.O.s Accepted. Prices and specifications subject to change. Customer Service Inquiries Call: 1-800-662-SERV BYTE 14-9

Shop PC Brand Today.

LAPTOP COMPUTERS*

NEC	
Multispeed HD	\$1995
Ultralite w/1MB	Call
TOSHIBA	
1000; 512K, 80C88, 1 FDD	\$699
1600 BACKLIT, 80C86-12, 1MG, 20MB HD, FDD	3240
3100E GAS PLASMA 80C86-12, 1MB, 20MB HD, FDD	2805
3200; EGA, 80286-12, 1MB, 40MB HD, FDD	3595
5200/40 VGA, 80386-20, 2MB, 40MB HD, FDD	6115
ZENITH	
Supersport 286, 20Meg	Call
Supersport 286, 40Meg	Call
Supersport 88, 20Meg	Call

Other Makes and Models Call

MONITORS*

MAGNAVOX	
7BM623 12" Amber TTL Monochrome	\$79
7BM749 14" VGA White Flat Screen	135
CM8762 13" RGB (640x200) Color	230
CM9043 13" EGA (640x400) Color	339
9CM08214" VGA (640x480) .31DP Color	415
MITSUBISHI	
XC-1410 14" EGA (640x350)	\$369
AUM-1381 14" Diamond Scan	499
HL6605 15" CAD Monitor	1295
HL6905 19" CAD Monitor	2325
NEC	
Multisync 2A 14" (800x600) VGA	\$499
Multisync GS 14" Mono	249
Multisync 3D 14" (1024x768) EGA/VGA	679
Multisync XL 19" (1024x768)	2150
PRINCETON GRAPHICS	
Max 15 15" Multifreq. Monochrome	\$249
Ultra 16 16" Multifreq. EGA/VGA	879
Ultrasync 14" Multifreq. EGA/VGA	520
PRINCETON PUBLISHING LABS	
Multiview 15" Full Page Monitor w/adapt.	\$890
RELISYS (Top Rated by Infoworld and PC World)	
RE-9513 14" VGA(720x480).31DP Color	\$369
SEIKO	
CM1430 14" (1024x768) Multifreq	\$549
SONY	
CPD1304 14".25DP(1024x768)Multiscan	\$689
CPD1302 13" Multiscan	610
CPD1320 13" (640 x 480) VGA	485
ZENITH	
ZCM-1490 14" Flatscreen Enhanced	\$619

NEC 14" Multisync 2A

800x600 Resolution Super VGA Monitor



\$499
Freight Free!

MODEMS

A.T.I.	
2400ETC Internal Modem w/MNP5	\$165
HAYES	
1200/2400 External	\$285/429
PC BRAND 100% Hayes Compatible!	
1200 Baud Internal w/Bitcom	\$49
1200 Baud External	70
2400 Baud Internal w/Bitcom	89
2400 Baud External	129
US ROBOTICS	
Courier HST/9600	\$599
Courier V.32 9600 Baud Ext.w/MNP5	889
Courier HST Dual Standard Modem	995

Internal Modems

100% Hayes Compatible. Free Software!

1200BPS	\$49	
2400BPS	\$89	

TAPE BACK-UP SPECIAL

80/40MB Internal Tape Back-Up*

\$279



Uses DC2000 Series Micro Cartridges
*When used with CMS Backup Software

VIDEO CARDS

ATI	
EGA Wonder	\$229
VGA Wonder w/256K	315
NEC	
1024-256	Call
MVA 1024	Call
PARADISE	
Autoswitch 480 EGA	\$179
VGA+	265
VGA+ 16 16 Bit Version NEW	299
VGA Professional w/512K	399
PC BRAND	
Mono Graphics w/Printer Port	\$55
Color Graphics w/Printer Port	49
EGA (640x480) Autoswitch	135
VGA	179
VGA 16 Bit	220
VIDEO SEVEN	
Vega Deluxe	\$209
Vega VGA	255
Fastwrite VGA	279
VRAM VGA	450

DISK DRIVES

FLOPPY DISK DRIVES:

360K 5.25" HH Black	\$75
720K 3.5" HH w/5.25" Mounting	80
1.2MB 5.25" HH Grey	85
1.44MB 3.5" HH Grey w/5.25" Mounting	95

PS/2 FLOPPY DRIVES

CMS 5.25" 360K/PS/2 Ext.Floppy	\$199
--------------------------------------	-------

HARD DISK DRIVES:

OMEGA

B120I Single 5.25" 20MB Int.	\$765
B144I Single 5.25" 44MB Int.	995
B244X Dual 5.25" 44MB Ext.	1995

MINISCRIBE

40MB 25MS M3053	\$419
71MB 18MS M3085	595
150MB 17MS M3180E ESDI 1/2 Hgt.	1295
320MB 16MS M9380 ESDI Full Hgt.	1550
640MB 16MS M9760 ESDI Full Hgt.	3400

PRIAM

130MB 20MS ID130AT Full Height	\$1395
160MB 28MS ID160EC ESDI w/CNTRL 1650	
330MB 20MS ID330PS INT. for PS/2	1895
330MB 20MS ID330EC ESDI w/CNTRL 2250	

SEAGATE

20MB 65MS ST225 w/XT Controller	\$249
20MB 65MS ST225	209
20MB 35MS ST125 w/XT Controller	299
20MB 35MS ST125	245
30MB 65MS ST238 w/XT Controller	269
30MB 35MS ST138	310
30MB 35MS ST138 w/XT Controller	355
40MB 28MS ST251-1	349
40MB 24MS ST151	419
80MB 28MS ST4096 Full Height	590

TOSHIBA

60MB 25MS MK134 RLL	\$429
110MB 25MS MK72 RLL	619
156MB 23MS MK-156FA ESDI Full Hgt.	1095

If the drive you require is not listed here please contact our sales department for a quote!

TAPE BACKUPS

60MB Archive Int. or Ext. w/Cntrl.	\$590
60MB Maynard Maynstream Portable	889
40MB Irwin Internal	415
80MB Irwin Internal	509
150MB Archive Internal	925

PC BRAND 16Bit VGA

Ultra Hi-performance VGA Card, compatible w/ VGA, EGA, monochrome, and multisync monitors, Analog and Digital output, upgradable to 512K, resolution to 1024x768, many software drivers



\$220

Save Time. Save Money.

SCANNERS/DIGITIZERS

Complete PC Handscanner.....	\$189
Complete PC Half Page Scanner.....	165
Complete PC Full Page Scanner	575
DFI HS3000 Plus Gray Scale Hand Scan.....	219
Hewlett Packard Scanjet Plus	Call
Microtek MSF300G	1785
Microtek MSF300Q w/64 Grey Level	1495
Summasketch 12X12	378
Summasketch 12X18	635

PRINTERS*

BROTHER

HL 8E Laser (HP LJ/LJ, HPGL) \$1875

EPSON

LX810 180/30.....189 LQ510 180/60.....329

FX850 330/88... 345 FX1050 264/54.....445

LQ850 330/88...Call LQ1050 330/88...Call

LQ950 264/88...Call LQ2550 400/108..Call

KODAK DICONIX

150Plus 150/50...315 300WP 310/73439

HEWLETT PACKARD

Deskjet Plus 710 Laserjet II 1720

LASER JET ACCESSORIES

CPI Superfont Cart. adds 150 fonts..... 295

CPI 1MB Memory Kit. 319 CPI 2MB MemoryKit. 549

PRINCETON PUBLISHING

PS-388 Postscript board 2250

Adds Postscript to your HP LASERJET!

NEC

P2200 170/55 335 P9XL 400/140 1030

P5200 265/90 530 P5300 Wide 675

LC890 Laser 3190 LC890XL Laser .. 4495

OKIDATA

ML320 300/62 .. 345 ML321 300/62 479

ML390 270/90 .. 475 ML391 270/90 655

ML393 450/120..995 ML393C 450/120..1069

PANASONIC (New Models Listed)

1180 192/38 189 1191 240/48 245

1124 192/63 339 1592 220/38 419

1595 290/51 469 1524 240/80 545

TOSHIBA

321SL 216/72... Call 341SL Wide Carr ... Call

351SX 360/120..Call Express 311 Call

EPSON FX 1050

15" Carriage 264 CPS Draft 54 CPS Letter Quality



\$445

Other Epson models comparably discounted

PC BRAND-YOUR #1 LAN SOURCE !



Call for Custom Server Configurations

NOVELL NETWORKING

GATEWAY (PC Magazines Editors Choice)

G/ Ethernet AT \$435

G/NET 269

G/ Ethernet for PS/2 Call

NOVELL

4 User ELS 286 Level 1 \$479

8 User ELS Level II 939

Advanced Netware 286 Latest Version 1850

SFT Netware 286 Latest Version 2850

Netware 386 Call

Disc Coprocessor Board 379

NE2000 Ethernet File Server Board 399

NE1000 Ethernet Card 299

STANDARD MICRO

PC130 Arcnet Board \$135

PC260 Twisted Pair Arcnet Card 130

PC500-WS 16 Bit Work Station Board 375

PC550 FS 16 Bit Twisted Pair File Server Bd. 495

PS110 Arcnet Board for PS/2 439

PC500-FS 16 Bit File Server Board 449

ARCNET Passive Hub 72

ARCNET Active Hub 359

TIARA (Lowest Priced Lincards)

Lincard /A 8 Bit 1/2 Slot Arcnet Board \$89

Lincard /A Arcnet Board for PS/2 279

Lincard /E 8 Bit Ethernet Card 199

Lincard /E Twisted Pair Ethernet Card 329

8 Port Active Hub 285

4 Port Passive Hub 49

WESTERN DIGITAL

Ethercard+ w/Novell Drivers \$219

Ethercard+ Twisted Pair Ethernet Board.....319

Ethercard+ A for PS/2 320

UNINTERRUPTABLE POWER

ELGAR

IDS1100 1000 Watt UPS Call

IPS 500 Watt UPS Call

PTI

DataShield Turbo/2 625 Watt 595

PC BRAND™

Free Freight

30-Day Money-Back
Guarantee

Toll-Free Service
and Support

No Credit Card
Surcharges

We carry over 10,000 different hardware and software products. Call for prices on products not listed.

SOFTWARE - TOP 10

ALDUS Pagemaker \$479

ASHTON-TATE DBASE IV 449

BORLAND Quattro 149

CENTRAL POINT PC Tools Deluxe 42

FUNK SOFTWARE Sideways 42

LOTUS 123 Latest Version 295

MICROSOFT Windows 386 125

MICROSOFT Word 5.0 205

WORD PERFECT Word Perfect 5.0 220

XEROX Ventura Publisher 2.0 479

SERIAL MOUSE

High Resolution (250DPI) Microsoft Compatible



\$35

CO-PROCESSORS/BOARDS

INTEL

Aboveboard Plus w/512K \$419

Aboveboard Plus I/O 512K 469

Inboard 386 for PC w/IMB 595

Inboard 386 AT 859

8087-2 139 8087-1 189

80387-16 369 80287-10 259

80387-25 559 80387-20 449

80387-SX 359 80387-33 795

*Oversized Monitors, Laser Printers, Laptops and Plotters are excluded from free freight.

To Order Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392



PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Int'l Fax# 312-226-6841 Int'l Voice# 312-226-5200. Open Mon thru Fri : 8am to 6pm Central. MasterCard, VISA, Discover, Checks, & Approved P.O.s Accepted. Prices and specifications subject to change. Customer Service Inquiries Call: 1-800-662-SERV BYTE 14-9



NEW YORK



HONG KONG



SYDNEY



LONDON

How Telebit modems can improve your Foreign Exchange.

When your data transmissions demand reliable connections, demand a Telebit® high-speed, dial-up modem.

Because only Telebit modems can handle the critical demands of international data transfer. Plus deliver the precision that businesses need. Like transferring stock quotes — where time and accuracy can make the difference between making a killing and taking a bath. And a misplaced decimal point can spell disaster.

Which is why one of the major international stock exchanges switched from other modems to a Telebit solution. Thanks to our unique technology they can now send crucial financial figures at speeds never before possible. With complete accuracy.

Imagine what Telebit modems will do for you.

On demanding business applications from

payroll information to business finances. In all industries from construction to insurance.

All with our full family of high-speed modems. From 9600 bps to 19,200 bps, including V.32.

To improve your international communication and receive a free application brochure, call 1-800-TELEBIT or 415/969-3800.

Or write: Telebit, 1345 Shorebird Way, Mountain View, CA 94043.

Because no one gets the message through like Telebit.

Circle 286 on Reader Service Card

© 1989. Telebit is a registered trademark of Telebit Corporation.



TELEBIT®
When connectivity counts.



THE MAILMAN COMETH

LAN E-mail applications take different approaches to E-mail delivery

In previous columns, we've examined LAN operating systems and the Open Systems Interconnection (OSI) model. But up to now we've been intentionally vague about LAN applications and how they work. This month we'll remedy that omission by looking at E-mail, one of the most natural and common LAN applications, and compare two good LAN E-mail systems, cc:Mail's cc:Mail and Da Vinci Systems' eMAIL. Both packages can run on many different LAN operating systems, including Banyan's VINES, IBM's PC LAN, 3 Com's 3+, and Novell's NetWare.

Regardless of the LAN operating system on which they run, LAN mail packages offer the same basic services as mail systems on larger hosts—the same services you find today on BIX or MCI Mail, or in a mainframe mail package. But you can do more than send and receive messages. You can create and maintain mailing lists, reply to messages, forward messages, and file important messages for later use.

The main differences between microcomputer-based mail systems and their earlier counterparts lie in the interface they provide. While earlier packages were typically line-oriented, microcomputer-based mail systems offer full-screen interfaces.

Where the Mailboxes Are

To provide its services, every E-mail package must face three main issues: how to store messages, how to deliver them, and how to keep them secure.

There are two main approaches to



message storage: distributed and centralized. A distributed mail system is much like the one that brings mail to your home; the mail comes to you. A centralized system is more like a post office box; all the mail is in individual compartments at a centralized location, and you have to go there to get it.

cc:Mail follows the centralized approach. It stores all the messages for a LAN and its users in a single database file. That file must reside in a location that is accessible to all those users, such as on a dedicated server.

cc:Mail manages that file in the same way that a multiuser database would. It uses DOS file- and record-locking primitives, which the underlying LAN must support, to let many users read from and write to that file concurrently. cc:Mail does not talk directly to NetBIOS or any other lower level.

In addition to the central message file, cc:Mail maintains, in the same location, a pointer file for each user. Each record

in a user's pointer file contains one logical pointer into the message file for each of that user's mail messages. cc:Mail also uses record-locking primitives to manage these files, because many users could need the same pointer file simultaneously. For example, user A could be reading messages while user B is sending him or her a new message. Both would need access to the same pointer file at the same time.

Perhaps the biggest advantage of centralized message storage is that it can reduce the space that mail messages consume. A system with centralized storage needs to store only one copy of each message, even if that message was sent to 10 different people. Instead of 10 full copies of the message, a single copy exists in the central file, with a pointer to it in each of the 10 users' pointer files.

The drawback to this approach is that it brings with it all the concurrency problems of any multiuser database. If too

continued

many users try to read from and write to the central file simultaneously, for example, performance can suffer.

The Distributed Approach

The eMAIL package, by contrast, takes a more distributed approach. It still has a central "mailroom" directory—usually \EMAIL\MAILROOM on the server—where it stores messages awaiting delivery. It uses that mailroom, however, only as a staging place. Before a user ever sees a message, eMAIL moves it from the mailroom to a file in that user's own mail directory. Each user's mail directory contains one file for each of that user's messages.

The mail directories for all users typically reside in a central place; by default they are subdirectories of \EMAIL\MAILBOX on the file server. They do not, however, have to be there. You can move your own mail directory wherever you want.

This approach can consume more space than cc:Mail's message database; sending a message to 10 users creates 10 copies of that message, one in each recipient's mail directory. It is simpler to implement the distributed approach, however, because it requires only file-locking operations. Record locking is not necessary because each file contains only one message. eMAIL also does not require NetBIOS. All it needs is the ability to share and lock the mail files.

By requiring only file-locking operations, eMAIL can work on some low-end LANs, such as LANLink from The Software Link, on which cc:Mail and other mail systems can't run.

Special Delivery

In addition to storing messages in a particular way, a mail system must have a way to get those messages to their storage locations. Many minicomputer and mainframe mail systems use a single-server process to solve this problem. That process manages the mail in much the same way that a database server manages a central database. LAN mail systems, however, typically avoid the single mail server process, primarily because of a desire for portability.

A central mail server would have to run on a central machine, which on a LAN could be executing any of several different LAN operating systems. LAN mail vendors would have to write one mail server for each LAN operating system that they wanted to support. While some mail vendors are considering this approach, it could be expensive. They would have to write different mail

ITEMS DISCUSSED

cc:Mail LAN Package 3.0

- 25-mailbox, one-server license (includes DOS user interface)\$695
- Unlimited additional mailbox license for same server.....\$595
- Macintosh user interface.....\$495

cc:Mail, Inc.
385 Sherman Ave.
Palo Alto, CA 94306
(415) 321-0430
Inquiry 1079.

eMAIL

- Five-user, one-server license
 - With DOS user interface ..\$295
 - With Microsoft Windows user interface.....\$445
- Unlimited user, one-server license
 - With DOS user interface ..\$995
 - With Microsoft Windows user interface..... \$1195

Da Vinci Systems Corp.
P.O. Box 5427
Raleigh, NC 27650
(919) 839-2000
Inquiry 1080.

servers for the very different architectures of such LAN operating systems as NetWare, Microsoft's LAN Manager, VINES, and CBIS's Network-OS.

Minicomputers and mainframes also have the advantage that interprocess communication between the mail server process and the message sender is usually straightforward. On a LAN, however, interprocess communication between the mail server machine and the sender's machine requires more network services than simple file and record locking. By requiring interprocess communication, a mail vendor would stop its product from being able to work on many low-end LANs.

Instead, all the LAN mail systems that we've encountered avoid the mail server process and make each user act as his or her own mailman.

In eMAIL, a "dispatcher" delivers each user's mail. When you run the eMAIL program, it automatically starts up the dispatcher executable file (by default, DSDISP.EXE) as well. When you want to send a message, the main eMAIL program hands that message to the dispatcher for delivery. The dispatcher also gets your incoming mail.

Da Vinci Systems delegated all of eMAIL's mail delivering and receiving to a dispatcher program to insulate the

main program from having to deal with the peculiarities of various mail systems. This makes it possible to provide different dispatchers for different mail systems. Da Vinci Systems offers a version of eMAIL whose dispatcher uses Novell's MHS (for Message Handling Service) to store messages.

Regardless of the dispatcher you use, the main program stays the same. In terms of the OSI model, the main program operates at the application layer, while the dispatcher works at the presentation layer. By so segmenting these two programs, Da Vinci Systems will be able to provide an eMAIL dispatcher that directly communicates with mail systems that obey the X.400 mail standard when such systems become more widespread.

cc:Mail also makes each user's mail program deliver that user's messages, but it integrates the mail delivery services tightly with the main user program. The mail program places mail messages directly into the central mail database; the user-interface part of that program is essentially a front end to a dedicated database application. While cc:Mail can also link its package to X.400 hosts, this design will force the firm to use an X.400 gateway to establish such connections.

Mail Fraud

The final major problem confronting every E-mail system is how to keep mail messages secure. Every user's mail should be safe from tampering.

The need for such security is one of the main reasons why mail systems on larger hosts use a central mail agent. Without such an agent, every user must have at least write access to the mail file to be able to send messages. With a central mail process, only that process needs to have write access to the mail file.

Because cc:Mail uses a single-message database, each user must have both read and write access to that database file. cc:Mail encrypts its database so that users cannot easily read the messages in it, but there's no foolproof way to stop a malicious user from modifying that file.

cc:Mail does prevent users from deleting that file if the underlying LAN operating system offers appropriate file protections, such as those that NetWare provides. cc:Mail's main way of protecting the message database is a simple one: It hides the mail files so that they don't show up in directory listings.

eMAIL's individual mail files make for a more secure system. When a user sends a message, his or her dispatcher

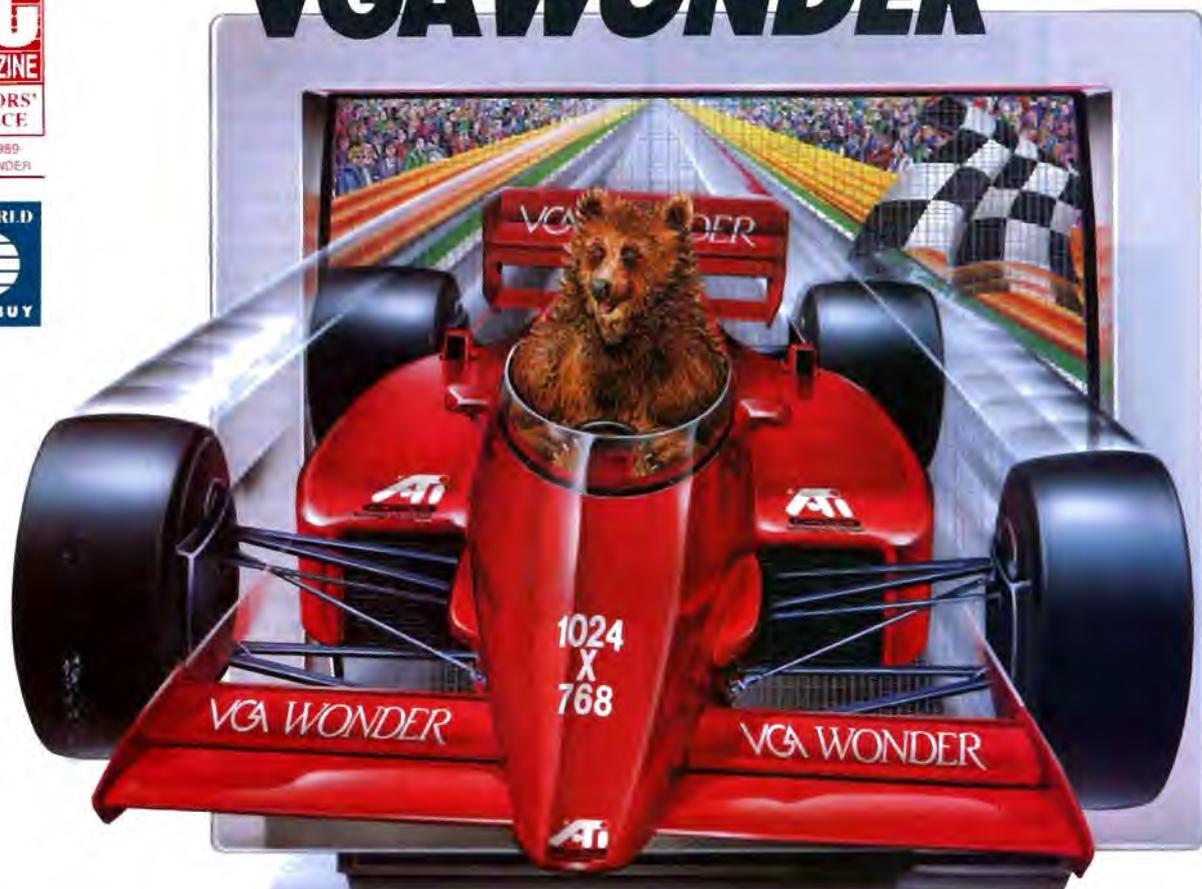
continued



July 1989
VGA WONDER



VGA WONDER



FASTER THAN THE AVERAGE BEAR

Are you asking yourself what a bear has to do with super speed, remarkable resolution and fabulous colors? We did, too. How can anyone bear to work with less than incredible speed, we asked ourselves. How can anyone bear to work without extraordinary resolution? Bear to work with less than 256 spectacular colors? We got so beared out, we decided to share one with you. Along with the bear facts about ATI's award-winning board.



Such as:

- high resolution 800x600 and 1024x768 graphics
 - fast 16-bit bus support
 - 100% register-level compatible in VGA*, EGA*, CGA*, MDA*, and Hercules* modes
 - analog and digital monitor support
 - easy, switchless installation
 - high resolution and 132 column drivers
 - Microsoft* compatible bus mouse and mouse port included
 - available in 256K and 512K versions
- Oh, and bear this in mind - when it comes to VGA WONDER*, you'll be getting a honey of a price!

For more information, contact your supplier or

ATI Technologies Inc.
3761 Victoria Park Avenue
Scarborough, Ontario
Canada M1W 3S2
Tel: (416) 756-0718
Fax: (416) 756-0720



Technology you can Trust.

NEW! REAL-TIME MONITORING & CONTROL

MENU-DRIVEN, EASY-TO-USE
STAND-ALONE COMPUTER

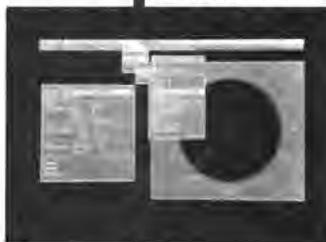
The stand-alone SOLUS™ computer connects to an IBM PC's RS-232 port, and provides 36 digital/analog I/O channels.

Menu-driven operation and a large graphics library make it easy to create monitoring and control applications. Use modems to remote locations. And daisy-chain up to 256 SOLUS computers.

For details or to order, call toll-free.

(800) 247-5712

In Oregon
(503) 635-3966



Only

\$895

VISA/MC/
AMEX
accepted.
Software
additional.

SOLUS™

PERSONAL CONTROL COMPUTER™



TMI, inc.
4000 Kruse Way Place, 2-120
Lake Oswego, OR 97035
FAX (503) 635-3004

386SX Performance IS as Easy as π

Upgrade to 386SX Power with
2 MB Ram for only \$795.00!

- Fits XT, Baby or Full AT's and Towers
- 387SX and Shadow BIOS Support
- Your choice of Award™ or Phoenix™ BIOS
- SXD (4 MB DIP) or SXS (8 MB SIMM) model
- Three year parts & labor warranty
- 45 day trial offer period
- 386DX motherboards, RAM, Drives, Cases, P/Ss, and Add-in Cards
- Custom full systems ARE available

Information: 804-978-3917



**Pi Computer
Corporation**

Your Best Value In Motherboards Since 1983

1030 Earlysville Forest Drive, Earlysville, VA 22936
Fax: 804-978-3906 Orders: 800-666-9248
Visa, MC and AMEX Accepted

© 1983 Pi Computer Corp

program puts that message in the central mailroom directory. If there are no other messages in the mailroom for that user, the dispatcher creates a file whose name is a hash value plus the extension .CNT. The hash value comes from a mailroom file, NAMES.DAT, that contains an eight-character hash value for each user. Each user's .CNT file contains the number of messages for that user. The dispatcher encrypts the message itself and then stores that message in another file whose name is the same hash value plus an extension that indicates the message's number. eMAIL can also send a notification to the recipient's screen that a new message has arrived.

When the recipient starts eMAIL, his or her dispatcher program checks if there is any mail in the mailroom. If messages are waiting, the dispatcher gets the message files, decrypts them, changes them into a form suitable for viewing, and moves them to the user's mail directory. This design ensures that only the owner of a mail file needs to have any access to that file. Each user's dispatcher, of course, must also be able to write into and read from the mailroom directory. eMAIL can limit, where possible, the dispatcher's rights to just those two. On NetWare, for example, each dispatcher receives only create access, not full write access, to the mailroom directory. Which users have read access to the mailroom is not a problem because the messages are encrypted.

Beyond the Basics

We've only scratched the surface of the many features that these two products offer. Both, for example, can use gateways to transfer mail to other LANs.

cc:Mail in particular excels at environments with many LANs and many different LAN architectures. It comes in both Macintosh and PC versions; Mac cc:Mail stations need only be able to access the same message and pointer files on the server. cc:Mail also can use gateways to link to other mail systems, such as Western Union's EasyLink, IBM's PROFS, and Digital Equipment Corp.'s mail systems. ■

Mark L. Van Name, a BYTE consulting editor, and Bill Catchings are independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Now Available
Activator/M™
with
Programmable
Memory



Natural selection provides unique passive protection for the porcupine.

The Activator - Natural Selection For Software Protection



Inventor and entrepreneur Dick Erett explains how "The Activator" provides sane protection for your intellectual property.

"In any industry, just as in nature, the process of natural selection raises one solution above another. Natural selection is the most elegant of engineers.

In the area of software protection The Block has been selected by the marketplace as the solution that works. Over 500,000 packages are protected by our device.

For the past 4 years our philosophy has been: 'You have the right and obligation to protect your intellectual property.'

A New Ethic For Software Protection

In allowing end-users unlimited copies of a software package and uninhibited hard disk and LAN operation, The Block has created a new ethic for software protection.



By removing protection from the magnetic media we remove the constraints that have plagued legitimate users.

They simply attach our key to the parallel port and forget it. It is totally transparent, but the software will not run without it.

A New Technology For Software Protection

Our newest model, The Activator, builds on our current patented design, and establishes an unprecedented class of software protection.

We have migrated and enhanced the circuitry of The Block to an ASIC (Application-Specific Integrated Circuit) imbedded in The Activator.

This greatly improves speed and performance, while reducing overall size. Data protection can also be provided.

Programmable Option

The Activator allows the software developer the option to program serial numbers, versions, or other pertinent data known only to the developer, into the circuit, and access it from the program.

Once you program your part of the chip, even we have no way to access your information.

The ASIC makes emulation of the device
Circle 265 on Reader Service Card

virtually impossible. It also presents an astronomical number of access combinations.

Full 100% Disclosure

Since The Activator is protected by our patent we fully disclose how it works. Once you understand it, endless methods of protection become evident.

Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.



We never cramp your programming style or ingenuity. Make it as simple or complicated as you desire.

Let us help safeguard what's rightfully yours. Please call today for additional information or a demo unit. *It's only natural to protect your software.*"

1-800-333-0407 ext.105
In Connecticut 203-329-8870
Fax 203-329-7428



870 High Ridge Road
Stamford, CT 06905



Mainframe-style connectivity challenges LANs

Howard Eglowstein
and Stanford Diehl

Now that the 80386 microprocessor, with its virtual 8086 mode, can supply the necessary horsepower, multiuser systems are emerging from hibernation. They're more compatible with DOS than ever before, loaded with new features, and ready to challenge LANs.

Multiuser operating systems that replace or extend MS-DOS aren't new, but they have caught on only recently. In the past, available hardware could not handle multiple DOS sessions effectively, and many users found the notion of a shared CPU unacceptable.

Those barriers are breaking down. Increasingly, users join microcomputers in LANs to pool hardware, software, and information. An irony not lost on the vendors of multiuser operating systems is that LAN connectivity emulates capabilities that are intrinsic to a multiuser system.

Products for this focus all emulate DOS as their primary function and support standard DOS applications on standard serial terminals. We evaluated four such systems: 386/MultiWare from Alloy Computer Products, Concurrent DOS from Digital Research, PC-MOS from The Software Link, and VM/386 from Intelligent Graphics (see table 1). We configured each system much as you'd configure a LAN and ran the same performance tests we use with LANs (see "Battle of the Network Stars," July

The Multiuser Solution

BYTE). In addition to evaluating the systems on their own merits, we assessed how they are and are not appropriate substitutes for a LAN.

Variations on a Theme

To appreciate the benefits of a multiuser system, it helps to understand how multitasking, multiuser, and network environments differ. Multitaskers can load several programs into memory and rapidly switch from one to another. The simplest form of multitasking under DOS is the TSR utility program. Such programs—Borland's SideKick is a noted example—lie dormant in memory until activated by a hot key. More sophisticated multitaskers, such as Microsoft Windows and Quarterdeck's DESQview, can run several programs concurrently. You can, for example, perform a lengthy database search as a background task while editing a document in the foreground.

With a TSR utility program, you could even run two word processors at the same time, but under a multitasker, they would have to take turns using the screen and keyboard. It would be great to connect a second screen and keyboard to the system and let two users work at once. That's where multiuser operating systems come in. These systems are multitaskers that have the added capability to assign an external terminal to each program.

A single 80386-based computer, simple cabling, and standard terminals can do much the same job as a LAN. A LAN just gives separate computers common resources like disk drives and printers. But that requires sophisticated control mechanisms to prevent the multiple copies of DOS—one per workstation—from fighting over resources that each thinks it owns exclusively.

The multiuser solution is naturally superior to a LAN in this respect. A single operating system is in charge. It owns and can effectively manage the resources made available to multiple users.

Of course, there's always a catch. When you're not using the disk system, you're using the CPU. On a LAN, each user has his or her own CPU. The multiuser environment requires that you share the CPU with a number of other users, perhaps as many as 24. Simple math tells you that a 25-MHz processor split 25 ways would be, from a user's perspective, a 1-MHz processor. Happily, the performance is much better than that, thanks to the creative efforts of software designers.

A multiuser system isn't the answer for a group of software developers who need to test programs on real DOS machines, not virtual DOS tasks. Nor is it suitable for a group of high-powered financial analysts who run lots of CPU-intensive simulations. It may work well, though, for an office in which the mix of applications tends toward word processing and data entry. Here, a network may be overkill. Rather than giving everyone an XT- or AT-class machine to do word processing or database management, it might be better to invest in one expensive 80386 system and use terminals and multiuser software to turn it into a flock of virtual 8086s.

There's no reason why your multiuser workgroup can't peacefully coexist with a LAN. If the 80386 host computer is connected to a LAN, all the users it supports automatically share the LAN resources that are available to the host. Moreover, multiuser systems typically deliver multitasking at the terminal end, so you're not forestalling that option, either.

The Science of Multitasking

The host computer in a multiuser environment works much harder than the file server on a LAN. The file server provides a common file system, but it leaves the individual workstations to do their own computing. The multiuser host, on the other hand, divides its time among all the users it supports; it actually runs



The workstations, from left to right: WY-60, Link MC5, WY-150, Kimtron KT-70.

their applications. It must also provide DOS services to each user.

DOS is a *nonreentrant* operating system. When a DOS function is in progress, you can't interrupt it and execute another. To transform DOS into a multi-user system, you must do one of two things: make DOS reentrant, so that multiple users can share its code concurrently, or arrange for each user to get his or her own private copy of DOS.

PC-MOS and Concurrent DOS adopt the former technique. They replace DOS and the BIOS with code that is fully reentrant. VM/386 takes the other tack—it gives each user a copy of DOS and the BIOS. 386/MultiWare combines the two strategies—tasks share a reentrant BIOS, but they have their own copies of DOS (well, for the most part; a small part of DOS is shared).

Which technique is best? PC-MOS and Concurrent DOS require less memory for each task, but software compatibility depends on the correctness of their rewritten DOS functions. VM/386 and

386/MultiWare need more memory for each task, but those tasks run under genuine DOS.

Despite these differences, all the systems ultimately do the same thing. A multitasking kernel allocates a blob of memory for each task. It cycles through the list of tasks, mapping task data into active memory and passing control to the task for a discrete *time slice*. When an application's time is up, the kernel regains control and passes it to the next program.

Operating systems handle this task-switching in subtly different ways. Those that give each task lots of tiny slices appear to run more smoothly than systems that let each task run a little longer, but they accomplish somewhat less total work because they spend more time switching. With any of these systems, you can tune the time slice (and associated task priority) to maximize throughput for your mix of applications.

Time slices are integer multiples of some basic unit of duration. PC-MOS uses the standard system clock tick of 55

milliseconds. Each task's slice is 1 tick long, and each task normally executes with equal priority. There are 18 ticks in a single second; with five tasks active, each task can therefore expect to get three or four slices. Concurrent DOS uses a system tick of $16\frac{2}{3}$ ms. With five active tasks, each gets 12 slices per second. The system does the same amount of total work (minus any switching overhead) but appears more responsive. VM/386 provides time slices in 1-ms increments, the minimum slice being 6 ms. Its System Resource Manager dynamically allocates time slices as a function of task activity. In this respect, VM/386 is self-tuning. 386/MultiWare uses an 18-ms time slice.

Each operating system lets you tailor the memory allotted to each program. You need 640K bytes to 1 megabyte (depending on the system) for each full 640K-byte application that you plan to run. You can, of course, allocate smaller pieces for programs that don't need

continued

640K bytes. All the systems we tested except for 386/MultiWare allocate the memory in contiguous pieces as soon as it's requested. 386/MultiWare can take better advantage of the 80386 system

page tables. It can build contiguous memory blocks out of memory that may be scattered throughout the physical address space, but it doesn't actually allocate physical memory until it's needed.

Putting the Systems to the Test

Our multiuser host was a Compaq Deskpro 386/20 with an 80387 processor, a Compaq VGA card, a 135-megabyte hard disk drive, and 6 megabytes of memory.

Table 1: The new breed of multiuser operating systems boasts an impressive array of features (● = yes; ○ = no).

	386/MultiWare	Concurrent DOS	PC-MOS	VM/386
Job/task control				
Multiple tasks on serial terminals (maximum no.)	21	10	25	9
Adjustable task priorities	Automatic	●	●	●
Text windows (multiple on-screen)	○	●	○	○
Administrative functions from any terminal	●	○	●	○
Reboot task from the terminal	●	○	○	●
Environmental				
DOS replacement	○	●	●	○
DOS add-on	●	○	○	●
Works with DOS version	3.30 and up	3.0 and up	3.0 and up	3.0 and up
Full set of DOS utilities	○	●	●	○
RAM disk support	●	●	●	●
EMS support	○	●	●	To 4 megabytes
Disk cache	64K to 1 megabyte	○	Available memory	32K up to available memory
Virtual serial ports	●	○	○	○
Maximum partition size (K bytes)	640	640	590	640
Security				
File system security (no. of levels)	○	3 levels	26 classes	○
Supervise other remote tasks	○	●	●	○
Separate start-up for each user	●	●	●	●
Ctrl-Alt-Del protection	●	Optional	○	●
Resource locking	●	○	○	○
Hardware protection for COM ports	●	○	○	●
Host system compatibility				
Runs on 8088 machines	○	○	●	○
Runs on 80286 machines	○	○	●	○
Network-compatible	●	●	●	●
NetBIOS-compatible	○	○	●	○
CP/M and CP/M-86 file compatible	○	●	○	○
Miscellaneous				
Print spooling	●	●	●	●
Supports local printing at workstation	●	●	●	●
Interterminal messages	●	○	○	○
Programmable function keys	○	●	○	○
Remote program execution	●	○	○	○
Multiuser access				
Allows terminals on COM1 and COM2	○	●	●	○
PCTERM terminal support	●	●	●	●
Other terminal support	○	●	●	○
Maximum terminal baud rate (bps)	38.4	38.4	38.4	38.4
Log-in from a modem	●	●	●	○
Log-in password	●	○	●	●
Supports direct or high-speed video terminals	○	●	●	○

Terminals and Multiport Boards

We used standard terminals from Wyse Technology, Link Technologies, and Kimtron, connected to multiport serial cards specified by the software vendors (see the text box "Terminals and Multiport Boards" at right). We reformatted the hard disk drive and installed the software according to the manufacturer's instructions. All relevant system parameters remained in their default conditions, including time slicing, keyboard control, and disk caching.

To gauge the systems as LAN alternatives, we used the same test suites featured in our July LAN Product Focus, "Battle of the Network Stars." The systems performed file I/O, DOS COPY, and database operations while subjected to increasing load. Figures 1 through 4 show the results of our network-oriented tests. For comparison, we've included the results for two LANS—3Com's 3+Share, which has average performance (at a per-user cost that's comparable to that of the multiuser systems), and Novell's NetWare, an excellent performer (though far more expensive). In general, the multiuser systems are faster than 3+Share but slower than NetWare.

Of course, these systems don't just provide a shared file system; they supply processors, too. So we tested each system's virtual 8086 tasks as single-user machines. We ran the standard BYTE low-level and application benchmarks from the host, in the presence of a constant load produced by two additional tasks running file I/O tests in the background. Figure 5 shows the results for these low-level and application tests. Here, Concurrent DOS outperformed the pack. We ran into a few incompatibilities, though. Because 386/MultiWare didn't support the 80387 numeric coprocessor, we couldn't run the low-level FPU test with it. And VM/386 didn't successfully complete our string-move benchmark, so we can't include its CPU index.

The testing procedure also gave us a good chance to evaluate the systems' ease of use, ease of installation, and responsiveness. PC-MOS proved hardest to install. We had to format the hard disk, manually create a complicated CONFIG.SYS file, and sort through a fair amount of detailed documentation. We wished the manual had documented a sample installation. But for any of these systems, you have to do more than just boot from a floppy disk and type COPY A:*.*C:. The operating system needs to know the I/O address of your interface card, the amount of free memory you have, the type and data transfer rate of

Multiuser DOS systems work best with PCTERM terminals. Unlike standard terminals such as the VT-100, these terminals have standard 84- or 101-key IBM PC keyboards complete with Home, End, PageUp, and PageDown keys. PCTERM terminals support the same escape sequences that control conventional terminals and extend these codes to control attached mice and printers. But what makes them different is that they transmit PC-compatible *scan codes* rather than ASCII characters.

Normally, you don't need to be aware of the PCTERM/ASCII distinction unless you're accessing your multiuser system remotely. Modem access is a natural extension of the multiuser environment. You connect an auto-answer modem to one of the host's serial ports, dial in from a terminal or terminal emulator located elsewhere, and voilà—you have access. There's just one catch. If the dialing modem is Hayes-compatible, you'll have to make the connection in an ASCII emulation and then switch to PCTERM.

By the way, this method of remote access is simpler than the LAN equivalent. On a LAN, you normally have to dedicate a local workstation as an "access server." It runs Carbon Copy, PC-Anywhere, or an equivalent program that can route the workstation's keyboard and screen activity through a serial connection to a remote user. With a multiuser system, you don't need to dedicate a terminal to achieve the same result—just a modem.

Wyse Technology provided us with samples of the WY-60, the WY-150, and the WY-99GT. All three support PCTERM and a cornucopia of conventional terminal emulations. The WY-99GT also provides Hercules graphics-emulation modes for those operating

systems that can use it. Both PC-MOS and 386/MultiWare provide WY-99GT drivers. Link Technologies sent us its MC5, which, like the Wyse terminals, supports speeds of up to 38.4 kilobits per second. Kimtron supplied two KT-70 terminals. These offer a standard AT keyboard but go only as fast as 19.2 kbps—a little slow for screen-intensive applications. Of the bunch, we favored the WY-60 for its nice bright display and the WY-150 for its superior screen speed and low price—it's the cheapest terminal we tested.

Multiuser operating systems connect their terminals through serial ports on multiport cards. The PC normally supports two serial devices, called COM1 and COM2. A multiport card extends that support to a larger number of devices. You can get four, eight, or more serial ports on a single card. Because these cards are nonstandard, you'll have to buy one that is supported by the operating system you choose.

PC-MOS supports the Maxpeed card, available through your PC-MOS value-added reseller. It's easy to install and to connect to terminals. The Maxpeed is currently available only for AT-bus computers.

Alloy's 386/MultiWare requires one or more IMP cards, available in both two- and eight-user configurations for either the AT or Micro Channel bus. Concurrent DOS and VM/386 support a wide variety of multiport cards. We used an eight-user Arnet Multiport-8, also available in a four-user configuration, to test both systems.

If you choose PC-MOS, Concurrent DOS, or VM/386, you can also opt for one of the high-speed graphics terminals. These connect by way of fiber optics or a direct bus connection and provide full color graphics on the workstation.

each terminal, the size of your cache, and so on. The procedure is not much different from that of a LAN.

We found both VM/386 and MultiWare extremely easy to use, while PC-MOS suffered from an especially steep learning curve. Once you find your way around PC-MOS, though, it is quite flex-

ible. PC-MOS's best performance comes from careful tweaking of a task's system parameters, and its command-line interface makes that customization easy for an experienced administrator. VM/386's relatively short time slices make for a responsive system—it keeps up with

continued

Multiuser Performance Results

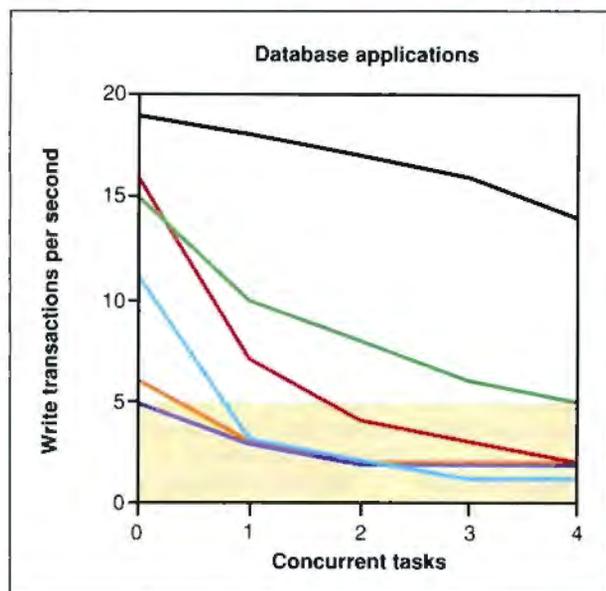


Figure 1: Multiuser performance on our network-based database test. The graph also depicts how much degradation you might expect from each system. PC-MOS outperforms the others when unloaded, but 386/MultiWare holds up to increasing loads.

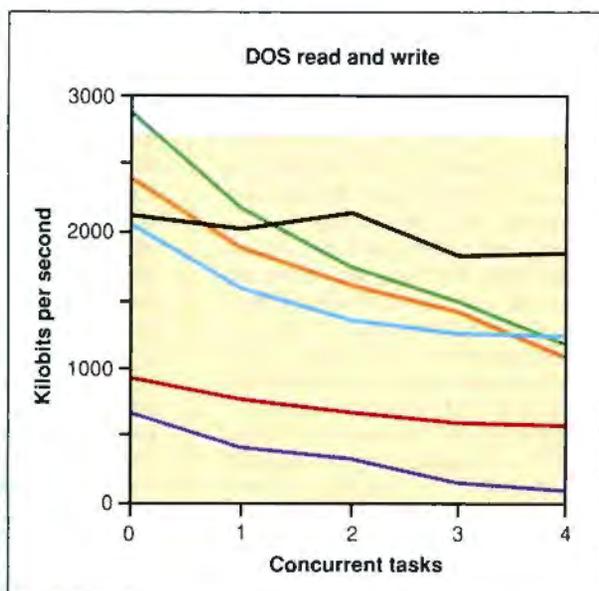


Figure 2: DOS operations. VM/386 and 386/MultiWare operate under DOS, while Concurrent DOS and PC-MOS are DOS replacements.

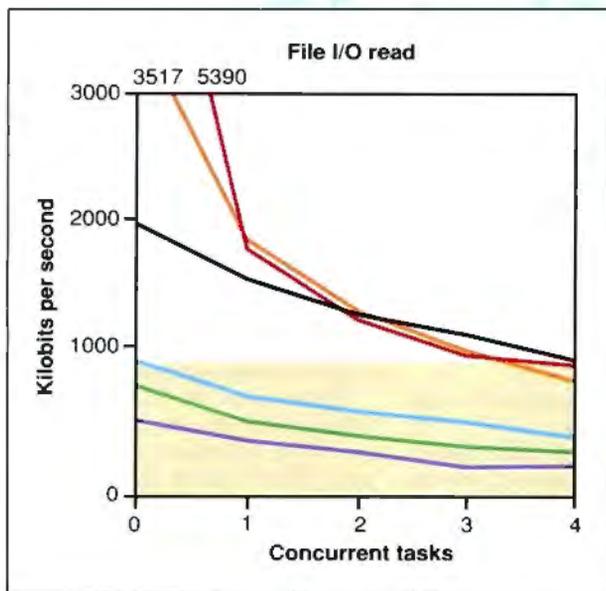


Figure 3: Accessing the file system. Again, PC-MOS displays strong single-user performance, but it degrades quickly.

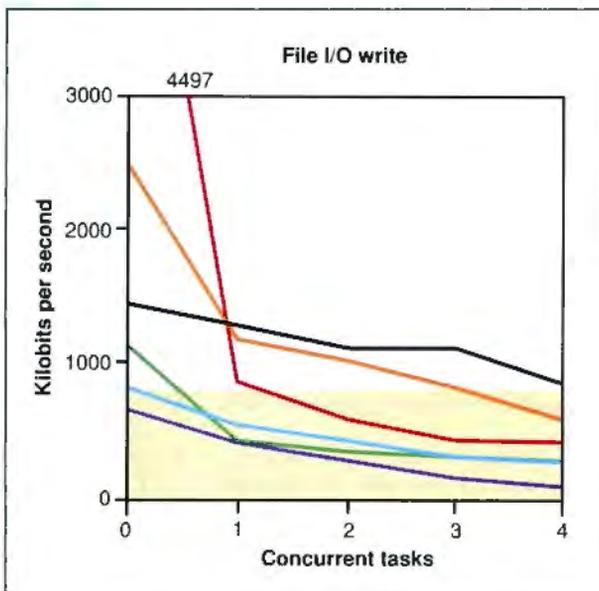


Figure 4: Writing to a file. The multiuser systems stack up very well against the networks when performing file I/O tasks.

■ PC-MOS ■ Concurrent DOS 386 ■ VM/386 ■ 386/MultiWare
■ 3+Share ■ NetWare Single-user DOS performance

keystrokes, even under heavy loads. And because VM/386 adjusts task priorities automatically, a task that needs CPU attention will get it. The other systems didn't do so well when heavily loaded; at times we experienced delays of several seconds.

The most exciting aspect of multiuser systems is their power to exploit the increased processing power of the 80386 processor without sacrificing the compatibility of DOS. But users who expect to load their present programs onto the host drive and happily run them may be disappointed. PC-MOS ran XyWrite Plus 3.52 sporadically. Concurrent DOS flunked Excel 2.0. MultiWare failed to run Lotus 1-2-3 release 2.01 unless we installed it from real-mode DOS, and only VM/386 successfully launched Windows 2.03. They all ran SideKick Plus as long as each terminal retained its own directory and files. We saw some peculiar anomalies and even a few spectacular crashes.

Compatibility with the standard disk devices on our Compaq Deskpro 386/20 was excellent. Each of the operating systems was able to read from and write to any disk we placed in the 1.2-megabyte disk drive, with only one exception—MultiWare failed to read the copy-protected Lotus 1-2-3 disk. Other devices we tried didn't work as well. If you have a CD-ROM drive or some other uncommon device, check with the vendor for specific compatibility. We achieved mixed results with a Bernoulli drive and a CD-ROM player.

386/MultiWare

MultiWare was the easiest system to install. Alloy's IMP-8 multiport adapter card is a full-length card with one large connector on the rear panel. We installed the card and then attached a short cable to a panel with 16 serial ports—eight for terminals and eight for devices such as mice and serial printers. The software loads as a normal DOS 3.3 executable file. At start-up, MultiWare automatically finds and self-tests the interface, determines the baud rates of the terminals, and runs the start-up files at each workstation.

To add a new workstation, you fire up the MultiWare administrative program and enter a name for the workstation; MultiWare does the rest. It has three levels of user privilege. A supervisor can add new users and assign passwords. High-level workstations get the best performance and the ability to create and switch among eight tasks. Low-level workstations run a single task. All work-

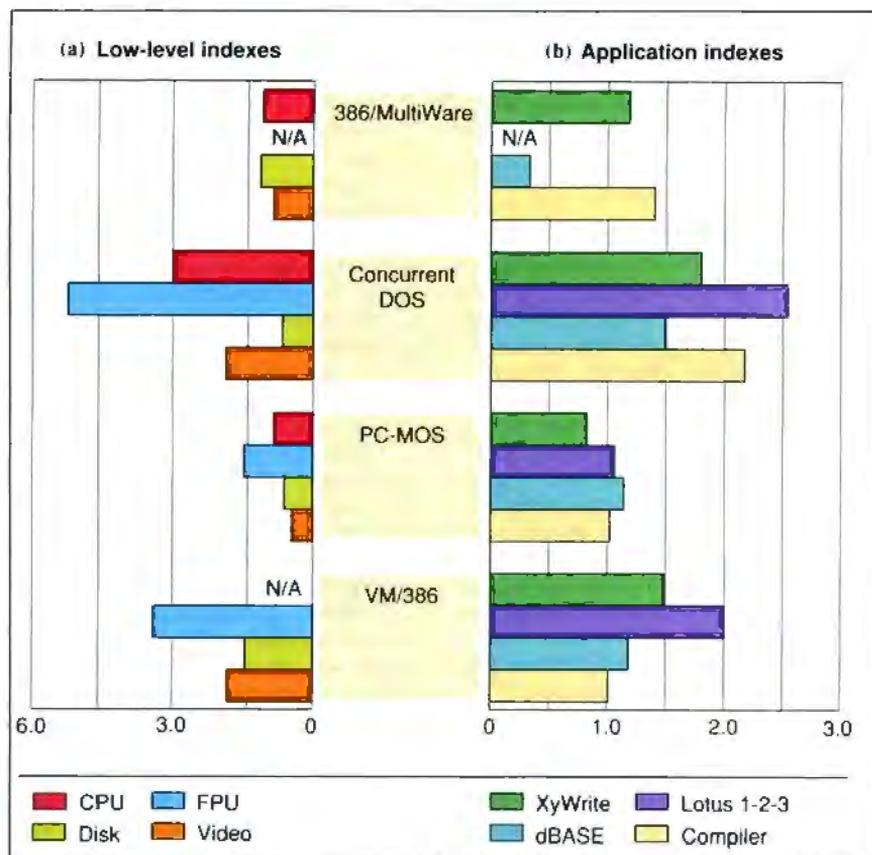


Figure 5: (a) Loaded low-level benchmarks. We loaded each system by running a file I/O loop at two terminals. The host then ran the low-level tests. 386/MultiWare, which does not support a coprocessor, lacks an FPU index. VM/386 did not negotiate our string move tests, so it did not register a CPU index. (b) Loaded application benchmarks. Again, we loaded each system with two active tasks. Concurrent DOS consistently displayed superior performance. 386/MultiWare would not run our copy-protected version of Lotus 1-2-3.

stations enjoy password protection.

The Alt-F9 sequence, issued from any keyboard, brings up MultiWare's Task Manager. Menu-driven commands provide control over disk drives, COM ports, messages, and users. Alt-F8 brings up the Task Swapper, which navigates among active tasks. Other tools include a message facility and a dispatcher that can execute programs on other terminals.

As noted, MultiWare does not support the 80387 math coprocessor. Equally disturbing was our test system's inability to install Lotus 1-2-3 release 2.01. Our Lotus 1-2-3 installation runs off the hard disk drive after reading from a key disk. MultiWare was unable to read from the key disk; the workstation just locked up. Alloy suggests that some products should be installed from real-mode DOS before starting MultiWare—and that worked for Lotus 1-2-3. A number of text-based applications ran erratically; both XyWrite and the Microsoft C Compiler had a cou-

ple of false starts before they finally ran.

Microsoft Windows made trouble for all the systems except VM/386. Windows is an invasive program that takes radical control of the system. MultiWare was able to start Windows on the host and run it for a while, but then the cursor just up and vanished.

MultiWare's file-system performance varied, depending on the type of I/O. It had a strong showing on the DOS COPY test, outperforming all the other multiuser systems and 3+Share. Curiously, it even did better than DOS when only one workstation was active—probably thanks to its disk caching. File I/O performance started a tad below DOS and degraded quickly as the system load increased.

But perhaps more important than the measured performance is a user's perception of system response—the way the keyboard responds. Despite the system loads, applications on a heavily loaded

continued

MultiWare system still perform reasonably. When you press a key on the keyboard, it shows up quickly on the screen. It took a fair amount of loading to bog down MultiMate Advantage II to the point where it was unusable.

Concurrent DOS

The 80386 version of Concurrent DOS is the latest in a line of operating-system products. Concurrent DOS clearly shows its roots in CP/M-86 and CP/M, even preserving file compatibility. In fact, the system command files for Concurrent DOS carry the CP/M-86 .CMD file extension. We installed our 10-user copy of Concurrent DOS with an Arnet Multiport-8 board. Installation involved setting the Arnet card's switches to the recommended I/O address settings and following Arnet's instructions for installing the card. Two ribbon cables must be precisely routed in order to install the card (see photo 1).

You can choose to retain DOS on your hard disk (and launch Concurrent DOS from the AUTOEXEC batch file) or to replace DOS so the host simply boots Concurrent DOS. In either case, Concurrent DOS takes over the machine. It provides all your favorite DOS functions using commands that feel similar, if not identical, to the DOS repertoire. Where there are differences, they're minor. For

example, Concurrent DOS merges the DOS BACKUP and RESTORE commands into a single BACKUP command. And some of Concurrent DOS's DOS-equivalent commands have menu-driven interfaces.

Power users will like Concurrent DOS's speed—its virtual 8086 tasks consistently outperformed those of the other systems, especially under load. Although the multiuser R:base tests showed a sharp degradation of performance as the system load increased—fully loaded, Concurrent DOS fell to the bottom of the pack—we nevertheless found it overall the fastest of the systems we tested.

Concurrent DOS also ran most of our applications, although it doesn't do Windows. It handily took on SideKick Plus and our graphics packages, AutoCAD 2.52 and MathCAD 2.0. Running Lotus 1-2-3 produced an unexpected "memory full" error. Microsoft Word ran, but with a very slow cursor. Word's performance was about a third of what you'd expect on a standard 8-MHz IBM AT.

Concurrent DOS does a particularly nice job with passwords. You can assign a password to each directory, or even to each file. You can also specify separate passwords for read, write, and delete privileges. There's no general log-in password because you don't need one: If all the directories in a system are pass-

word-protected, an unauthorized user can see the names of the directories but nothing more. With 386/MultiWare and VM/386 there's a log-in password, but once you're through the front door, you have full access to the system. Concurrent DOS's password support lets the administrator restrict access to some programs and give free access to all others.

Concurrent DOS has also carried over the multiple text windows that made the original Concurrent DOS so unique. The system console can run four tasks and provides control keys to switch from one task to another. A workstation can switch freely between two tasks. The console can also place each of the four tasks in a different window and freely resize and color the windows. This works well on applications that follow the standard rules for writing to the screen, but it's ineffective with applications that write directly to video memory.

In addition to the standard PCTERM terminal type (see the text box "Terminals and Multiport Boards"), Concurrent DOS supports ASCII terminals. Concurrent DOS lets you prevent the Ctrl-Alt-Del sequence (at the host console) from rebooting the computer. If you choose to keep the sequence enabled, a Ctrl-Alt-Del will pull the plug on all users. The REBOOT command does what Ctrl-Alt-Del does and can be performed from any workstation. You can choose the Ctrl-Alt-Del lockout and control access to the REBOOT command by means of password protection, and there won't be any accidents. 386/MultiWare and VM/386 require you to use the administrative menus to reboot the host, while PC-MOS allows Ctrl-Alt-Del to work from the host console at any time.

PC-MOS 3.00

The Software Link has devised a unique approach to software evaluation. Like many vendors, the company offers a demonstration version. Unlike many demonstration products, however, this one is fully functional. The hitch? It locks up after 30 minutes, forcing you to reboot. The half-hour session gives you enough time to evaluate the product, but it's disruptive enough to keep you from just using the demo forever. It's a nice idea. You should take advantage of it to try out your applications and see how well they run.

While PC-MOS ran many of the programs we launched, it seemed, well, flaky. For instance, we ran all the Xy-Write benchmarks under PC-MOS, but not without tribulations. Keystrokes were

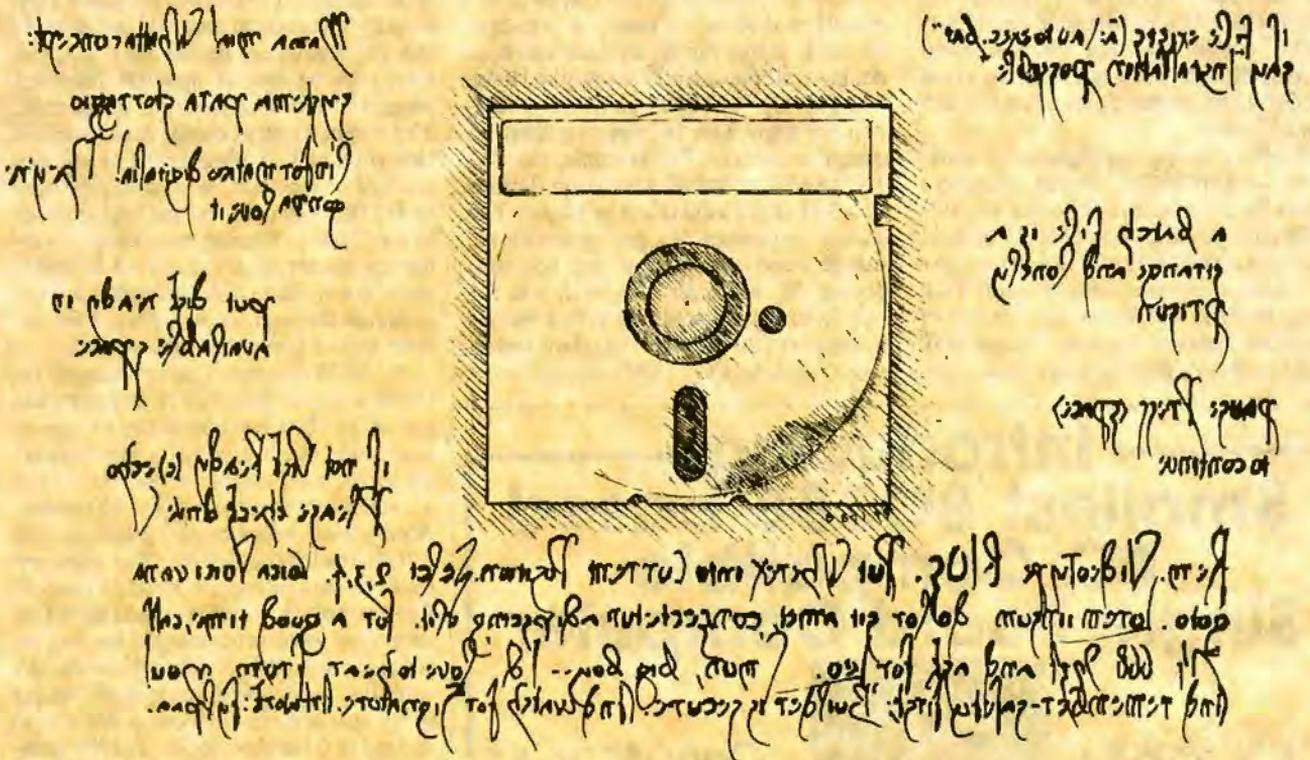
continued



Photo 1: Eight-user Maxspeed (left) and Arnet's Multiport-8 multiport boards.

THE BUILDER™

The problems you've had with batch files are a thing of the past.



T rue visionaries don't batch and moan about life. They build solutions. The Builder™ from Hyperkinetix is the first compiler that eliminates all your beefs about batch. It compiles the batch files in your library into blazingly fast .COM and .EXE files—but speed and compatibility are just the ground floor. The Builder extends the DOS batch language by giving you more than 50 new commands and keywords, high-level control structures such as WHILE and CASE, and menu-building capabilities. It has DOS dexterity that BASIC and C just can't match. And for added convenience, The Builder sports a state-of-the-art editor to provide a fully integrated development environment.

No More Semi-Solutions. Once you use The Builder, external utilities and shell programs will seem like journeymen carpenters. With The Builder, you can produce menus that don't hog memory, yet accomplish precisely what you want. And it's the ideal tool for creating installation scripts for software packages, thanks to its small compiled code size and close relationship with DOS. The Builder also helps your company safeguard security by making it easier to create dual-purpose menu and installation programs—ones that are user-friendly *and* secure. To take advantage of The Builder's introductory price of \$99.95, just call (800) 873-9993, Dept. B. Visa and Mastercard orders are welcomed. Shipping and handling are on us.

hyperkinetix, inc.

System Requirements: ■ 384K RAM
■ DOS 2.1 or later ■ one floppy disk

666 Baker Street, Suite 405, Costa Mesa, CA 92626
(714) 668-9234 • FAX (714) 979-2813

often doubled on the screen, demanding excessive correction and rekeying. A Ctrl-Alt-Del from the PC-MOS host brought the whole system down—there's no reboot protection.

The Software Link recommends that a value-added reseller install the PC-MOS system, and for good reason. A number of tweakable parameters require technical expertise. The FREEMEM statement in the CONFIG.SYS file allocates free memory space above C0000 for use by PC-MOS. PC-MOS can then relocate itself out of the primary (0 to 640K bytes) address space, leaving more memory for applications. It's an advanced and highly useful feature, but not for the casual user. Although you're not required to use FREEMEM, some applications won't run without it.

Another tricky configuration statement is SMPSIZE, which allocates RAM for the System Memory Pool. PC-MOS uses the SMP to keep track of open files and active tasks. Device drivers are also loaded into the SMP. A small SMP frees memory but limits the number of available tasks and devices. A large SMP soaks up RAM, leaving insufficient mem-

ory for your tasks. Finding the optimal setting takes trial and error. It took us a while to get PC-MOS up and running.

Connecting terminals is easier. You just cable a modem or a terminal to the serial ports. The Maxpeed multiport serial board is manufactured exclusively for The Software Link. It supports eight users at speeds of up to 38.4 kilobits per second and allows you to install three boards for a total of 25 users. To start a task on a terminal, you supply the terminal type, location, and baud rate as arguments to the ADDTASK command.

PC-MOS supports several types of terminals, but there's a catch. A standard terminal supports only 24 lines and does not have all the extra PC keys like Home and PageUp. PC-MOS provides emulation for these keys by mapping them to escape sequences. For example, the VT-100 (ANSI) terminal emulation defines Esc-S-H as the equivalent of Home. The escape sequences can get very tedious, though, and arrow keys are not supported. To its credit, PC-MOS was the only system we tested that even attempts to support full-featured standard terminals other than PCTERM compatibles.

The ADDTASK command can specify the amount of memory allocated to a task, the task's ID, its security class, and the name of its start-up batch file. You can switch among tasks by using the Alt key combined with the ID number. By invoking the ADDTASK command from within your partition, you can start additional tasks. You can keep track of task activity with the MOS MAP command.

The MOSADM command adjusts the number of time slices granted to each task, sets priority levels, and turns the cache on and off. You've got to be careful when assigning priorities. We passed top priority to a remote task and could never recover time slices for the host. You can also pass control of specific interrupt vectors to a device or to an active task. The selected task or device then owns the interrupt, and no other device or task can use it. For instance, we had to give control of IRQ 4 to our LapLink task in order to use COM1. You can even assign an interrupt vector to a number of different serial ports. Each task could then use the interrupt through its own port. This enables mouse support at each station.

PC-MOS employs a rather unusual security scheme. Each file or directory has a security class represented by an uppercase letter. Each user has a four-character name, a six-character password, and a level of access to each of the 26 classes. Access levels range from 0 (no access) to 3 (full read/write/delete). The administrator retains full access to all 26 classes. For example, a secretary could have full access to word processing files and no access to spreadsheet files, while the accounting department could have access to its spreadsheets but could not snoop around in other directories. All the security information resides in the \$\$USER.SYS file.

As a single-user operating system, PC-MOS performs admirably. It consistently placed at or near the top of our benchmark charts when unloaded. Unfortunately, when you start adding tasks, PC-MOS quickly bogs down. Despite its problems, however, PC-MOS is the most flexible package we reviewed. Each user can run up to 255 tasks from a remote terminal, depending on available memory. The command-line structure supports some powerful features. And it's the only system that lets the supervisor hot-key into another terminal's task.

VM/386

We had heard that VM/386 is bullet-proof; it's true. It ran every application we threw at it. The other packages may

continued

Introducing Smallest 80386 based PC Compatible Single Board Computer



Now Available
DR DOS®

Only 4" x 6"

Quark/PC® II

- EGA® Video/Color LCD Controller
- SCSI Hard Disk Control • Floppy Disk Control
- Up to 4 Mbytes Memory and much more....

WE ARE EXPANDING TO MEET DEMAND

Megatel Computer Corp.

NEW LOCATION

125 Wendell Ave.
Weston, Ont. M9N 3K9
CANADA

(416) 245-2953

Fax: (416) 245-6505

Trademarks: Quark - F+ K. Mfg. Co. DRDOS

- Digital Research Ltd. EGA - IBM Corp

REPS: Italy 39 331 256 524

W. Germany 49 6074 98031

U.K. 44 959 71011

Norway 47 986 9970

Denmark 45 244 0488

Austria 43 222 587 6475

Finland 358 0757 1711

Sweden 46 40 78 078

Netherlands 31 838 529 505

Australia 61 03 568 0988

megatel

DRAFIX CAD ULTRA™ FINALLY FILLS AN IMPORTANT GAP IN LOW-COST CAD.

NEW!
Drafix CAD Overlay™
 For importing scanned images!



CADAPULT™ YOUR DRAWING INTO LOTUS 1-2-3 OR DBASE.

Drafix introduces CAD for the real world. Any CAD package lets you create drawings. New Drafix CAD Ultra with CADapult is the first inexpensive CAD software that can turn your drawings into usable database and spreadsheet information.

First, you can give every element in your drawing specific attributes—a name, a part number, a price, for example. Then, with little more than a push of a button, you can convert the data into a spreadsheet, move it into a database or insert it into your drawing.

Suddenly your concept becomes a bill of materials, a component pricing list, an order form, a job estimate.

"SIMPLE TO LEARN AND EXTREMELY EASY TO USE."

—PC Week

You'll never find an easier CAD software to use. With Drafix all of the menus are on the screen all of the time—there's nothing to memorize! In minutes you'll create sketches and drawings naturally and effortlessly—drawings that would require weeks of training on other CAD systems.

AMAZING POWER AND SOPHISTICATION FOR ONLY \$395.

All of the drawing, designing and editing functions



demanded by architects, engineers, drafters, contractors and other serious CAD users are included.

- Create your own symbol libraries with attributes or use our pre-attributed, pre-drawn symbols supplied with the package.
 - Draw lines, arcs, polygons, splines and bezier curves or freehand sketch.
 - Access our full complement of item and grid snaps for superior accuracy.
 - Use our powerful and flexible automatic dimensioning system and crosshatching and solid fill for complex drawings.
 - Take advantage of function key macros for even greater performance.
 - Use the revolutionary word processing window for adding and editing text in drawings.
- Plus much, much more.

EVERYTHING YOU NEED IN A SINGLE PACKAGE.

Other low-cost packages require expensive add-on modules. There's nothing missing from Drafix CAD Ultra. For no extra cost you get:

- DotPlotter™ for high resolution Dot and Laser Printer output.
- General Symbols Library of 450 pre-drawn objects.
- CADapult exchange utility.
- HPGL compatibility with desktop publishing programs and a full range of pen plotters.

CALL US TODAY.

For the name of your nearest Drafix dealer, call us today at 1-800-231-8574.

Ask about Drafix 3D Modeler and Drafix CAD Report too!

PC
 MAGAZINE
 EDITOR'S
 CHOICE

FORESIGHT RESOURCES CORP.
 10725 Ambassador Dr.
 Kansas City, MO 64153
 816-891-1040

Circle 113 on Reader Service Card (DEALERS: 114)

COMPANY INFORMATION

Alloy Computer Products, Inc.
(386/MultiWare)
100 Pennsylvania Ave.
Framingham, MA 01701
(617) 875-6100
NX386E, five users\$395
NX386, 21 users\$895
IMP2 or IMP2/PS\$495
IMP8 or IMP8/PS \$1195
Inquiry 1071.

Arnet
(Multiport-4 and Multiport-8)
618 Grass Mere Park Dr., Suite 6
Nashville, TN 37211
(800) 366-8844
Multiport-4\$495
Multiport-8\$735
Inquiry 1072.

Digital Research, Inc.
(Concurrent DOS)
60 Garden Court
P.O. Box DRI
Monterey, CA 93942
(408) 649-3896
Three users\$395
10 users.....\$495
System Builder's Kit \$700
Programmer's Toolkit \$200
Inquiry 1073.

Intelligent Graphics Corp.
(VM/386)
4800 Great America Pkwy.
Santa Clara, CA 95054
(408) 986-8373
1.21 Multiuser\$895
Inquiry 1074.

Kimtron Corp.
(KT-70)
1709 Junction Court, Building 380
San Jose, CA 95112
(408) 436-6550
\$569
Inquiry 1075.

Link Technologies, Inc.
(MC5)
47339 Warm Springs Blvd.
Fremont, CA 94359
(415) 651-8000
\$579
Inquiry 1076.

The Software Link, Inc.
(PC-MOS)
3577 Parkway Lane
Norcross, GA 30092
(404) 448-5465
Five users\$595
25 users.....\$995
Maxpeed board, eight users\$695
Inquiry 1077.

Wyse Technology
(WY-60, WY-99GT, WY-150)
3571 North First St.
San Jose, CA 95134
(408) 433-1000
WY-60\$599
WY-99GT.....\$649
WY-150.....\$549
Inquiry 1078.

provides templates for the most popular configurations. You can load a profile and then adjust individual parameters to your liking. VM/386 lets you set up tasks with the full 640K bytes of memory that DOS allows, accommodating even the most RAM-hungry applications. (Concurrent DOS and MultiWare also support full 640K-byte tasks; only PC-MOS necessarily steals some conventional memory from DOS programs.) Tasks retain their own DOS and BIOS.

Once your virtual machines are configured, you can access the Switcher from any terminal by pressing the Alt and SysRq keys simultaneously. Active tasks appear in a window. You simply select a task and press Return to bring the task to your screen. You can also use a quick-key sequence (hold down the Alt key and press SysRq twice) to cycle through all your tasks.

VM/386 also lets you link devices to virtual machines. This prevents two tasks from accessing the same output device, such as a modem or a floppy disk drive. You can either link the device to a number of terminals or force an exclusive link to one terminal. You can link a device from the DOS prompt or from a VM/386 menu. All the systems provide some method of protecting your task's devices from other users. VM/386's method worked as well as those of the other systems.

Our benchmarks showed VM/386 to be an adequate, though not spectacular, performer. It excelled on DOS and file I/O operations but lagged somewhat on application tests. On the other hand, it was the only package to run every test in our application suite. So although it may be a bit slower than the others, you won't waste precious time trying to get things to work. From installation to configuration to applications, everything ran flawlessly.

What Will It Cost?

We compared the prices of each of the multiuser systems—with terminals for three, five, 10, and 20 users—with two LANs (3Com's 3+Share and Novell's NetWare). The multiuser environment requires a fast 80386-based computer with a lot of memory—640K bytes to 1 megabyte per person. For comparison, assume that you could buy a machine like this for about \$10,000. The multiuser workstations we selected were dedicated terminals, in this case WY-150s from Wyse. The price of an average dedicated terminal was about \$600. If you have microcomputers lying around, you can

continued

have their virtues, but none can make that claim. VM/386 wasn't the fastest operating system, or the slickest, but it was refreshingly reliable. It was also the most responsive of the systems we tested. Rarely did the display lag behind typed input. As we've mentioned, VM/386 dynamically adjusts time slices according to each task's needs. Its System Resource Manager (SRM) even suspends tasks that aren't receiving external interrupts, passing valuable time slices to active tasks.

The SRM also provides you with additional performance options that you can adjust manually. For instance, some applications run long processes in memory. It is possible that the SRM will interpret these operations as an idle task, thus denying the task the necessary time slice. You can either set the SRM to stop ana-

lyzing the task altogether so that the task is always active, or you can adjust the SRM Burst (the amount of time without external interrupts before a task is suspended). You can also increase the foreground slice if your application doesn't seem to be responsive enough. All this clever engineering results in remarkably smooth operation.

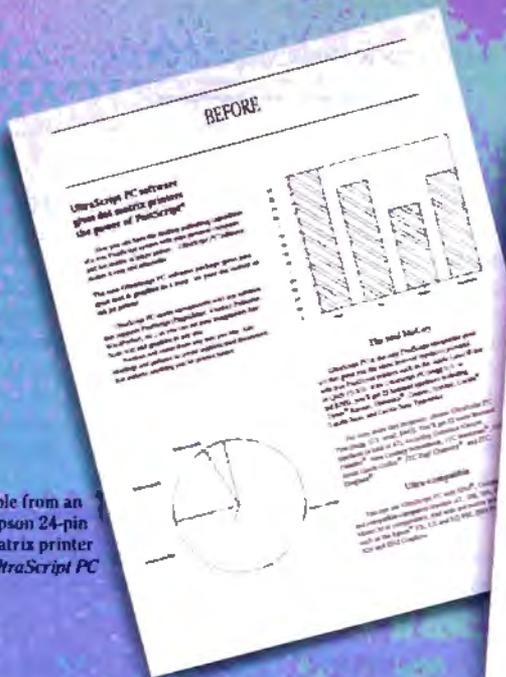
Installing VM/386 was quick and painless. The documentation guided us through the Arnet Multiport-8 card configuration, and the software installation flowed smoothly through a series of questions. Usually, default values were acceptable. We had the system up in a matter of minutes. Configuration changes took effect immediately—there was no need to reboot after each change.

You create so-called virtual machines from a series of menus. A list of profiles

Sample from an Epson 24-pin dot-matrix printer with *UltraScript PC*



Sample from an Epson 24-pin dot-matrix printer without *UltraScript PC*



Desktop publishing on a dot-matrix budget

UltraScript™ PC software gives dot-matrix printers the power of PostScript® printing at a fraction of the cost.

At last, the power of PostScript printing for thousands less. *UltraScript PC* software runs on your PC and gives ordinary dot-matrix and ink jet printers full desktop publishing capabilities. Create attractive documents that surpass anything you've printed before. It works with software that supports PostScript output, such as PageMaker®, WordPerfect®, Ventura Publisher® and Microsoft® Windows. And it works without forcing you to leave your application to print a document. Use it to scale text and graphics to any size, add shadings and patterns, and position them on the page however you like.

Top-quality typefaces

UltraScript PC is the only PostScript-compatible product that gives you the same licensed typefaces used by professional typesetters and provided with Adobe® PostScript printers such as the Apple® LaserWriter®.

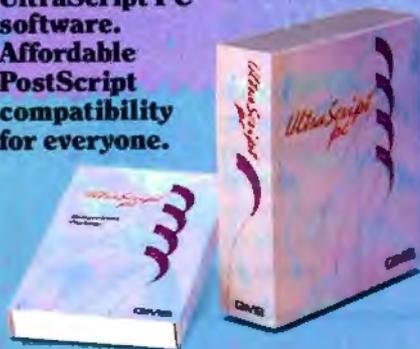
With *UltraScript PC* (U.S. list, \$195), you'll get 25 licensed typefaces. For more font firepower, choose *UltraScript PC plus* (U.S. list \$445). You'll get 22 more for a total of 47.

Ultracompatible

You can use *UltraScript PC* with most IBM®, Compaq® and compatible computers (80286-based or higher with 1.5 MB of RAM recommended). And with dot-matrix printers such as the Epson® FX, LX and LQ 950, IBM Proprinter® X24 and IBM Graphics. Or ink jet printers such as the HP® DeskJet™ and Canon® BJ-130, or HP LaserJet™ Series II laser printers. And any printer that emulates them.

Join the desktop publishing revolution today—the smart way. Just contact QMS at **1-800-635-3997** and ask about *UltraScript PC*.

UltraScript PC software. Affordable PostScript compatibility for everyone.



QMS®

The following are trademarks or registered trademarks of their respective companies: QMS and UltraScript of QMS, Inc.; Adobe and PostScript of Adobe Systems, Inc.; Ventura Publisher of Xenix Corporation; Microsoft of Microsoft Corporation; Epson of Epson America, Inc.; PageMaker of Aldus Corporation; Compaq of Compaq Computer Corporation; IBM and Proprinter of International Business Machines Corporation; WordPerfect of ARTS Computers Products, Inc.; Canon of Canon, USA, Inc.; HP DeskJet, LaserJet of Hewlett-Packard Company; and Apple and LaserWriter of Apple Computer, Inc. ©1989 QMS, Inc.

Circle 238 on Reader Service Card

save some money by using terminal-emulation software and connecting them instead of terminals. You gain the option of local autonomy, but you'll be transferring files between the workstation and the host, not sharing them.

For the LAN setup, we chose a 12-MHz 80286 with 640K bytes of memory and a single floppy disk drive to represent a typical workstation. Dell Computer will sell you a System 200 for about

\$1600. Add a copy of DOS, the network card, and cabling, and the workstation comes to about \$2100. The LAN's server needs less processor power and memory than the multiuser system's host. A \$7000 80286-based machine should make a reasonable server for a small office.

For a small installation of three users, the higher cost of the 80386 computer makes the comparison close. When using

PC-MOS or Concurrent DOS with three users, you can connect terminals to COM1 and COM2 and so eliminate the need to buy a special multiport card. Our cheapest multiuser system came in at about \$3800 per user. The LAN weighed in at a hefty \$4800. A large installation of 20 or so users can lower the per-workstation cost of the multiuser solution to \$1100—cheaper than the equivalent

continued

Table 2: Comparative costs for different multiuser operating systems. As the number of users increases, the higher cost of the 80386 host is distributed, making the multiuser solution more economical. Costs for 3+Share and NetWare are included for comparison.

	386/MultiWare	Concurrent DOS	PC-MOS	VM/386	3+Share	NetWare
Workstation						
Wyse WY-150	\$549.00	\$549.00	\$549.00	\$549.00		
Dell System 200					\$1600.00	\$1600.00
Network adapter					\$399.00	\$399.00
DOS					\$100.00	\$100.00
Cabling	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00
Total	\$574.00	\$574.00	\$574.00	\$574.00	\$2124.00	\$2124.00
System cost — 3 users						
Host computer	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$7000.00	\$7000.00
DOS (for host)	\$100.00			\$100.00	\$100.00	\$100.00
Server software	\$395.00	\$395.00	\$595.00	\$895.00	\$595.00	\$4695.00
Interface card	\$495.00	N/A	\$695.00	N/A	\$399.00	\$399.00
Workstations	\$1148.00	\$1148.00	\$1148.00	\$1148.00	\$6372.00	\$6372.00
Total	\$12,138.00	\$11,543.00	\$12,438.00	\$12,143.00	\$14,466.00	\$18,566.00
Cost/user	\$4046.00	\$3847.67	\$4146.00	\$4047.67	\$4822.00	\$6188.67
System cost — 5 users						
Host computer	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$7000.00	\$7000.00
DOS (for host)	\$100.00			\$100.00	\$100.00	\$100.00
Server software	\$395.00	\$495.00	\$595.00	\$895.00	\$595.00	\$4695.00
Interface card	\$1195.00	\$495.00	\$695.00	\$495.00	\$399.00	\$399.00
Workstations	\$2296.00	\$2296.00	\$2296.00	\$2296.00	\$10,620.00	\$10,620.00
Total	\$13,986.00	\$13,286.00	\$13,586.00	\$13,786.00	\$18,714.00	\$22,814.00
Cost/user	\$2797.20	\$2657.20	\$2717.20	\$2757.20	\$3742.80	\$4562.80
System cost — 10 users						
Host computer	\$10,000.00	\$10,000.00	\$10,000.00		\$7000.00	\$7000.00
DOS (for host)	\$100.00				\$100.00	\$100.00
Server software	\$895.00	\$495.00	\$995.00		\$2495.00	\$4695.00
Interface card	\$1690.00	\$735.00	\$1390.00		\$399.00	\$399.00
Workstations	\$5166.00	\$5166.00	\$5166.00		\$21,240.00	\$21,240.00
Total	\$17,851.00	\$16,396.00	\$17,551.00		\$31,234.00	\$33,434.00
Cost/user	\$1785.10	\$1639.60	\$1755.10		\$3123.40	\$3343.40
System cost — 20+ users						
Host computer	\$10,000.00		\$10,000.00		\$7000.00	\$7000.00
DOS (for host)	\$100.00				\$100.00	\$100.00
Server software	\$895.00		\$995.00		\$2495.00	\$4695.00
Interface card	\$4980.00		\$2085.00		\$399.00	\$399.00
Workstations	\$11,480.00		\$13,776.00		\$53,100.00	\$53,100.00
Total	\$27,455.00		\$26,856.00		\$63,094.00	\$65,294.00
Cost/user	\$1307.38		\$1074.24		\$2523.76	\$2611.76



Micro Channel and AT-bus 386SX Micros --Only From Mitac

Mitac is the first to give you a choice of architectures on the 386SX platform.

Whether you use the "industry standard" (AT) architecture or the up-and-coming Micro Channel of IBM's new PS/2s, Mitac's 386SX-based computers assure you the power of Intel's future-compatible 80386SX microprocessor. The power you need to affordably run today's (and tomorrow's) most advanced

32-bit applications. Of course, you don't need both the MPS2386 and the MPC2386, but whichever system you choose, you get a compact micro with 386 performance and a host of built-in features. On-board VGA-compatible graphics controller, space for both 5-1/4" and 3-1/2" diskette drives, room for four storage devices and a total of six expansion slots assure you maximum flexibility with room for growth.

And, as with all Mitac microcomputers, the MPS2386 and MPC2386 are backed by a one-year warranty and Mitac's complete service and support programs. For more information on Mitac's full range of AT- and Micro Channel-compatible computers and the name of your nearest authorized dealer, call today **800-648-2287 Extension 348.**

mitac
When reliability is a decisive factor

Mitac's microcomputers are distributed in the U.S. by Microamerica and Schweber Electronics. Canadian distribution is handled through TLS.

LAN cost of \$2500. Table 2 shows the breakdown. If your application mix is an appropriate one, the multiuser solution is clearly cheaper.

Multiuser Operating System or LAN?

There's no simple answer. Like a LAN, a multiuser operating system provides a shared file system, but with faster disk access. Screen performance is slower if you compare a serial terminal to a LAN

user's microcomputer. But text applications run beautifully on the new generation of serial terminals, and the display quality of our test terminals is sure to please any experienced microcomputer user. The fonts easily rival those of a good monochrome display.

Performance can vary widely depending on your application. The best applications for a multiuser environment are those that spend a fair amount of time waiting for keyboard input, such as word

processing and data entry. The worst applications are the CPU-intensive ones. These have no effect on a LAN, but they can cripple a multiuser system.

Databases that require a fair amount of disk access may run better on a multiuser system. LAN-oriented databases normally ship all data through the network to workstations, where the processing happens. Server-based LAN applications now emerging will change that, but most people aren't using them yet. Transferring all those packets over the wire incurs a substantial cost. A multiuser system processes data in place (that's just what LAN server-based applications aim to achieve), avoiding all that traffic.

The issue of application compatibility is one you should address on a case-by-case basis. We doubt that Windows (or any other graphically intensive application) makes sense for the multiuser environment. But text-oriented programs and character-based graphical programs may make sense—it just depends on which ones. Be sure to specify to your dealer the applications (and external devices, such as CD-ROMs) that you plan to use, and make sure that everything will work.

If you're interested in custom application development, note that Concurrent DOS and PC-MOS provide functionality above and beyond DOS. Applications specially written for these systems can take full advantage of task spawning, background processing, and the ability to change their priorities depending on need. Both manufacturers will sell you system developer's kits with utilities and enhanced documentation.

Choosing between these operating systems wasn't easy. While testing each of them, it became clear to us that they all have specific strengths and weaknesses. In spite of the developer's features of Concurrent DOS and PC-MOS, we thought that either 386/MultiWare or VM/386 would be the best substitute for an office LAN. Both run applications more reliably than the other two, and we attribute this to the real copy of DOS underlying the multiuser shell. 386/MultiWare was the easiest to install and use. VM/386 was the most compatible. Ultimately, you have to select a product that takes care of the details of resource sharing and allows you to get your work done. For some environments, a multiuser solution may be the way to go. ■

Howard Eglowstein and Stanford Diehl are BYTE Lab testing editors. You can reach them on BIX as "heglowstein" and "sdiel," respectively.

(T)EXPERTISE.

For document typesetting and formatting quality, PC T_EX is the difference between average and expert. It's the next step beyond standard desktop publishing.

Of PC T_EX, INFOWORLD said: "... No non-T_EX-based program has such typographical aesthetics... enormously flexible..."

And PC MAGAZINE wrote: "(With PC T_EX) ... you can achieve incredible precision in formatting text, especially mathematical expressions."

For a free PC T_EX demo diskette, product catalog and information on a configuration for your system, call 415/388-8853. Then give your next job the (t)expert touch.

PC T_EX is a registered TM of Personal T_EX, Inc. T_EX is an American Mathematical Society TM. Inquire about PTI distributorships. Site licenses available to qualified organizations. This ad was typeset using PC T_EX and Bitstream fonts.

(T)EXPERT TYPE

Name	Definition
Gamma	$\Gamma(z) = \int_0^{\infty} t^{z-1} e^{-t} dt$
Sine	$\sin(x) = \frac{1}{2i}(e^{ix} - e^{-ix})$
Error	$\operatorname{erf}(z) = \frac{2}{\sqrt{\pi}} \int_0^z e^{-z^2} dz$
Bessel	$J_0(z) = \frac{1}{\pi} \int_0^{\pi} \cos(z \sin \theta) d\theta$
Zeta	$\zeta(s) = \sum_{k=1}^{\infty} k^{-s} \quad (\Re s > 1)$

(T)EXPERT FORMULAS & MATH

T_EX for PCs = Personal T_EX, Inc.

12 Madrona Avenue
Mill Valley, CA 94941



MicroWay Means Numerics!

MicroWay is your best source for the software and hardware you need to get true 32 bit performance from your 386. These include 32-bit tools, such as NDP Fortran, C, and Pascal, and the 32-bit applications that were developed with them (see last paragraph). These products run in protected mode under Unix, Xenix, or Phar Lap extended MS-DOS.

Starting with release 1.4VM, NDP Fortran, C and Pascal not only access 4 gigabytes of memory, but run with Phar Lap's new VMM extension which provides 386 protected mode virtual memory. Now you can run a program with a 30 MB array on a 2 MB system simply by having 30 MB of space on your hard disk.

MicroWay also offers transputer based parallel processing boards and languages that run in an XT, AT, or 386. Each of the T800 RISC processors on these boards packs the power

Dr. Robert Atwell, leading defense scientist, calculates that NDP Fortran-386 is saving him \$12,000 per month in rentals of VAX hardware and software while doubling his productivity!

Fred Ziegler of AspenTech in Cambridge, Mass. reports, "I ported 900,000 lines of Fortran source in two weeks without a single problem!" AspenTech's Chemical Modeling System is in use on mainframes worldwide and is probably the largest application to ever run on an Intel processor.

Dr. Jerry Ginsberg of Georgia Tech reports, "My problems run a factor of six faster using NDP Fortran-386 on an mW1167 equipped 386/20 than they do on my MicroVAX II."

of a 20 MHz 386/1167. Our best selling board, the Quadputer2™, has four T800s and boasts 40 MIPS/6 megaflops of processor throughput.

MicroWay manufactures Weitek 1167 and 3167 coprocessor cards that run with the 80386. Both cards include an 80387 socket. The 1167 is 2 to 4 times faster than the 80387. The 3167 runs 30% faster than the 1167 in double precision. The key to achieving this speed increase is our NDP Fortran or C and the new 32-bit applications that offer Weitek support. Either processor provides a dramatic increase in throughput for graphics intensive applications. These include VersaCad and Hoops 3D graphics, ANVIL 5000 CAD/CAM, SRAC and Swanson Analysis finite element packages, Mathematica and a host of other packages that were recently ported to the 386 using our NDP Fortran and NDP C. Please call (508) 746-7341 for more information.

32-Bit Compilers and Tools

NDP Fortran-386™, NDP C-386™, and NDP Pascal-386™ compilers generate globally optimized, mainframe quality code. Each runs in 386 protected mode under Unix, Xenix or Phar Lap extended MS-DOS. The memory model employed uses 2 segments, each of which can be up to 4 gigabytes. They generate code for the 80287, 80387, mW3167 or mW1167 and include high speed EGA graphics extensions written in C that perform BASIC-like screen operations. **NDP Fortran-386™** is a full implementation of FORTRAN-77 with Berkeley 4.2 and Fortran-66 extensions. **NDP C-386™** is a full implementation of AT&T's PCC with MS and ANSI extensions. **NDP Pascal-386™** is a full implementation of ANSI/IEEE Pascal, with extensions from C and Berkeley 4.2 Pascal. **NDP Fortran/C/Pascal-386/DOS** each \$595 **NDP Fortran/C/Pascal-386/VM**..... \$695 **NDP Fortran/C/Pascal-386/UNIX**..... \$795

Phar Lap 386/VMM extensions are supported by the VM releases of NDP Fortran, C, and Pascal, making it possible to compile and run programs as large as the free space on your hard disk.

Phar Lap Virtual Memory Manager .. \$295
Phar Lap Development Tools \$495

NDP Windows™ — NDP Windows includes 80 functions that let you create, store, and recall menus and windows. It works with NDP C-386 and drives all the popular graphics adapters Library: \$125, C Source: \$250

NDP Plot™ — Calcomp compatible plot package that is callable from NDP Fortran. It includes drivers for popular plotters and printers. Works with CGA, MDA, EGA and VGA ... \$325

NDP/FFT™ — Includes 40 fast running, hand coded algorithms for single and double dimensioned FFTs which take advantage of the 32-bit addressing of the 386 or your hard disk. Callable from NDP Fortran with mW1167 and 80387 support \$250
387FFT for 16-bit compilers \$250

NDP to HALO '88 Graphics Interface — Enables you to call graphics routines in HALO '88 from NDP Fortran, C or Pascal. \$100

Parallel Processing

Videoputer™ — The highest performance graphics card on the market. Uses a T800 and TI 34010 in conjunction with a 130 MHz Brook-Tree DAC. Includes one MB of system RAM, one meg of video RAM and a library of graphics primitives. Runs standalone or in conjunction with a transputer network and drives 32 and 64 KHz analog monitors \$4995

Monoputer™ — The world's most popular PC transputer development product now extends the memory available for developing transputer applications from 2 to 16 MB. The board features a DMA bus interface for fast I/O.
Monoputer with T414 (0 MB) \$995
Monoputer with T800 (0 MB) \$1495

Quadputer™ — This board for the AT or 386 can be purchased with 2, 3 or 4 transputers and 1 or 4 MB of memory per transputer. Two or more Quadputers can be linked together to build networks of up to 100 or more transputers providing mainframe power from \$3495

Linkputer™ — Uses four Inmos C004 programmable cross bar switches. It allows the user to dynamically change the topology of the processors in a network. Using this board, it is possible to get 100% linkage among eight Quadputers and design larger, custom topologies. CALL

Transputer Compilers and Applications
These Parallel languages are designed for use with Monoputer2 and Quadputer2.

Logical Systems Parallel C \$595
3L Parallel C or 3L Parallel Fortran .. \$895
COSMOS/M - Finite element analysis ..CALL
ParaSoft: Parallel Environment \$500
Performance Monitor .. \$500
C Source Level Debugger \$500
T800/NAG™ (See NDP/NAG) \$2750

387BASIC™ — Our 16-bit MS compatible compiler introduces numeric register variables to produce the fastest running 80x87 code on the market. \$249

NUMERICS HOTLINE
(508) 746-7341

386 Your AT

386/387 Turbo™ AT — This board plugs into your 80286 socket, allowing your IBM AT to run 32-bit protected-mode code written for the 80386. Includes an 80387 socket. The most cost-effective AT upgrade!
386/387 Turbo AT/16MHz \$495
386/387 Turbo AT/25 MHz \$695

Weitek-Based Coprocessor Boards

mW1167™ and mW3167™ coprocessor boards are built at MicroWay using Weitek components. Each includes an 80387 socket.
mW1167-16 \$895
mW1167-20 \$1095
mW1167 Microchannel-16/20 CALL
3167-20 \$995
3167-25 \$1295
3167-33 \$1695
mW3167/80387 Board \$150

Intel Coprocessors and RAM

80387-33 \$550	8087-2 \$120
80287-8 \$195	80287-10 \$220
80387-16 \$360	80387-18SX \$310
80387-20 \$400	80387-25 \$500
80C287A (CMOS) \$280	287 Turbo-12 (for AT compatibles) \$350
RAMPak™ one meg 32-bit memory module for Compaq 386 20/25 \$425	RAMPak™ - four meg \$1500
256K 80ns DRAM \$8.00	258K 100ns DRAM \$6.50
258K SIMMs 100ns \$90	1 meg SIMMs 100ns \$275

(All of our Intel coprocessors include 87Test.)

Multi-User Accelerators

MicroWay's AT8™ and AT16™ intelligent serial controllers run 8 to 16 terminals under Unix or Xenix without bogging down your AT, 80386 or PS/2 PC. AT8: \$895 AT16: \$1295

12 MHz PC Accelerators

FastCACHE-286 12 MHz \$299
SuperCACHE-286 12 MHz \$399
FastCACHE-286 9 MHz \$199

MicroWay

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 508-746-4678 Germany 069-75-2023

Discover the Quality, Service, Price and Performance in Eltech.

Eltech Model 9870

Floating Point Processor
80387-25/Weitek 3167

Memory RAM	1or 4MB on Board
Cache Memory	64 or 256KB S-RAM
Expansion RAM	4 or 8MB on 32-bit Board
Maximum RAM	16MB
Data Bus Width	32-bit
Wait States	Zero Wait State
I/O	1 Serial and 1 Parallel Ports



High Performance Systems

30 Day Money-Back Guarantee

Next Day Free On-Site Service



Model #9671/#9770
80386-16/20

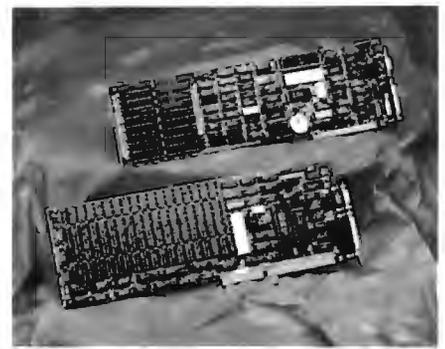
Memory RAM	1MB on System Board
Expansion RAM	16MB on 32-bit Board
Maximum RAM	33MB
Data Bus Width	32-bit
Wait States	Zero Wait State
I/O	2 Serial and 1 Parallel Ports



Model #3861/#8661
80286-12/16

Floating Point Processor 80287

Memory RAM	1or 4MB on Board
Expansion RAM	8MB on 16-bit Board
Maximum RAM	12MB
Data Bus Width	16-bit
Wait States	Zero Wait State



Eltech EGA, VGA Graphics Cards

Eltech EGA, autoswitching, maximum resolution of 800x600 with 16 colors, 640x480 resolution with 16 colors, 320x200 resolution with 256 colors.



1725 McCandless Drive
Milpitas, CA. 95035
(408) 942-0990

So Call Today

408-942-6823

408-942-0990

Circle 104 on Reader Service Card



ALR Revs Up MCA

The MicroFlex 7000
is a fast, expandable
MCA clone, but
is it better than an AT?

Bill Catchings
and Mark L. Van Name

Advanced Logic Research's MicroFlex 7000 combines the Micro Channel architecture (MCA) with a 25-MHz 80386 and a proprietary cache architecture to raise the performance ante for MCA machines. Its cache architecture is similar to that used in ALR's AT-compatible FlexCache 25386, which combines a high-speed static RAM (SRAM) cache with dual memory and I/O buses to let the 80386 CPU run with no wait states most of the time.

The MicroFlex 7000 cache differs from that of the FlexCache 25386 in two ways: It uses the MCA bus, and it moves data between the cache and main memory 64 bits at a time. While it uses the same 64K-byte cache of 25-nanosecond SRAM as the FlexCache 25386 does, the MicroFlex replaces the FlexCache's 60-ns DRAM with slower 80-ns DRAM.

The slower DRAM seems to cancel out the improved cache system to yield a processor/memory combination that is close to the speed of the FlexCache. That's not bad, however, because the FlexCache 25386 is the fastest IBM PC compatible that BYTE has reviewed.

A Lot of Box, a Lot of Money

The MicroFlex 7000's high performance and MCA bus do not come cheap; the Model 120-A21 (with a 150-megabyte



hard disk drive) costs \$8499, while the Model 300-A31 (with a 310-megabyte hard disk drive) runs \$12,397. Standard features include 2 megabytes of DRAM, a math coprocessor socket, SuperVGA circuitry, a 1.44-megabyte 3½-inch floppy disk drive, and an ESDI controller. Software includes an ALR Reference Diskette that lets you configure MCA peripherals; Multisoft's Super PC-Kwik disk cache; and Quarterdeck's DESQview and Expanded Memory Manager (QEMM-386).

The Model 300-A31 evaluation system included three optional components. One

was a VGA monitor, which BYTE supplied. ALR now offers a 14-inch VGA monitor for \$499. The unit also came with an 80387 coprocessor and MS-DOS 3.3. (ALR now offers only MS-DOS 4.01.) With these extras, the evaluation unit costs a tidy \$13,940.

Oddly enough, a MicroFlex 7000 Model 120-A21 with the same extras as our evaluation unit would run a far more reasonable \$10,042. That means ALR is hitting you for \$3898 for the additional 160 megabytes of disk space. We suspect that this is because ALR is pricing its

continued

ALR MicroFlex 7000

Company

Advanced Logic Research, Inc.
9401 Jeronimo
Irvine, CA 92718
(714) 581-6770

Components

Processor: 25-MHz 32-bit Intel 80386; socket for 25-MHz Intel 80387 or Weitek 3167 math coprocessor

Memory: 2 megabytes of 32-bit 80-ns DRAM in two 1-megabyte IBM PS/2-compatible SIMMs; 64K bytes of 25-ns static RAM for the cache; 128K bytes of 200-ns BIOS ROM

Mass storage: 1.44-megabyte 3½-inch floppy disk drive; 150-megabyte hard disk drive (Model 120-A21) or 310-megabyte hard disk drive (Model 300-A31)

Display: ALR 14-inch VGA monitor; VGA circuitry and DB-15 connector on motherboard

Keyboard: 101 keys in a modified IBM-Enhanced keyboard layout, with separate numeric keypad and cursor-control clusters

I/O interfaces: RS-232C serial port with DB-25 connector; DB-25 parallel port; AT-style keyboard connector; PS/2-style mouse connector; eight Micro Channel expansion slots (three 32-bit and five 16-bit)

Size

7½ by 17½ by 23 inches,
70 pounds (maximum)

Software

MicroFlex 7000 Reference Diskette and custom utilities; Multisoft Super PC-Kwik disk cache 3.23; Quarterdeck DESQview 2.25 with QEMM-386 version 4.23

Documentation

User's manual

Price

Model 120-A21: \$8499
Model 300-A31: \$12,397
System as reviewed: \$13,940

Inquiry 852.

MicroFlex 7000 models to compete with comparable IBM PS/2s—the Models 70-A21 and 80. From that perspective, ALR's Model 120-A21 does reasonably well; it costs \$451 less than IBM's Model 70-A21. The IBM system, with its maximum disk size of 120 megabytes and its meager three MCA slots, is also far less expandable than the ALR system.

Another MCA compatible, the 20-MHz Tandy 5000 MC, is a bit cheaper

than the MicroFlex 7000: With a 170-megabyte SCSI hard disk drive and a smaller (32K-byte) cache, it costs about \$200 less than the MicroFlex 7000 Model 120-A21.

The MicroFlex Architecture

Most cached 80386 systems, MCA or otherwise, use the Intel 82385 cache controller. ALR bucks this trend by implementing in discrete logic its own improved version of the 82385. ALR gains performance with this approach, but at the cost of quite a few chips on the motherboard.

The most important improvement of ALR's cache controller over the 82385 is in its handling of direct-memory-access writes. When a DMA write changes a memory location whose contents are in the cache, the ALR controller updates the cache data; the 82385 would simply mark the location invalid. ALR's cache also fetches 64 bits of memory when there is a cache miss. Because most memory accesses are sequential, prefetching the second 32 bits increases the cache's hit ratio.

ALR packages the main memory on two 1-megabyte single in-line memory modules that the firm claims are compatible with IBM's PS/2 memory modules. Because of the 64-bit-wide bus between the cache and main memory, the MicroFlex 7000's memory must come in pairs of SIMMs. With 2-megabyte SIMMs in the eight SIMM slots, the MicroFlex 7000 can handle up to 16 megabytes of DRAM. (ALR does not yet offer 2-megabyte SIMMs, but the company claims that the MicroFlex 7000 will work with IBM's 2-megabyte PS/2 memory modules.)

Performance

The result of this fancy architecture is an extremely fast system. The BYTE CPU, FPU, and text video tests place the MicroFlex 7000 about 20 percent faster than Compaq's 386/25 and within 1 percent of the performance of the FlexCache 25386.

On the hard disk tests, the news is not so good. Here, the MicroFlex 7000 Model 300-A31 is significantly slower than a FlexCache 25386 with a similar 300-megabyte hard disk drive. An ALR spokesperson said that the overhead of the MicroFlex 7000's emulation of the IBM PS/2 Model 70's hard disk drive and the fact that the BIOS checks the disk status after every read and write operation slow the performance. ALR plans to fix this in a future release of the BIOS.

Still, the performance of the Micro-

Flex 7000's 310-megabyte hard disk drive is not that bad. The system is about 10 percent faster than the 150-megabyte hard disk drive version of the FlexCache 25386, and it compares favorably with other MCA machines—it's about 50 percent faster than the 20-MHz IBM PS/2 Model 70-A21 and almost twice as fast as the Tandy 5000 MC.

Compatibility

Speed alone, of course, is not the whole story, especially with MCA systems. The system must be able to handle MCA expansion boards and run standard software. The MicroFlex 7000 does well on both counts.

It had no problems running a simple MCA internal modem (Computer Peripherals' Hook-Up PS2400). More impressively, it also worked with a bus-master card, Pixelworks' Ultra Clipper UM1280 high-resolution graphics card. The MicroFlex 7000 successfully ran a Pixelworks test that alternately exercises that video card and the ESDI controller, which is also a bus master. According to Pixelworks, this test can use as much as 50 percent of the MCA bus bandwidth. The MicroFlex 7000 also had no trouble with a Xircom Pocket Ethernet Adapter that attaches to the unit's parallel port.

It did not fare as well with a simple Microsoft Serial Mouse. When we tried to load the mouse driver software, the system claimed that no mouse was attached. An ALR spokesperson said the company plans to fix this problem by making minor changes to the MicroFlex 7000's motherboard, and that a Microsoft Mouse works with the MicroFlex 7000's built-in, PS/2-style mouse port.

The MicroFlex 7000 ran all the software we tried on it, including Borland's Quattro 1.0, Reflex 1.14, SideKick Plus 1.00A, SuperKey 1.16A, Turbo C 1.0, and Turbo Pascal 4.0; Digital's Smalltalk/V 1.2; Kermit 2.32/A; MicroPro's WordStar 3.3 and 4.0; Lotus's Symphony 2; Microsoft's PC Paintbrush 2.0, Windows/386 2.0, and Word 4.0; Norton Utilities 3.00; Novell's NetWare 2.15; and Symantec's Q&A 1.1.

In fact, the only software problem we found was a holdover from the FlexCache 25386. The MicroFlex 7000's FDISK program froze when we tried to make the penultimate partition of the 310-megabyte hard disk drive a full 32 megabytes. (You can work around this problem easily by making that partition smaller.) An ALR spokesperson said that the problem was due to an odd interaction between the DOS 3.3 FDISK

continued



ALR MicroFlex 7000

APPLICATION-LEVEL PERFORMANCE

ALR MicroFlex 7000 **17.6***

WORD PROCESSING

XyWrite III+ 3.52	Medium/Large
Load (large)	:11
Word count	03/:15
Search/replace	04/:14
End of document	02/:08
Block move	08/:09
Spelling check	06/:38

Microsoft Word 4.0

Forward delete	:11
----------------	-----

Aldus PageMaker 1.0a

Load document	:06
Change/bold	:16
Align right	:13
Cut 10 pages	:11
Place graphic	:03
Print to file	1:24

Index: 3.54

SPREADSHEET

Lotus 1-2-3 2.01

Block copy	:02
Recalc	:01
Load Monte Carlo	:14
Recalc Monte Carlo	:03
Load rlarge3	:04
Recalc rlarge3	:01
Recalc Goal-seek	:02

Microsoft Excel 2.0

Fill right	:03
Undo fill	1:09
Recalc	:01
Load rlarge3	:14
Recalc rlarge3	:01

Index: 3.82

DATABASE

dBASE III+ 1.1	
Copy	1:10
Index	:19
List	1:18
Append	1:37
Delete	:03
Pack	1:19
Count	:17
Sort	1:11

Index: 1.50

SCIENTIFIC/ENGINEERING

AutoCAD 2.52

Load SoftWest	:31
Regen SoftWest	:21
Load StPauls	:07
Regen StPauls	:04
Hide/redraw	7:00

STAT 1.5

Graphics	:21
ANOVA	:10

MathCAD 2.0

IFS 800 pts.	:10
FFT/IFFT 1024 pts.	:09

Index: 5.45

COMPILERS

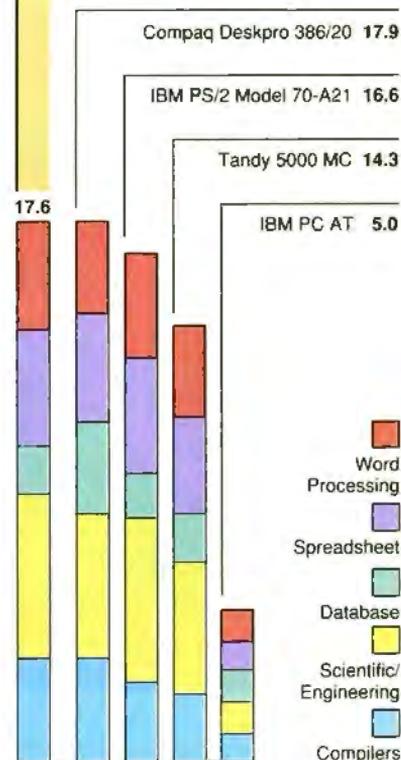
Microsoft C 5.0

XLisp compile	2:40
---------------	------

Turbo Pascal 4.0

Pascal S compile	:04
------------------	-----

Index: 3.30



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8 MHz IBM PC AT = 1.

LOW-LEVEL PERFORMANCE¹

ALR MicroFlex 7000

CPU

Matrix 2.65

String Move

Byte-wide 16.58

Word-wide:

Odd-bnd. 22.60

Even-bnd. 8.30

Doubleword-wide:

Odd-bnd. 16.47

Even-bnd. 4.15

Sieve 14.06

Sort 10.52

Index: 4.99

FLOATING POINT

Math 4.87

Error² 0.00E+00

Sine(x) 1.66

Error 2.00E-09

e^x 1.82

Error 1.00E-09

Index: 10.29

DISK I/O

Hard Seek³

Outer track 3.33

Inner track 3.33

Half platter 6.67

Full platter 8.39

Average 5.43

DOS Seek

1-sector 8.38

32-sector 16.86

File I/O⁴

Seek 0.04

Read 0.89

Write 0.82

1-megabyte

Write 2.97

Read 4.36

Index: 2.41

VIDEO

Text

Mode 0 3:27

Mode 1 3:18

Mode 2 3:54

Mode 3 3:55

Mode 7 N/A

Graphics

CGA:

Mode 4 1:19

Mode 5 1:16

Mode 6 1:33

EGA:

Mode 13 2:27

Mode 14 2:85

Mode 15 N/A

Mode 16 2:78

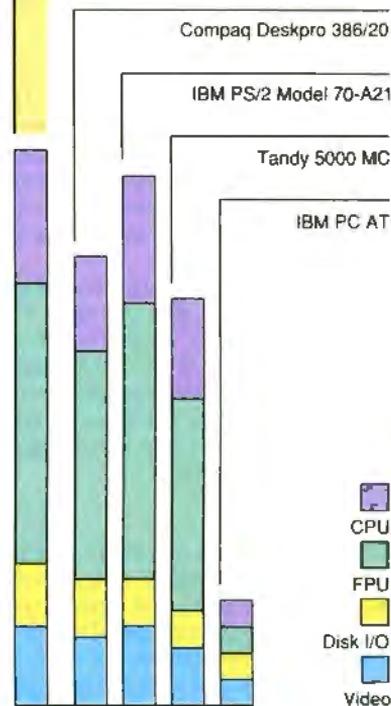
VGA:

Mode 18 2:96

Mode 19 1:25

Hercules N/A

Index: 2.97



N/A = Not applicable

¹ All times are in seconds. Figures were generated using the 8088/8086 and 80386 versions (1.1) of Small-C.

² The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

³ Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

⁴ Read and write times for File I/O are in seconds per 64K bytes.

⁵ For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

CONVENTIONAL BENCHMARKS

LINPACK 135.33

Livermore Loops⁵

(MFLOPS) 0.22

Dhrystone (MS C 5.0)

(Dhry/sec.) 8278



MP386



MP286



MP386s



mp286L

REVIEW

ALR REVS UP MCA

program and the MicroFlex 7000's hard disk subsystem.

Disk Space to Burn

The MicroFlex's hard disk drive is a 310-megabyte, 5¼-inch, full-height Control Data drive. An Adaptec ESDI controller with an on-board 32K-byte cache uses a 1-to-1 interleave with that drive; the combination delivers an average access time of 16 milliseconds.

The MicroFlex 7000 has two empty 3½-inch drive bays, plus two open 5¼-inch half-height bays. ALR offers as options a 1.2-megabyte 5¼-inch floppy disk drive and a 150-megabyte ¼-inch streaming tape drive. The system's standard floppy disk drive is a 1.44-megabyte 3½-inch Fujitsu unit.

The Wrapper

All this hardware is in a tower that can weigh up to 70 pounds. Getting into that box starts out easy: You remove two thumbscrews on the rear and slide off its left side panel. From there, however, the going gets tough. Just to insert an expansion card you must first remove a 3-inch-wide metal support that runs the height

The
*MicroFlex 7000 has
no pop-out components.
It packages
MCA technology in
AT-style mechanical
engineering.*

of the unit. Then you have to swing out a metal arm that holds the standard hard disk drive and one of the optional 3½-inch hard disk drives. Finally, you must remove a restraining brace that helps hold the expansion boards in place.

This process illustrates the difference between an MCA compatible and a PS/2 clone. Unlike the PS/2s, the MicroFlex 7000 has no pop-out components. In-

stead, it packages MCA technology in AT-style mechanical engineering. Because PS/2s are much simpler to disassemble, users and in-house service organizations can easily add boards and replace and upgrade parts in their systems. ALR relies on its dealers to perform such tasks.

The reward for the journey inside the MicroFlex 7000 is eight MCA slots, only one of which—the uppermost 16-bit slot—is full; it contains the hard disk drive controller. Open are three 32-bit slots and four 16-bit slots.

The heart of the system is ALR's proprietary 14-inch-square motherboard. It uses Chips & Technologies' seven-chip Chips/280 chip set, which implements the MCA interface, the communications, and the 16-bit VGA circuitry. Even with these highly integrated chips, however, the motherboard contains an amazing 164 chips. The board was also fairly new; the 19 wires on its underside plainly marked many last-minute fixes.

The large chip count, by the way, does not include the memory on the SIMMs. Each 1-megabyte SIMM contains 12 chips, including eight 1-megabit memory

If Everyone Worked Alike, We Would Only Have To Make One Computer.

But they don't. So we created a broad line of PC compatible computers to meet your individual computing needs while working within your budget.

Whether you are with a Fortune 1000 corporation, manage a small business or work at home, there's a Mitsubishi computer to fit your requirements in size, speed and power.

The sleek mp286L portable is easy to use at home or carry from home to the office. The MP286 is a small footprint desktop PC. For expandability, it's the 32-bit MP386 or the new 16 MHz MP386s — the perfect balance of size and power.

For greater convenience and performance flexibility, you can integrate your PC with a wide choice of Mitsubishi peripherals including color monitors, disk drives, scanners and color thermal transfer printers.

See our full line at your authorized Mitsubishi dealer who is ready to listen and recommend just the right Mitsubishi system and peripherals. Or contact the Mitsubishi Information Center by calling in the U.S. and Canada 1-800-556-1234, ext. 25 (in California, 1-800-441-2345, ext. 25).

With over a decade of experience, Mitsubishi has delivered over a half million personal computers earning a reputation for unparalleled quality and dependability.

Mitsubishi Electronics. Personal computers and personal service.



Circle 196 on Reader Service Card (DEALERS: 197)

Mitsubishi Electronics America, Inc.
Information Systems Division
991 Knox Street, Torrance, CA 90502.
Mitsubishi Electric Sales Canada, Inc.
8885 Woodbine Avenue
Markham, Ontario L3R 5G1.

© 1989 Mitsubishi Electronics America, Inc.
Mitsubishi is a registered trademark of Mitsubishi Electric Corp., Tokyo

REVIEW

ALR REVS UP MCA

chips; there is no parity on this memory.

The MicroFlex 7000's keyboard controller and ROM BIOS (version 1.02.02) are by Phoenix Technologies. The ROM BIOS automatically steps down the effective speed of the system when it reads or writes to the floppy disk; otherwise, the MicroFlex 7000 does not offer any compatibility speeds.

Odds and Ends

The MicroFlex 7000's keyboard follows the IBM Enhanced keyboard layout, except that it places the backslash (\) key next to a reduced Backspace key, in the older AT style. This keyboard also uses an AT-style, rather than PS/2-style, connector. While the keyboard has a nice feel and an audible, mechanical click, we miss the switch on the back of older ALR keyboards that lets you swap the function of the Control and Caps Lock keys.

The MicroFlex 7000's Reference Diskette includes the Phoenix Reference Diskette, which provides an attractive, simple user interface for MCA configuration. The Reference Diskette also contains other useful software, including NetWare Ethernet drivers, a low-level

disk formatter, and VGA drivers for programs such as AutoCAD, Ventura Publisher, and Windows. Drivers for the VGA's higher 800- by 600-pixel modes were not available at this writing.

The MicroFlex 7000's documentation is too technical for novices, containing such occasionally useful information as the pin-outs for the external connectors. It also has at least one error: Its list of ROM BIOS drive types does not include any disk drives over 300 megabytes.

Service and Assistance

The MicroFlex 7000 comes with a one-year parts-and-labor warranty. You can also buy from one to three years of extended warranty service, but it's not cheap: One extra year costs \$600 for the Model 120-A21 and \$680 for the Model 300-A31.

When the MicroFlex 7000 needs maintenance, you can mail it either to ALR or to one of Intel's 35 service locations. Intel will also provide on-site service within 50 miles of any of those locations for \$30 per month.

ALR also gives you unlimited telephone support. The support people with

whom we spoke were knowledgeable and helpful. Our only complaint is that ALR does not provide a toll-free number.

The Bottom Line

If you need a high-performance MCA server, the MicroFlex 7000 is currently your best choice. It has more expansion capability than IBM's PS/2 Model 70 and much greater performance than such other large MCA boxes as the Tandy 5000 MC and the IBM Model 80.

The big question is whether you need an MCA system. You pay more money, but BYTE's benchmarks don't show any performance gains over fast AT machines. Furthermore, few add-in boards are available to take advantage of the MCA bus, although IBM and other vendors have promised more.

If you do decide to purchase an MCA PC, the MicroFlex 7000 is a good, very expandable, high-performance option. ■

Bill Catchings and Mark L. Van Name are independent consultants and freelance writers based in Raleigh, North Carolina. They can be reached on BIX as "wbc3" and "mvannname," respectively.



Northgate's 386 SuperMicro

800,000 BYTES PER SECOND SYSTEM THROUGHOUT . . . Northgate system throughput is second to none. We understand how to design, engineer and produce for optimum throughput. Using specially manufactured and modified components—controllers, bus, software, etc.—Northgate gives you maximum performance—800,000 bytes per second or more.

Few others can hardly coax a 300,000 BPS data transfer rate out of their systems. So why spend good money for ordinary performance when you can get Northgate-optimized performance for the same or less price?

VGA VIDEO TWICE AS FAST AS MOST OTHERS . . . Again, optimized performance from Northgate. We've gone right past EGA straight to 16-bit VGA as standard, not 8-bit as many others offer. It's more than twice as fast as standard monochrome!

You get a wider VGA video selection with Northgate. Either VGA Greyscale, Analog or Multi-synchronous models are available. VGA Greyscale adds only \$395.00 to monographics costs.

Of course, we still offer monographics featuring 14" flatscreen with 1000 line resolution capability in either amber or the increasingly popular paper white screen.

NOW, THE SYSTEMS WITH SCSI CAPABILITY . . . SCSI (Small Computer System Interface) is the technology of the future and Northgate offers it today! Our SCSI model has an SCSI host adapter. Connect as many as 7 intelligent devices—hard drives, tape backups that can run in background, optical laser drives, etc.

Now SCSI technology no longer costs a fortune. Check our prices for SCSI with a 40MB hard drive. Performance rips with these drives—under 18 Millisecond access speeds. Ideal for intensive data base applications, or loading your spreadsheet in a blink.

Check our prices and phone for more details on how Northgate's SCSI technology can put more zip in your system performance at a price that more than pays for itself.

ESDI HIGH SPEED DRIVES TO 600 MEGABYTES . . . Northgate brings price reality to high capacity hard drive systems. Where others charge outlandish prices, Northgate's down-to-earth pricing puts these memory monsters well within your budget. Cost per megabyte is nearly halved when you enter this realm.

OMNIKEY/102 IS A NO-COST OPTION . . . You'll delight in using Omnikey/102. Every magazine review and thousands of users agree. Omnikey is the standard against which all other keyboards can be judged. And it comes with all Northgate systems as a no-cost option. If you don't buy a Northgate system and still want the best keyboard in the world, you can buy OmniKey separately for \$99.00.

Add it all together. Compare with the other buys. Then call Northgate and feel confident you're buying the best!

SAVE \$\$\$!

NEW LOW PRICE FROM NORTHGATE

Crackling 20MHz Performance in a Complete System with 28 Millisecond 65MB Hard Drive, Desktop Model and Monitor at the price others charge for 16MHz!

\$2599⁰⁰

POWER CASE MODEL NOW \$2799⁰⁰

COPYCAT technology just doesn't meet Northgate's standard. So our engineers developed a spanking new 386 system that by-passes 16MHz completely and goes straight up to 20MHz processing speed.

Performance and features like no other. And priced where you'd expect to buy an ordinary 16MHz system.

The new Northgate 386/20SM is a speed-burner. With a zero wait state page mode memory management method that produces performance as fast as any in standard DOS programs.

And, when using higher memory applications such as in networking, Windows 386 or Xenix, the 386/20SM leaves others in its wake.

Truly the new price/performance leader in the industry!

32-BIT ARCHITECTURE THROUGHOUT ...

This new Northgate system uses one or four megabytes of high speed 32-bit memory on the motherboard. When you need additional RAM, two 32-bit slots each hold 8MB memory cards. That's right—20MB RAM capacity.

And of course the motherboard has 387 and Waitek sockets.

Fully enhanced, Northgate's 386/20SM exceeds the speed of many mainframe systems.

SELECT "386 NORTHGATE POWER" OR DESKTOP CASE ...

Widely applauded as the Rolls Royce of floor standing cases, the Northgate cabinet is a fine piece of engineering. It has space for three exposed half-height devices and two internal half-highs or one full-high.

Not a re-hashed desktop with sheet metal welded to the bottom, but a true free-standing extra-heavy-duty steel case.

It has a big heart, too. A 230-watt switching power supply is now standard. Add any peripheral you want. 386/20SM can handle it with ease.

Front-mounted controls for high/low speed, system reset and keyboard lockout.

Our desktop model has the same drive capability as the Power case, features quality construction, front controls and \$200.00 lower price.

**Feature for feature,
Northgate's 386/20SM
is your best buy.**



Northgate 386/20SM includes:

1MB RAM; 20MHz Intel Processor; Power Case (for desktop case deduct \$200.00); One 1.2 MB Floppy; One 1.44 MB Floppy; 65MB RLL 28MS Hard Drive, with 1:1 Interleave 16-Bit Controller; 14-inch High-Resolution Flatscreen Amber or Paper White Monitor; OmniKey/102 MS-DOS 4.01 or 3.3 with GW-BASIC; Super PC-KWIK Disk Cache Software **\$2899.00**

Northgate Options Prices

Video Options Add:	VGA GREYSCALE	\$395.00
	16-BIT VGA ANALOG	\$595.00
	16-BIT VGA COLOR	\$725.00
Hard Drive Options Add:	SCSI 40MB 28MS	\$300.00
	ESDI 150MB 17MS	\$900.00
	ESDI 300MB 17MS	\$2,300.00

Other options include Streaming Tape Backup, Hard Drives to 720MB, VGA and Desktop Publishing/CAD Monitors to 37 inch.

800-548-1993

Canada: 800-338-8383

HOURS: Monday through Friday 7 a.m. - 8 p.m. Central
NEW EXTENDED SATURDAY HOURS: 8 a.m. - 4 p.m. Central

TERMS: VISA, MasterCard, COD, "Big N" credit card, prepayment (wire transfer); and purchase orders for rated accounts. We also ship to APO and FPO. All shipments are FOB Minneapolis, MN.

Personal checks up to \$6000 receive instant approval through TeleCheck.

Northgate Computer Systems, Inc.
13895 Industrial Park Blvd., Suite 110
Plymouth, MN 55441



Maxon MVGA-16 adapter works with flying colors



with features that make it unequalled by any other VGA adapter

- Operates up to 400% faster than IBM VGA adapter
- Extended modes (require 512K of RAM): 1024x768 - 16 colors; 640x480 - 256 colors
- Full BIOS and REGISTER compatibility with MDA[®], CGA[®], MCGA[®], EGA[®], VGA[®] and Hercules[®]
- Works with either XT[™] or AT[™]: 16 bit design - auto-detects and adapts to 8 bit slots
- High-res drivers for popular software

For more information about Maxon's 16 bit VGA adapter, phone (415) 377-0269, FAX (415) 377-0236 or write to Maxon Systems, Inc., One Waters Park Drive, Ste. 117, San Mateo, CA 94403.

maxon[®]
SYSTEMS INCORPORATED

A Wholly Owned Subsidiary of Maxon Electronics Co. Ltd. of Korea

The following are trademarks or registered trademarks of the companies listed: IBM, XT, AT, VGA, MDA, CGA, MCGA and EGA - International Business Machines Corp.; Hercules - Hercules Computer Technology, Inc.; MVGA - Maxon Systems, Inc.; AutoCAD and ADI - Autodesk, Inc.; Lotus and 1-2-3 - Lotus Development Corp.; Framework II - Ashton-Tate Corp.; GEM and Desktop - Digital Research, Inc.; Ventura Publisher - Ventura Software, Inc.; MS and Windows - Microsoft Corp.; WordPerfect - WordPerfect Corp.; and WordStar - MicroPro Intl. Corp.

© 1989 - Maxon Systems, Incorporated

providing VGA[®] compatibility equal to IBM's own VGA adapter

That's right . . . Maxon's MVGA-16 adapter is 100% IBM[®] compatible. So, if you're using one of the standard IBM modes (up to 640x480 with 16 colors), you don't need a special driver at all.

When extended resolution* is required, Maxon still comes through with flying colors. The MVGA-16 includes drivers for AutoCAD[®] - ADI[®] versions 2.1 and 3.1, Lotus[®] 1-2-3[®] - release 2.x, Framework II[®] - releases 1.0 and 1.1, GEM[®] Desktop[™] - version 2.x, Ventura Publisher[®] - releases 1.1 and 2.0, MS[®] Windows[®]/286 - versions 2.03 and 2.1, WordPerfect[®] - releases 4.0 and above, and WordStar[®] - release 3.xx.

And that's not the whole story . . . additional drivers are being added constantly.

Circle 178 on Reader Service Card (DEALERS: 179)

*High-res drivers offer different resolutions for different software packages



Long Live the Low End

The smartly designed
AST Bravo/286 is
a winner among the
8-MHz AT compatibles

Roger C. Alford

AST Research is known for producing well-made IBM PC-compatible machines, and its newest entry, the Bravo/286, is no exception. While it might seem late in the game to introduce a low-end AT system, the 8-MHz Bravo/286 is stylish and cost-effective, with several built-in peripheral devices, a small footprint, and a high level of compatibility.

A Look from the Outside

The Bravo/286's 14¾- by 15-inch footprint takes up minimal desk space, and its 5-inch height is less than that of most XT systems. The system has an attractively simple front panel. Its two half-height drive bays are accessible from the outside of the unit. Besides the normal disk-access LEDs on the installed drives, the front panel has only a power-on LED, and the little-used keylock is absent.

I have one nit to pick: The power-on and floppy disk drive access LEDs on the front panel are visible only from a limited viewing angle. If you are too far above or to one side of the LEDs, it is difficult to tell when they are on.

The rear of the unit provides clues to how AST put so much computer into such a small box. The most notable difference from a standard AT is the orientation of the four expansion slots: They are horizontal instead of vertical. Below them are two 25-pin D-shell connec-



tors—a parallel printer port (female connector) and an RS-232C serial port (male connector). A recessed reset button resides at the far bottom-left corner.

An Inside Look

The power supply is physically much smaller than that of a normal AT and sits immediately behind the drive bays. Its 100-watt output is meager by today's standards, but the low-power design of the logic board and the four-slot, two-bay limitations of the system minimize power requirements. The Bravo's power supply is adequate for most situations.

The logic board is simply elegant. It is almost evenly split between through-hole

and surface-mount components, and single in-line memory modules are used for the main DRAM to provide high-density storage. The combined use of surface-mount parts, SIMMs, and the highly integrated G-2 80286 chip set allowed AST to combine a lot of circuitry on a small motherboard, which takes up the entire floor of the left side of the chassis. The motherboard is nicely built; I found only two engineering jumper wires on it.

To keep the height of the system low, the expansion slots are horizontal. To accomplish this, a separate "bus card" containing the expansion connectors plugs vertically into a special connector

continued

Have you ever wished that WordPerfect could format complicated equations, use 150+ high quality fonts and hundreds of special symbols on almost any monitor or printer?

NEW FASE

Font And Science Extensions

makes your wish come true

Requires

- IBM PC 640K
- MS-DOS 2.00+
- WordPerfect 5.00

Supports

- HP LaserJet +, II
- Epson 9 & 24 pin
- NEC PinWriter
- HP DeskJet
- ProPrinter
- PostScript
- Toshiba

ans-Serif
Dunhill
Roman
Italicized
Monospaced

$\sqrt{2} + \sqrt{3} + \sqrt{4} + \sqrt{\pi}$

Q R M S

Prices start from \$149. Demo Diskette \$3. For more information or to order call or write to

MICROPRESS inc
67-30 Clyde Str. #2N
Forest Hills, NY 11375
(718) 575 1816

WordPerfect is a trademark of WPC. NewFase is a trademark of MicroPress.

AST Bravo/286

Company

AST Research, Inc
2121 Alton Ave
Irvine, CA 92714
(714) 863-1333

Components

Processor: 8-MHz 80286, socket for 80287 coprocessor
Memory: 512K bytes of DRAM, expandable to 4 megabytes
Mass storage: 1.2-megabyte floppy disk drive
Keyboard: 101 keys in IBM Enhanced layout
I/O interfaces: RS-232C serial port (DB-25P connector), parallel printer port (DB-25S connector), 5-pin DIN keyboard connector, floppy disk drive controller, IDE hard disk drive interface, four AT expansion bus slots (three 16-bit and one 8-bit)

Size

14¾ x 15 x 5 inches, 30 pounds

Software

Setup and disk utilities

Documentation

User's manual

Price

Model 1: \$1095
Model 5 with 1.2-megabyte 5¼-inch floppy disk drive: \$1245
Model 45 with 1.2-megabyte 5¼-inch floppy disk drive and 40-megabyte hard disk drive: \$2095
System as reviewed: \$3834

Inquiry 851.

on the motherboard. The bus card then provides the four expansion slots—three 16-bit slots and one 8-bit slot. Because of the unusual orientation of these slots, AST provides an extra support for the expansion boards. You must remove this support to install or remove a board, so there's one more step than usual.

The drive bays are a little narrower than those in a standard AT system. AT systems typically have slide-rail guides for the drive bays, so drives need a slide rail on either side. The Bravo/286's drive bays lack these guides. Instead, AST used the approach typically found in XT systems, securing the drives to vertical metal plates by two screws on either side.

In addition to the standard motherboard parts (the 80286 processor, the 80287 coprocessor socket, the keyboard controller, the G-2 chip set, and the memory), several other circuits are

worth noting. A serial port and a parallel port are accessible by connectors on the rear panel. A floppy disk drive controller is also included on the motherboard, as is an Integrated Drive Electronics (IDE) hard disk drive interface. A small piezo-electric transducer mounted on the motherboard functions as a speaker.

For the real-time clock, AST used the Dallas Semiconductor DS1287. This single module has all the circuitry needed for the real-time clock (including the crystal and oscillator) and includes a built-in lithium battery with an expected 10-year life. This circuit not only saves board space but virtually eliminates the need to ever replace the battery.

Standard Equipment

Unlike most AT systems, where many components cost extra, the Bravo/286 includes several common peripheral devices as standard equipment. Most are integrated directly onto the motherboard. The primary extras are the serial and parallel ports, the floppy disk drive controller, and the IDE hard disk drive interface. On other systems, these items often require one or more add-in boards.

With all these peripherals integrated, having only four expansion slots seems more reasonable; the Bravo/286 doesn't need the "standard" add-in boards (a floppy/hard disk drive controller and a multifunction card). You probably won't need a memory board, either, since the system's four SIMM sockets can hold either 256K-byte or 1-megabyte SIMMs, allowing up to 4 megabytes of DRAM on the motherboard. The standard system ships with only 512K bytes of DRAM.

My evaluation system reflected the efficiency of the Bravo/286's design. It had 1 megabyte of DRAM (a \$350 upgrade), a 1.2-megabyte 5¼-inch floppy disk drive, a 40-megabyte hard disk drive, an AST VGA adapter (\$599), and the serial and parallel ports, yet only the VGA adapter used an expansion slot.

The system also came with a good 101-key keyboard, MS-DOS 3.3 (a \$95 option), a well-designed and well-illustrated user's manual, and the system setup and disk utilities. The setup utility offers the flexibility you need when so many devices are integrated on the motherboard. It lets you enable or disable each standard peripheral device so you can plug in expansion boards with these functions, if you desire.

Performance

With an 8-MHz 80286 processor as its workhorse, the Bravo/286 is clearly de-

continued



AST Bravo/286

AST Bravo/286 **6.9***

APPLICATION-LEVEL PERFORMANCE

WORD PROCESSING

XyWrite III + 3.52	Medium/Large
Load (large)	14
Word count	06/41
Search/replace	09/40
End of document	02/21
Block move	12/13
Spelling check	17/2 16

Microsoft Word 4.0

Forward delete	:26
----------------	-----

Aldus PageMaker 1.0a

Load document	:16
Change/bold	:48
Align right	:37
Cut 10 pages	:32
Place graphic	:07
Print to file	3:25

Index: **1.57**

SPREADSHEET

Lotus 1-2-3 2.01

Block copy	:07
Recalc	:03
Load Monte Carlo	:32
Recalc Monte Carlo	:09
Load rlarge3	:08
Recalc rlarge3	:02
Recalc Goal-seek	:06

Microsoft Excel 2.0

Fill right	:11
Undo fill	3:58
Recalc	:03
Load rlarge3	:47
Recalc rlarge3	:03

Index: **1.30**

DATABASE

dBASE III + 1.1

Copy	1:16
Index	:19
List	1:39
Append	2:29
Delete	:04
Pack	1:46
Count	:18
Sort	1:30

Index: **1.22**

SCIENTIFIC/ENGINEERING

AutoCAD 2.52

Load SoftWest	1:48
Regen SoftWest	1:31
Load StPauls	:23
Regen StPauls	:17
Hide/redraw	29:35

STAT 1.5

Graphics	:41
ANOVA	:25

MathCAD 2.0

IFS 800 pts.	:43
FFT/IFFT 1024 pts.	:44

Index: **1.53**

COMPILERS

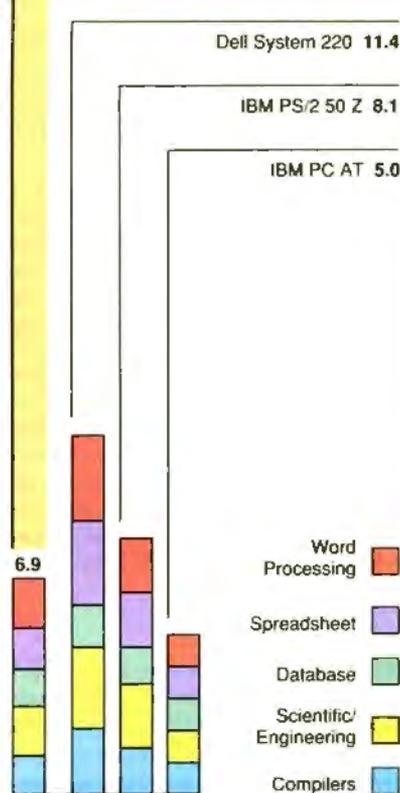
Microsoft C 5.0

XLisp compile	7:25
---------------	------

Turbo Pascal 4.0

Pascal S compile	:09
------------------	-----

Index: **1.27**



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT = 1

LOW-LEVEL PERFORMANCE¹

AST Bravo/286

CPU

Matrix	9.58
String Move	
Byte-wide	53.64
Word-wide:	
Odd-bnd.	53.64
Even-bnd.	26.83
Sieve	56.12
Sort	42.71

Index: **1.48**

FLOATING POINT

Math	45.26
Error ²	0.00E+06
Sine(x)	19.49
Error	2.00E-09
e^x	1.66
Error	1.00E-09

Index: **1.03**

DISK I/O

Hard Seek³	
Outer track	3.33
Inner track	3.26
Half platter	8.76
Full platter	10.03
Average	6.34
DOS Seek	
1-sector	14.80
32-sector	46.58
File I/O⁴	
Seek	0.39
Read	1.26
Write	1.16
1-megabyte	
Write	7.43
Read	7.28

Index: **1.12**

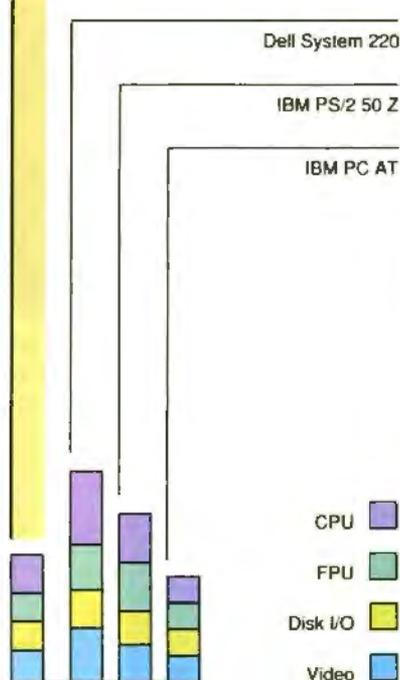
VIDEO

Text	
Mode 0	7.60
Mode 1	7.60
Mode 2	7.52
Mode 3	7.54
Mode 7	7.56
Graphics	
CGA:	
Mode 4	3.93
Mode 5	3.92
Mode 6	4.21
EGA:	
Mode 13	6.46
Mode 14	7.12
Mode 15	N/A
Mode 16	7.12
VGA:	
Mode 18	7.47
Mode 19	4.29
Hercules	N/A

Index: **1.18**

CONVENTIONAL BENCHMARKS

LINPACK	959.11
Livermore Loops ⁵	
(MFLOPS)	0.02
Dhrystone (MS C 5.0)	
(Dhry./sec.)	2253



N/A = Not applicable

¹ All times are in seconds. Figures were generated using the 8088/8086 version (1.1) of Small-C.

² The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

³ Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

⁴ Read and write times for File I/O are in seconds per 64K bytes.

⁵ For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

signed to maximize economy, not performance. Indeed, a quick check revealed that the IBM PC AT is the only 8-MHz 80286 system for which the BYTE Lab has benchmark results, using the new BYTE benchmarks. Thus, I had to compare the Bravo/286 to 10-MHz 80286 machines.

The Bravo/286 compares favorably to the true-blue IBM AT in all the benchmarks, probably because of improved memory and I/O accessing. The benchmarks reveal similar performance between the Bravo/286 and IBM's original 10-MHz PS/2 Model 50, except in the disk and database areas, where the Bravo/286 is noticeably faster. The newer IBM PS/2 Model 50 Z, on the other hand, leaves the Bravo/286 behind. With the exception of the database tests, the Bravo/286's performance fits right in the middle, between the 8-MHz IBM AT and the 10-MHz PS/2 Model 50 Z for all the benchmarks.

Compatibility

With a company as mature as AST Research and an architecture as well established as that of the 80286 AT, compati-

bility should hardly be an issue. Every program I could get my hands on ran without a hitch.

The only glitch I noticed was with the VGA adapter running a not-well-behaved VGA demo program for an Intecolor monitor. When the program started playing around with the color palette, the display switched from 256 colors to shades of gray. AST is checking on the problem. Aside from this little anomaly, I had no other compatibility problems with this system.

An Economical Choice

The economy of the AST Bravo/286 is most visible in the pricing of its base (Model 1) configuration (512K bytes of DRAM, no floppy disk drive). Unfortunately, the options quickly add to the bottom line (\$150 for a 1.2-megabyte 5¼-inch floppy disk drive, and \$850 more for a 40-megabyte IDE hard disk drive), making the expanded system economically less competitive. However, you could certainly buy these options from a less-expensive source and install them yourself.

Its small size makes the diskless Bra-

vo/286 a good choice for use as a LAN workstation. You'll just have to add video and network interface boards.

The AST Bravo/286 is a small, well-designed system that integrates many of the peripherals that you would commonly need in an AT system. It offers moderate performance in an economical package that is nonetheless made with the same care and quality construction that have given the AST Premium/286 and other AST systems good reviews in the past.

If you're looking for a high-performance super-AT, this is not your system. But if you want a well-made, economical, AT-class machine with the extras built in, the Bravo/286 might be just the machine for you. ■

Roger C. Alford is a project manager for Nematron Corp., a manufacturer of industrial computers and terminals in Ann Arbor, Michigan. He has written over 75 computer- and electronics-related articles and is the author of the Programmable Logic Designer's Guide (Howard W. Sams & Co., 1989). He can be reached on BIX c/o "editors."

The most powerful expanded memory software available.

TURBO EMS



Turbo EMS now includes "Automatic Spillover" and special support for Windows, Excel, DESQview, and Ventura.

- Provides "Automatic Spillover" between any combination of expanded memory, extended memory and disk file space
- Simulates LIM 4.0 expanded memory with LIM 3.2 hardware
- Allows customized individual configuration files for multiple software applications
- Supports the LIM XMS 2.0 specification for extended memory
- Provides up to 32 megabytes of LIM 4.0 expanded memory
- Totally network compatible and relocatable to RAM between 640KB and 1 megabyte

Turbo EMS \$99.95 Suggested retail

For the name of the dealer nearest you or for more information call Lantana.

4393 Viewridge Avenue, Suite A • San Diego, CA 92123 • 619/565-6400 • FAX 619/565-0798



Data to Go

Sysgen's removable hard disk cartridge system hooks to Macs or PCs

Don Crabb

Removable hard disk drives have been around for years as backup devices, but they have recently caught on for everyday use. Their performance has improved significantly in the past year, and they're available in both Mac and PC versions, thanks to the SCSI-standard interface.

Removable media schemes include removable drives, which have the spindle sprocket and read/write heads in the cartridge, and removable disk cartridge systems, which let you remove the disk platter from the drive mechanism. Typical of the latter is the Sysgen Maxi RD45 hard disk drive, which uses a SyQuest drive mechanism and 45-megabyte disk cartridges.

As a hard cartridge system, the Maxi is less fragile than removable drives, and additional cartridges are less expensive, since they contain only the platter. They're also quite fast: The Maxi has a 25-millisecond average seek time. The drive works with the Mac Plus or higher and the IBM PC, PS/2s, and compatibles (the PS/2 version was not available for this review). But Macs and PCs can't share the same cartridge; if you plan to use the drive on both platforms, you'll have to buy two cartridges.

The Maxi isn't cheap: The Mac version includes installation software and one cartridge for \$1695. For the IBM machines, you'll also need a PC-bus interface (\$195) or an MCA-bus interface (\$250). Additional cartridges are \$175



The Sysgen Maxi RD45 combines the speed of a fixed hard disk drive with the portability of a removable media system.

each. The Maxi compares well against removable hard disk systems, but it is more expensive than my portable Jasmine DirectDrive 140 (\$1499). For backup purposes, it's considerably more expensive than slower Bernoulli drives or tape backup systems.

Each removable hard disk cartridge holds 44.4 megabytes of data when formatted. The clear plastic case houses a single platter suspended in the center of the case. The drive mechanism accesses the platter via a sliding window located on the side of the case. The drive is about as fast as many Mac SCSI disk drives; the PC versions are more than twice as fast as a standard 30-megabyte IBM PC AT internal hard disk drive.

The Maxi drive includes two SCSI ports and an external SCSI ID DIP switch that's convenient when you're plugging the drive into an existing chain of SCSI devices. The Maxi lacks internal SCSI termination but includes an exter-

nal SCSI terminator that you'll have to add, depending on the place of the drive in a SCSI chain.

Testing to the Max

I tested the drive by connecting it to a color Mac II with 8 megabytes of RAM, a 1-megabyte Mac SE, and an IBM PC AT with 1 megabyte of memory. In all the tests, the Maxi drive was the only SCSI device I connected, and the test disk was always the start-up (boot) disk.

On the Mac, I installed System 6.0.2, Finder 6.1, and the other system software from the 6.0.2 System Tools package. I kept only the desk accessories, fonts, INITs, and cdevs that were supplied with the Apple system. I didn't install any other INITs, cdevs, DAs, or fonts, and I disabled the CPU's data cache for all the tests. I also installed version 2.56 of the Maxi software on the drive. For purposes of comparison, I've

continued

included benchmarks for Apple's Hard Disk 40SC 40-megabyte internal drive and Mass Micro's DataPakhd 120, which comprises a 120-megabyte drive along with a SyQuest 45-megabyte removable hard cartridge drive system in one box (see table 1).

On my AT running DOS 3.3, I installed the Maxi PC-bus (16-bit direct

memory access [DMA]) SCSI adapter card in slot 3 and version 1.00 of the Maxi software. Table 2 shows a comparison of the Sysgen Maxi RD45 against the standard 30-megabyte IBM drive in my AT.

I ran virtually every Mac and DOS application I had on the drive—everything from Excel (both PC and Mac) to

ParcPlace's Smalltalk-80 (Mac)—without any problems. The drive worked equally well when connected to the Mac and the AT.

One look at the benchmark tables proves that the Maxi is fast. With a 25-ms average access time, you'd expect that. But I didn't expect it to perform over twice as fast as the 30-megabyte internal drive in my AT. I attribute most of that increased performance to the Maxi's 16-bit SCSI DMA adapter. Sysgen says that this card blasts data out at sustained rates of almost 1 megabyte per second, with burst rates reaching 5 megabytes per second.

Delicate Matters

While portable, the Maxi cartridges are still essentially platters, and you should treat them with care. If dropped to the floor, the cartridge would probably break. And unlike normal drives, which are sealed, a sliding window on each cartridge can let in potentially damaging dirt and dust. Under normal conditions, however, the drive movement blows dust particles off the disk, keeping the cartridge clean.

Sysgen claims that the cartridges are rugged enough (when transported in the supplied padded cases) to take along in your briefcase or ship cross-country. They are rated to survive impacts of up to 40 g's. I carried a full cartridge (with 40 megabytes of Mac files on it) in my soft-sided briefcase for about a month. It saw significant abuse (i.e., the case was bumped, jostled, and repeatedly x-rayed at airports) yet never failed to work properly; even the Mac Desktop remained pristine.

I also shipped this same cartridge from my office to my home and back again via Federal Express. I enclosed the cartridge in its padded plastic case, and then I put it into a standard cardboard overnight letter (the package went from my office in Chicago to the Federal Express hub in Memphis and back to my home). The cartridge worked fine after both trips, although the plastic carrying case was a little worse for wear.

In a month's worth of accelerated abuse and testing, the two cartridges I used worked fine. But be warned: Repeated abuse of a cartridge can have a cumulative effect on cartridge components.

Decisions, Decisions

Other vendors besides Sysgen incorporate the SyQuest drive in their removable hard cartridge systems, but the Maxi is

continued

Table 1: Benchmark results on the Macintosh. All times are in minutes:seconds. Each timing reflects the mean of 10 repetitions of each benchmark (N/A = not applicable).

SCSI read (1 block/32 blocks); 500 seeks		
	Mac II	Mac SE
Sysgen Maxi RD45	0:14.09/0:36.60	0:15.51/0:39.20
Apple Hard Disk 40SC	0:15.30/0:36.10	N/A
Mass Micro DataPakhd 120		
Fixed hard disk drive	0:18.97/0:37.78	0:21.35/0:41.90
Removable cartridge	0:14.07/0:37.75	0:18.50/0:40.77
Large file (5-megabyte) write/read		
	Mac II	Mac SE
Sysgen Maxi RD45	0:26.10/0:26.14	0:39.20/0:38.03
Apple Hard Disk 40SC	0:26.14/0:23.46	N/A
Mass Micro DataPakhd 120		
Fixed hard disk drive	0:32.26/1:43.54	0:45.18/2:15.10
Removable cartridge	0:26.46/0:25.50	0:41.67/0:39.12

Table 2: Byte disk I/O benchmark results as run on the IBM PC AT. All times are in seconds.

	Sysgen Maxi RD45	IBM 30-megabyte internal hard disk drive
Hard seek		
Outer track	3.19	3.28
Inner track	3.18	3.30
Half platter	8.44	11.30
Full platter	10.32	16.59
Average	6.28	8.62
DOS seek		
1-sector read	5.15	11.66
80-sector read	18.45	24.33
File I/O		
Seek	0.15	0.22
Read	0.013	0.021
Write	0.014	0.022
1-megabyte		
Write	4.04	8.92
Read	3.55	8.16

NOW YOU CAN DESIGN JUST ABOUT ANYTHING... INCLUDING YOUR OWN CADD SYSTEM!



Anyone can produce a computer-aided drafting and design package that sells for thousands of dollars. But creating one that's fast, powerful, and affordable takes real ingenuity.

That's exactly what we've done at Generic Software.™ We sell the most widely used CADD program in the world for under \$500.



Now available for Macintosh™

PC Magazine ranked it "Editors Choice" in a face off with 17 low-cost CADD packages. "This product is an outstanding value from every point of view and is highly recommended." "A paperback version of AutoCAD", stated PC Week.

And our CADD programs are just part of what we offer.

You can start with Generic CADD Level 1,™ then advance to other levels as your needs—and skills—expand.

And you can use our CADD add-ons, Utilities, and symbols libraries to design the CADD system that fits your needs.

You only pay for the functionality you need, and the functionality you get has depth.

Critic tested, market approved. Generic Software offers price, quality, and support. Match our customer support against anyone!

- Unconditional 60-day guarantee on most products
- Unlimited free technical support
- Free monthly newspaper
- Regular updates at modest prices. All adding up to prove that the only thing generic about us is the price.

Call us for a free CADDalog™ or for the name of your local dealer: 1-800-228-3601.

© Generic Software Inc., Level 1 and Generic CADD are trademarks of Generic Software Inc., 11911 North Creek Parkway South, Bothell, WA 98011. Macintosh is a trademark of Apple Computer Inc.

Generic
S O F T W A R E

Sysgen Maxi RD45

Company

Sysgen, Inc.
556 Gibraltar Dr.
Milpitas, CA 95035
(800) 821-2151

Size

4¾ by 11 by 7¼ inches; 3½ pounds

Hardware Needed

Macintosh Plus or higher; IBM PC,
PS/2, or compatible

Documentation

User's manual

Price

External hard disk drive (includes one
45-megabyte cartridge and a SCSI
terminator): \$1625

Internal hard disk drive (for PC and
PS/2s only): \$1325

Macintosh interface: \$80

PC-bus interface: \$195

MCA-bus interface: \$250

Additional cartridges: \$175 each

Inquiry 889.

the only drive with a 16-bit SCSI adapter for the PC. The real decision to make with regard to the Maxi is not whether you'll buy this particular drive, but whether a removable hard cartridge system is right for you.

The Maxi is convenient for backing up fixed hard disks, since it's reliable and fast. But the cost is high: \$175 for a blank 44.4-megabyte cartridge isn't cheap. Compare that to \$30 for a 38.5-megabyte DC-2000 streaming tape or \$45 for a 60-megabyte DC-600 tape. Although both tape formats are much slower than the Maxi, and you can't use them as random-access system drives, they're a lot less expensive for archival storage. Also, the reliability of magnetic tape for long-term storage is well documented.

A better use for the cartridge might be to keep only critical system backups of important data and applications that need to be up and running immediately after a hard disk crash.

The Maxi is useful for day-to-day data storage, if you don't need more than 44.4 megabytes of disk space. But the Maxi's best application is probably in locations where security is a big concern, since

you can remove Maxi cartridges and lock them away at the end of the day.

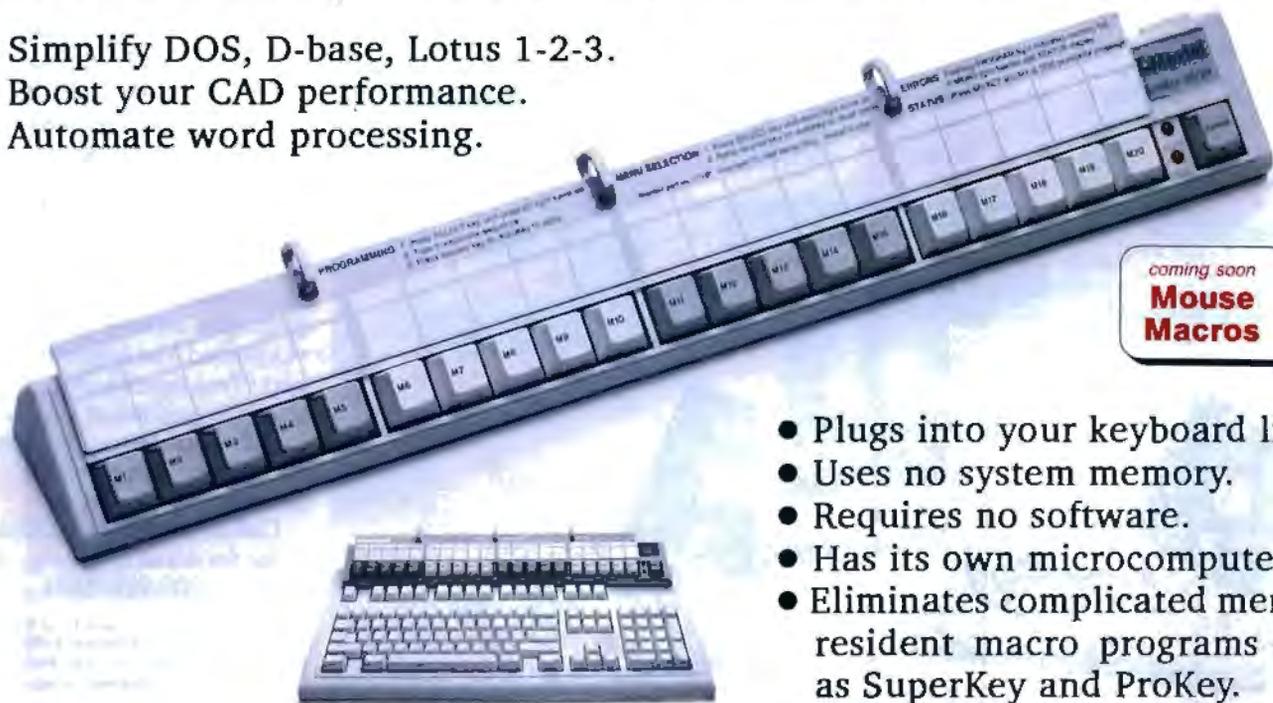
If you decide to use the Maxi to transport data between offices or on business trips, you'll have to make sure that a Maxi drive awaits you at your computing destination. This is a drawback over totting a small portable drive. I carry my Jasmine DirectDrive 140 with me when I go on the road; it plugs into any Mac SCSI port. It may be more fragile, but after a year of abuse, the drive still hasn't failed. Of course, the Jasmine drive is heavier to carry than a Maxi cartridge.

Personally, I need more than 44.4 megabytes of data on a single hard disk volume, so I can't use the Maxi. But your data needs might be different. And for the price of an interface kit and an extra cartridge, you can use the Sysgen Maxi RD45 in Macs, PCs, and Micro Channel PS/2s. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

AutoKey 400 programmable macro keys!

Simplify DOS, D-base, Lotus 1-2-3.
Boost your CAD performance.
Automate word processing.



- Plugs into your keyboard line.
- Uses no system memory.
- Requires no software.
- Has its own microcomputer.
- Eliminates complicated memory resident macro programs such as SuperKey and ProKey.

Mextel Corp. 159 Beeline Road
Bensenville, Illinois 60106

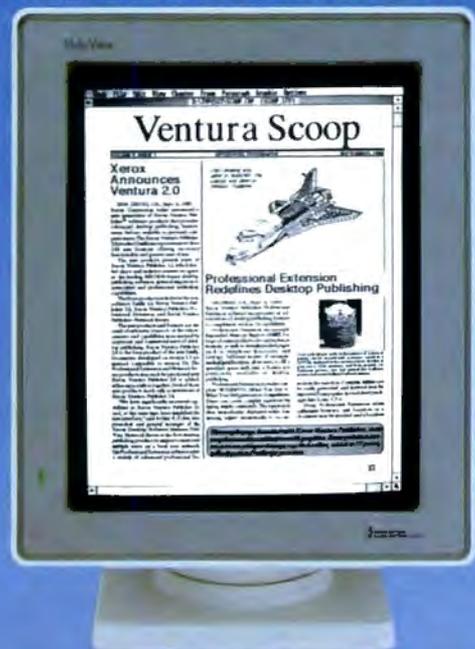
AutoKey is trademark of Mextel Corp. All other product names are trademarks of their respective manufacturers. ©1989 MEXTEL CORP.

Call 1-800-888-4146
(inside IL call 312-595-4146)

AutoKey 40 \$139.00
AutoKey 20/20 \$289.00

Visa/MC/AmEx.

THE ONE THAT RUNS THEM ALL.



The MultiView Monitor with GrafixPro Gives You True Full Page Viewing And Runs Any Standard PC Compatible Software.

The display that runs them all, does it all!

PPL's MultiView Monitor . . . for full page viewing with super high 800 X 1000 resolution, 16 levels of gray, plus multiscanning capability from 15.75 KHz to 60 KHz. Now you don't have to give up anything for VGA full page, plus true (not emulated) EGA, CGA, MDA and Hercules modes.

PPL's GrafixPro Video Adapter . . . hardware register-level compatible to run all your PC software in the required modes. Think about it, one display with true VGA full page viewing that runs every piece of PC software you presently use. We even include high resolution drivers for WordPerfect 5.0, Ventura, PageMaker, Windows, AutoCad, Lotus 1-2-3, Publisher's Paintbrush and GEM, so you can take full advantage of our full page and extended VGA modes.

Simplify your life. Make your dollars work harder. For only \$1,050 (MultiView \$455.00, GrafixPro \$595.00), the display that runs them all can do it all for you!

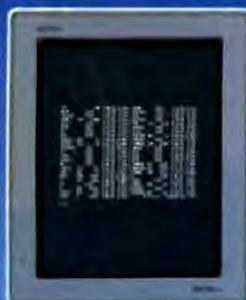


1-609-924-1153

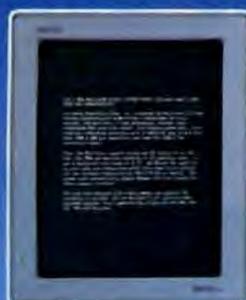
PRINCETON PUBLISHING LABS

Advanced Electronic Publishing Hardware
19 Wall Street, Princeton, NJ 08540

Hercules is a trademark of Hercules Computer Technology • Ventura Publisher is a trademark of Ventura Software, Inc. • AutoCad is a trademark of Autodesk, Inc. • Windows is a trademark of Microsoft, Inc. • Lotus 1-2-3 is a trademark of Lotus Development Corporation • SuperFax is a trademark of Pacific Image Communications • PageMaker is a trademark of Aldus Corporation • GEM is a trademark of Digital Research, Inc. • Publisher's Paintbrush is a trademark of Z-Soft Corporation • WordPerfect 5.0 is a trademark of WordPerfect Corporation



CGA, 640 X 200, 15.75KHz,
DOS Directory



EGA, 640 X 350, 21.8KHz,
WordPerfect 5.0



Hercules, 720 X 348, 18.4KHz,
ChessMaster 2100



Hercules, 720 X 348, 18.4KHz,
BosIt



VGA, 720 X 400, 31.5KHz,
DOS Directory



VGA, 720 X 400, 31.5KHz,
Lotus 1-2-3



VGA, 640 X 480, 31.5KHz,
Publisher's Paintbrush



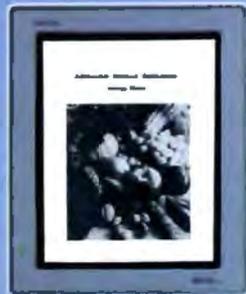
Non-interlaced, 1024 X 768, 49KHz,
Windows 386



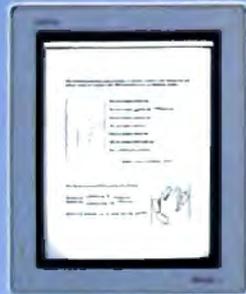
Full Page VGA, 800 X 1000, 60KHz, 16
Shades of Gray, Publisher's Paintbrush



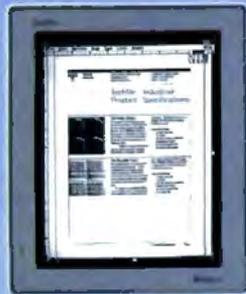
Full Page VGA, 800 X 1000, 60KHz,
AutoCad release 10



Full Page VGA, 800 X 1000, 60KHz,
Scanned Grayscale Image



Full Page VGA, 800 X 1000, 60KHz,
WordPerfect 5.0



Full Page VGA, 800 X 1000, 60KHz,
PageMaker



Full Page VGA, 800 X 1000, 60KHz,
SuperFax



Full Page VGA, 800 X 1000, 60KHz,
16 Shades of Gray, Ventura Publisher 2.0

Graphics Choices Driving You Crazy?



Indecision about graphics platforms is costing software developers money. At Media Cybernetics, we maximize our development productivity and minimize our risks by basing our application programs on HALO. We used HALO to develop popular applications like Dr. HALO and Image-Pro.

Making the HALO choice gives you DOS or OS/2 support today with a clear source code compatible path to Presentation Manager tomorrow. It also gives you a shortcut to building a user interface, the hardest part of application development.

The HALO development environment offers a comprehensive, reliable series of libraries and tools that are professionally documented and supported. Even more important, HALO is here to stay. We've been supporting software developers since 1982 and we are proud that 70,000 programmers and nearly 400 Independent Software Vendors (ISVs) are part of the HALO family.

Media Cybernetics now offers three versions of the HALO Graphics Toolkit:

HALO

- The premier graphics toolkit
- 200 graphics subroutines
- Supports over 180 input, output, and graphics devices
- Device support for scanners, high resolution imaging and VESA boards
- 18 compiler interfaces

The HALO Window Toolkit

- Event-driven environment for graphical user interface design
- Command bars, pull-down menus, scroll bars, radio buttons and icons
- Available for Microsoft C
- Intelligent memory management
- Full HALO capability

HALO for OS/2

- Source code compatible with HALO
- HALO speed, power and capability
- Multi-threaded, multi-tasking
- Dynamic Link Library
- Supports background mode graphics

HALO™

Making these decisions isn't easy, but HALO has the best track record in the industry. We believe that a strong contemporary graphics toolkit is essential to your success.

If you are concerned about the long term consequences of your graphics choices, call 1-800-992-HALO

**MEDIA
CYBERNETICS™**
Imaging and Graphics Technology

8484 Georgia Avenue
Silver Spring, Maryland 20910
301/495-3305
301/495-5964 FAX



Add PCX compatibility to your graphical software using the PCX Programmer's Toolkit

Bert Tyler

The graphics programmer confronts a bewildering array of graphical file formats. The PCX Programmer's Toolkit, from Genus Microprogramming, supports one of the more prevalent—PCX. ZSoft developed PCX for its PC Paintbrush package. Ventura Publisher and PageMaker support it, as do virtually all fax and scanner products. So PCX compatibility is a handy feature to add to your graphical software.

I tested version 3.5 of the PCX Programmer's Toolkit on an IBM PS/2 Model 80 with its built-in VGA adapter. The PS/2 is connected to a LaserJet II printer, and it uses a Logitech C-7 serial mouse as a pointing device. The Toolkit directly supports virtually all the standard IBM CGA, EGA, and VGA modes. Only CGA mode 5 is missing. The Toolkit also supports Hercules monochrome mode and SuperVGA modes up to 800 by 600 pixels by 256 colors for the Paradise, Tseng Labs, and Video Seven chip sets. It also supports the most popular extended SuperVGA video modes. I was able to test all the standard IBM modes on my PS/2.

The Toolkit Utilities

The Toolkit comprises a set of stand-alone utilities that create and manipulate .PCX files, and a set of library routines that let you add the same kinds of func-

tions to your own programs. The utilities were built from the supplied library routines, and they demonstrate the strengths and weaknesses of the library.

Unless you already have a collection of .PCX images to manipulate, the first utility you're likely to use is PCXGRAB, a TSR program that grabs the contents of your screen and saves it to disk when you press a preselected hot key. PCXGRAB can save both graphics and text screens. I tried it with every IBM graphics format supported by the Toolkit. I had no problems saving the various screen images.

I did run into minor conflicts with the F11 and F12 keys on the IBM Enhanced keyboard. With PCXGRAB loaded and intercepting keyboard activity, other programs, such as MS-Kermit and my own graphics programs, lost the ability to detect F11 and F12. Fortunately, few programs require the capabilities of the Enhanced keyboard, and PCXGRAB is easy to deinstall, so this wasn't a major problem. For particularly nasty programs that don't use the BIOS to perform video-mode changes—the manual cites AutoCAD—you can tell PCXGRAB to expect to find the screen in a particular mode.

After you've grabbed an image, you will want to display it with PCXSHOW. It can display stand-alone PCX files as well as PCX images stored in special PCX-format libraries. Options include specifying a region of the screen in which to display the image, and leaving the screen in graphics mode (useful for slide shows and demonstrations). I ran into a minor but annoying problem with PCXSHOW and monochrome images saved by PCXGRAB. Unless I forced PCXSHOW into the proper monochrome mode (by means of its `/m` command-line argument), monochrome CGA and EGA images appeared on my VGA system in odd colors—green and white in CGA 640-by-200-pixel mode, and brown and blue in EGA 640-by-350-pixel mode.

PCXPRINT was the most disappoint-

ing of the utilities. This program, which does what its name suggests, works only with monochrome images and (at least in version 3.5) only with LaserJet II and compatible printers. Moreover, the largest image I could print on my LaserJet II—using a 640-by-480-by-2-pixel image at the largest scaling (200 percent)—filled only about a sixth of the printed page. Images generated from anything other than a square pixel format, such as 640 by 480 pixels, appeared flattened; this effect was most pronounced with CGA 640-by-200-pixel and EGA 640-by-350-pixel images.

Although the manual says that the Toolkit supports IBM and Epson dot-matrix printers, that's not the case. A note in a READ.ME file on the distribution disk explains that dot-matrix printer support will be included in the next release, scheduled to be available in December for a nominal upgrade fee. Even so, there's no promise that the Toolkit will support color printers. Genus specifically recommends the use of programs like PC Paintbrush for printing PCX images in color. A Genus spokesperson acknowledged that the Toolkit's printer support was weak, and that the primary focus of its next version would be to add dot-matrix printer support and expand printed output to full-page images.

PCXCUT clips a rectangular chunk out of a displayed PCX image—you specify the region with cursor keys or the mouse—and saves it to a separate image file. PCXLOC displays an image along with the pixel coordinates of a keyboard- or mouse-driven cursor. It's a handy way to identify landmark locations within an image.

PCXLIB is an ARC-like utility for PCX files, with the added feature that the other utilities and the routines included in the Toolkit can manipulate images "in place" within an image library. PCXHDR interprets a PCX file's

continued

PCX Programmer's Toolkit 3.5

Company

Genus Microprogramming
11315 Meadow Lake
Houston, Texas 77077
(800) 227-0918
(713) 870-0737

Hardware Needed

IBM PC XT, AT, PS/2, or compatible;
IBM CGA, EGA, VGA, Hercules, or
compatible adapter; Paradise, Video
Seven, or Tseng Labs SuperVGA chip set.

Software Needed

MS-DOS 2.1 or higher

Price

Toolkit: \$195
Toolkit with library source: \$495

Inquiry 885.

header. It reports the image's resolution, palette contents, and preferred video mode. PCXTRANS converts text screens saved by means of PCXGRAB into ASCII text format and vice versa.

PCXFIX fixes up older PCX files that don't conform to the latest specifications. I tested all these utilities successfully, except for PCXFIX. I just didn't have old-style PCX files to convert.

The Library Routines

The library routines provide functions that assist in the manipulation of PCX files, libraries, and displays. Note that the supplied routines don't help you to create images from scratch (though they do support cutting and pasting from other PCX images). Figuring out how to draw a circle on the screen is still up to you or some other graphics package.

The routines enable you to display images, store and retrieve them from files and image libraries, and print them. In addition, the routines support image buffers and virtual memory buffers. Think of these as RAM-resident versions of PCX files. The buffers are compressed PCX images, and the virtual memory buffers are uncompressed images. These buffers—which may be stored in conventional or expanded memory—confer significant speed advantages.

A variety of query routines let you detect the presence of an MDA, CGA, EGA, MCGA, VGA, or Hercules video adapter. It can even detect the presence of a Paradise, Tseng Labs, or Video Seven SuperVGA chip set. You can also check for the presence and amount of free EMS or standard memory.

The libraries come with interfaces to C (Microsoft, Borland, and Lattice), Pascal (Microsoft and Borland), BASIC (Microsoft), FORTRAN (Microsoft), assembly (Microsoft and Borland), and the Clipper. I ran all my tests using Microsoft C 5.1. You don't owe Genus royalties if you distribute executables containing the Toolkit routines, but you can't distribute .OBJ or .LIB files that contain the routines, and you can't distribute the Toolkit's stand-alone utilities. For \$300, you can get the library source code.

To test the Toolkit routines, I added PCX read, write, and print features to a Mandelbrot program that I wrote. The program already creates graphical displays in all the IBM-specific video modes, and it writes and reads an alternate file format (GIF), so that using the

continued

An Introductory Short Course taught by
Celso Grebogi, Edward Ott and James Yorke

Broadcast Live from the University of Maryland

October 3, 1989 from 11:00 am to 5:00 pm Eastern

Receivable at designated locations and on your organization's satellite dish.

For a **free color poster** and for information on fees and viewing locations
call **1-800-344-6712, or 301-454-8955 (FAX # 301-454-8841)**

OURS

Quality Features Service

Reliability...
Value...
Ergonomic...

✓ Performance ▶

✓ Lower Price
✓ Higher Resolution
1600(H) x 1280(V)
Pixels
✓ 3 yr Warranty
✓ 60 Day Money Back
Guarantee
✓ Faster
✓ Custom Screen Fonts
✓ The Elite/1600™
Display System ▶
✓ Highest Data Rate
✓ Unlimited Technical
Support
▼

or

THEIRS?

Expensive Features

✓ Higher Price
✓ Lower Resolution
1280(H) x 960(V)
Pixels
✓ 1 yr Warranty
✓ NO Money Back
Guarantee
✓ Slower
✓ ???

✓ Delivers a picture that
Publish magazine called
*"a real knockout with the
finest text display you'll
find on any monitor—
Mac or PC."*

GET THE PICTURE?

Meet our new Elite/1600™ a complete ultra high resolution 19-inch monochrome display system with a 1600 x 1280 pixel resolution. It offers the highest quality two-page display system available for the IBM PS/2 Series, and IBM PC and compatible.

It has the same resolution as the Sun-4 workstation monitor. The extraordinary display, combined with a clean, stable, flicker-free picture means your images are razor sharp, alignment perfect, drawings pin-point precise.

Each display system comes complete with a high resolution monitor, video interface card, and software drivers.

The Elite/1600™ is part of our extensive family of display products for the IBM compatible and Macintosh computers.

We carry a complete line of high resolution color, monochrome and gray-scale display systems.

The monitor you've got in mind is probably in our warehouse right now!

Call our toll free number today, for our free information package.

1-800-343-5532

Discover for yourself how beautiful a big monitor can be.

Got the picture?



4201 Remo Crescent, Bensalem, PA 19020 USA
Phone: (215) 639-1636 FAX: (215) 639-3420

Circle 103 on Reader Service Card



**VOTED #1 BEST OF
UNIX COMMUNICATIONS SOFTWARE**

ONE COMMUNICATIONS PROGRAM THAT MAKES ALL OF OUR INCOMPATIBLE COMPUTER SYSTEMS COMPATIBLE?

I CALL THAT UNLIKELY.

They call it TERM.

TERM runs identically under DOS, UNIX, XENIX, VMS, BTOS and MAC?

TERM is keystroke-for-keystroke compatible across all of our different computer systems and offers features like automatically restartable file transfers, data compression and CRC error detection.

But, can it be customized?

TERM's built-in script language is so sophisticated that it allows exact solutions to be tailored to our specific needs. In fact, there are over 25 pre-built scripts provided for solving problems like unattended file transfers, remote system polling, and error logging. TERM script allows building customized menus, data entry screens and pop-up windows designed for your unique applications.

And it talks to non-TERM systems?

Fluently. TERM comes with nine protocols and thirteen terminal emulations... that's enough to communicate with a wide variety of different systems.

DEC Terminal Emulation?

Wait till you see it. TERM's VT220 emulator meets the needs of all of our divisions by providing exact VT220 and VT102 emulation on all terminals. We've got full graphics character support even under Unix...not to mention Televideo, SCO color console and the other emulations.

Where did you find it?

I called: 801-268-3088

Circle 57 on Reader Service Card

United Kingdom: Systems Marketing Ltd. (0636) 247 031
France: Taurus Data (331) 80 21 55 06, Top Log (331) 42 04 21 18
Belgium: Top Log (322) 672 22 40
Italy: ESA (0641) 741113
Australia: Qunix (07) 831 8666

All orders shipped 2nd Day Air

TERM. Powerful Communications.

Features:

- ✓ Automatically restartable file transfers
- ✓ State-of-the-art Lempel-Ziv-Welch data compression
- ✓ Exact VT220, VT102, and VT100 Emulation on ALL systems
- ✓ Fully remappable keypad support
- ✓ Full color support
- ✓ 38.4K file transfers
- ✓ KERMIT Protocol for mainframes
- ✓ XMODEM and YMODEM Protocols for bulletin boards
- ✓ Remote PC execution
- ✓ Powerful script language for customized applications
- ✓ Wildcard file send/receive capability
- ✓ Auto-login, dial/redial modem control
- ✓ Unlimited autodial directory
- ✓ Performs unattended file transfers
- ✓ Remote maintenance capability
- ✓ Online User's Manual for instant help
- ✓ Electronic mail/TELEX/FAX
- ✓ Easylink/MCI Gateway

TERM is available now on Altos, Apple Macintosh, Ariz/Arete, AT&T, British Telecom, Bull, Burroughs, CCL, Celerity, Convergent Technologies, Counterpoint Systems, Cubix, DEC VAX, Formac, Gould, Harris, Heurikon, Hewlett Packard, Honeywell, IBM, ICL, ICON, IMP, Integrated Solutions, Intel, Jarogate, Lanier, Masscomp, Momentum, Motorola, NCR Tower, Nixdorf Targon, Northern Telecom, Plexus, Prime, Pyramid, Ridge Computer, Sequent, Sigma Designs, Sun Workstation, Tandy, Unisys, Victor, Wang PC, Zenith and Zilog. Find out how easy it is to get your VMS, UNIX, XENIX and MSDOS machines all together.

TERM

COMMUNICATIONS SOFTWARE

Call or write for complete information



CENTURY SOFTWARE

5284 South 320 West, Suite C134 Salt Lake City, Utah 84107 (801) 268-3088

MASTERING THE PCX FORMAT

Toolkit's routines to add PCX support was straightforward.

I liked the fact that I didn't have to use the Toolkit routines to initialize the graphics adapter. Although the Toolkit, of course, supports that, you can also just tell it what video mode the adapter is already using. That's handy in cases like mine, where you're simply adding PCX capability to an existing program, and it's vital if you're using another graphics package that must initialize the adapter.

Adding a PCX-save feature to my program took just eight lines of code. Half the job was to convert my internal video modes to the Toolkit's video-mode IDs. The feature worked on the first try. Putting in PCX-restore took longer, since my program needs information about the resolution of the incoming image. But I also got it working in short order, and then I tackled PCX-print. Considering that my program didn't have any print options to begin with, I was pleased to be able to implement PCX-print in just 10 more lines of code. Of course, the printer routines suffer from the same limitations as the PCXPRINT utility, so I had to settle for tiny and, in non-640-by-480-pixel modes, squashed printouts.

I wrote several additional utility programs while checking out the library routines and found the routines to be clearly documented and easy to use. The manual documents each routine separately, with short examples for each routine in C, Pascal, BASIC, FORTRAN, and the Clipper; that was invaluable.

Technical support is available by way of telephone, fax, CompuServe, and ZSoft's BBS. When I called technical support to ask about printer support, I talked to a courteous person who didn't know the answer right away but found someone else with the information in less than a minute.

I found the PCX Programmer's Toolkit to be intuitive and useful. The lack of dot-matrix printer support was annoying, but this problem may be resolved shortly. I would recommend checking on this item first if it's a priority for your application. Other problems, such as PCXGRAB's difficulty with the Enhanced keyboard, and PCXSHOW's inability to display monochrome images correctly, were minor, and I had no trouble working around them. If you want to add PCX support to your graphics programs, here's a convenient and inexpensive solution. ■

Bert Tyler holds a B.A. in mathematics and is an independent PC consultant. He can be reached on BIX as "btyler."

Oh, No!!

 They squashed the monitor!

It's the first laptop with a screen as readable as a CRT...

**SPECIAL
Introductory Price
\$3995**

*Viewable from
all angles.*

- Fast 80286 CPU
- Upgradable to 80386
- Fast 40MB Hard Disk



Revolutional technology - less than an inch thick, yet looks like a hi-res amber monitor...



KISS Computers 414 - 652 - 5477
2604 Washington Rd. 414 - 694 - 5477
Kenosha, WI. 800 - 438 - 5477
53140-2375 (Fax) 414 - 694 - 2441

NEW **SHOOT TO THRILL!**
Count Disk
Computer Dart
Gun Game



*Relieve stress and
have hours of fun
with your computer!*

\$19.95



*The perfect
gift for any
computer user*

INCLUDES:

- *.45 Caliber Dart Gun
- *6 Soft Darts (Suction Type)
- *5.25" Game Disk With:
Bullseye Darts
Championship Darts
Baseball Game
Count Disk Target
Executive Decision-maker
Boss Panic Screen
And FREE membership to
the Count Disk Club

1-800-344-1996

Supports: IBM, & Compatibles, CGA, EGA, VGA and Hercules



*To order call our toll-free order line or send \$19.95 + \$3.00 (S & H) Check or Money Order to Count Disk, 2601-38 South Military Trail, Suite 164, West Palm Beach, FL 33415. Florida residents add 6% sales tax. Dealer inquiries welcome at (407) 241-6050.

The New
804
Series

AFFORDABLE CONNECTIVITY



A VERSATILE LAN-ALTERNATIVE FOR \$395



THREE MODELS TO MEET YOUR APPLICATIONS

The Print Master® II 804 Series is BayTech's newest intelligent controller with four ports and a 256KB dynamically allocated buffer. Available in your choice of four serial ports (RS-232C or RS-422A), four parallel ports, or two serial and two parallel ports, the 804 Series offers affordable connectivity.

The 804 Series provides a cost-effective solution for users who want to maximize their resources. Each four port model allows you

to connect any combination of computers, printers, and plotters for:

- ▶ printer sharing
- ▶ plotter sharing
- ▶ buffering of data
- ▶ LAN printer expansion

Models with serial ports allow you to also connect modems or any other RS-232C device for computer-to-computer communication and modem sharing.

The 804 Series allows simultaneous data input from computers, output of print data and full duplex communication between pairs of computers.

LAN APPLICATIONS

The 804 Series is ideally suited for expanding the printing capabilities of a LAN system. By acting

as a printer server, it can off-load network traffic and provide port expansion and extra buffering.

BayTech products are covered by a one-year warranty and are supported toll-free by a team of application engineers.

Call us today to learn how the new Print Master® II 804 Series can become your connectivity solution.

BayTech

Bay Technical Associates, Inc.
Data Communications Products Division
200 N. Second Street, P.O. Box 387
Bay St. Louis, MS 39520 USA
FAX: 601-467-4551
Telex: 910-333-1618 BAYTECH
Phone: 601-467-8231 or toll-free

800-523-2702



A HyperCard for the PC

Build and launch applications with HyperPAD's object-oriented, push-button approach

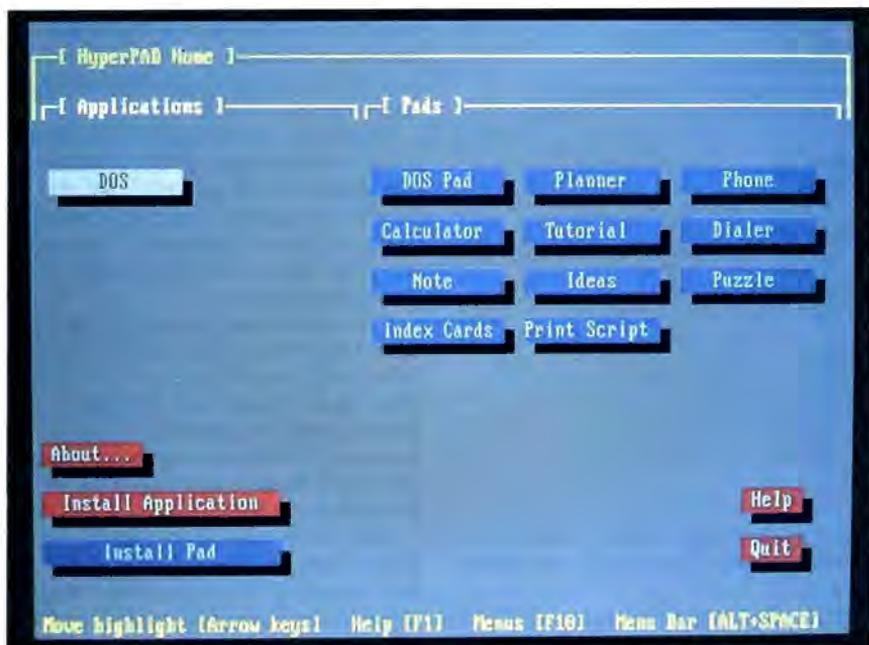
Bob Stepno

Following in the footsteps of Apple's HyperCard for the Macintosh, Brightbill-Roberts' HyperPAD for MS-DOS is an intriguing product that might attract a new generation of programmers.

Actually, HyperPAD is part toolkit for building front ends and tutorials, and part application package. As a toolkit, it is the most fun I've had since my folks gave me that Erector Set. As an application package, it's more useful than I expected.

Like HyperCard, HyperPAD shows you screen after screen of layered backgrounds, information fields, and buttons. Each screen is called a *page*, and files that contain the screens are called *pads*. (With HyperCard, you call each screen a card and each file of related cards a stack.)

If you like to streamline your DOS applications with batch files, shells, and front ends, and if you're curious about object-oriented programming, HyperPAD deserves your attention. It also makes quick work of building a tutorial or a prototype of a new application. It includes a screen-capture utility that quickly imports spreadsheet layouts, word processing menus, data-entry screens, and other displays from text-based applications.



The home pad can launch any of 11 built-in applications plus DOS utilities.

Object-Oriented Programming

HyperPAD's programming language, PADtalk, is similar to HyperCard's HyperTalk. For example, to put today's date in a field in HyperCard, you would use the following HyperTalk line:

```
put the long date into field "Date"
```

In HyperPAD, you just join "long" and "date" into one word (longdate) and end the line with a semicolon.

From the user's perspective, HyperPAD is object-oriented. Each button, field, background, page, or pad is an object. Each object has attributes, such as color, size, and shape, and it can have a program script that makes it do tasks. A button's script can make it run WordPerfect or play "Mary had a Little Lamb." With cut-and-paste editing, you can combine the scripts of several buttons to make one button play a tune while it

launches WordPerfect. The editing buffer lets you clip text, buttons, or whole pages and then paste them in other pads.

A music pad lets you pick out notes on a text-based image of a piano keyboard, save or edit tunes, manipulate playing speeds and rests, and paste the result into your scripts with a Play command.

The scripts and attributes travel with their object, whether you drag the object from one corner of the screen to another or cut and paste your favorite button into all your pads. For example, while I was writing this review, all the pads in my HyperPAD directory had copies of a button called BYTE that started my word processor and loaded the current manuscript.

Nothing Fancy

As for working with graphical environments, HyperPAD takes an interesting

continued

HyperPAD 1.0

Company

Brightbill-Roberts
120 East Washington St., Suite 421
Syracuse, New York 13202
(315) 474-3400

Hardware Needed

IBM PC, AT, PS/2, or compatible with 384K bytes of RAM, two 360K-byte floppy disk drives or one 720K-byte floppy disk drive, and any color or monochrome display graphics board

Software Needed

DOS 2.1 or higher

Documentation

User's manual, quick reference card, installation booklet

Price

\$99.95

Inquiry 884.

route around DOS's many graphics standards—it does practically everything with text.

HyperPAD's buttons are mostly words that are in boxes, words with shadows, words with color backgrounds, and words modified with IBM extended characters. For example, a notepad application distributed with HyperPAD uses the color attributes and line-drawing characters to paint a spiral-bound notebook on the screen. Another pad features a lined index card background, and yet another shows the ever-popular telephone index card, complete with notches at the bottom.

HyperPAD lacks bit-mapped images, diagonal lines, and curves. It could be prettier, but the advantage is that you can use anything developed in HyperPAD on a low-end PC with a monochrome monitor without so much as a Hercules graphics card. (For this review, I tested the program on a monochrome VGA-based IBM AT-compatible system and a monochrome AT&T PC 6300.) If you have a graphics machine, you can still use HyperPAD buttons to launch graphics-display applications. Brightbill-Roberts has also posted special monochrome versions of the sample pads on its BBS.

In another concession to the realities of DOS machines, HyperPAD lets you switch between a mouse and the keyboard. This means that you can build an application using a mouse on your PC and then take the application on the road in a mouseless laptop, using it with just the keyboard.

Built-in Applications

HyperPAD comes with a library of 25 sample pads. Calling an application is as easy as pushing a HyperPAD button and entering the DOS path. You can even give HyperPAD the parameters that you would normally enter as command-line options. After that, you give the newly created button a name (usually the application name).

By default, HyperPAD automatically starts at its home pad, which includes one application button labeled DOS and 11 buttons that launch pads for a schedule planner, phone directory, calculator, and other desktop-accessory style applications (see photo).

The planner and phone pads are similar to their HyperCard cousins. The first is actually a launching pad for several other pads—yearly and monthly calendars and a daily appointment log. Clicking on any half-hour entry in the appointment book opens a scrolling text field for that time period.

The phone pad is an address book, with a button linking it to a dialer pad that actually dials the phone for you (i.e., if you have a modem connected) and tells you when to pick up the receiver. Other phone-related buttons and pads help you time your calls and keep track of incoming and outgoing messages.

The DOS button runs COMMAND.COM, putting you back at the DOS prompt. HyperPAD "shrinks" to take up only 2K bytes of RAM, which leaves enough memory for you to run most DOS applications.

Separate from the DOS button is a DOS pad button, which may be the least successful of the sample HyperPAD applications. It tries to save you from the trials and tribulations of DOS commands, giving you push buttons for eight DOS operations: copy, move, delete, view a subset of a directory, launch a program, format (defaulting to drives A and B only), and make or remove a directory.

The DOS pad uses three scrolling fields or windows. One is for files, one for directories, and the other for disk drives. You can browse through the filenames on your disks in the 16-line Files window, but you can view only one di-

rectory at a time, and there is no facility for inspecting a file or performing other operations found in popular DOS shell programs. Strangely, HyperPAD lets you type over the filenames in the Files window, though doing so does not affect the files.

Not All Fun and Games

Error-detection is one of HyperPAD's weaknesses. For example, when I told it to format a 3½-inch floppy disk in an empty 5¼-inch floppy disk drive, HyperPAD sent the empty drive spinning into hyperspace for a while and then returned to the HyperPAD screen. There were no error messages saying I used the wrong type of drive or that I had an open drive door.

Coincidentally, the READ.ME file on the disk warns that if you try to print with the printer off-line, HyperPAD may give you a "disk drive door open" error message. However, I got no error message at all when I issued print commands with the printer off.

I also discovered that it was possible to lock up my computer by typing non-HyperPAD filenames after the program name at the DOS prompt. Normally, you can supply the name of the pad you want to run as a parameter when you execute HyperPAD from the command line. But whenever I gave HyperPAD an invalid parameter—even though it may have been a valid filename—it locked up my computer.

The system also locked up when I attempted to import delimited ASCII data files that were not as clean as HyperPAD wanted. The file-import routine requires quotation marks as well as commas between fields and allows no empty or missing fields. These requirements are not mentioned in the documentation. Also, I could not load an ASCII file larger than 600 records, but the company's technical-support person was unable to help me find the problem. The company says, however, that it is working on the problem.

Still, with a product that stresses ease of use and even trademarks the phrase "push-button computing," you should not have to push the hardware reset button because of an incorrect file type.

Nearly as bad, the imported data files became HyperPAD pads three to seven times the size of the originals. A 14K-byte file containing data about 100 newspaper editors, for example, turned into a 64K-byte pad. A 2K-byte ASCII list of names became a 14K-byte pad. A 7K-byte dBASE file became a 23K-byte pad.

continued

GOD DIDN'T MAKE LITTLE BLUE APPLES. KMW DID.



KMW brings Apple and Big Blue together. KMW makes your Macintosh more versatile - more *productive* - by linking it to your IBM midrange. Our line of TwinAccess™ protocol converters connects any Macintosh to your System/3X or AS/400.

New board connection for the Mac II. For a simple, cost-effective board solution, choose our TwinAccess for the Mac II. This easy-to-install card plugs into any member of the Mac II family, with connection to your host through twinax cable.

Field-proven multiport products. Our TwinAccess Series II and Series III protocol

converters are ideal when you need remote attachment capabilities, or when you need support for up to seven devices. TwinAccess system-level protocol converters provide midrange connections for any Macintosh, as well as IBM PCs and compatibles, laptops, ASCII terminals, and most popular printers. We can also help you connect to a mux, a data PBX, AppleTalk, or DECnet.

Powerful features on every level. TwinAccess protocol converters benefit your Macs, your

other peripherals, and your host, with these features:

- file transfer to and from your host
- terminal emulation
- manipulation of IBM midrange data within software programs such as Excel, Lotus 1-2-3, and MacWrite
- access to your host's mass storage capabilities
- printer pass-through to ImageWriter and LaserWriter

We'd like to give you more information on all of our connectivity choices. Call KMW today at our toll-free number below.

(800) 531-5167

In Texas, (512) 338-3000

In Europe, 44 1 844 1525



**KMW
SYSTEMS
CORPORATION**

The increased size may also account for HyperPAD's poor performance at locating text in the files—WordPerfect was much faster searching the original text file.

Helpful Ideas

Back at the home pad, the first buttons to investigate are help and tutorial. The help button launches the help pad, which is a 48-screen hypertext help system that is also available by pressing the F1 key in

most application pads. The tutorial button launches the tutorial pad, which is a 36-screen document designed to look like an open spiral binder. Both provide good introductions to HyperPAD.

Although both the help and tutorial pads are little more than electronic page turners, they do show you how to use HyperPAD to create more-advanced interactive texts and demonstrations. For example, both pads have index or table of contents screens in which each subject

heading is a button that links to a page elsewhere in the document. Using the same technique, any word on this page could be linked to a page of definitions for beginners, a more detailed discussion of the subject, or a list of related topics covered by other pads—and linked to them.

You can add your own notes field to either pad, or you can create a separate pad for notes and then build links to sections of the tutorial and help pads. Opening files, moving between pads, and building your applications are all managed neatly with a Macintosh-like system of pull-down menus.

An ideas pad features clip art and sample buttons for common commands such as Forward, Backward, Go to First Page, and Go to Home. But all the ideas aren't in the ideas pad. Each sample application is written in PADtalk, and the script for each pad, page, field, and button is available to any user via a command that overrides the access-level protection of a pad.

But don't expect much help from the manual. Although it has an alphabetical section of PADtalk elements, the HyperPAD manual does not have a detailed tutorial on how to write your own scripts. The manual even lacks a list and explanation of error messages.

I'd also like to see some documentation in the code of all those sample pads, which are hardly mentioned in the manual. (PADtalk allows Pascal-style comments.) Heavily commented code would be especially instructive on the more complex sample pads, such as the move-the-numbers box puzzle and the scientific calculator.

Caveats aside, I like HyperPAD. It lets you easily create and modify attractive and easy-to-operate user interfaces. Generally, HyperPAD works well for building tutorial systems and front ends for other software. In fact, using HyperPAD, you could make life easier for someone learning and using a new word processor or database manager.

It may not, however, offer the joys of graphics doodling and iconography you find in Apple's HyperCard. But it's the easiest system I've seen for experimenting in interface design and exercising your own opinions about the *right* way a program should work. ■

Bob Stepno is a journalist and systems humanist who has been working with computers since 1978. His master's thesis was on reading and writing with hypertext. You can reach him on BIX c/o "editors."

C compiler
software simulator
source level debugger
macro assembler—development board
IBM-PC MSDOS—Sun, Apollo,
Dec UNIX—VAX VMS—Apple Macintosh

AVOCET

AVOCET
SYSTEMS, INC.

The Source For Quality Embedded-System Tools

Avocet Systems, Inc., 120 Union St., P.O. Box 490, Rockport, ME 04856
In Maine, or outside U.S., call (207) 236-9055
TLX: 467210 Avocet CI / FAX: (207) 236-6713
Call today for free catalog 1-800-448-8500



**OS/2
BRINGS
NEW POWER
TO PCs.**

*SAA to be Cornerstone
For New Office Apps.*

**SAA Flag Unfurled
As IBM Sets Course.**

Different systems,
one standard, SAA.

**IBM
ANNOUNCES
SYSTEMS
APPLICATION
ARCHITECTURE.**

Multiuser
support in
OS/2 plan.

**SAA TO PROVIDE
COMMON LOOK
AND FEEL,
BUT WHEN?**

How Soon
Till SAA
Products?

*SAA: The Yellow Brick Road
to Cooperative Processing.*

OS/2:
Multi-tasking
for the
masses.

Promises made.



IBM's first SAA application: IBM OfficeVision.

Promises kept.

SAA is a reality you can plan on.

Two years ago IBM had a vision for the future. We called it Systems Application Architecture,™ or SAA.

We said that SAA would bring IBM systems closer together. So that PC, midrange, and mainframe screens could look alike. So that people accustomed to one could feel at home at another.

We also said that SAA would make it easier for systems to work with each other.

So here we are, two years hence. Only now, SAA is much more than a promise. We've announced our first SAA application.

It's called IBM OfficeVision, and it could change the way your company works, even the way it thinks.

A familiar face at every desk. IBM OfficeVision.

Imagine a desktop with a self-dialing phone, electronic mail, a connected calendar, an automatic address book, a terrific word processor.

Then, imagine every other desk in your company with all the same things, always there, arranged the same way.

Finally, imagine several computers working as one, running different programs at once, just for you.

That's the idea behind IBM OfficeVision.

Your screen is the desktop, and it will give you the basic necessities of office life—phone, mail, calendar, etc. But more to the point, because OfficeVision will run across multiple IBM environments—VM,™ MVS,™ OS/400™ and OS/2™—it can be a launching pad for bigger things, especially at workstations powered by OS/2.

In the middle of an OfficeVision screen, you'll be able to "snap-in" familiar PC applications like Lotus 1-2-3® or Microsoft Excel.® At the same time, you can run larger business applications on host computers, get files from a mainframe, crunch numbers on a midrange and send a report on your local area network.

You'll also be able to swap information right on your screen—for example, paste a graph from a spreadsheet into a memo. Icons and mouse clicks make it very simple.

What's more, OfficeVision will protect your previous investments. It not only accommodates your DOS and nonprogrammable terminals, it

extends their power, and it will work with existing office applications like IBM PROFS.™

And your programmers will be able to create compatible applications for OfficeVision, thanks to SAA's open architecture.

To be delivered over the next 12 months, OfficeVision will unite your systems as never before, including your most valuable "data processors," your people.

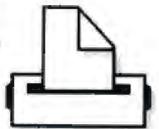
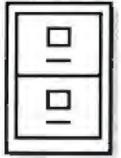


Unleashing the power of OS/2.

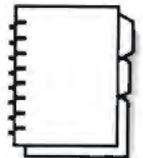
OS/2 Extended Edition is the high-test fuel of personal computing, but it's also a cornerstone of SAA.

Which means that IBM OfficeVision can really put OS/2 EE to work, building on advances like multitasking and, even more exciting, cooperative processing.

With cooperative processing, an OfficeVision user can have several computers sharing one task. A midrange computer might search files in a mainframe for constructing a graph that's displayed on a PC.



Each system does its part, but as a user you're completely unaware. You simply ask for the work to be done. How it gets done isn't your worry.



A single standard. Multiple solutions.

We can call SAA a standard, but that doesn't mean much unless software developers agree with us. And indeed they do.

Major software firms are embracing SAA, creating applications of their own for everyone from secretaries to CEOs, for needs ranging from manufacturing to human resources to finance to telecommunications.

The question is, when should you embrace SAA? With applications like IBM OfficeVision, companies who adopt SAA will enjoy a clear advantage over those who don't. So the time to start planning is now.

To learn more about SAA, OfficeVision and your future, call your IBM Marketing Representative today.



On a PC network.



On a midrange computer.



On a mainframe.



Unforgettable.

If your AT-bus computer runs out of RAM . . . expand with the unique BOCARAM/AT PLUS and forget about memory problems.

In today's demanding business world, advanced software asks for more memory. Boca Research has created an answer that supplies essential memory for the latest applications. BOCARAM/AT PLUS adds a whopping 8MB of software-configurable memory per board, per slot to 286 and 386 computers. With more room to run your favorite software packages, and less time spent on setting switches, you'll see your productivity dramatically increase.

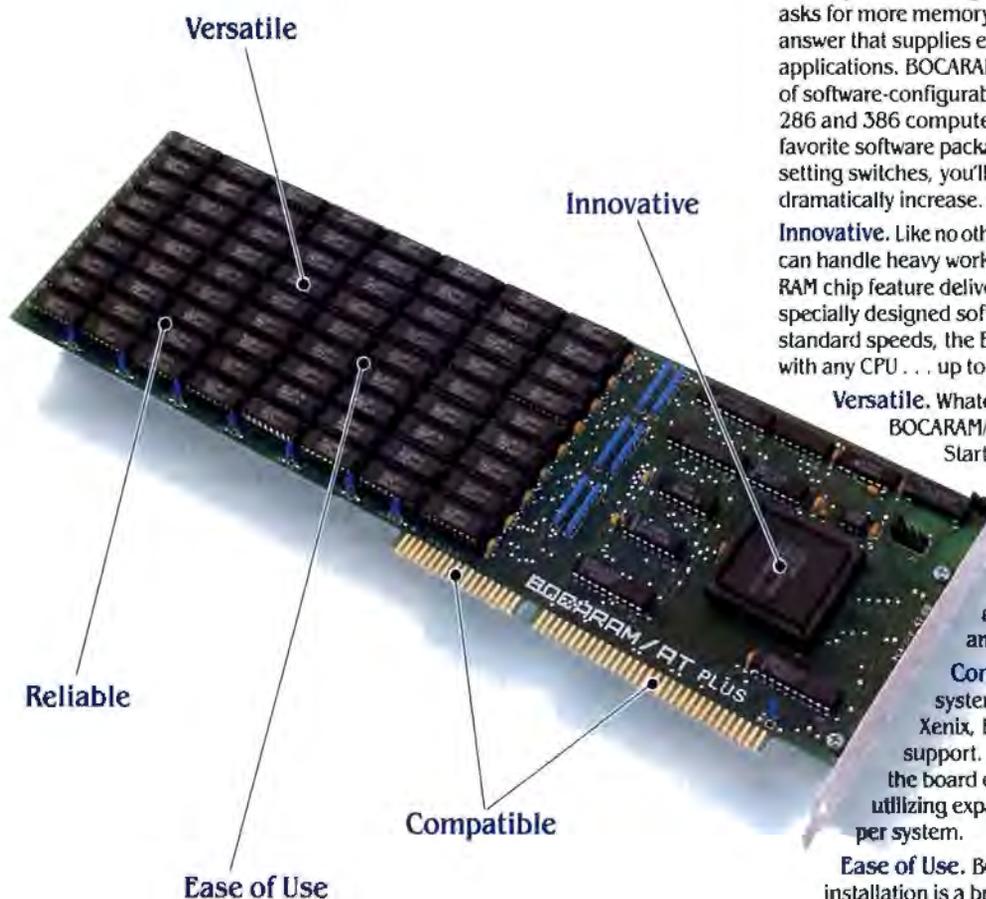
Innovative. Like no other memory board, BOCARAM/AT PLUS can handle heavy workloads at faster speeds. Its unique RAM chip feature delivers zero wait-state* performance via specially designed software. For ATs zipping along above standard speeds, the Boca-designed VLSI chip keeps up with any CPU . . . up to 33MHz.

Versatile. Whatever memory you're lacking, BOCARAM/AT PLUS can fill your requirements. Start with 2MB and simply add readily-available 1MB chips as your need grow. The board uses split memory addressing and backfills 128K, allocating the remaining RAM as expanded and/or extended memory to satisfy any software.

Compatible. No matter which operating system you choose DOS, OS/2, Unix or Xenix, BOCARAM/AT PLUS offers complete support. By complying with LIM/EMS 4.0, the board ensures compatibility with software utilizing expanded memory . . . up to 32MB per system.

Ease of Use. BOCARAM/AT PLUS' switchless installation is a breeze. The configuration is chosen via software, stored in an EEPROM and is in place at boot-up. Future changes are painless.

Reliable. Each BOCARAM/AT PLUS is carefully tested and packaged before leaving the factory so you'll be guaranteed a quality product. Additionally, diagnostics software is provided to assure proper functioning of board components. If a defective chip is located, just replace the one chip . . . no need to replace a whole bank of nine as in SIMM architecture. A two-year warranty and free technical support ensures Boca quality.



\$225.

OK RAM

For the memorable BOCARAM/AT PLUS and an unforgettable performance, see your local dealer or contact us directly. Also, ask about BOCARAM/AT I/O PLUS with 4MB of RAM and serial/parallel ports.

BOCA
RESEARCH INC

6401 Congress Avenue, Boca Raton, FL 33487 • Phone: 407/997-6227 • FAX: 407/997-0918

BOCARAM/AT PLUS and BOCARAM/AT I/O PLUS are trademarks of Boca Research, Inc. All other references to computer systems, software and peripherals use trademarks owned by their respective manufacturers. © Copyright 1989 Boca Research, Inc. *Zero wait-state performance is dependent on the design, layout and chip types on the system board.

Circle 42 on Reader Service Card (DEALERS: 44)



Arriba: The Painless PIM

Good Software shows that using a personal information manager needn't be an ordeal

Lamont Wood

Arriba offers something that is generally lacking in personal information managers (PIMs)—ease of use. Unlike with other PIMs, with this \$195 PC package you can become productive almost immediately, thanks to its cookbook approach to information management. But should you itch to do so, you can break away from its recipes and come up with your own.

Arriba has, of course, problems and limitations. And it's not as polished as some of its big-name competitors. But if it gets what you need done with minimal hassle, you may not care.

Notes and Folders

It's inevitable to compare Arriba 1.0 with Lotus's Agenda (see "The Database Redefined," December 1988 BYTE). Both let you assemble your thoughts or your daily schedule in an intelligent notebook that sorts, arranges, and probes itself on command.

But using Agenda requires that you vault a series of conceptual hurdles and figure out what the programmers meant by the terms *note*, *item*, *view*, and *section*. Slowly, you learn to jot down your thoughts as items, expound them with appended notes, sort them by categories, and view them in sections. As you go along, you add categories, filters, and other functions, until finally you arrive

Last Name	First Name	Phone number	Company/Reference
Abraham	Mr. and Mrs. Burl	555-555-2861	Senior Citizen's Grp
Abraham	Mr. and Mrs. Robert	555-555-7937	Community Charity Org
Bandy	Mr. and Mrs. Ward	555-555-8205	Historical Committee
Bell	Mrs. Helen	555-555-3820	ABC Paint Supply
Cassler	Mr. and Mrs. Don	555-555-5723	Chamber of Commerce
Clay	Mr. and Mrs. Ed	555-555-2898	Bay Area Outdoor Club
Good	Mr. and Mrs. Wilfor	555-555-9248	Northwest Liberty
Kosfeld	Mrs. Gerry	555-555-3340	Kosfeld Associates
O'Kane	Mr. and Mrs. D.N.	555-555-8392	Mutual Savings
O'Kane	Mr. and Mrs. H.M. O	555-555-2899	O'Kane Party Supplies
O'Kane	Mr. and Mrs. Michae	555-555-7734	Dynamic Investments
Seyler	Mr. and Mrs. Bill	555-555-2389	Community College
Weich	Dr. William and Car	555-555-3349	Oilfield Works
Young	Mr. and Mrs. Harry	555-555-8826	Young-Dlarney Assoc.

Each entry in Arriba's phone list represents a folder that contains related notes.

at the application you need—it's like adding clay until you get a statue.

With Arriba, you load the software and immediately get three canned applications—a phone list, an appointment calendar, and a to-do list. Other formats let you create a variety of other common data files, or you can cook up your own formats.

Arriba lets you write notes about appointments, contacts, and so forth. Part of the note can serve as the title, somewhat corresponding to an Agenda item. You can search all the text in an Arriba note, and it can be 16K bytes long.

Where Agenda has sections and views, Arriba has folders and file cabinets. A file cabinet is the entire textbase, and the folders are the subject headings it contains. A folder can contain notes, other folders, or both. But there the prod-

ucts diverge. Agenda sorts items into views based on their contents and the specifications you give in the category manager. Agenda even lists the items in columns, with the matching text in the adjacent columns to the right or left, letting you sort by more than one specification.

Arriba is not as sophisticated; it mainly has the search command. You can give Arriba a search specification—complete with AND, OR, and NOT logical operators, parenthetical clauses, and wild cards—and it searches the notes of the current folder and its subsidiaries for the text. If it finds a match, it displays a screen with that note, with the matching text highlighted. Should there be more than one match, Arriba shows a list of the note titles, which you can browse through. You arrange the folder contents

continued

Arriba 1.0

Company

Good Software Corp
13601 Preston Rd., Suite 500W
Dallas, TX 75240
(800) 272-4663
(214) 239-6085

Hardware Needed

IBM PC XT or compatible with 384K bytes of RAM and a hard disk drive

Software Needed

MS-DOS 2.0 or higher

Documentation

User's manual

Price

\$195

Inquiry 883.

manually, whereas Agenda's category manager does it automatically.

Cookbook Recipes

The phone list is actually a mailing-list program. It displays a list of entries, each with a name, phone number, and company reference (see photo). But the entries are just the titles of individual notes, and each note has formatted data fields for an address, plus a field for general text (so you can make notations). Using the print command, you can print a personal telephone directory as shown on the screen, or you can print mailing labels.

If you have an auto-dialing modem, Arriba can dial the phone number in the entry for you. If you need to dial 9 to get through a local private branch exchange or wait for a second dial tone or add long-distance access codes, you use the Setup menu. You can even tell Arriba what your area code is so it will add 1 to any calls outside the area code and drop the area code while calling inside it—common-sense features you don't normally see. (What Arriba does not do, although it would be nice, is track the duration and destination of your calls, in case you need to charge them to someone else.)

You can dial any number that appears in any note, not just the phone list, by having the cursor on the line that contains the number and invoking the dial command. If you are in the phone list application, Arriba dials and then calls up the note associated with the number, so you can start typing notes regarding your phone conversation.

Meanwhile, calling up the calendar

gives you a screen window with a three-month calendar display, laid out in typical fashion, with the current month on top and the current day highlighted.

Pressing Return brings up a display showing a list of time slots (every half hour is represented), and along the bottom of the display is a chart showing how much of the day is scheduled. If, for instance, you put the cursor on 9:00 a.m. and press Return, Arriba gives you a data input window that asks you for the starting and ending time or the duration of the appointment and a brief description. If the appointment lasts 90 minutes, the next two lines displayed will have ditto marks added to them, and the chart will show highlights between 9:00 a.m. and 10:30 a.m. You put the cursor on the new appointment and press Return again. You can then add a note to that appointment to remind yourself of what will be discussed.

You can search the contents of the note—and all the notes in the calendar, for that matter. Short work with the search command can, for instance, show which day you had that "court appearance" concerning "Smith."

You can page through the months, for example, from January 1980 to December 2037. Arriba accepts a wide range of time inputs (e.g., 330 will be seen as 3:30 p.m.), and you can input the current date and time with function keys. But it falls far short of Agenda, which can make sense of things like "a week from Thursday." In fact, Arriba seems to know nothing about the days of the week—this is troubling, especially if you do most of your scheduling on a daily basis.

The to-do application is a simple listing of items you need to do. There are fields for description, date due, person assigned to, and priority.

Further Cooking

Arriba does not limit you to its defined applications. You can add your own folders with your own formats for the data. Here, again, it provides recipes—Arriba comes with 10 data-file formats to choose from. These include a format for auto-expense records, business-expense records, a calendar (for writing applications like the canned calendar file), contact management, a daily journal, a property locator, real-estate tracking, a phone list, and two to-do lists.

You can also create an entirely new form, to your own specifications. Doing so requires a little more expertise and planning, since you have to specify the field lengths for your data elements and

decide which ones will appear in the note titles. In fact, it's a lot like ordinary database programming, except Arriba handles many of the details. For instance, you can move the data fields around on the screen, as you would move text with a word processor; the subsequent data input window shows the inputs as you arranged them.

Like Agenda, Arriba has no provision for mathematical calculations—you can't add up the numbers in particular fields. You can only fill them in, search them, read them, and edit them—or dial them, if they happen to be phone numbers.

Other Entrées

You can run Arriba as a 137K-byte TSR program. But it has no facility for importing data from whatever was on the screen previously.

The TSR mode will not work with a program that intercepts keyboard input. Also, if you pop it up atop a program using a graphics screen, Arriba will work fine, but when you go back to the original program, you'll have only garbage on the screen and you may have to reboot. (Alas, Arriba is hardly the only TSR program that does this to you.)

You can also load Arriba normally and escape to DOS. Once there, you can execute simple DOS commands such as DIR and COPY—although anything else is likely to produce a "cannot load program" error message. Typing Exit returns you to Arriba.

Arriba lets you import ASCII files into a note and export a note as an ASCII file. It also has a function that exports the entire contents of a folder to a "file," but in this case a "file" turns out to be another Arriba textbase (a collection of folders under one name). Arriba will not handle any file types other than ASCII—a shortcoming, since many PIM packages make a point of handling popular word processing formats. For example, if you currently keep your phone list in a word processing file, you are likely to encounter difficulty importing it into Arriba.

The 16K-byte limit on notes, which at first seemed copious compared to Agenda, is actually a problem when you want to import large amounts of data. Arriba just loads its 16K-byte maximum, cuts off the rest, and gives you an error message. I tried importing a phone list of about 750 people only to find out that Arriba could only handle about 200 per folder. Basically, it's up to you to cut the data into smaller chunks—a tedious additional chore.

continued

Take Your Pick.

Only ZEOS lets you decide between two great keyboard styles. Choose the ZEOS/RS with standard Enhanced key spacing yet a 25% smaller footprint. Or choose the ZEOS/F12 with all the function keys on the left. ZEOS gives you the choice. Two great keyboards, one great price!

Only \$89.95

Please add \$5.00 for shipping & handling. Your ZEOS keyboard comes with the standard 6' coiled cable. For an additional 10' cable extension (16' total) add \$10.00. ZEOS keyboards use the standard DIN type connector as do most compatibles. If you're not sure what you need, contact your computer retailer. For PS/2 style connectors add \$15.00. XT, AT and PS/2 are trademarks of IBM Corporation. Prices are subject to change without notice. Call for complete warranty details. Available in 12 languages, call to verify stock. ZEOS is a publicly traded company, MPLS/ST PAUL Local OTC.



ZEOS/F12



ZEOS/RS

Your favorite Keyboards. Guaranteed.

ZEOS/F12, "F" Keys on the Left!
Many people prefer their function keys on the left. That's why we developed the ZEOS/F12. If you use your "F" keys frequently, then definitely give the F12 a try. You'll never go back.

ZEOS/RS, 25% smaller footprint!
We made it 25% smaller yet kept the standard Enhanced key size and spacing. People love it by the thousands. You will too. Just decide what you're going to do with all that extra desk space!

Who said typing can't be both fast and fun! Now it's both. ZEOS gives you your choice of *two* great keyboards.

Choose the ZEOS/RS (Reduced Size) keyboard. It's 25% smaller! Or select the ZEOS/F12. All 12 function keys are on the left, where a lot of us learned to use them. It's great for Function-intensive applications. It's fantastic for typing!

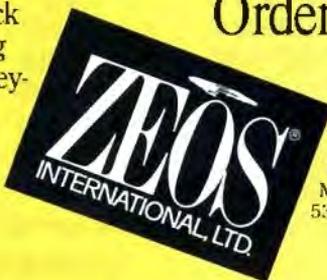
Either way you get that great ZEOS Mechanical Tactile feel with the perfect "Click!"

Plus, you will also get that extra ZEOS value. Like an anti-static dust cover included at no additional charge. Our famous ZEOS 30 day Money Back guarantee, Full One Year Warranty, Toll Free Technical Support and Expedited Replacement policy are yours too.

So take your pick and start enjoying your new ZEOS keyboard right away. Order yours now by calling 800-423-5891.

Order Now Toll Free
800-423-5891

Open days, evenings and weekends.
Fax Orders Dial: 612-633-2310.
In Minnesota Call: 612-633-4591.
MasterCard, VISA and COD
530 5th Avenue NW, St. Paul, MN 55112



Within a textbase you can, as you'd expect, copy material from one note to another—swiping a phone number, for instance, from the phone list to an appointment note.

As for performance, Arriba is quite responsive. No matter what you're doing, the screens pop up like flashbulbs (at least they do on my 16-MHz AT-clone); file imports are almost as fast, provided they're the proper size.

In general, getting between screens is only a matter of two or three keystrokes. Repeatedly pressing the Escape key eventually brings you back to the main menu, so you're not likely to ever get lost. Pressing Escape to "back up," however, can be a problem. When inputting a note, for example, the Escape key still means "escape," and I had to learn the hard way that you need to press the Save key when you're through typing a note. Otherwise, the search command frustratingly refuses to find anything—since escape preceded save, there's nothing in the notes.

The user's manual that comes with Arriba is adequate, if unexciting. But it is irrelevant anyway since everything you

No matter
what you're doing,
Arriba screens
pop up like flashbulbs.

might need to know about Arriba is in an enormous (367K-byte) help file. You can invoke the help command at any time and get a somewhat context-sensitive help screen. F10 loads the help file as a textbase. You can then invoke the search command and get the help topics you need. Searching for "export and ASCII" will get you a list of the seven help notes that contain the two words. You would see that one of them is titled "exporting note text to an ASCII file" and call it.

Proper Diet

Arriba, like Agenda, provides a simplified database language—with additional calendar and phone functions—suitable

for managing personal information. The simplification puts mathematical analysis out of the picture. But for those of you whose PCs have replaced your filing cabinets, you can easily do what you could always do before you computerized—browse through your material.

But Arriba manages to avoid a problem that Agenda typifies. Too often, software evokes an appreciative "golly, this is neat" reaction from the user as he or she surveys the sophisticated complexity of the new package, just prior to abandoning family and friends for whatever time it takes to master its intricacies.

Eventually, somewhere on the other side of the learning curve, the user may return to the original job and actually become more productive (i.e., before some new software comes along).

Software doesn't have to forsake simplicity for functionality, and users need not be programmers. Arriba sets an example. ■

Lamont Wood is a freelance writer and computer consultant living in San Antonio, Texas. You can reach him on BIX as "lwood."

LAPTOPS \$385 FAX

TOSHIBA T1000 . . . \$635	NecUltralite 2meg. \$2289	CANON Fax 20 . . . \$949	AVATEX 110/220V . . \$625
" T1200F \$1299	Prospeed 286/20 . \$3049	" Fax 225 \$1545	NISSIE 320 \$495
" T1200FB \$1385	" 286/40 \$3399	" Fax 270 \$1795	" 303 \$495
" T1200H \$1795	" 386/40 \$4395	" Fax 350 \$1995	MURATA 1200 . . . \$569
" T1200HB \$1895	Mitsubishi 286-219 \$1995	" Fax 450 \$2349	" 1600 \$669
" T1600 \$3045	" 386-290 \$2299	" Fax 630 \$2699	" F30 \$1399
" T3100E \$2565	" 386-240 \$2795	" Fax 705 \$2999	RICOH RF800 . . . \$649
" T3200/40 \$3299	SHARP 7241/40mb \$1999	" Fax 730 \$3499	" Fax 15 \$1155
" T5100 \$4099	" 4602 \$1445	PANASONIC	" Fax 25 \$1295
" T5200 40 \$4795	" 4641 \$2295	KXF 100 \$825	" Fax 35 \$1545
" T5200 100 \$5299	" 5541 \$3599	KXF 120 \$975	" Fax 65 \$1595
ZENITH Z-184-10 . . \$1495	PANASONIC PRINTERS	PANAFAX UF 135 . . \$799	SHARP FO 220 . . . \$699
" Z-184-20 \$2129	KXP1180 \$179	" UF 145 \$895	" FO 300 \$849
" Z-286-20 \$2949	KXP1191 \$229	" UF 250 \$1299	" FO 330 \$999
" Z-286-40 \$3388	KXP1124 \$325	" UF 260 \$1549	" FO 550 \$Call
" Z-384-40 \$4799	KXP1592 \$395	SANYO SF 100 . . . \$765	" UX 350 \$1099
COMPAQ 286-20mb \$call	LASER KXP 4450 \$1369	" SF 200 \$929	TOSHIBA 30100 . . . \$745
" 286 40 MB \$call	KXP1595 \$425	" SF 515 \$1145	T3300 \$799
NEC MLTSPD HD. \$1949	KXP1524 \$509	SHARP UX 50 . . . \$535	T3600 \$965
" MLTSPD EL \$1499	CANON Fax 8 \$619	Remfg. UX 30 . . . \$385	T3700 \$1099

PREPAY PRICES: VISA/MC/COD + 2.9% Restock 20% Handling Chg. 5.95 No Exchange/Returns.

T.P.C. 12603 Hoover St.
Garden Grove, CA 92641

714/898-8262
FAX 714/891-1202

1-800-383-3199

FINALLY. A debugging tool tough enough to handle the DOS Nasties.

New Version 2.0



Nasty over-write? No sweat!

Soft-ICE memory range break points help you track down memory over-write problems whether you are doing the over-writing or another program is over-writing you.

Hung program? No problem!

When the system hangs, you now have hope. With Soft-ICE you can break out of hung programs no matter how bad the system has been trashed. And with Soft-ICE's back trace ranges you can re-play the instructions that led up to the crash.

Program too large? Not with Soft-ICE!

Soft-ICE runs entirely in extended memory. This means you can debug even the largest DOS programs. And since your program runs at the same address whether Soft-ICE is loaded or not you can find those subtle bugs that change when the starting address of your code changes.

System debugging? Soft-ICE is a natural!

Soft-ICE is ideal for full source level debugging of TSRs, interrupt service routines, self booting programs, DOS loadable device drivers, real-time kernels, non-DOS O/Ss and ROMs. Soft-ICE can even debug within DOS & BIOS.



How Soft-ICE Works

Soft-ICE uses the power of the 80386 to surround your program in a virtual machine.

This gives you complete control of the DOS environment, while Soft-ICE runs safely in protected mode. Soft-ICE uses the 80386 to provide real-time break points on memory locations, memory ranges, execution, I/O ports, hardware & software interrupts. With Soft-ICE you get all the speed and power of a hardware-assisted debugger at a software price.

Don't want to switch debuggers?

You don't have to!

Soft-ICE can run stand-alone or it can add its powerful break points to the debugger you already use. Use your favorite debugger until you require Soft-ICE. Simply pop up the Soft-ICE window to set powerful real-time break points. When a break point is reached, your debugger will be activated automatically.

MagicCV with Soft-ICE

Using Soft-ICE with CodeView gives you the features necessary for professional level systems debugging. MagicCV and Soft-ICE can work in concert with CodeView to provide the most powerful debugging platform you will find anywhere.

"These may be the only two products I've seen in the last two or three years that exceeded my wildest expectations for power, compatibility and ease-of-use."

— Paul Mace
Paul Mace Software

Soft-ICE	\$386
MagicCV	\$199
MagicCV for Windows	\$199
Buy Soft-ICE & MagicCV(W)	—Save \$86.
Buy MagicCV and MagicCVW	—Save \$100.
Buy All 3	—Save \$186.

30 day money-back guarantee
Visa, MasterCard and
AmEx accepted



New Soft-ICE 2.0 features

- Back Trace Ranges
- Symbolic & Source level debugging
- EMS 4.0 support with special EMS debugging commands
- Windowed user interface



Nu-Mega
TECHNOLOGIES

CALL TODAY (603) 888-2386
or FAX (603) 888-2465

RUN CODEVIEW IN 8K MagicCV



CodeView is a great integrated debugger, but it uses over 200K of conventional memory. MagicCV uses advanced features of the 80386 to load CodeView and symbols in extended memory. This allows MagicCV to run CodeView in less than 8K of conventional memory on your 80386 PC.

NEW—Version 2.0 includes EMS 4.0 driver
Attention Windows Developers!
Version available for CVW.

P.O. BOX 7607 ■ NASHUA, NH ■ 03060-7607

Circle 215 on Reader Service Card

Reviewer's Notebook

Reviewer's Notebook is a compilation of brief reviews and updates to previously published evaluations. BYTE will publish Reviewer's Notebook each month on a space-permitting basis.

PixC Leaves Windows Overhead in the Dust

Windows without the operating system overhead: The idea is great. As a hardware implementation of windows for SCO Xenix and MS-DOS, PixC makes this idea a reality for 80386 AT-bus PCs.

PixC includes a 1536- by 950-pixel monochrome monitor, a video-control board, and a three-button mouse. A four-port serial board for connecting to other machines is a \$400 option. The window manager and programs are embedded on the video board, which has an Intel 82786 window chip and 3 megabytes of video RAM. You can display as many as six windows on the screen at a time. Each window has function icons for sizing, positioning, scrolling, cloning, closing, and cutting and pasting.

I used four windows: one PC window (the Xenix equivalent of an MS-DOS console), a window through one of the serial ports to a Unix minicomputer, and two windows into Xenix on the local machine. I also ran VP/ix in the PC window, which, like the standard console, handles 12 virtual terminals of its own.

My job requires me to maintain a minicomputer, to program in 80386 Unix/Xenix, and to transfer files to and from MS-DOS. PixC let me work simul-



PixC can simultaneously run six windows without slowing down the host.

taneously in all these environments on the same screen, each window a full 80 columns (optionally 132) by 25 rows. This did not slow down my computer, because PixC operates transparently, using its own hardware.

But PixC has some limitations (the manufacturer says that it is working to resolve them). First, the PC window is 25 rows, while all others end at 24 rows. Thus, it is inconvenient to run another PC in any of the other windows.

Second, the serial ports don't extend their communications to the system bus;

they only communicate internally with the video board. So although I created a window to an external machine without taxing the local system, I had no way for the local system to communicate with the external machine on the same line. This weakness extends to the use of the mouse. To use the screen mouse within an application, you need to run a cable between the fourth PixC port and a system serial port—a loss on both accounts.

Overall, PixC is economical and easy to use. I learned the display quickly due to the intuitive nature of the windows and because the actions and icons were consistent with other common (and more-expensive) systems. In fact, the most difficult part about writing this review was finishing it. Now I'll have to send the PixC back, and I will surely miss it.

—Ben Smith

PixC Display System

International Software Corp.

528 Commons Dr.

Golden, CO 80401

(303) 526-0388

\$2995 with system-software interface

\$495 for each additional interface

Inquiry 886.

Inconsistency Mars Budget-Priced Scanner

At \$899, The Complete Page Scanner provides some of the features of flatbed scanners, such as Hewlett-Packard's ScanJet, at about half the price. But in terms of image quality and overall performance, it compares to the cheaper hand-held models.

The product offers 4-bit, 300-dot-per-inch, full-page scanning for the IBM PC, PS/2 Model 30, and compatibles. Unlike flatbed scanners, it uses three rollers to

pull pages past a scanning window. You can select resolutions of 200 or 300 dpi, choose two halftone settings, and pick three dithering patterns: bayer, spiral, and mesh. The scanner supports 16 gray scales.

Menu-driven SmartScan software, which is included, converts images into various file formats, such as TIFF, PC Paintbrush+, Dr. HALO, Windows Paint, and GEM. It also imports and

combines graphics and text files so you can merge them with scanned images and store them as one file.

I easily installed the interface card and software into my AT clone in about 15 minutes. From the main menu, I found the configuration screen, where I selected page size, orientation (portrait or landscape), and scanning resolution.

I tested the scanner with BYTE's scanning template and a variety of line art,

halftones, and continuous-tone images. For comparison, I scanned the same elements with an HP ScanJet. I printed the scanned images with an HP LaserJet Series II.

After experimenting with scanner adjustments, I generated some clean copies, but my results were inconsistent. Black stripes appeared at the top corners of printouts, or stray pixels dotted the page. Dithered images showed less contrast than with the ScanJet, but the quality was adequate for newsletters.

Unacceptable, however, were the size distortions. Images scanned and printed at 300 dpi shrank 4 percent to 288 dpi horizontally and 10 percent to 270 dpi vertically. The manufacturer claims that the software shrinks images so 8½-by-11-inch scans fit 8-by-10-inch formats—the maximum for some laser printers. To print the image correctly, you must store it in your PC and then import it into another application, such as PageMaker.



The Complete Page Scanner is economical for some applications.

The manufacturer designed The Complete Page Scanner to work with The Complete Fax board and The Complete

OCR/Page software. Unfortunately, the SmartScan software doesn't integrate these products. To use the scanner with the fax board, you scan the image from within SmartScan and save it as a fax image file. Then you send the image with The Complete Fax software. A similar procedure is necessary to run The Complete OCR/Page software.

Overall, the scanner lends itself to low-end desktop publishing applications where high-quality images and accurate sizes aren't required. Otherwise, you might as well spend the extra money on a flatbed scanner. —Robert Mitchell

The Complete Page Scanner

The Complete PC
521 Cottonwood Dr.
Milpitas, CA 95035
(408) 434-0145
\$899
Inquiry 888.

Trim Mac IICx Still Packs Power

Do you need a 68030-based Mac for high-powered, Information Age processing? The Mac IIX and Mac SE/30 both have their problems. The Mac IIX demands a healthy chunk of desk space, and the 9-inch, built-in monitor on the Mac SE/30 is too small for many tasks. Now there's the Mac IICx, which is essentially a trim Mac IIX with only three expansion slots (see "Apple's New Compact Mac IIX," May BYTE).

The Mac IICx's CPU box is smaller than either the Mac IIX's or the IBM PS/2 Model 50's. Yet the Mac IICx accommodates several monitors that are larger than the Mac SE/30's, but still fit on top of the CPU.

I evaluated a system with 4 megabytes of RAM, an 80-megabyte hard disk drive, and a Portrait Display monitor and video board. The BYTE benchmarks rated the Mac IICx as fast as the other 68030-based Macs (see table 1).

Software-compatibility tests showed some problems. For example, Adobe Illustrator 1.6, which behaved passably on the Mac IIX, crashed on start-up with the Mac IICx. (Adobe says that a redesigned version now runs on the newer Mac.)

Apple revamped the Mac CPU layout for the IICx, with good and bad results. On the plus side, the hard disk access light now glows when the IICx performs a lengthy I/O operation. Also, the inter- and reset switches sit in the front

where you can easily get at them.

However, problems center on the plastic lip that surrounds the ends of the NuBus boards. This lip reduces the area available for cable connectors. Also, the video cable socket for the SuperMac Spectrum/24 video board rides high on its card end and nearly collides with the plastic lip. Connecting a monitor to the Spectrum/24's video socket required major surgery on the cable connector to bypass this lip. If you plan to recycle NuBus boards from another Mac system into a IICx, check for this problem.

Overall, the Mac IICx is a nice compromise with more expandability; it has a

larger screen than the Mac SE/30, and it requires less space than the Mac IIX. You're certainly not sacrificing any processing power by using it.

—Tom Thompson

Macintosh IICx

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Base price: \$4669
System as reviewed: \$8767
Inquiry 887.

continued

Table 1: The BYTE benchmark tests for 68030-based Macintoshes show that the trimmed-down Mac IICx can keep pace with its Mac cousins. The major differences are in CPU performance and hard disk speed, where the Mac IICx's 80-megabyte hard disk drive (also used in the Mac SE/30) outpaces the 40-megabyte hard disk drive on the Mac IIX test unit.

	Mac IIX	Mac SE/30	Mac IICx
CPU	3.81	4.61	4.61
FPU	1.00	1.16	1.15
Disk	2.56	3.01	3.65
Video	2.35	2.33	2.58
Applications	13.7	17.0	17.97

Note: Indexes show relative performance. For all indexes except FPU, a Mac SE = 1; for FPU, a Mac II = 1. For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

Lisp Dialect Taps Mac Riches

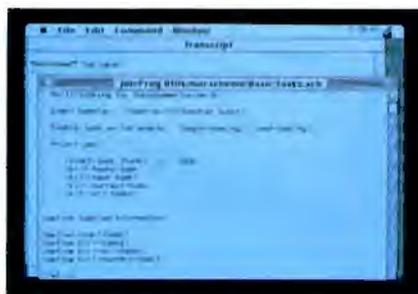
Programmers new to the Mac need to immerse themselves in the Byzantine ROM Mac Toolbox, where the machine's richness resides. MacScheme+Toolsmith 2.0 can help that process, especially if you're a Lisp aficionado.

MacScheme is an interpreter and compiler of Scheme, the Lisp dialect that turns functions into object-oriented programming modules and lets programmers use suspended computations called *continuations*. Toolsmith integrates MacScheme with the Mac Toolbox.

The development system provides an event-driven, multitasking environment that's well suited to object-oriented programming. To create a document window, for example, I entered `(define window (make-window 'text))` at the MacScheme prompt. An empty window appeared and behaved like any Macintosh window.

Behind the scenes, MacScheme performed some fascinating things. The `make-window` value was a Scheme function built to object-oriented programming specifications outlined in MacScheme. As such, it responded to a variety of window-related commands. When I typed `(window 'operations)`, the window listed the things it knew how to do, including activating and deactivating itself, displaying its width and height, and editing text.

This message originates from two sources. MacScheme can trap Macintosh system events pertinent to its own interface and convert the others to messages



MacScheme + Toolsmith offers a multitasking environment on the Mac.

that it sends to Scheme objects, such as windows and menus. Second, user-written Scheme code can also send messages to the same objects. Therefore, I could close the window by clicking in its close box or by typing `(window 'close)`.

This arrangement has interesting ramifications. I found the interaction with a live Mac interface to be instructive. Also, because MacScheme encapsulates the event loop that is normally at the heart of programs written in Mac high-level languages, it supports an object-oriented style of programming. I didn't need to manage raw system events; instead, I concentrated on building objects that could act independently.

MacScheme predefined a set of high-level window, menu, and text-editor objects; these worked in conjunction with event handlers that mediated between Macintosh system events and the MacScheme high-level objects. The objects

and event handlers gave me an effective environment for building Scheme programs that use the Mac interface.

The product's multitasking facility supported the development of Scheme programs made up of concurrent tasks. Yet MacScheme didn't interfere with MultiFinder, which manages icons and controls the Clipboard and Scrapbook. Both the development system and the stand-alone applications built with MacScheme ran under MultiFinder.

The question is, does MacScheme's rapid prototyping, object-oriented programming, and multitasking capabilities make it a compelling option for Mac developers? For some, the answer is no. Like all Lisp systems, MacScheme levies a significant run-time burden. For example, the sample text editor included with MacScheme is noticeably less snappy than the Think C equivalent. Of course, not every Macintosh program requires the blazing speed expected of commercial software. For those who can accept that, I recommend MacScheme as an aid to interactive Macintosh exploration and as a flexible object-oriented programming environment.

—Jon Udell

MacScheme + Toolsmith 2.0
Lightship Software
P.O. Box 1636
Beaverton, OR 97075
(503) 643-6909
\$395
Inquiry 889.

Better than Cache in the Bank?

Wouldn't it be great if you could wave a magic wand and make your hard disk drive run twice as fast? A screwdriver can do the same thing for you, if you use it to add Western Digital's SpeedKit caching controller to your computer. Five minutes was all it took to dramatically improve my old drive.

The SpeedKit is a \$225 replacement hard disk drive controller for your 80286- or 80386-based AT compatible. This short card has a built-in memory cache that holds up to 13 sectors of data, and a data transfer rate fast enough to handle a 1-to-1 interleave. The SpeedKit is designed for ST-506 standard hard disk drives.

The SpeedKit performs a "look-

ahead" during reads, storing up to 13 sectors of data in its memory. If you read sequential data from the disk, the controller provides it quickly from memory.

I installed the SpeedKit in an 80386-based clone with a 70-megabyte MiniScribe 6085 hard disk drive. The controller I replaced was the Western Digital WD1003-WA2. After installation, the machine booted on the first try.

To take full advantage of the board, you need to do a low-level reformat of the hard disk drive at a 1-to-1 interleave. The WD1003 normally runs the MiniScribe with an interleave of 3 to 1 or 4 to 1. Western Digital provides WDFMT, which requires that you know how many

continued



The Western Digital SpeedKit improves hard disk performance.

October 27, 1988

Mr. Charles Bostwick
Bostwick Parker Company
13644 148th Avenue
Detroit, Michigan 49684

Dear Mr. Bostwick:

The results of the computer simulation are in, and you'll find them quite fascinating. Here is an interesting surprise: the greatest sales potential exists with product three. What's more, the largest sales will result from Europe and the Far East, not the United States.

Bostwick Parker Co.
New Product Sales Projections



These sales projections take into account the requested in the model. Specifically, the simulation was reduced to reflect the

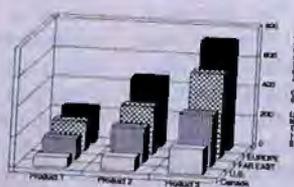
October 27, 1988

Mr. Charles Bostwick
Bostwick Parker Company
13644 148th Avenue
Detroit, Michigan 49684

Dear Mr. Bostwick:

The results of the computer simulation are in, and I think you'll find them quite fascinating. Here is an interesting surprise: the greatest sales potential exists with product number three. What's more, the largest sales will result from Europe and the Far East, not the United States.

Bostwick Parker Co.
New Product Sales Projections



These sales projections take into account the requested in the model. Specifically, the simulation was reduced to reflect the

0111 S.E. 14th Street, Suite 100
Miami, Florida 33139
Tel: 214-2760
Fax: 214-238-1434

CAN YOU SPOT THE \$700 DIFFERENCE?

One of the nearly identical samples you see above was printed with the HP Laserjet Series II. The other is from the Mannesmann Tally* MT905. Both are reprinted here exactly as they came out of the printers.

But what might surprise you is the rather dramatic difference in the manufacturers' suggested retail prices.

The Mannesmann Tally laser is \$700 less. Yet it offers the same high quality output, lowers operating costs 25 percent, and prints at six pages per minute.

The MT905 comes with the same resident type fonts as HP, accepts standard HP font cartridges, and lets you choose optional memory upgrades from one to four megabytes.



MT905 Specifications

- Technology: scanning laser.
- Print Speed: 6-pages per minute.
- Resolution: 300 x 300 dpi.
- Emulations: HP Series-II, [optional emulations: Epson,* IBM* Proprinter, & Diablo 630.]
- Standard I/Os: Serial & parallel.
- Memory: 512K. [upgrades: 1, 2, & 4 megabytes.]
- Typefaces: Courier medium & bold, line printer, accepts standard HP font cartridges or any downloadable font in HP-format, 6-resident fonts + 2 font cartridge slots.
- Paper Handling: 150-sheet input & output bins. Manual feed handles single sheets, envelopes, transparencies, and labels.
- Workload: 4,000 pages-per-month.
- Suggested Retail: \$1,995.

For more convenient paper handling, the universal paper cassette holds letter, legal, and international sizes, plus up to 15 standard envelopes. You can choose face-down output to keep long documents in the right order. And the manual feed lets you print labels or transparencies.

So any way you figure, the answer still comes up the same. The Mannesmann Tally laser looks perfect. And so does the price.

For the name of your nearest dealer, call the toll-free number listed below.

**MANNESMANN
TALLY**
1-800-843-1347

Ext. 360

Epson and IBM are registered trademarks.

heads and cylinders your drive has before formatting. This information may be posted somewhere on the drive, but in many cases, it's not. You need to know the correct parameters for your drive, because if you try and format more cylinders than your drive has, you can severely damage it.

WDFMT's screen and lack of clear instructions were a bit unsettling. Rather than trust the screen defaults, I used SpeedStor from Storage Dimensions. The SpeedKit worked perfectly with it. After reformatting, the raw transfer rate of my drive doubled from a typical 243K bytes per second to a very respectable 496K bytes per second.

Windows and PageMaker flew. A 112K-byte PageMaker file that previously took 15 seconds to save was now whisked to disk in about 8 seconds. Other applications showed varying amounts of improvement—from none at all to twice as fast. The best performance increase came from applications that use one file laid out in consecutive sectors and ac-

cessed sequentially. Typical overall performance increased about 30 percent. As the disk became more fragmented, the caching was less effective and performance dropped. You should use a disk optimizer and defragment your disk often for best performance.

The manual has excellent instructions for installing the SpeedKit controller in place of a Western Digital controller. If you have some other brand, however, you may find the installation a bit trickier.

Make sure that when you connect the drive cables, you connect pin 1 on the drive to pin 1 on the controller card. The manual would have you believe that all disk cables have identifying red stripes—but this is not always true. Look at your controller first and check each of the cables *before* you remove them to find out which side is connected to pin 1. Otherwise, you may trash your drive by connecting the cables improperly.

The SpeedKit also provides a floppy disk drive controller for the standard types of floppy disk drives. If your hard

disk drive controller doesn't control your floppy disk drives, you'll have to disable the floppy disk drive controller on the SpeedKit board. The manual explains how to do this.

If your computer began its life as one type of machine and has been upgraded to something faster, your hard disk drive now probably seems a bit sleepy. Perhaps you tried to save money by buying a slower hard disk drive and would now like better performance. Either way, take a look at the SpeedKit. Getting more out of an old drive is cheaper than buying a new machine. Besides, who can't use a little extra cache? —Howard Eglowstein

SpeedKit
Western Digital Corp.
2445 McCabe Way
Irvine, CA 92714
(714) 863-0102
\$225
Inquiry 948.

In Search of a Faster 80287

The world of floating-point coprocessors is one of desire. If you don't have one, you want one. When you've got one, you want a faster one.

Enter the IIT-2C87, a pin-for-pin, instruction-for-instruction replacement for the 80287 coprocessor. The designers of the 2C87 have hot-rodded the chip. It looks like an 80287 to the CPU, but it executes floating-point operations in fewer cycles.

I pitted the 2C87 against an 80287 using BYTE's floating-point benchmark tests; both FPUs were running at the same clock speed inside an 8-MHz AT. All the tests ran without a hitch. The 2C87 doesn't seem to suffer from any compatibility problems.

The Livermore Loops test showed the 2C87 performing at nearly twice the rate of the 80287: 0.045 million floating-point operations per second versus 0.024 MFLOPS. On the LINPACK benchmark, the 2C87 chip performed about 1.7 times faster than the 80287. This agreed closely with our low-level FPU benchmarks, which showed the 2C87 to be, on average, 1.8 times faster than the 80287.

Inside a normal 80287, you will find a set of eight 10-byte storage locations that you can access either independently (as though each were a register) or in a group

(as though the entire set were a push-down stack). If you take a look inside the 2C87, however, it reveals 32 10-byte locations, in four banks of eight each. You can access banks 0 through 2, but the coprocessor reserves bank 3 for its own use. When you apply power to the 2C87, its internal bank pointer is automatically set to bank 0. But special op codes that only the 2C87 recognizes allow you to switch the bank pointer to bank 1 or 2.

During normal operation, the 2C87 operates as though it is aware of only the currently active bank. In this case, the 2C87 is indistinguishable from a souped-up 80287: There's no way to operate on values in separate banks simultaneously.

With one exception.

The 2C87 has one more special instruction, which gives it the appropriate mnemonic F4BY4. It allows you to multiply a four-element row vector in bank 0 by a 4x4 matrix in banks 1 and 2 in one fell swoop. This may sound like a quirky instruction to add to a coprocessor, but it's not. If you are doing intense graphics operations in three dimensions—three-dimensional CAD, for instance—a fast matrix multiplication operation of the sort that F4BY4 provides is a godsend.

I executed a demonstration program

that rotated a simple polygon through 360 degrees, one rotation per degree (each rotation required a matrix multiplication on eight points). The 80287 finished the job in about 345 seconds, while the 2C87 was done in only 179 seconds. Although I expected a better showing from the 2C87, a nearly 2-to-1 performance boost is nothing to sneeze at.

Integrated Information Technology has not yet set a single-unit price for the 2C87, though I was told that it should cost about the same as an 80287. IIT's engineers said that they had contacted compiler and CAD package developers, hoping to convince those companies to create special libraries that will recognize a 2C87 and make use of its added capabilities.

If you've got to have an FPU in your AT, paying 80287 prices and getting twice the throughput looks like a deal to me. —Rick Grehan ■

IIT-2C87
Integrated Information Technology, Inc.
2540 Mission College Blvd.
Santa Clara, CA 95054
(408) 727-1885
10 MHz: \$189 each in lots of 1000
20 MHz: \$239 each in lots of 1000
Inquiry 856.

Whose ad is this, anyway?

That's a very good question.

Because, instead of being an ad for the 20 very different companies you see here, it's actually an ad for the one industry standard that makes them very much alike.

The PostScript® language from Adobe Systems.

Choose a printer or typesetter from one of these companies and you can make the choice for PostScript. Because each of these manufacturers has licensed Adobe's page description language.

Why did they do it?

For one thing, PostScript delivers the ultimate in output quality and

capability. Whether you're printing simple text for everyday correspondence or complex graphics for electronic publishing, PostScript makes it easy.

PostScript also gives you absolute freedom to select the best hardware and more than 4,000 software programs for your needs and budget.

That's called compatibility and Adobe PostScript guarantees it.

So, even though different PostScript printers and typesetters offer different resolutions, paper handling options and output speeds, you can be sure they all work together.



Because they all speak the same language. The language of PostScript.

Now, aren't you glad you asked?



Quarterdeck

DESQview 2.2 and DESQview 386. The multitasking, windowing environments that work with your favorite software.

DESQview™ is the operating environment that brings OS/2™ power to DOS. And it lets you, with your trusty 8088, 8086, 80286, or 80386 PC, leap into the next generation in PC productivity. For not much money. And without throwing away your favorite software.

Introducing DESQview 2.2

And now, DESQview 2.2 adds capabilities, performance, and compatibility enhancements you've been asking for:

Like being able to fine tune DESQview performance "on the fly." Run Lotus Express and Metro. And the Intel Connection Co Processor. Even use the DOS 4.0 shell with DESQview. Have DESQview automatically install Quattro, Sprint, Aldus PageMaker, Microsoft Excel, Word Perfect, Dataease and as many as 80 other programs. And using the DESQview API, be able to dynamically link them.

More bang; less bytes

While other programs get bigger, we've worked to make DESQview smaller. And we've succeeded in a big way on PCs and PS/2's with extended, EMS 3.2 (AboveBoard), EEMS and EMS 4.0 memory—as well as on 386 PCs and



DESQview lets you run your favorite programs in windows side-by-side.

PS/2s. For example, DESQview overhead on EMS 4.0 and 386 PCs can be as low as 10K on EGA/VGA PCs. And DESQview actually increases memory 30K on CGA PCs; 20K on monochrome and Hercules PCs. That's good news for users of big desktop publishing, CAD and database programs.

Introducing DESQview 386

For users of 80386 PCs and PS/2s (or PCs with 80386 add-in boards, such as the Intel Inboard 386), there's DESQview 386 (a combination of DESQview 2.2 and the new QEMM-386

Quarterdeck Expanded Memory Manager, version 4.2).

DESQview 386 gives you extraordinary power. Run text, CGA, EGA, VGA, and Hercules programs in windows and in the

background. Run 32-bit 386 programs, like Paradox 386, and IBM Interleaf simultaneously with your favorite DOS programs. All with the speed and performance you expect out of your 386. And with protection against 'misbehaved' programs.

Promise and performance

And, of course, both DESQviews have all the features that made prior versions the popular choice in operating environments. The ability to multitask in 640K and beyond. View programs in windows or full screen. Transfer data. Access DOS via menus. Dial your phone. And create key-stroke macros within and between programs.

Our story gets better and better

If there's any doubt about our commitment to your PC and PS/2 productivity, just look at our accomplishments over the years. We think you will understand why GE, Ford, Aetna, Monsanto, and so many other major corporations use DESQview.

And why PC Magazine twice gave DESQview its Editor's Choice Award for "The Best Alternative to OS/2," why readers of InfoWorld voted DESQview "Product of the Year" three times. Why, by popular vote at Comdex Fall for two years in a row, DESQview was chosen "Best PC Environment" in PC Tech Journal's Systems Builder Contest, and just won their "Professional Solutions" Award.

DESQview lets you have it all now.



Quarterdeck Delivers.

QEMM. Break the 640K barrier for \$59.95

Your 80386 PC, IBM Personal System/2 Model 80, PC or AT with 80386 add-in board, as well as your IBM Personal System/2 Models 50 or 60 can all break through the DOS 640K barrier. Now you can have maximum use of your memory—whether you have one megabyte or 32—with the Quarterdeck Expanded Memory Manager. All without having to purchase special expanded memory boards.

QEMM uses hidden features within your existing memory to make it compatible with the Lotus-Intel-Microsoft Expanded Memory Specification (EMS) version 4.0.



Now you can run colossal spreadsheets, databases, and CAD models designed for expanded memory, using Lotus 1-2-3, Symphony Framework, Paradox, AutoCAD, Excel and more.

And if you'd like to use these programs all together—multitasking beyond 640K—QEMM works with our popular DESQview multitasking environment.

If you are one of the 12 million or so 8088, 8086 or 80286 PC users who feel left out, don't despair. We have options that let you keep your computer and favorite programs and give you today what the newest PCs and operating systems are promising for the future.

Visit your dealer for more information on barrier-breaking Quarterdeck products.

DESQview API Toolkit. New C and Pascal Libraries, Debugger, Panel Designer. And more.

DESQview API
Conference '89
Coming in August
Write for details

API Reference Manual

The key to the power of the DESQview API, our Reference Manual contains all you need to know to write Assembly Language programs that take full advantage of DESQview's capabilities. And there's an 'include' file with symbols and macros to aid you in development.

API C Library

Here are C language interfaces for the entire set of API functions. It supports the Lattice[™] C, Metaware[™] C, Microsoft[™] C, and Turbo C compilers for all memory models. Included with the C Library package is the API Reference Manual and source code for the library.

API Pascal Library

The Pascal library provides interfaces for the entire set of API functions. It supports Turbo Pascal V4.0 and V5.0 compilers. Included are the API Reference Manual, source code for the library, and example programs.

API Debugger

The DESQview API Debugger is an interactive tool enabling the API programmer to trace and single step through API calls from several concurrently running DESQview-specific programs. Trace information is reported sym-

bolically along with the program counter, registers, and stack at the time of the call. Trace conditions can be specified so that only calls of interest are reported.

API Panel Designer

This interactive tool helps you design windows, menus, help screens, error messages, and forms. It includes an editor that lets you construct an image of your panel using simple commands to enter, edit, copy, and move text, as well as draw lines and boxes. You can then define the characteristics of the window that will contain the panel, such as its position, size, and title. Finally, you can specify the locations and types of fields in the panel.

The Panel Designer automatically generates all the DESQview API data streams necessary to display and take input from your panel. These data streams may be grouped into panel libraries and stored on disk or as part of your program.

More Tools are Coming

Quarterdeck is committed to adding tools as needed by our users. To that end we have been working with Ashton Tate and Buzzwords International on dBASE III and dBASEIV translators. And in the works, we have BASIC and DOS Extender libraries.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405 (213) 392-9851
FAX: (213) 399-3802

For additional information, please use the following Reader Service numbers: DESQview: #207 QEMM: #208 API Tools: #209 API Conference: #210

4 Steps to PC-to-Mainframe Success:

1. Select 3780 or 3270...



2. Select your hardware...



3. Select your operating system...



4. Rely on CLEO.

CLEO's PC-to-mainframe products have been proven in over 80,000 worldwide installations.

Our solutions range from single-user interface boards and modem boards to high-performance co-processor boards supporting up to 32 simultaneous 3270 mainframe sessions.

The software is complete, powerful, and reliable. With 3780Plus, you get auto dial/auto answer, API, and an easy-to-use Scripting Command Language. DataTalker 3270

provides 32 IUs, file transfer, BSC/SNA support, API, HLLAPI 3.0, NETVIEW support, and more.

Plus, all CLEO systems are available in both DOS- and UNIX-compatible versions.

With CLEO, you get this simple guarantee: *it works.*

We stand behind our products with complete, ongoing technical support. We can even create custom PC-to-mainframe systems, if your applications demand it.

To insure your satisfaction, we back each CLEO product with a 30-day money-back guarantee and a full 12-month warranty.

To learn more...

Call us today at **1-800-233-2536**. We'll send you our free PC-to-mainframe guide.

CLEO

In a recent transaction, CLEO Software merged with Winterhalter, Inc. to become:

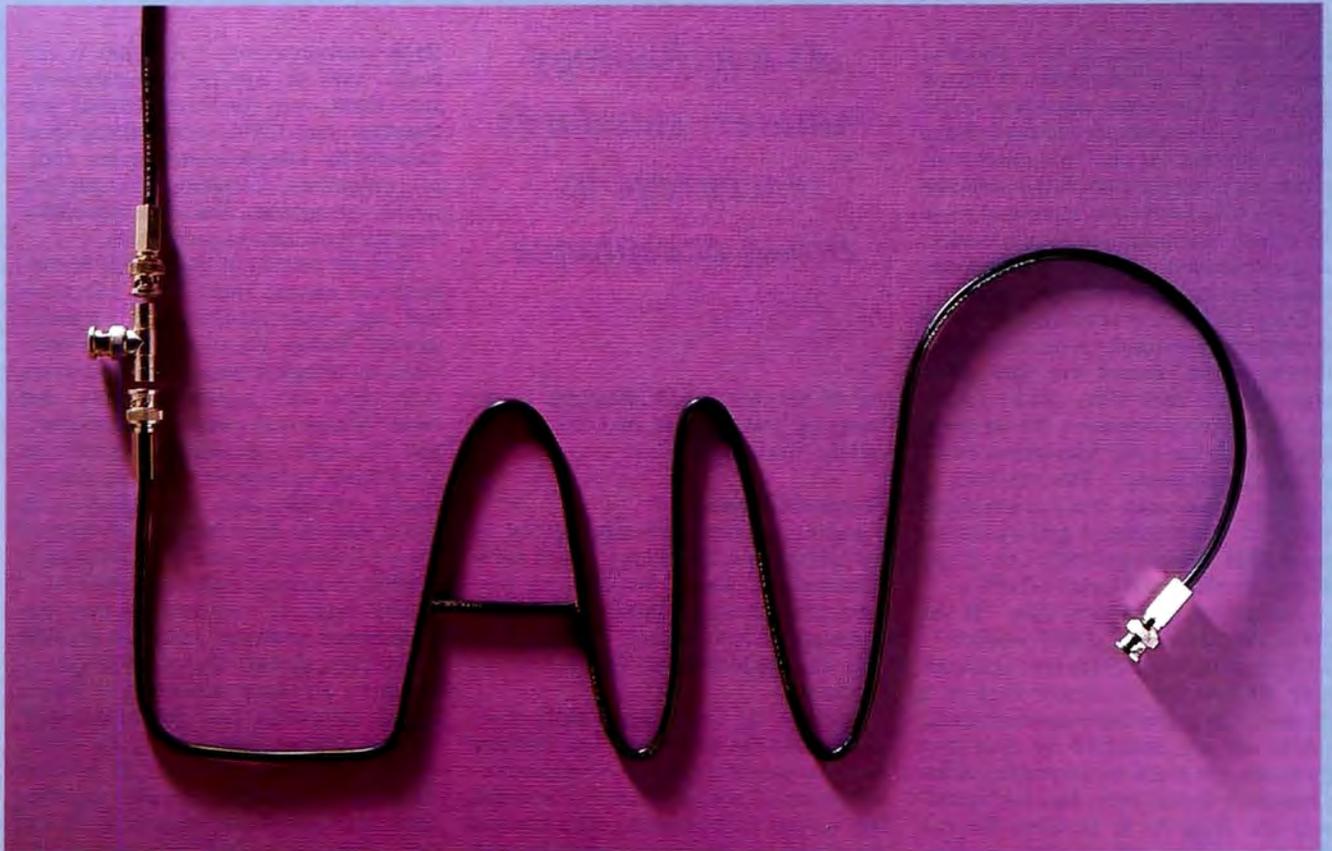
CLEO Communications

A Division of Interface Systems, Inc.

BYTE

September 1989

BONUS



SUPPLEMENT

Standards

TCP/IP

Heterogeneous Systems

Multiuser Applications

LAN Standards: Do You Need Them?

Jonathan Schmidt

*As a technology
matures, standards
encourage its
broad acceptance*

LANs were developed to serve personal computers with the economics of shared resources. Connected machines could share expensive printers and hard disks. Now it is often the case that microcomputers are installed to serve the purposes of the LAN. LANs are more and more the actual "computer" of choice to solve data-processing, office automation, manufacturing, and control problems.

Early LANs were often nothing more than alternatives for the popular "printer sharing boxes" except that they could also share a hard disk. When LANs served personal computers, the big question was "Is the LAN transparent to all desktop applications?" That was back in the days when other familiar questions were "Is this particular personal computer IBM PC-compatible? Can it run Flight Simulator and Lotus 1-2-3?"

Today, the question is this: "Is the LAN compatible with LAN products?" *LAN products?* LANs are now real ends unto themselves, no longer used as a means to the individual computer's ends. LANs are now installed for their own purposes, not to aid the economics of the computer's installation. Real LAN products are designed to facilitate the end purposes of the LAN: database engines, System Network Architecture (SNA) gateways, and servers of all types.

As with personal computers, it's not good if LANs don't conform to the standards that let you use the popular added-value products designed for them. Also, the synergistic support industry is more highly motivated to invest in product development when there is a large base of compatible users to absorb the products.

LANs are layered, and products for LAN users range from wires and connectors to MS-DOS applications. Proponents of particular solutions, promoted as candidates for standards, range from Datapoint with ARCnet, Xerox with Ethernet, and IBM with Token Ring at the wire end, to Novell, Microsoft, and, of course, IBM at the higher levels. Add-

ing to the richness of offerings is the emerging participation of OS/2, Unix, and the Macintosh.

Standardization

Standardization is a two-edged sword. In the infancy of a technology, it can stifle advancement. Later, however, as personal computers have shown, it generates widespread competence, familiarity, and an explosion of value-adding products.

Luckily for LAN users, early standardization did *not* occur. The industry is now in the final stages of a frenzied development of a wide variety of network species that are competing for a place in the world—a cretaceous period for networks, so to speak.

Some consolidation and effective standardization have occurred. LAN hardware is mature. It has assimilated existing hardware technology and is awaiting future developments to make the full speed of fiber-optic technology and even higher-speed modulation and propagation media accessible.

The "war of the wires" of several years ago is over. A brief tour through issues of BYTE of the early 1980s (when which "LAN" you used referred to the type of hardware, not to Novell or Banyan) will bring it all back, as in these caricature quotes: "Token Ring is too fragile and expensive," says an Ethernet spokesperson; "Ethernet is too unreliable and unpredictable," says a Token

Ring spokesperson; "ARCnet is the best," says an ARCnet spokesperson. And there were (and are) Orchid and Omninet, too. LANs were coming from universities, telephone companies, copier companies, computer companies, modem companies, and some apparently through spontaneous generation.

Now 90 percent of the market is consolidated around Token Ring, Ethernet, and, yes, nearly 2 million ARCnet nodes as well. Today, the competition is dedicated to bringing users these survivors with lower cost, higher reliability, and easier wiring with coaxial, twisted-pair, and fiber-optic connections available on all of them. All three are mature, easy to install, reliable, fast, and dropping in price. And the huge numbers of users of these LANs have forced the LAN system vendors to accommodate each of them.

The choice of wiring of any new network is now often decided by an existing installation already dedicated to one of the three. Or, accommodation of the selected computers may determine your wiring choice: Token Ring for IBM, Ethernet for Unix or VAX, or ARCnet for commercial data-processing installations or factory-floor integration. In any case, choosing among these mature and comparable disciplines solely on the basis of the price/performance ratio is difficult.

LAN Protocol Standards

LAN protocols are in a high state of flux. Competing interests, from international standards to IBM to defense systems, all have different agendas. Most LAN users with no one else to talk to on special protocols don't need them and don't use them. Besides, there is an interesting back door that takes care of the problem in many instances.

Immediately above the hardware layer in most networks, you usually find a protocol that handles communication across the LAN (e.g., TCP/IP). But, of course,

continued



there is also Open Systems Interconnection (OSI), XNS, variants of XNS (such as Novell's IPX), and myriad simple protocols optimized for restricted use within a particular hardware environment. Some are fully layered, and some are just part of a full stack. But does it really matter?

It does if you are seriously planning to use a *complete* integration of your personal computer LAN and other facilities *soon*. Involvement with other participating computers, such as a VAX or an IBM mainframe, can dictate which LAN protocol is used. This factor becomes especially important if a wide-area network is involved. TCP/IP proponents are pleased to point out that this "internetwork suite of protocols" not only is here today (an obvious reference to the lack of implementation of the OSI model) but is aided by an awesome array of support products and by virtually every major computer vendor. However, you pay a price today in terms of memory consumption that may just render other MS-DOS operations impossible.

Protocols, especially those following sophisticated, fully implemented stacks such as TCP/IP or OSI, can eat up so much of MS-DOS's precious 640K bytes of memory (or require expensive cards for implementing the protocol) that popular memory-hungry programs are unusable. Remember, both the network software itself and MS-DOS are also in there gobbling memory. In addition, lots of code means that it gets executed, and that implies time—lots of time to do even the simplest network operations. Faster PCs and memory-unshackled operating systems (such as OS/2 and Unix) will bring this problem to an end and offer up the delights of a broadly applicable protocol to PC LAN users.

But there is the hazard of adopting the "protocol of the month." What do you do next year when nobody remembers it?

The great innovative microcomputer support industry, as it often does, has come to the rescue with protocol gateways: software that causes your existing protocol to look like whatever you want to the outside world. That's one purpose for choosing a specific protocol, isn't it? Do you want your ARCnet LAN to look like an Ethernet TCP/IP network to an HP system in another department? Do you want it to look like an IBM Token Ring SNA network to your mainframe? Both at the same time? No problem, and you don't have to touch your network, which has been humming along just fine for several years. Nor does it require subjecting your entire network to a particu-

lar protocol to achieve this circus on interconnection. Just install one of the many gateways on the market, and you are set. Often you get better performance than you would if the network were completely homogeneous with the other protocol. And next year, just plug in another gateway for the new protocol that reigns supreme, and you'll be right up to date.

Gateways, however, are not for every purpose. They can't always use other internetwork facilities and, as Banyan can do with its internal TCP/IP, can't act as an IP router for other TCP/IP users. But they can link your networks together with X.25 so they look like a single networked set of users and resources. They can join every microcomputer to the IBM mainframe. They can link a microcomputer network to your Unix and VAX systems with TCP/IP. All this can be done without disturbing any existing functionality on your current LAN. Gateways can keep you going with full MS-DOS memory for your sensitive users. They can keep your network performance up until newer personal computers and operating systems come along that can handle protocol overhead as well as computing. In short, they can keep your personal computers unshackled.

MS-DOS is a *personal computer* operating system for *personal computing*. Its purpose often must be preserved to the exclusion of expeditions into new areas that offer magnificent possibilities for the future but can harm the immediate usefulness they offer.

LAN System Standards

LAN system standards are just beginning to rapidly evolve. Pioneers like Novell developed and proved the efficacy of basic mechanisms. In a repeat of the IBM PC evolution, IBM and Microsoft have incorporated these facilities directly into their operating systems. This time, however, their designs acknowledge this rapid transformation and take evolution and the resulting administrative hassle of updates into account.

Although early LANs were dedicated to sharing expensive hard disks, now LAN interface cards often cost more than the hard disks. So what's the appeal of the LAN, anyway? The whole is greater than the sum of the parts—the microcomputers are working together.

In Data Processing 101, one of the first precepts you learn is "one fact in one place." In simple terms, if you have several copies of a customer list, they will probably never be identical. With a LAN, you can assign one machine the responsibility for maintaining the list, and

everyone can access that machine when it's time to work on the list (shades of timesharing on minicomputers). Don't just share data, share other resources. Plug in one gateway, and everyone can be an IBM 3270. Plug in one asynchronous gateway, and everyone can get on BIX or call a BBS (n users at a time for n modems on the gateway) without their own modems or telephone lines.

That's how it is right now. Shared, synergistic power. But more is coming.

Current-generation LANs almost universally provide the IBM/Microsoft MS-DOS-defined NetBIOS. In simple terms, it's a lot like a Hayes-compatible modem in your personal computer. It's now a standard whereby your program tells NetBIOS to connect to another program or task on the network, and it does so if it can. A whole new world has opened up for products that just plug into a running network and provide value for everyone—gateways, database management machines, internetwork bridges, print management systems, plug-in shared power, and power to the n th for your LAN of n users.

Once the other popular LAN manufacturers such as Novell and Banyan produced NetBIOS-emulation facilities (3Com doesn't need to "emulate"; it licenses the core LAN from Microsoft), the support industry exploded in plug-in power for LANs.

OS/2 was announced with a better "NetBIOS" than NetBIOS: named pipes. Named pipes do everything NetBIOS does and more—and more easily. With announcements from Novell that it will support this facility, the stage is set for another explosion in development.

Exciting new structures can be built with multitasking and named pipes. With MS-DOS, it was one program running on one machine at one time. One machine was only the gateway, a rather complete program. With OS/2 and Unix providing named pipes, parts of your program, called *tasks*, can migrate to other machines on the network where they may be more appropriate. An I/O task can migrate to the machine with the laser printer; a computing task can migrate to a really big and fast machine; and a communications task can migrate to the machine with the channel on it and not bother you until something comes in that you want.

You say that you have only MS-DOS and can't have multiple tasks? Well, you can, if OS/2 or Unix machines take some of them for you. The MS-DOS for the LAN Manager (OS/2 networking) lets

continued

TWO POWERFUL

TWO ATs on ONE card!

The QL 2286 board features TWO 80286 AT business workstations on ONE AT add-in card. Plug one or more QL2286s into your Compaq or IBM AT's bus and create an instant closely-coupled network!

TWICE THE POWER FOR HALF THE PRICE!

QL 2286 features TWO 80286 processors with full EGA/CGA colour support and up to TWO MB RAM per user, for about the price of ONE standalone AT. Word processors, spreadsheets and thousands of Novell multiuser applications operate with lightning speed.

JUST PLUG IT IN!

Plug the QL 2286 into your fileserver's bus, connect a low profile, noiseless peripheral box to the board, attach your monitor, printer and mouse, load NetWare or ELS (or Network-OS), and your installation is complete! No need for hubs, controllers, transceivers or complicated wiring schemes.

ULTIMATE NETWORK SPEED!

Network transfer is at AT bus speeds — that's as fast as you can go — which makes QL 2286 ideal for processing disk intensive database applications. Data travels much faster on the bus than on controller based topologies that require inefficient protocols, serial data paths and expensive controllers.

NETWORKING AT ITS BEST!

QL 2286 boasts an unsurpassed state of the art design that allows you to maximize performance and minimize cost.

QL 2286 supports TWO independent users

Each user has:

- 80286 AT processor
- 80287 math coprocessor (optional)
- 1 MB RAM (with expansion to 2 MB)
- EGA/CGA video card
- Keyboard, Monitor, and Mouse or printer support
- COM 1 Port
- COM 2 Port supported
- Parallel Port supported
- Multisync colour monitor support



Put QL 2286 in your LAN plan and be TWO POWERFUL TOO!

Network-OS is a trademark of CBIS, Inc.
Compaq 386 is a trademark of Compaq, Inc.
IBM AT is the trademark of International Business Machines.
Novell NetWare is the trademark of Novell, Inc.

Call 1-800-648-2130 to order.

CUBIX
CORPORATION

Cubix Corporate Offices • 2800 Lockheed Way, Carson City, Nevada 89706 • Tel (702) 883-7611 • Fax (702) 882-2407
Europe • Unit 4 Colonial Business Park, Watford, Hertfordshire, WD2 4PR, England • Tel (44) 923 51150 • Fax (44) 923 37021

Circle 373 on Reader Service Card (DEALERS: 374)

you run multiple tasks from your MS-DOS machine as long as the others run on an OS/2 or Unix LAN Manager somewhere else on the network. There is now a true basis for remote procedure calls, the Xanadu of early network theorists.

Gradually, LAN System Standards

Microsoft has carefully been building this networking into all its operating systems; even Xenix comes with it. Recent versions of MS-DOS and OS/2 have networking modules, licensed separately, that obey the carefully designed behavior created by Microsoft to automatically network together users, resources, and even procedures. The delight of this design is that it is both upward compatible and downward compatible. This compatibility means that fully functional parts of your network, when operating with an older version of MS-DOS and its network, don't have to be uprooted to install an OS/2 server for newer OS/2 users. In fact, in most cases, you can install the OS/2 server without turning the network off. And to top that, the resources on the OS/2 server can be accessed by the old MS-DOS users as soon

as it is brought up. Microsoft networks have a negotiation built in, with newer versions always able to talk the more basic "language" of older versions, thus assuring hassle-free evolution. That design would certainly have been welcome when users were forced to upgrade MS-DOS versions on stand-alone PCs.

With both Hewlett-Packard and AT&T independently announcing that they are producing Unix systems to obey this same Microsoft LAN Manager networking language, the stage is set for a truly generic LAN. It is capable of absorbing not only accessories from the support industry, but also workstations, file and print servers, and facilities of all types on a wide variety of operating systems.

For LANs that support only MS-DOS, the standards picture is very bright indeed. All Microsoft-based LANs—including those from IBM and 3Com, Microsoft "clones" such as PowerLAN and Network O/S, and the majority of proprietary LANs such as NetWare, VINES, and LANtastic—fully support the MS-DOS LAN mechanism for communications (NetBIOS) and record locking. Thus, applications in general should

find these LANs accommodating.

OS/2 is another matter. OS/2 was designed with the network as an integral part—it's a *networking* operating system and needs no network operating system to support it. Vendors whose products are based on the premise of a network operating system that sits on top of the computer's operating system will continue developing features to demonstrate that they do add value. Microsoft, no doubt, will strive to make sure that OS/2 and MS-DOS don't need them.

The frantic pace of LAN development is continuing. Novell and Banyan have both indicated intentions to provide some degree of emulation for most of the current OS/2 networking mechanisms with a steady series of announcements over the past year. And it is no trivial detail that this "LAN Manager" is also IBM's LAN language. After witnessing the evolution of the PC, this indeed may be the most important fact. ■

Jonathan Schmidt is chief technical officer of Performance Technology in San Antonio, Texas. He can be reached on BIX c/o "editors."



Protect the one you love.

Yours is not just any computer. It's your friend. Your confidant. Your business partner. You wouldn't be without it.

But it can happen in a flash. A sudden storm, distant ditch digger, motor, or even a toy metallic balloon can send data-killing, component-killing electric surges and sags smack into your computer. Even knock it out altogether.

It's a matter of time before this happens to you. So protect your friend with Emerson's

new low-cost SW1000 Uninterruptible Power System. Only 2¼ in. high, it fits smartly right under your PC's monitor for less than \$700.

In a brownout or blackout, a battery will instantly take over giving you ten minutes or more to shut down your computer.

Call 1-800-Back-UPS for the Emerson dealer nearest you. Before it's too late.

EMERSON
Computer Power
Computers Won't Run Right
On The Wrong Fuel.

How to DEC a PC, without throwing a punch.

And make it count...

The Answer is RAF.

Or Remote Access Facility. And it works great. We've already DECed over 30,000 IBM compatible PC users.

RAF is the fastest PC-to-VAX link in the industry. (Over 100,000 cps transfer rate on Ethernet.)

No staring out the window or tapping your fingers while you wait for an application to load. Or a file to save.

VAX access from your PC is fast. It's like calling-up an application from your local hard disk. And just as easy too. In fact, you won't notice RAF working for you. It's absolutely transparent.

What's more, connecting to the VAX is so easy...no VAX commands, no VMS prompts...just connect your PC to Ethernet or to any asynchronous connection, and you're ready to go.

Finally, RAF brings you auto log-on, terminal emulation and multiple VT220 VAX sessions.

Try RAF for a 30 day, no-risk, free trial* and receive our free brochure.

OR

Receive our free brochure: "How to DEC a Mac. Or PC." When you call or FAX.

1-800-DIAL-DSS

NY (212) 807-7800

FAX (212) 463-0459

Canada (613) 937-4444

Our brochure explains how RAF provides network integration, seamless filesharing and storage, as well as terminal emulation.

*Offer valid in the U.S. only and expires October 31, 1989.

DATABILITY

YES. I would like to try RAF for 30 days and receive your free brochure. I understand that it is a no-risk, free trial of RAF.

BT1989

YES. Please send me your brochure on "How to DEC a Mac. Or PC."

Name _____

Title/Dept _____

Company _____

Address _____

City _____ State _____ ZIP _____

Telephone (____) _____

DATABILITY

322 Eighth Avenue, New York, NY 10001 London • Boston • Chicago • San Francisco

Copyright 1989, Datability Software Systems, Inc. RAF is a trademark of Datability Software Systems, Inc. All product names are registered trademarks of their respective manufacturers.

Circle 375 on Reader Service Card

ZEOS[®]

"For Overall Excellence.."



286/SS

Complete 12MHz 286
with 32MB Hard Drive!

Only \$1395.00

It's the fastest 286-12 you can buy. Workhorse of the industry. Rugged from the ground up. This true Zero-Wait state system features a fast Seagate auto-park hard drive. Nothing can touch it!

- 80286-12 CPU, 6/12MHz Dual Speed Keyboard/hardware selectable. Reset and Turbo buttons right up front.
- Zero-Wait State DRAM, 512K expandable to 4MB on the motherboard (16MB System Total), EMS capability!
- Fast 32MB Seagate 138R Hard Drive with auto-park, 1.2MB Floppy Drive.
- Ultra high speed Hard/Floppy controller. 1:1 interleave, 800 KB/sec transfer rate.
- Genuine Hercules[®] brand graphics controller. High-Res Amber Display with Tilt/Swivel.
- ZEOS Enhanced 101 Key Keyboard, with Pleasant Tactile/Click Feel.
- Serial and Parallel Printer Ports.
- Clock/Calendar with Battery Backup.
- 6-16 and 2-8 bit expansion slots.
- 80287 Coprocessor support.
- Heavy Duty Case complete with Security Lock and LED indicators.

Announcing 24 Hour a Day Sales and Technical Support!

That's right, ZEOS is now open to serve you 24 hours a day, 365 days a year. Call us any time Toll Free at 800-423-5891.

"Out of 104 machines from 58 companies...for overall excellence in both the 16- and 20MHz categories, we selected ZEOS International's 386-16 and 386-20"
PC Magazine, May 30, 1989

PC Magazine, May 30, 1989

In the May 30th issue PC Magazine reviewed 104 machines from 58 manufacturers. Virtually every 286 in production was tested. The systems were grouped into three speed categories, 16, 20 and 25MHz. In two of the three categories *only one* company was selected for "overall excellence." That company is ZEOS.

The selection of ZEOS over IBM, Compaq and all others is a direct reflection of our goals and objectives. Simply, to deliver to you the very best *value* in computing today. To further quote PC Magazine:

"Price is always a consideration. So are benchmark results. But both factors can be deceiving, which is why we consider other aspects that will make the difference months and years down the road. Things like quality of construction, reliability, expandability and ease of service."

These are the qualities PC Magazine used when selecting ZEOS over 57 others. These are the qualities we build into each and every ZEOS system. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value*. Comparing ZEOS to virtually every other manufacturer in the world PC Magazine called it "overall excellence."

In *all areas* ZEOS systems are top performers. Take our guarantee for instance. We offer every customer a 30 day Full Refund Satisfaction Guarantee. And that's backed up by our Full One Year Limited Warranty and our Express Parts Replacement policy.

And then there's Technical Support. At ZEOS, Technical Support is not only free, it's *Toll Free*. 24 hours a day, 365 days a year!

Quality, Performance, Reliability and Support. *Overall Excellence*. That's why ZEOS is PC Magazine's #1 choice. And that's why ZEOS is *your best choice* as well. So pick out your dream machine today and order it now with confidence. Your choice of ZEOS excellence is *Guaranteed*. Order now by calling 800-423-5891.





'386SX

The New ZEOS 386SX Hard Drive System. Below '286 Prices! Only \$1695.00

"A terrific all around choice..." PC Magazine

PC Magazine says "386SX-based machines are the right choice..." the new ZEOS 386SX is why. The future is yours now with the new ZEOS '386SX. It's even priced below comparable '286 systems!

- 80386SX-16 CPU, 8/16MHz Dual Speed Keyboard Selectable. Reset/Turbo buttons.
- 512K DRAM, expandable to a System Total of 16MB.
- Shadow RAM and EMS capability.
- Fast 32MB Seagate 138R Hard Drive, 1.2MB FDD
- Ultra high speed Hard/Floppy controller. 1:1 interleave, 800 KB/second transfer rate.
- Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.
- ZEOS Enhanced Tactile/Click keyboard.
- 2 High Speed Serial Ports plus one Parallel and one Game Port.
- 6-16, 2-8 bit expansion slots. 80387SX Math coprocessor support.
- Rugged ZEOS space saver case. Including security lock and LED indicators.

Options Galore: As PC Magazine said, "more options than even the most configuration hungry hound could possibly need." Including 14" VGA, add only \$595. And incredible selection of hard drives: SCSI, RLL, ESDI or MFM and virtually any other add-on you could want! Corporate leasing plans are available, too. Call Toll Free for details 800-423-5891.



'386DT

Complete ZEOS 20MHz '386 System. 80 MB SCSI Drive! Only \$2995.00

16 MHz systems from \$2295!

The new '386 desktop standard. Featuring our 64K CACHE (twice that of most competitors) providing Zero-Wait State performance vastly superior to page/interleave memory schemes. Incredible value.

- High speed Zero-Wait 64K SRAM CACHE.
- Genuine 32-bit Intel 80386-20MHz CPU.
- 1MB of Zero-Wait DRAM Expandable to 16MB System Total.
- Fast 80MB, 28ms SCSI Seagate Hard Drive, 1.2MB Floppy Drive.
- High speed HDD/FDD SCSI Host Adapter with Software.
- Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.
- 101 Key ZEOS Tactile/Click keyboard.
- High speed Serial and Parallel Ports.
- 1-32, 6-16 and 1-8 bit slots.
- 80387 math coprocessor support.
- ZEOS 5-bay case. Including Security Lock and LED indicators.



'386/V

Complete 25MHz '386 Vertical System. 80MB SCSI Drive! Only \$3995.00

Complete 33MHz systems only \$4995!

ZEOS 25MHz and 33MHz 80386 systems are the fastest, most advanced available anywhere. Review after review, these ZEOS systems are selected as the best price/performance buys. A power-user's dream.

- High Speed Zero-Wait 64K CACHE.
- Genuine 32-bit Intel 386-25 or 33MHz CPU.
- 1MB Zero-Wait 32-bit DRAM expandable to 8MB on board plus 16MB 32-bit expansion (24MB total).
- Fast 80MB, 28 ms SCSI Seagate Hard Drive, 1.2MB Floppy Drive.
- High speed HDD/FDD SCSI Host Adapter with software.
- Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.
- 101 Key ZEOS Tactile/Click keyboard.
- High Speed Serial and Parallel Ports.
- 1-32, 6-16 and 1-8 bit slots.
- 80387 and Weitek 3167 support.
- Heavy Duty 6-bay Vertical Case.

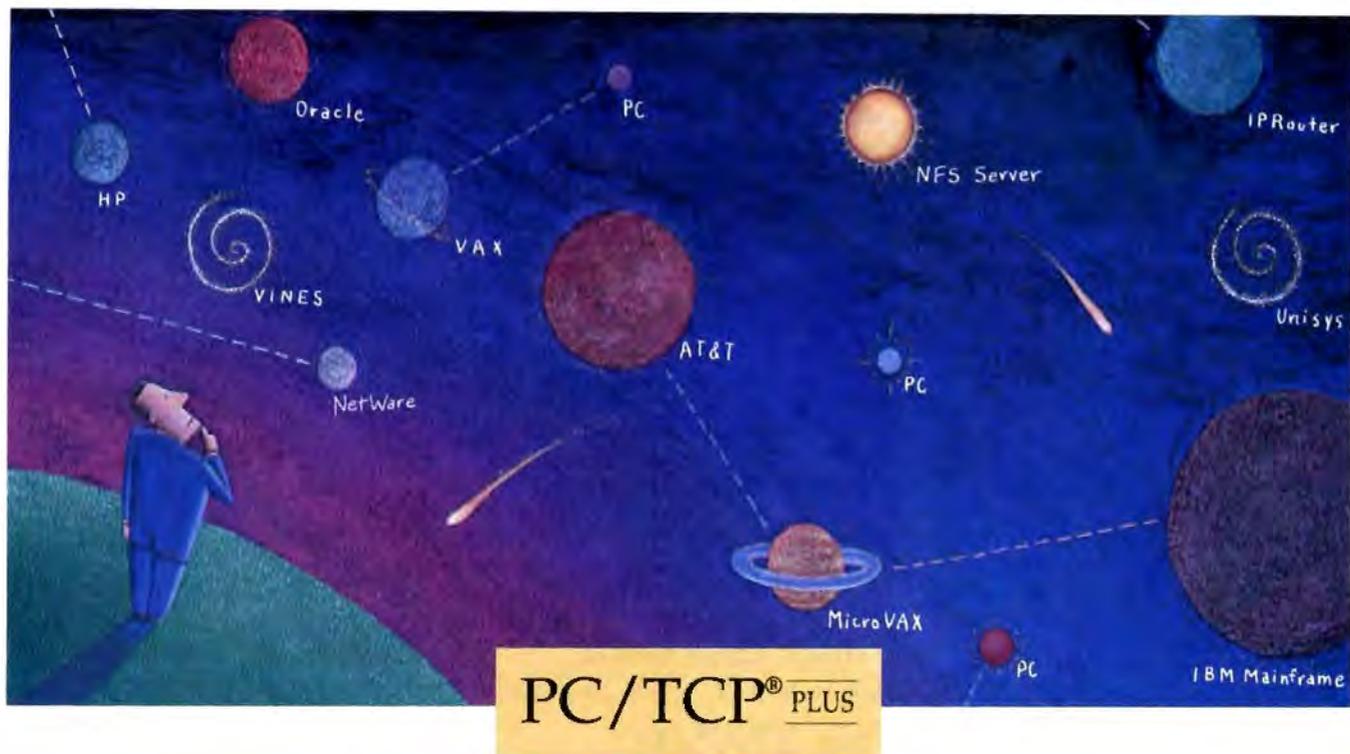
Desktop configurations deduct \$150.00!

**Order Now Toll Free
800-423-5891**



FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA, ZCard and COD
Open 24 Hours a day!

There's only one way to get around out here.



The most comprehensive TCP/IP implementation in the industry.

No matter who or what your PC needs to communicate with, there's nothing like PC/TCP Plus. It's not only the fastest, but also the most comprehensive TCP/IP implementation in the industry. And PC/TCP Plus has NFS™ access built right in.

Providing connectivity to other PCs, minicomputers and mainframes, PC/TCP Plus communicates over Ethernet, Token Ring and StarLAN networks with operating systems ranging from UNIX and VMS to VM and MVS. And you can forget hardware incompatibility; PC/TCP Plus

supports the largest selection of LAN interfaces in the business.*

From around the world to around your office, now your PC can transfer files, send and receive electronic mail, emulate VT100, VT220 and IBM 3278 terminals, access NFS servers, and much, much more. VINES™ and NetWare™ users will appreciate PC/TCP's full compatibility, as will customers of Oracle's distributed PC database products. And with our Development Kit, including a Berkeley Sockets library, you have all you need to produce custom applications.

So, the next time you want to get from here to there, get PC/TCP Plus, the TCP/IP implementation that gives you a whole new perspective on network communication. Call us at (617) 246-0900 for more information.

PC/TCP is a registered trademark of FTP Software, Inc.
VINES is a trademark of Banyan Systems, Inc.
NetWare is a trademark of Novell, Inc.
NFS is a trademark of Sun Microsystems, Inc.

FTP Software, Inc.
26 Princess St.
Wakefield, MA 01880-3004
Phone: (617) 246-0900
Fax: (617) 246-0901



SUPPORTS NFS!

*PC/TCP Plus supports interfaces from Acer, Allied Telesis, Apricot, AT&T, BICC, DEC, D-Link, DSC, Excelan, Gateway Communications, IBM, IMC Networks, Intel, Interlan, Longshine, MCAssociates, National Semiconductor, Novell, Proteon, Schneider & Koch, Scope, 10Net, 3Com, Tiara, Torus, TRW, Ungermann-Bass, Univision, Western Digital and YCS, in addition to the NDIS and Packet Driver specifications.

Circle 379 on Reader Service Card

The Glue for Internetworking

William Stallings

TCP/IP binds together LANs and networks of LANs

As more and more personal computers hook into LANs, more and more LANs are in turn being connected to form WANs (wide-area networks). To move beyond the simple disk server and printer server applications of the typical LAN requires a powerful communications architecture. The most popular such architecture is based on the TCP/IP suite of protocols.

The Department of Defense (DoD) created TCP/IP as part of the experimental packet-switched network ARPANET, and it has since become a military standard. But TCP/IP also has been quietly building a following in the commercial arena—ironically during a time when the industry has focused a great deal of attention on the International Organization for Standardization's Open Systems Interconnection (OSI) model. Currently, over 200 vendors provide TCP/IP products, making TCP/IP the most widely available and most widely used set of standardized computer-communications protocols.

Five core protocols make up the TCP/IP architecture, although the entire set carries the names of only two: Transmission Control Protocol (TCP) and Internet Protocol (IP). TCP/IP has four layers: network access, internet, transport, and application. The network-access layer contains the protocols that provide access to a communications network such as a LAN. The TCP/IP suite includes no unique protocols at this layer. Rather, it supports whatever protocol is appropriate for a particular network (e.g., Ethernet, IEEE 802, or X.25).

The internet layer consists of the procedures required to allow data to traverse multiple networks. Thus, it must provide a routing function. The IP functions within network hosts and routers (a router relays data between networks using an internetwork protocol). (See "When One LAN Is Not Enough," January BYTE.) The IP connects multiple LANs within the same building or at different sites

through a wide-area packet-switched network.

The TCP at the transport layer provides the logic for ensuring the reliable delivery of data exchanged between host systems. It's also responsible for directing incoming data to the intended application.

Finally, the application layer contains protocols for specific user applications. Each type of application, such as file transfer, requires a protocol that supports that application. TCP/IP includes three such protocols: Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), and TELNET.

Operational Issues

Figure 1 shows a typical TCP/IP network configuration. Some sort of network-access protocol, such as Ethernet, connects computers to a network. This protocol enables the host to send data across the network to another host. IP resides in all end systems and routers. It acts as a relay to move a block of data from one host, through one or more routers, to another host. TCP resides only in the end systems; it keeps track of the blocks of data to ensure reliable delivery to the appropriate application.

For successful communication to occur, every entity in the overall system must have a unique address. Two levels of addressing are needed. Each host on a network must have a unique global Internet address. And each process within a host must have an address that is unique within the host; this allows the host-to-host protocol (TCP) to deliver data to the

proper process. The latter addresses are called *ports*.

Suppose that a process associated with port 1 at host A wants to send a message to a process associated with port 2 at host B. The process at A hands the message down to TCP with instructions to send it to host B, port 2. TCP hands the message down to IP with instructions to send it to host B. Note that IP does not need to know the identity of the destination port. It needs to know only that the data is intended for host B. Next, IP passes the message to the network-access layer (e.g., the Ethernet logic) with instructions to send it to router X (the first leg on the journey to B).

Controlling this operation requires transmitting control information as well as user data (see figure 2). When TCP receives a block of data from a process, it appends control information as the TCP header, forming a TCP segment. The peer TCP protocol entity at host B will use this control information. The following are examples of items that are included in the header.

- Destination port: When the TCP entity at B receives the segment, it must know to whom it should deliver the data.
- Sequence number: TCP numbers the segments that it sends to a particular destination port sequentially so that if they arrive out of order, the TCP entity at B can reorder them.
- Checksum: The sending TCP includes a code that is a function of the contents of the remainder of the segment. The receiving TCP performs the same calculation and compares the result with the incoming code. A discrepancy results if there has been some error in transmission.

TCP then hands over each segment to IP, with instructions to transmit it to B. IP must then transmit these segments across one or more networks and relay them

continued

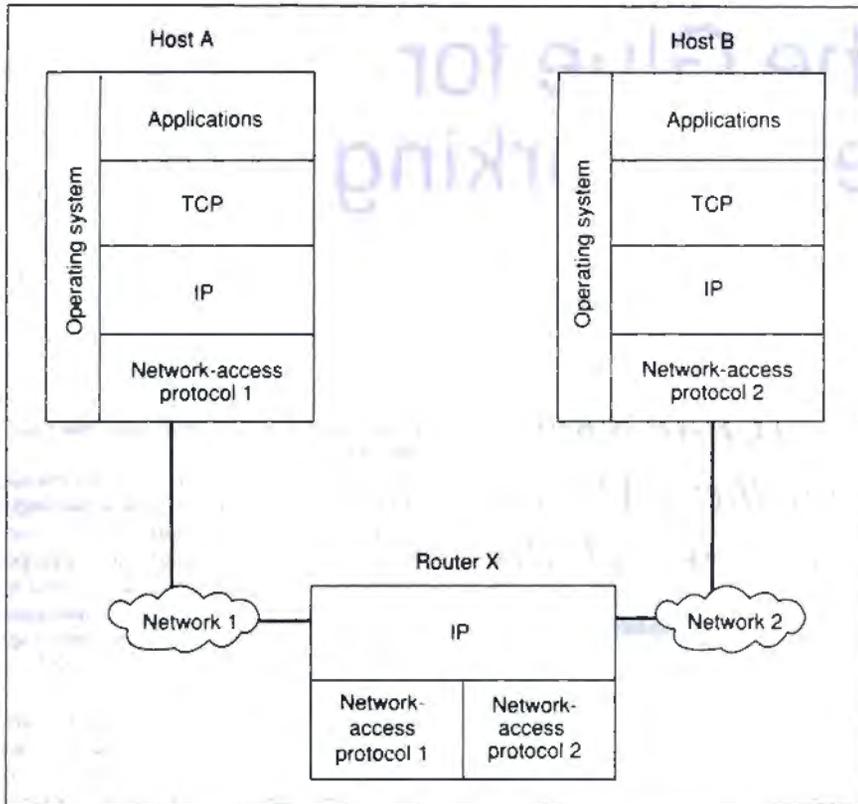


Figure 1: This simple configuration demonstrates how you might internetwork two hosts via TCP/IP.

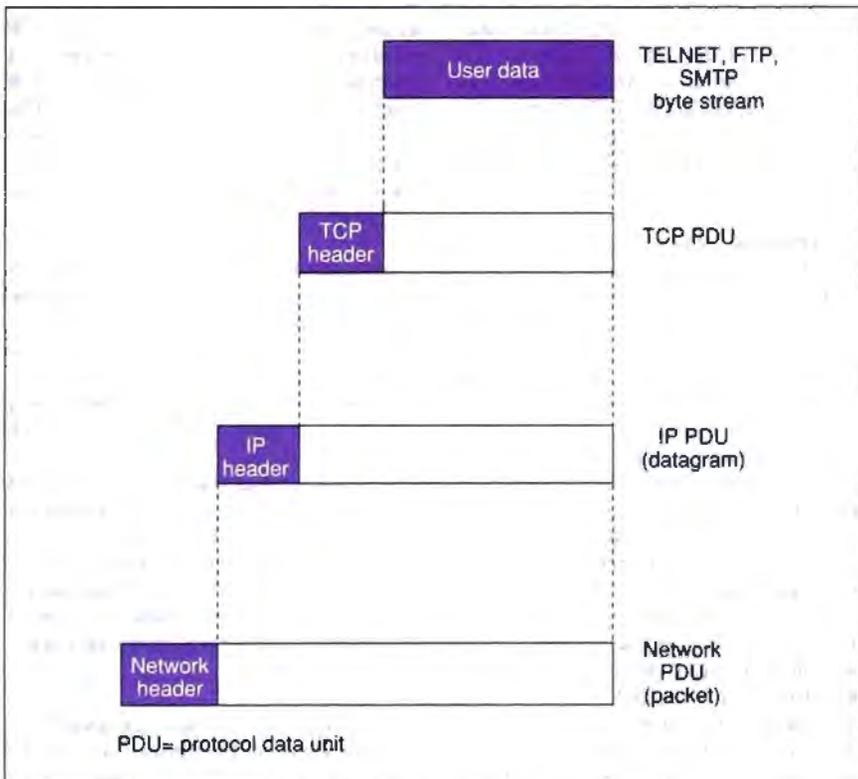


Figure 2: The levels of protocol header information in a TCP/IP packet.

through one or more intermediate routers. For this purpose, IP appends a header of control information to each segment to form an IP datagram. One item stored in the IP header is the destination host address (in this example, B).

Finally, IP presents each datagram to the network layer for transmission across the network to router X. The network-access layer appends its own header, creating a packet, or frame. The packet header contains the information, such as the destination address, that the network needs to transfer the data across the network.

Router X strips off the packet header and examines the IP header. Based on the address information in the header, the router's IP module directs the datagram out across network 2 to B. To do this, it must augment the datagram with a network-access header.

When B receives the data, the reverse process occurs. At each layer, B removes the corresponding header, passing the remainder on to the next higher layer, until the original data arrives at the destination process.

Applications

As mentioned earlier, TCP/IP's three application protocols are SMTP, FTP, and TELNET. SMTP provides a basic E-mail facility. Its features include mailing lists, return receipts, and forwarding. The SMTP protocol doesn't specify how to create the messages; it requires some local editing or native E-mail facility. Once a user has created the message, SMTP accepts it and uses TCP to send it to an SMTP module on another host. The target SMTP module uses a local E-mail package to store the incoming message in the recipient's mailbox.

FTP sends files from one system to another under user command. It accommodates text and binary files and provides features for controlling user access. When a user wants to engage in file transfer, FTP sets up a TCP connection to the target system for the exchange of control messages. These allow the user to transmit an ID and password and to specify the file and file actions desired. Once the system approves the file transfer, it sets up a second TCP connection to handle the data transfer. FTP transfers the file over the data connection without header or control information overhead at the application level. When the transfer is complete, the control connection signals completion and is ready to accept new file transfer commands.

TELNET provides a remote log-on capability that lets a user at a terminal or

personal computer log onto a remote computer and function as if he or she were connected locally to that computer. TELNET was designed to work with simple scroll-mode terminals. The protocol actually has two modules: User TELNET interacts with the terminal I/O module to communicate with a local terminal. It converts the characteristics of real terminals to the network-standard virtual terminals and vice versa. Server TELNET interacts with an application, acting as a surrogate terminal handler so that remote terminals appear as local to the application. Terminal traffic between User and Server TELNET is carried on a TCP connection.

Microcomputer Connections

Figure 1 shows the simplest architecture for interfacing a host system to a network using TCP/IP. The TCP/IP protocols sit above the network-access protocol, which is unique to the particular network. The host operating system supports all these protocols. This approach is common for large computers but is of questionable value for microcomputers. TCP and IP are complex protocols that perform a considerable amount of processing, and they impose a burden on the host in terms of memory consumption, processing time, and the number of interrupts.

Figure 3 shows an alternative approach that uses a communications coprocessor board. All the protocols up through TCP (i.e., TCP, IP, and network access) reside on the board, and only the application-level protocols (SMTP, FTP, and TELNET) reside in the host CPU. This approach relieves the CPU of the communication processing burden, enhancing efficiency. Also, the board can be procured from a different vendor than the supplier of the host system, allowing greater flexibility when you're selecting equipment to attach to the network. Currently, a number of vendors offer such boards for the most popular microcomputer buses.

Figure 3 also indicates the need for some sort of interface protocol, referred to in the diagram as a host-to-front-end protocol (HFP). To see the need for an HFP, consider the operation of an application in figure 1.

If an application protocol such as FTP is to transmit a block of data, it invokes TCP with a SEND command. The TCP standard doesn't specify how to implement this command; this is up to the implementer, who can invoke it as a procedure or subroutine call or as some sort of trap in the operating system that gener-

ates a message to TCP. The implementer will choose a technique that optimizes some parameter, such as performance or code size. Indeed, the standard must not dictate the interface between TCP and the application protocols so that the implementer remains free to design the most efficient solution.

However, when TCP is running on the coprocessor board and the application protocol is running on the host system's CPU, a mechanism is needed for transmitting commands and their associated parameters between the application protocol in the host to TCP in the coprocessor board. This is the function of an HFP. The HFP formats the application command and its parameters into a standardized message to be sent to the front end. If the host and front-end systems are from the same vendor, the details of the HFP are of concern only to the implementer, but if they're from different vendors, a standard for the HFP is desirable. Unfortunately, no such standard exists. In a personal computer LAN environment, the de facto standard that fills this role is NetBIOS.

NetBIOS

NetBIOS, the standard interface for networking IBM PCs, PS/2s, and their compatibles, has become the dominant

mechanism for personal computer networking. Normally, the personal computer makes use of the BIOS in ROM. This comprises a set of drivers that provide simple hardware support for standard equipment on the PC (e.g., drivers for printers and disk controllers). NetBIOS is the equivalent of the BIOS, but for the network interface.

NetBIOS enables PCs on a LAN to establish connections between themselves and to communicate directly without having to go through a central host computer, file server, or other device. It lets applications talk directly to the network, instead of talking to DOS, which in turn talks to the network operating system. Implemented on a circuit chip that resides on the network communications board, NetBIOS provides fast service because it bypasses the PC's operating system.

The NetBIOS specification defines a set of system calls that allow an application on a PC to gain access to applications on other PCs on the same LAN. To carry out a certain operation, the application loads various processor registers with given values and performs a software interrupt. The application issues an interrupt 5Ch to access the network interface board directly and use NetBIOS.

continued

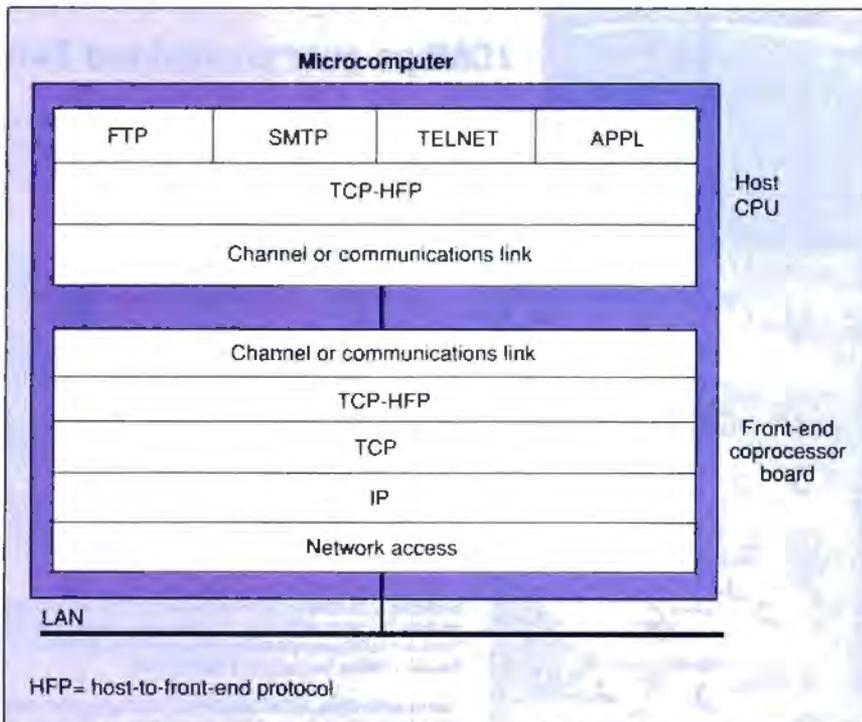


Figure 3: When implementing TCP/IP on a microcomputer host system, using a host-front-end coprocessor board is a way of taking some of the processing burden off the CPU.

The NetBIOS scheme has been hobbled by one major factor: its inability to span incompatible networks. Fortunately, the DoD has developed a merger of TCP/IP and NetBIOS that overcomes this limitation.

NetBIOS Over TCP/IP

In the past several years, many vendors have independently developed products that let NetBIOS applications run in a TCP/IP environment. These vendors were already offering TCP/IP networking products and wanted them to be able to interoperate with the growing number of NetBIOS applications. All the products used NetBIOS as the HFP between the applications on the host and TCP on the network. Unfortunately, all these different implementations would not work with each other. To solve this problem, the DoD issued the RFC 1001/1002 specification, which defines the interaction between NetBIOS and TCP. The products now coming into the marketplace conform to this specification.

The most difficult problem in integrating NetBIOS and TCP/IP is handling names. In the NetBIOS world, communi-

cating entities (applications and servers) all have names, which users obtain via a simple announcement scheme. If you want the name FileManager001, you broadcast your claim to that name to everyone else on the LAN; if no one objects, that becomes your name. In an internetworking environment, this scheme presents two problems. One occurs when you connect two formerly separate networks, and two devices on the different networks have the same name. The second problem is that broadcasting in an internetwork almost always is forbidden because it would quickly overwhelm the communications links. To overcome this problem, the DoD developed a mapping between NetBIOS names and internetwork names and adapted the existing Internet name protocol to facilitate name creation.

The RFC 1001/1002 specification provides for three forms of NetBIOS: B-nodes, P-nodes, and M-nodes. B-nodes are restricted to communications on a single LAN and use a broadcast type of naming protocol, similar to the unadorned NetBIOS. Therefore, a B-node doesn't implement TCP/IP. P-nodes

make full use of TCP/IP and can communicate with other P-nodes on the same LAN and with P-nodes on other networks to which they're connected. M-nodes have mixed functionality and can communicate with both B-nodes and M-nodes.

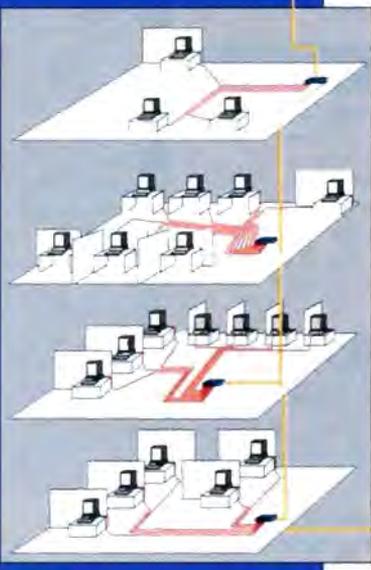
If you run NetBIOS over TCP/IP, you can communicate with any other system that implements NetBIOS over TCP/IP—as long as it supports the NetBIOS interface as defined in the RFC 1001/1002 specification. For example, you can't access files from a Unix system that supports TCP/IP but not NetBIOS. But because so many systems, especially Unix systems, support TCP/IP, and because it is relatively easy to add NetBIOS support to such systems, the possibilities for networking these machines are substantial. ■

William Stallings is president of CompComm Consulting in Pride's Crossing, Massachusetts. This article is based on material in his Handbook of Computer Communications Standards, Vol. III: DoD Protocol Standards, 2nd ed. (Howard W. Sams, 1988).

THE SMART ETHERNET CONNECTION

10Mbps over unshielded Twisted-Pair Wiring

The Quick-Net™ 3000 Ethernet Series from Intellicom provides Novell Netware®, 3Com3+Share® and IBM® PC Networking compatibility with unshielded twisted-pair wiring operation at 10Mbps. Complete integrated solution for XT, AT, PS/2 or MACII computers or compatibles.



- Total compatibility with Standard or Thin Ethernet coax based LAN's. Expand your network or establish a new one using our twisted-pair wiring solution with no performance degradation.
- Complete range of industry compatible Media Access Units/ Network adapter cards available to establish star-based network topologies using low-cost telephone wiring; IBM® Type 3 or AT&T® PDS cabling.
- The Quick-net solution is cost effective for both small and large networks offering full compatibility with most popular network operating systems.
- MAU's located on each building floor inter-connect via an Ethernet 10Mbps coax backbone. Connect up to 256 PC's on a single coax cable using multiple MAU's. Installation is easy as plugging in a telephone.

Intellicom is an established manufacturer of high performance communication products with over 75,000 units installed worldwide. The Quick-net 3000 series is simply the best way to establish a low cost and flexible 10Mbps twisted-pair Ethernet LAN.

Call or write Now, and let us share our extensive networking expertise with you to meet your networking needs today, and into the future.



Distributor, VAR, System Integrator & Dealer inquires welcome

9259 Eton Avenue,
Chatsworth, California 91311
Telephone: (818) 882-8877
Toll Free (800) 992-2882
FAX (818) 882-2404

Intellicom
The Smart Solution

Novell and Netware are trademarks of Novell. 3Com3+Share is a trademark of 3Com Corporation. IBM, IBM PC, AT, XT, PS/2 and IBM PC Network Program are trademarks of International Business Machines Corporation. MAC II is a trademark of Apple Computers, Inc. Ethernet is a trademark of Xerox Corporation. Quick-net is a trademark of Intellicom, Inc.

The PERFECT LAN FRONT-END!

Meet Perfect Menu. The Perfect LAN Front-End.

Menu Program, System Administrator, Electronic Mail System, Usage/Project Tracker, Security Watchdog, and much more, all in one program for your DOS LAN or stand-alone.

Perfect Menu is a total LAN Front-end solution—compatible with ALL DOS LANs (Novell, 3COM, PC-MOS, Network-OS, Banyan, you name it). For all its power, **Perfect Menu is completely Non-Memory Resident**, and self-installs across any network, to any local, redirected and virtual drive of any size.

Perfect Menu gives you access to 640 individual menu selections with over 10,000 command options for each user. Menus can even be nested up to 32 levels deep! Perfect Menu lets you create a Common Integrated User Interface—tailor it to your specifications and needs.

Perfect Menu gives you System Administrator sophistication, power and ease-of-use with features like advanced security control, innovative usage and project tracking, handy PIM tools and much more. Perfect Menu's autonomous System Administrator program sports more tools than we have room to explore. Suffice to say—it defines power and convenience.

And, if all of the above is not enough, Perfect Menu comes with a full feature E-mail system! You have to see Perfect Menu to believe it, check it out today!

LAN PAK/UNLIMITED Users Per File Server.

If you're looking for best value in network front-end, menu, E-mail, usage/project tracking, security and productivity software—then this is the perfect selection! Easy to setup, administer and use, yet completely customizable and extremely powerful and sophisticated. It's simply perfect.

Retail Price: \$349.95

LAN PAK/FIVE User Network.

If you have a PC-based network or applications, then our five user version sets the standard for small networks! Not only is it easy-to-use, it's easy-to-administer and has all the power of its Unlimited Big Brother. Of course, if you have growth in mind, all versions are fully upgradeable.

Retail Price: \$195.95

BUSINESS PAK/Stand-alone.

With our single user BUSINESS PAK, many users share one stand-alone computer. You can have all the power of the PERFECT MENU network versions as you administer productivity—not headaches!

Retail Price: \$84.95

BASIC SYSTEM/Single User.

Want perfection at home? PERFECT MENU BASIC SYSTEM is as powerful as it is easy to use. At a \$49.95 suggested retail, it's one of the best values in its class.

International Computer Group, Inc.

18520 Office Park Drive
Gaithersburg, MD 20879

(800) 833-2324

(301) 670-7007 in MD, (301) 330-7274 fax

*Trademarks are registered per their respective manufacturers.

Circle 382 on Reader Service Card

Reaching New Heights

The MaxSys 386T/33 and 386MT/33



The MaxSys 386T (lower photo) and 386MT (upper photo) feature 12 slots to provide the systems with expandability.

At CSS, we've built a reputation for dependability, value, and performance. That's why we're pleased to unveil the latest addition to our line of computing solutions — The MaxSys 386T™ and 386MT™.

The architecture of the MaxSys 386T features 12 slots and a 400 watt power supply giving you mainframe capabilities at

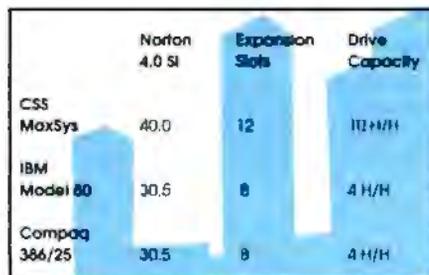
a fraction of the cost. The five full-height drive capacity allows you to configure up to three gigabytes (formatted) storage including erasable, optical, Winchester, and removable disk drives, as well as 8mm and 1/4" tape and floppies.

Our smaller version, the 386MT, features 12 slots, five half-height drives, and a 200 watt power supply. Both MaxSys systems allow you to upgrade your original hardware and software investments to meet the standards

of today... and tomorrow. They're 100% IBM™ compatible and have an Adv Norton 4.0 SI rating of 40.0 — the highest for AT™ systems. Application options range from an ultra high-end personal computer to networked file/compute/print servers supporting diskless work-stations and ASCII terminals. Plus, the MaxSys systems run MS DOS™, Ethernet™, ARCnet™, Cheapernet, Helios™, Novell™, UNIX™/XENIX™, 3Com™, Token Ring, OS/2™, or POSIX.

Both MaxSys systems are available in a variety of configurations and include full technical support, complete documentation, and a one year warranty.

Reach new heights — call us today.



Compared to IBM and Compaq the MaxSys 386T comes out on top.

A Solid Investment

CSS
LABORATORIES, INC.

CSS Laboratories, Inc. and CSS logo registered and CSS MaxSys are trademarks of CSS Laboratories, Inc. Ethernet is a trademark of XEROX Corp. Novell is a trademark of Novell, Inc. MS DOS and XENIX are trademarks of Microsoft Corp. UNIX is a trademark of AT&T. Helios is a trademark of Penbilon. ARCnet is a trademark of Datapoint Corp. 3-Com is a trademark of 3-Com Corp.

1641 McGaw Ave., Irvine CA 92714
Tel: 714-852-8161 Fax: 714-852-9464

LAN-Aware DOS Programs

Barry Nance

Multiuser design: issues and strategies

Most DOS programs rely on DOS disk services and thus will work with a LAN that emulates those services. But the remote disk that a LAN provides is also a shared disk. Unmodified single-user programs tend to fare badly in the multi-user LAN environment. Data files are updated haphazardly; one user's configuration options are overwritten by someone else; the software crashes at mysterious times; users collide when they access files; performance suffers when dozens of users simultaneously load programs and data files.

LAN-aware software recognizes and understands shared disks, shared printers, and shared files. The software anticipates and correctly handles concurrent accesses and concurrent updates to files. It flexibly allows different drive letters and directory paths. It provides configuration options for each user. It is compatible with any LAN that supports the sharing and access mechanisms that have been part of DOS since version 3.0. In this article I'll discuss ways in which you can transform a single-user DOS program into a multiuser, LAN-aware DOS program.

Testing the Waters

For your development work, you'll need access to a LAN with a DOS 3.x-compatible network operating system that can share files, lock records, recognize network drives, and obtain machine names. (Or you can emulate a LAN using the freely distributed program described in the text box "Testing LAN Software Without a LAN" on page 228.) If you'll be doing advanced network programming using NetBIOS, you'll want the network operating system to provide a NetBIOS emulator that's compatible with the IBM NetBIOS standard.

You should also upgrade to DOS 3.3 if you haven't already done so. The networking support in earlier versions of DOS suffered from omissions and bugs. Why not go all the way to 4.0? For the

same reason—too many bugs. When you're doing development work, operating system bugs are the last thing you need. Get version 3.3.

The environment your program will find itself running in should correspond to your development environment. So the first thing your program should do is check the version of DOS. If it discovers a version earlier than 2.0, it should definitely tell the user to upgrade. If the version is 2.x, it should probably do the same. Although Novell's networking support for DOS predates the support added by IBM/Microsoft in DOS 3.0 and thus will work with DOS 2.x, your program shouldn't rely on that peculiarity.

Turbo C and Microsoft C both place the DOS version in the global variable `_osmajor`. In Lattice C, it's `_DOS[0]`. In Turbo Pascal, use the function `DosVersion`. With Microsoft Macro Assembler, use the `GetVer` macro found in `DOS.INC`.

Next, your program needs to check for the presence of a LAN. One approach, illustrated in listing 1, is to try to exercise `SHARE`, a DOS utility that attaches itself to the DOS multiplex interrupt 2Fh and enables file sharing. If you find a pre-DOS 3.0 version, though, don't use this method or you'll crash the machine.

You can also look for NetBIOS. Interrupts 2A and 5C (not to be confused with DOS function call 5C) are the entry points for NetBIOS services; here's how you check for NetBIOS:

```
regs.h.ah = 0;
int86(0x2a, &regs, &regs);
if (regs.h.ah == 0)
    puts("NetBIOS not
        installed.");
```

Note, though, that NetBIOS is not a required feature of a LAN.

A DOS IOCTL call (function 44h, subfunction 9) is yet another way to detect a LAN; it tests whether a drive is local or remote. To use it, put the number of the logical drive in the BX register (I = A:) and do the call. If bit 12 of the DX register is a 1 following the call, the drive is a network drive. Do this for all possible drives (C through Z), as shown in listing 2.

There's one problem with the IOCTL method. It can't discriminate between a network drive and a CD-ROM drive. Both look like remote drives to DOS. There's a set of MSCDEX (Microsoft CD-ROM extension) function calls that can help here. Interrupt 2F is the entry point for the MSCDEX functions. Function 15h, subfunction 0, returns in BX the number of drives mapped to CD-ROM devices. If BX is 0 after this call, don't worry about CD-ROMs. If it's non-0, though, things can get complicated. CX will be the first CD-ROM (e.g., 3 = D), but there may be multiple CD-ROM drives. Function 15h, subfunction 0Bh, checks if a drive is a CD-ROM drive, and subfunction 0Dh gets a list of all the CD-ROM drive letters. Unfortunately, only the newer version (2.0) of MSCDEX.EXE supports the additional query subfunctions 0Bh and 0Dh. If your application detects a CD-ROM—there aren't many of them in use yet—the best course might be to ask the user to tell you which drives are CD-ROMs.

Of these tests, I've found that the test for `SHARE` is necessary to ensure that file sharing is enabled and that the test for network drives is a reliable means of detecting a network.

Identifying the User/Workstation

Your program will need to distinguish the machine it's running on from other workstations on the network. To do this, use DOS function 5E00 to get the net-

continued

Testing LAN Software Without a LAN

If you don't have a LAN but want to do LAN programming, or if you have a LAN and want a controlled file-sharing and record-locking environment for testing purposes, you can use a program called NETWORK to simulate a LAN. NETWORK supports the following features:

- Machine name requests
- Sharing-retry-count/delay IOCTL calls
- Network drive identification
- File sharing between your computer and a separate pseudo-workstation (for testing access mode, sharing mode, and inheritance)
- Record locking/unlocking between your computer and a separate pseudo-workstation

While your application is running, you

can call up NETWORK and tell it to open one of your files just as if NETWORK were a separate workstation. Your application can use any combination of access mode, sharing mode, and inheritance, and it can lock and unlock records.

Editor's note: NETWORK is available on disk from BYTE (see page 5 for details). It can also be downloaded from the "listings" topic of the lans conference on BIX. After logging onto BIX, join lans/listings and download NETWORK.DOC and NETWORK.EXE. The same files are available on floppy disk from the author. Please specify 5¼-inch or 3½-inch format. Send your name, address, and \$15 (check or money order) to cover shipping and handling to Barry Nance, 47 Cider Brook Dr., Wethersfield, CT 06109.

work name of your program's machine.

```
char machine_name [16];
regs.x.ax = 0x5e00;
regs.x.dx = /* for small
    model */
(unsigned) machine_name;
int86(0x21, &regs, &regs);
if (regs.h.ch == 0)
    puts("No machine name.");
```

If the machine name was never set, this function returns 0 in the CH register. Otherwise it returns a 15-byte name in ASCIIZ (null-terminated) form; Pascal programmers will have to do a little jiggling to set the length of the string. The name will be padded on the right with spaces to fill out the 15 bytes. With some LANs, such as Novell's, the machine name is optional. I'd recommend that your application require users to set the machine name. It's a piece of information your application can use to good advantage—for example, to create user-specific configuration files.

File Locking

Beginning with DOS 3.0, you specify how you want to share a file when you open it. There is also a function for creating a new file that guarantees that some other workstation won't be able to create a file of the same name at that same mo-

ment (DOS function 5B).

When you open a file, either by calling DOS directly or by means of facilities provided in your programming language, you can specify three kinds of properties: access mode, sharing mode, and inheritance. If your language doesn't let you specify these, you'll probably need to code some assembly routines that let you call DOS directly.

You specify the inheritance flag, sharing mode, and access mode by setting the AL register prior to the open, as shown in listing 3. The inheritance flag is significant only if you are planning to spawn other programs; it indicates whether or not a child process can access the file.

The access and sharing modes work hand-in-hand with the read/write attribute stored in the file's directory entry. Access mode tells DOS (really, the network operating system) whether you intend to write to the file. If you don't need to write to the file, opening it with a read access mode gives you two advantages: There can be multiple readers, and, if the file's directory attribute is read-only, workstations can buffer the file locally.

Sharing mode lets you control how other workstations can open the file once you've opened it successfully. For example, an open call that specifies deny-read/write mode succeeds if no other

workstation has the file open and, if successful, confers exclusive control of the file. Of special interest is the deny-none mode. It allows multiple workstations to open the file and defers control of concurrent reads and writes to the record-locking functions discussed below.

Compatibility mode, generally, is an exclusive mode. It's set automatically when a file is created (rather than opened) or when you use file control blocks instead of file handles. You should avoid setting compatibility mode yourself when opening files. You should also avoid using file control blocks in LAN-aware software.

When you create a file with either the regular DOS function (3C) or the new one (5B), you are given exclusive access to the file. If you want to share it with another workstation, you'll have to close the file and then open it with a suitable sharing mode.

Record Locking

Most of the sharing modes allow you to keep other workstations from accessing a file for the entire time that it's open. However, if you open the file in deny-none mode (and all other workstations have it open in the same mode), you can truly share the file among all users. Concurrent updates become possible, so you'll want to protect a file (or certain records within it) from collisions resulting from simultaneous I/O. DOS function 5Ch—lock/unlock a file region—provides for this. With it, you can lock (or unlock) a given range of bytes in the file, starting at a specified file position (position 0 is the first byte). Listing 4 shows how to lock a range of bytes.

If a collision occurs when you read or write a record, DOS returns an error code to you and the I/O you requested does not take place. If you expect heavy traffic and frequent collisions, there is a DOS IOCTL call (440B, set sharing-retry-count/delay) that you can use to fine-tune the way DOS handles collisions before returning an error to you. With this call, you specify how many times DOS should retry the operation and how long it should wait between tries. The defaults are delay = 1 and retries = 3, where one delay period is a simple (MOV CX, 0; LOOP S) instruction sequence.

In Turbo Pascal, to set the delay period to two loops and tell DOS to retry six times before calling it quits, you would specify

```
Regs.ax := $440b;
(* Set 1 Delay period =
```

continued



Terminal emulation doesn't have to be this way.

We've all been there. Trying to remember whether the "Do" key is really <Ctrl-F1> or was it <Alt-F1>? And the editing keypad. Can you be absolutely sure you're about to press the "Select" key and not the "Remove" key? The results can be disastrous.

That's why KEA developed the PowerStation. The PowerStation, an exact VT200 layout keyboard bundled with VT240 or VT220 terminal emulation software, turns your IBM PC or compatible into a key-by-key replica of a DEC terminal - without messy labels!

But what does that get you?

Peace of mind. The PowerStation keyboard takes the frustration out of switching between a DEC terminal and a PC *because each key is right where you'd expect it to be*. And our "Gold Key" version makes ALL-IN-1 and WPS a breeze.

Savings. If you think you can't afford both emulation software and a keyboard, think again! The PowerStation can actually save you money by eliminating the time you waste every day translating between VT and PC keystrokes. And with the PowerStation, *startup training costs are virtually eliminated*.

Consistency. The PowerStation keyboard provides a consistent interface for both VT emulation and regular PC applications. In emulation mode you get the 105-key functionality of a real DEC keyboard and in PC mode you get a super enhanced keyboard. *And you can use the PowerStation on virtually any PC!* Move between an XT, AT, PS/2, AT&T PC and a DEC terminal *without missing a keystroke*.

The best in terminal emulation software. With the PowerStation keyboard you get the fastest, most precise, DEC terminal emulation software available: ZSTEM. You have the choice between two popular software packages: ZSTEM 240, our VT241/VT340 graphics emulator and ZSTEM 220, our VT220 text emulator. Both packages will impress you with their speed and feature-by-feature accuracy.

To top it off, the PowerStation gives you all this at a surprisingly low price. But find out for yourself why Digital Review Labs says "the PowerStation 240 is a godsend." Call us at 800-663-8702.



PowerStation and ZSTEM are trademarks of KEA Systems Ltd. All other brand and product names are trademarks or registered trademarks of their respective holders.



KEA Systems Ltd., 2150 West Broadway, Suite 412
Vancouver, B.C., Canada V6K 4L9
Telephone: 604-732-7411 Fax: 604-732-0715

Circle 383 on Reader Service Card

Listing 1: Detecting a LAN—the SHARE.EXE method.

```

In C (most compilers):

if (_osmajor < 3)
    printf("Can't check for SHARE.\n");
else
{
    regs.x.ax = 0x1000;
    int86(0x2f, &regs, &regs);
    if (regs.h.al != 0xf)
    {
        printf("SHARE.EXE (file-sharing support) is not loaded.\n");
        exit(1);
    }
}

In Turbo Pascal:

if OS_Major < 3 Then
    Begin
        Writeln('Can't check for SHARE. ');
    End
Else
    Begin
        Regs.ax := $1000;
        intr($2F, Regs);
        if Regs.al < > $FF Then
            Begin
                Writeln('SHARE.EXE (file-sharing support) is not loaded. ');
                Halt;
            End;
    End;
End;

```

Listing 2: Detecting a LAN—the DOS IOCTL method.

```

remote_drive_present = 0;
for (i = 3; i <= 26; i++)
{
    regs.x.ax = 0x4409;
    regs.x.bx = i;
    int86(0x21, &regs, &regs);
    if ((regs.x.dx & 0x1000) == 0x1000) /* drive remote */
        remote_drive_present = 1;
}

```

```

    2 Loops *)
Regs.cx := 2;
(* Double the default number of
   retries *)
Regs.dx := 6;
MSDOS(Regs);

```

Suppose you have a homegrown B-tree file-access method (each data file has a corresponding index file) that you want to enhance so that it can handle multiple users. When workstation A rewrites a data record, do you have to lock the index file even though you're not updating the index? Yes, because workstation B may want to add a new record (and a new index entry) at the same moment, and B will try to lock both data and index files. In fact, to prevent deadlock, it's important that you successfully acquire *all* necessary locks before proceeding with the actual I/O operations on a set of related files.

Ideally, you want your file-access method to function in either a single- or

multiuser environment. The following is an outline of the changes you would make:

1. Detect the presence of the LAN in your initialization logic. Set sharing-retry-count and retry-delay.
2. Open files in a sharing mode if you're running on a LAN.
3. If the file contains a control record, read it on each access; don't try to store it in memory between accesses (this workstation is not the only one that will update the control record).
4. When doing I/O to the data or index files, acquire a lock on the entire file (length in SI:DI = FFFFh:FFFFh) for the duration. Why the entire file? Because nodes in an index can be split by additions or coalesced by deletions. And even if you're only doing a read operation, another workstation may want to split a tree node at the same moment.
5. Make sure that the lock has been successful before doing any further I/O on the file.

6. Unlock the file region when you're through.

User Locking

When the application retrieves one or more records, displays them on the screen, and begins accepting keyboard input from the user, it's intuitively clear that physical record locking is an inadequate method of collision protection while input data is being entered. Physical record locking is useful only for those moments when actual I/O is being performed on a file. It's unfair to other users to physically lock records in a file during keyboard-entry time, and there's no guarantee that users will actually fulfill their intention of updating those records.

The solution is to implement a user lock facility at the application level. Such a facility makes use of a centralized control file on a file server, in which records representing user intentions and fulfillments are placed. This scheme makes it possible for the application, running on several workstations, to coordinate with itself.

The control file might look like the following:

Field	Purpose
User ID	Machine name of user doing an update
File ID	File the user intends to update
Key	Identifies the record(s) that are affected by the update
Transaction	Code identifying the type of update
Date/Time	Date-and-time stamp
In-progress	1 while update is in progress; 0 when finished

When a user signals an intention to enter new or changed information, the application does the following:

1. Physically locks the control file.
2. Looks to see if it's OK for the user to proceed (i.e., checks to see if there's an entry in the control file that shows that another user already has something in progress).
3. If there's a conflict, unlocks the file and returns a "not available" indication. (If the date/time stamp is quite old, the record may be obsolete. These will need housecleaning and should not cause conflicts.)
4. If it's OK, inserts an entry in the

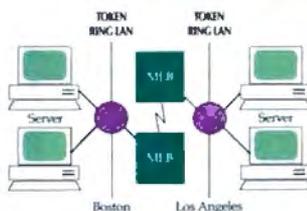
continued

WHAT OUR REMOTE LAN BRIDGE CAN DO FOR YOUR WORLD.



Bringing people and information together is what a Microcom LAN Bridge is all about. And, with our unique MNP[®] Data Compression feature, remote LANs can be connected at unprecedented performance levels. MNP squeezes twice the performance out of your wide-area link compared to other bridges at a fraction of the price.

In fact, the Microcom LAN Bridge is the only remote bridge on earth that uses data compression to move oceans of data between LANs. And, it's the first



to support Token Ring networks, in addition to the Ethernet LAN standard.

Think about it. A fully integrated transparent MAC-level bridge built around the IBM PC/AT bus. In four fully upgradeable, multi-line models with speeds from 9600 bps to 1.544 Mbps (T-1). And with prices beginning at \$6,198, the only thing a Microcom LAN Bridge can't squeeze is your budget.

The Microcom LAN Bridge. It brings information and people closer together, no matter where in the world they are.

Call toll-free, 800-822-8224 for more information.

500 River Ridge Drive
Norwood, MA 02062
Telex:
710-336-7802 Microcom NWD.
U.S. FAX: 617-551-1006
Worldwide Distribution.
International FAX: 617-551-1007

 **Microcom**

MNP is a registered trademark of Microcom, Inc. Microcom LAN Bridge and MNP Data Compression are trademarks of Microcom, Inc. IBM Token Ring and IBM AT are trademarks of International Business Machines Corp. Ethernet is a trademark of Xerox, Inc.

BECAUSE YOU CAN SAVE A HUB!

Our ARCNET BUS is designed to eliminate the need for HUBS in a small (up to eight nodes) installation with segments that extend up to 1,000 feet.

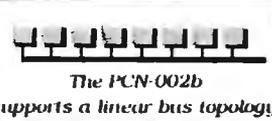
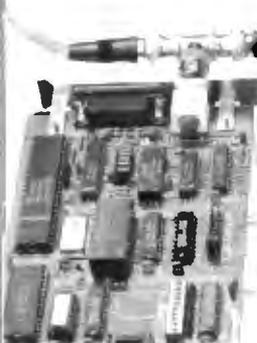
Other Network Products:

- 8-PORT ACTIVE HUB
- TWISTED PAIR ETHERNET BOARD
- TWISTED PAIR ETHERNET CONCENTRATOR
- 16-BIT ETHERNET BOARD
- DISKLESS PC
- CHEAPERNET REPEATER
- INTELLIGENT ETHERNET BOARD
- INTELLIGENT ARCNET BOARD
- MICRO CHANNEL ETHERNET BOARD

WHY TAKE A BUS?

8-PORT ACTIVE HUB/TWISTED PAIR ETHERNET BOARD/TWISTED PAIR ETHERNET CONCENTRATOR/16-BIT ETHERNET BOARD/DISKLESS PC

NOVELL LABS
TESTED AND APPROVED
NETWORK COMPATIBLE



M2
MICROUSA INC
LAB

HEADQUARTER
5830 E. WASHINGTON BLVD.
CITY OF COMMERCE, CA 90040
TEL: (818) 968-0643
TEL: (213) 724-0643
FAX: (213) 724-5453

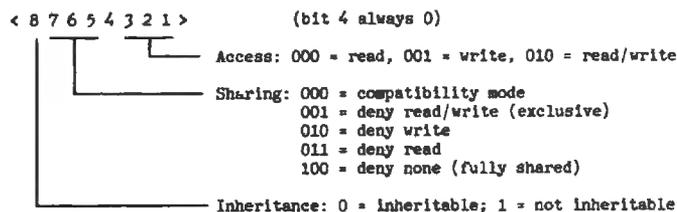
EAST COAST OFFICE
307 WEST CENTRAL ST.
NATICK, MA 01760
TEL: (508) 820-1102

601 WEST 112 AVE.
NEW YORK, NY 10025
TEL: (212) 865-5030

MCA is a trademark of IBM

LAN-AWARE DOS PROGRAMS

Listing 3: Access mode, sharing mode, and inheritance.



Listing 4: Locking a range of bytes.

```
regs.h.ah = 0x5c;
regs.h.al = 0; /* 0 to lock; 1 to unlock */
regs.x.bx = file_handle; /* returned by open() */
regs.x.cx = 0;
regs.x.dx = 499; /* CX:DX = position in file */
regs.x.si = 0;
regs.x.di = 100; /* SI:DI = byte count to lock */
int86(0x21, &regs, &regs);
if (regs.x.flags & 0x0001 == 0x0001) /* Carry Flag check */
    puts("Could not lock record.");
```

control file for this user, unlocks the file, and proceeds with the update.

Then, when the user finishes by causing the data to be written to disk (with appropriate physical locks on the records/files as the I/O takes place), his or her entry in the control file can either be deleted or, if an audit trail is desired, copied to a separate file and then deleted. Deletion can take the form of marking the control file record as "finished" and therefore available for reuse.

If one workstation discovers that the control file has an entry from another workstation that prohibits a given update at this time, it's relatively simple to tell the user to try again later. But what happens if a physical lock needs to be established and DOS returns "Access Denied" to the application? No matter how you tune sharing-retry-count/delay, you still must account for the possibility that a locked region of a file may become inaccessible because of a network operating system bug, server problem, or other odd problem.

My suggestion is that you implement your own automatic retry logic, to augment the sharing-retry-count/delay settings. But if, after a time, a lock still cannot be acquired, you should abort the current process as gracefully as possible. Close any open files and inform the user at the workstation that a significant error has occurred that will require the attention of a system administrator. It may even be necessary, for example, to

broadcast a message telling all the users to log off so that the servers can be restarted.

Final Tips

From a multiuser point of view, one of the most devastating things that a program can do is store configuration data back inside the executable file itself. This scheme has two problems: First, you can't store individual configurations; second, you can't make the executable file shareable and read-only. Don't do this.

Wherever possible, avoid the temptation to write code that is specific to a particular network operating system. If you decide, for example, to use Novell's Transaction Tracking System—a facility for grouping sets of database updates into atomic operations—be aware that you'll have to substitute your own such facility to make your software available to non-Novell users.

Identify each file—including executable files—in your application and specify, on a file-by-file basis, the kinds and the extent of sharing that your application will provide. Test your collision handling as thoroughly as possible. If you follow these suggestions, your programs should run happily in a networked environment. ■

Barry Nance works in the R&D department at Programming Resources Co. in Hartford, Connecticut. He can be reached on BIX as "barryn."

SOME COMPANIES MAKE ALL THE RIGHT CONNECTIONS.

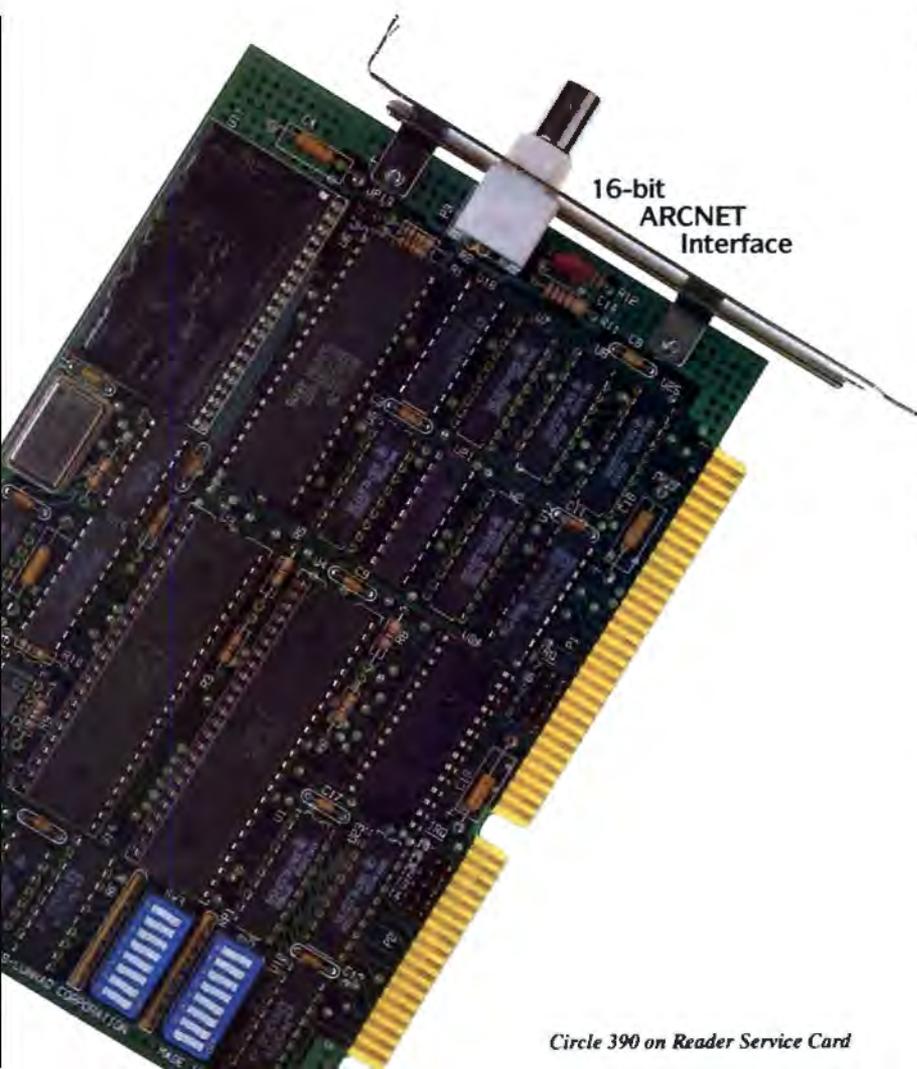


THEY CONNECT WITH 16-BIT ARCNET® CARDS.

Face it. Some companies are better connected than others. Success often depends on who can deliver. Successful businesses are turning to Thomas-Conrad for reliable ARCNET networking products.

- **GET 12 HOURS OF WORK IN AN 8 HOUR DAY.** Our 16-bit interface gives you up to a 50% increase in network throughput.
- **COAX, TWISTED-PAIR, FIBER OPTICS** – Whatever you want to work with, we work with.
- **DELIVERABLE HARDWARE** – While others are talking, Thomas-Conrad is shipping.

To find out how you can connect with ARCNET products that have the networking world talking, call Thomas-Conrad today.



16-bit
ARCNET
Interface


THOMAS • CONRAD
CORPORATION

800-332-8683

1908-R Kramer Lane
Austin, Texas 78758. (512) 836-1935

Arcnet is a registered trademark of Datapoint Corporation.

Circle 390 on Reader Service Card

LANtastic!

Cost Effective—Power Based LAN/RAN Solutions

CERTIFIED
COMPATIBLE



VIDEO SEVEN

VIDEO SEVEN

FastWrite VGA™

DISPLAY ADAPTER EXCEEDS STANDARD VGA PERFORMANCE AND RESOLUTION

- Maximum Resolution 1024 x 768
- 256 Color Palette
- VGA/EGA/CGA/MDA/Hercules
- Supports 1 or 2 Monitors
- Drivers for Most Popular Software
- Works in AT/XT/386

\$199*

Including Multi-Sync Monitor Now \$569*

BBS SOFTWARE



Multi LINE BBS SOFTWARE SYSTEM WITH MULTIPLE

ON-LINE DATABASES

DLX is a Multi-Line Bulletin Board and Information Host System that is easy to install and operate. It can accommodate up to 24 Simultaneous Users, and runs under PC or MS-DOS. Features include unlimited Key-Word Search Databases, Chat Mode, Password Protected Electronic Mail-Boxes, Special Interest Forums, Questionnaires, Order Entry and much more.

Optional "Instant Business" Modules allow turn-key subscription systems to get up and running immediately to begin producing on-line revenues from the startup.

Complete INFORMATION PACKAGE

- Demonstration Disks
- Actual Case Studies
- Full Documentation
- Comprehensive Handbook on How to Start & Run an Information Host System

\$10

WORLD'S LARGEST MODEM DEALER...

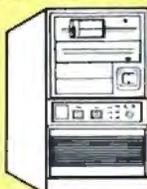
...AND WITH PRICES LIKE THESE ON HIGHEST QUALITY HAYES COMPATIBLE MODEMS YOU'LL SEE WHY.

			Internal Version	External Version
Fast	2400 BAUD	FULLY HAYES COMPATIBLE	\$69*	\$99*
Faster	4800 BPS	HAYES COMPAT. W/ LEV. 5 MNP	\$99*	\$129*
Fastest	9600 V.32	TRUE INDUSTRY STANDARD	\$399*	\$499*

All modems are top quality, famous brand OEM models offering savings of up to 80%. Each features auto fallback to slower speeds. Five year warranty.

SYSTEMS

386 MICRO TOWER



IBM/OS2 COMPATIBLE

\$995 Full Cash Price

While Special Supply Lasts!

PORTABLES TO GO

PORTABLE 286/386



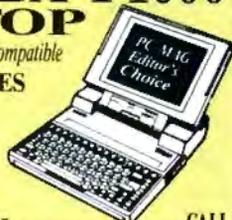
- 6 Expansion Slots
- 640 x 400 Backlit LCD
- Handsome Carry Case
- High Speed Processor
- 2400 Baud Modem

286 Processor, 40 MB Hard Disk, 640K \$1495*
386 Processor, 65 MB Hard Disk, 1 MB 1895*

TOSHIBA T-1000 LAPTOP

• Battery/AC • IBM Compatible
LOWEST PRICES ANYWHERE!

\$639*



20MB Hard Drive Option CALL
T-3100E 20MB HD, Gas Plasma \$2495*
T-1200FB Dual FD, Batt/AC 1495*

NETWORKING

WORKSTATIONS

- Disk or Diskless
- Novell Compatible
- E-NET Installed



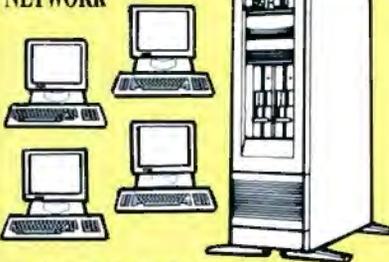
\$399 Full Cash Price

Attractive Slimline Design

BEST MULTI-USER

386 POWER BASED

LOCAL AREA NETWORK



4 WORKSTATIONS

For the cost of most stand alone 386 computers, you can have the processing speed and power of a 130MB, 386 network file server with four workstations, modem, plus BBS software for password protected remote access.

\$3995 Full Cash Price

Complete System Now Only
On-Site Installation & Support Now Available in Most Areas!

ALL *PRICES SHOWN ARE WHOLESALE AND REFLECT AN ADDITIONAL 3% CASH DISCOUNT. THE ON-LINE STORE'S WHOLESALE + 7% PURCHASERS PAY JUST 7% ABOVE THE WHOLESALE PRICE, PLUS SHIPPING AND HANDLING. Minimum shipping: \$5 per order. International orders: call for rates. Prices subject to change. Products subject to availability and may be private label versions. WE ALSO SERVE LARGE CORPORATE ORDERS: call for information. This ad supersedes all previous.

CALL NOW! 24 HOUR ORDER LINE:

805/650-0188



BBS 805/650-0193

FAX 805/650-0195

CUSTOMER SERVICE 805/650-0188

3037 Golf Course Dr., Ventura, CA 93003

Circle 386 on Reader Service Card

ONLINE STORE

Your International Headquarters for BBS

Building Heterogeneous Networks

L. Brett Glass

Creating a heterogeneous network—a network consisting of machines made by more than one vendor—is one of the most common and challenging problems confronting personal computer buyers today. Computer manufacturers support different sets of network standards; many (most, in fact) even seem to try to limit users' choices to discourage them from using other vendors' hardware. In this article, I'll address the problems I'm most often called upon to solve in my consulting practice—those that relate to choosing physical media, protocols, and software for a multivendor network.

Choosing a Physical Medium

One fundamental choice you'll have to make when planning a multivendor network is the physical medium to use. Each major standard has something to recommend it. Ethernet, for instance, has the widest support among different vendors. Token Ring has the largest number of new installations in IBM PC-compatible systems and can span larger physical distances, but it's more costly; adapters are still in the \$400 to \$600 range. ARCnet, which uses chips and hybrids that are farther down the "learning curve," has the best cost-to-bandwidth ratio of the greater-than-1-megabit-per-second LANs. And Apple's LocalTalk, an order of magnitude slower, is one of the cheapest; it runs off the Mac's existing serial ports, and an adapter card for an IBM or Sun is relatively simple and inexpensive.

In some cases, your choice of medium may be limited by the selection of peripheral cards or software available for one of your machines. IBM, for instance, has been slow to support Ethernet in its zeal to promote its own Token Ring. But Token Ring cards aren't available for many other brands of computers, so—in response to consumer demand—IBM is grudgingly providing Ethernet drivers in system software such as OS/2 Extended Edition 1.2. (Ironically, you still have to buy a card from a third party, such as

*Practical advice on
the formidable task
of networking
dissimilar systems*

Western Digital, to use this software.) When it arrives, Fiber Distribution Data Interface (FDDI) will be a good choice for harsh environments and high data rates, but because the standard is not yet complete, the equipment you buy today may not be compatible with the final version.

Finally, your choice may already have been made for you. Your building may have existing coaxial cable or twisted-pair wiring, and the cost of installing more wires may be prohibitive. Fortunately, many network standards now support several different kinds of media. ARCnet, for example, is available on twisted-pair and 92-ohm coaxial cable, and Ethernet can be used with thick coaxial cable, thin coaxial cable (Cheapernet), and twisted-pair (10BASET).

It's often possible to convert wiring for use with a different network standard by using a device called a *balun*. A balun (the word is a contraction of "balanced" and "unbalanced") allows equipment intended for twisted-pair media to run on coaxial cables or vice versa. Thus, if your building is wired for Token Ring, you may still be able to use Ethernet equipment on that wiring.

Picking a Protocol Suite: Open or Proprietary?

The next (and hardest) choice you'll need to make is what suite of protocols and whose software to use on your network. Network protocols fall into two broad

categories: proprietary standards, developed and sold by a single vendor or a small group of vendors, and "open" standards, supported by many companies and usually standardized by industry groups such as CCITT, IEEE, ANSI, and ISO.

In the microcomputer world, the open standards most worthy of note are TCP/IP and the ISO protocol suite, which is still under development. Because the latter is not yet finished or widely implemented, TCP/IP is likely to be the best choice in this group until the middle of the next decade.

Among the proprietary protocols, Novell's IPX controls the lion's share of the IBM PC-compatible market, while others (including IBM) provide networks based on MS-Net, NetBIOS, APPC, and/or LU 6.2. Apple's AppleShare (provided as part of the system software) and Sun's TOPS are popular on the Macintosh. Both these vendors seek to provide connectivity to several different kinds of machines; however, since only they (or their licensees) can do a port to different hardware, you may be left waiting for software or upgrades. In some cases, hardware and software gateways to networks that speak other protocols are available from third parties or from the vendors themselves.

Peer-to-Peer or Server-Based?

Another important consideration you'll need to address when designing your network is whether you want a peer-to-peer network (in which any machine can share resources with any other) or a server-based network (in which only servers share resources). Each has its pluses and minuses.

One common problem of server-based networks has to do with turning machines off and on. As long as the server is up, it doesn't make any difference if one user shuts off or reboots a machine. The same action on a peer-to-peer network

continued

could disrupt other people's work. On the other hand, a single-point failure at a server in a server-based network can bring an entire office full of workers to a screeching, expensive halt.

Server-based networks have advantages from a security standpoint. If your server is secured (say, in a locked room) and protected by passwords from illicit access, it's hard to steal data from it. But in a peer-to-peer network, users may be able to snoop on one another—and it may be easier to obtain physical access to a machine that contains critical data. It's also easier to perform backups if most, or all, of the information that needs to be backed up is kept on a server.

The choice between server-based and peer-to-peer networks is critical in a multivendor environment because many vendors offer *only* client or server software for certain kinds of hardware. TOPS, for instance, offers peer-to-peer connectivity between Macintoshes and PCs but only server capabilities for Suns. Other companies offer NetBIOS implementations for minicomputers and mainframes but allow them to act only as servers despite the usual peer-to-peer nature of NetBIOS networks. Novell offers only server-based networks.

As if things weren't complicated enough, you'll find that some of the server-based network packages require dedicated servers while others do not. Proponents of server-based networks claim that having a dedicated server provides performance advantages, but in fact it's not clear that this is so. A dedicated server may be able to devote a lot of computing power to its one job, but the combined contributions of several non-dedicated servers may prove superior.

Filenames and Formats: Smoothing Out the Differences

One especially important problem you'll need to deal with in a heterogeneous network is how—or whether—it can handle the differences between various operating systems' filenames and formats.

Table 1 shows three examples of file-naming conventions. A filename in IBM's PC-DOS has up to eight characters followed by an extension of up to three characters; Unix filenames allow up to 256 characters, and Macintosh names up to 32. Each operating system allows and prohibits different characters in filenames; thus, accessing a file on a different kind of machine may require you to type a filename that's "illegal" on your system. What's more, the characters used to indicate a directory ("/" in Unix, "\ " in DOS, and "<" and ">" in TOPS-20) may be prohibited on other machines. Most network software attempts to solve these problems—either by maintaining multiple names for each file or by performing algorithmic translation—but alas, few of these schemes are graceful. And if a server supports *n* naming conventions at once, *n* separate directories or *2n²* conversions will potentially be required.

File formats present yet another obstacle to connectivity. Sharing files with another machine isn't much use if you can't read them, yet even the formats of simple text files differ from machine to machine. On the IBM PC, Atari ST, DEC-20, and VAX side, each line ends with a carriage return and a linefeed. Unix and the Amiga use a linefeed only; the Mac uses only a carriage return. The results can be confusing: When I recently tried to open a DOS text file from MacWrite on a networked Mac, I discovered a strange "block" character (which turned out to be a linefeed) at the end of each line. To complicate matters still further, Mac files have two "forks"—a data fork and a resource fork—which essentially make them two files in one.

Fortunately, some software products, such as Microsoft Excel and WordPerfect, ease these differences by supporting a single file format across all architectures. (Some even support other vendors' formats; Macintosh Excel, for example, can read files produced by Lotus 1-2-3 on an IBM PC.) But in the

majority of cases, you'll need a way to convert your files, and the conversion process may cause information to be lost. For this reason, it may be impractical to share the same copy of a file between two genres of machines; you might have to work on, say, a spreadsheet on only one machine and send text file output across the network to others.

Peripheral Access, E-Mail, and Mainframe Gateways

Most LANs provide ways to share peripherals, but sharing devices in heterogeneous networks can pose special problems. For instance, you probably won't be able to print Macintosh graphics on an IBM Graphics Printer attached to an IBM PC even if the two can share the printer via the network. Likewise, an IBM PC program can use a PostScript driver to print graphical output on an Apple LaserWriter and a C. Itoh Pro-Writer driver for the Apple ImageWriter, but it probably won't be able to use a QuickDraw printer. Fax cards may not understand graphics file formats intended for a machine they don't plug into directly. And shared modems aren't supported across some networks.

Often, you can get network software from the same vendor who wrote your network software; some, such as TOPS's InBox, span more than one kind of machine. Still, the protocols used by almost all E-mail systems are unique to the vendor that provides them. However, only TCP/IP's SMTP (Simple Mail Transfer Protocol) and the emerging CCITT X.400 standard are likely to be available from many vendors; if you're building a heterogeneous network, it pays to insist on having such a protocol available.

One of the most asked-for features in heterogeneous LANs is a way to get to the big behemoths: software that will let you emulate a 3270 or other mainframe terminal and transfer files back and forth. Fortunately, almost every computer and/or network vendor addresses the problem—some with special hardware for each machine, and some with gateways that concentrate data from LAN workstations at a central server before passing it on to the mainframe.

Some Real-World Products

In the sections that follow, I'll discuss the specifics of some popular network offerings and point out some key advantages and disadvantages relating to heterogeneous networks. While this isn't intended to be a review or even a comprehensive survey, the products I'll mention

continued

Table 1: Examples of operating-system naming conventions for files, directories, and folder names. Note the diversity that must be accommodated when you try to share files among dissimilar systems. (Courtesy of TOPS)

Operating system	Conventions
DOS	Up to 8 characters, optional 3-character extension; no blank spaces; cannot use " / \ [ ] : | < > + = ; . * ?
Unix	Up to 256 characters; blank spaces OK; cannot use / Avoid \$ ' * ? ! # [] [] " ()
Macintosh	Up to 31 characters; blank spaces OK; cannot use colons



Our Printer Sharing Unit Does Networking!

An Integrated Solution

Take our **Master Switch™**, a sophisticated sharing device, combine it with **MasterNet™** networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

Versatile

Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The

MasterLink™ utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

Other Products

We have a full line of connectivity solutions. If you just want printer sharing, we've got

it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

Commitment to Excellence

At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.



ROSE
ELECTRONICS

**Call now for literature or
more information.
(800) 333-9343**

Give a Rose to your computer.

Think Gig!

Let's talk
STORAGE!

RACET'S Cosmos 600 Optical Drive gives you nearly 600MB of removable formatted capacity with full Novell compatibility. Media is ISO standard, with an average seek time of 50ms, **AND, here's the best part**, it looks like any other hard disk; fully eraseable, and it's available right now for MAC & IBM!



And That's Just for Starters!

- New digital audio tape (DAT) with 1.25GB capacity. Fast transfer rates and short search times combine to make this an excellent choice for large volume applications.
- GigaSTOR™ series of SCSI devices provide over 16GB of on line storage.
- High performance series includes a proprietary IBM host adapter and total network compatibility. A ½MB cache RAM is expandable to over 12MB. ESDI or ESMD drives with a 1.25MB/sec transfer rate and integrated tape/optical backup. This is the network systems solution!

Check us out, you'll find RACET's product range of integrated sub-systems and stand alone storage and back up devices is the most complete in the industry.



RACET computes, Ltd.
3150 E. Birch
BREA, CA 92621
714/579-1725
FAX 714/579-3183
AppleLink D0411



Ask your favorite retailer or VAR for more information about RACET products. If they cannot provide product information, give us a call and tell us their name; we'll make sure they have an opportunity to provide you with RACET products along with their own special service and support.

are representative of what's available in the marketplace as a whole.

• **AppleShare**—AppleShare is Apple Computer's own server-based network protocol. It lets Macintoshes share files on an AppleShare server via either EtherTalk (AppleTalk on Ethernet media) or LocalTalk (AppleTalk on twisted-pair). Peer-to-peer communications are possible using lower-level AppleTalk protocols, but peer-to-peer file sharing is not supported.

Apple—like many other companies with proprietary protocols—is now beginning to release implementations for other vendors' hardware. AppleShare client software will soon be available for IBM PCs; server software is available for the VAX family running under VMS.

Third parties have also written AppleShare implementations (e.g., Novell; see below); others have created hardware gateways that let AppleShare clients access servers on other kinds of networks. Notable among these units is the Gator-Box from Cayman Systems, which translates AppleShare requests into NFS requests and transmits them to an NFS host. This lets any machine running the NFS protocol act as an AppleShare server.

• **NetWare**—Novell's NetWare holds about 50 percent of the IBM PC LAN market. In the IBM world, NetWare uses two proprietary protocols, called IPX (Internet Packet Exchange) and SPX (Sequenced Packet Exchange), that are somewhat similar to Xerox's XNS protocols.

NetWare has always supported a wide variety of media, including ARCnet, Ethernet, and the Token Ring. The Novell server software is also quite elaborate and includes provisions for disk mirroring, backup, and E-mail. But until recently, NetWare ran *only* on the IBM and its clones. This changed with the advent of NetWare for VMS, which lets a VAX running under VMS act as a NetWare server.

Last December, Novell announced NetWare for the Macintosh. (Developed in cooperation with Dayna Communications, this product is also marketed as DaynaNet, a less expensive solution that offers fewer options.) And earlier this year, Portable NetWare, a version of NetWare designed to be ported to many machines, made its debut. Numerous ports are reputed to be under way to systems manufactured by such companies as Data General, NCR, Prime, Unisys, Northern

continued

USSMSG10: MAINFRAME 0013: Enter Applicaton

E-Mail

USSMSG2: R70302 E-MAIL COMMAND UNRECOGNIZED

E-Mail PLEASE!

USSMSG2: R70302 E-MAIL COMMAND UNRECOGNIZED

E-Mail PRETTY PLEASE!!

Why can't mainframes speak English?

You have to wonder why the people who design big computers make it so difficult for normal human beings to use them.

Particularly non-technical, hastily trained human beings, who need to talk to the mainframe from their PCs.

It's been a serious dilemma. Until NOW!

NOW! is a menu-making, macro-writing tool that automates the drudge work of

PC-to-host communication.

When someone wants to review their E-Mail, for instance, all they need do is make one menu selection.

NOW! then takes on the tedious job of loading the 3270 software, log-

NOW!
PC/HOST AUTOWARE™

Attachmate

1-800-426-6283

IN WASHINGTON STATE 206-644-4010.
NOW! and Autoware are trademarks of Attachmate Corp., Bellevue, Wa.
IBM is a registered trademark of International Business Machines Corporation.

ging onto the mainframe, and wading through the passwords and commands to arrive at the E-Mail screen.

It's not hard to see how NOW! reduces wasted time, needless stress and training costs.

Nor is it difficult to find out more. Simply call or write and we'll send you a free demo disk and detailed information.

All of which, you'll be pleased to hear, is written in a language called English.

Rack & Desk PC/AT Chassis

Integrand's new Chassis/System is not another IBM mechanical and electrical clone. An entirely fresh packaging design approach has been taken using modular construction. At present, over 40 optional stock modules allow you to customize our standard chassis to nearly any requirement. Integrand offers high quality, advanced design hardware along with applications and technical support *all at prices competitive with imports. Why settle for less?*



Rack & Desk Models

*Accepts PC, XT, AT Motherboards
and Passive Backplanes*

Doesn't Look Like IBM

Rugged, Modular Construction

Excellent Air Flow & Cooling

Optional Card Cage Fan

Designed to meet FCC

204 Watt Supply, UL Recognized

145W & 85W also available

Reasonably Priced

*Now
Available*
Passive
Backplanes



INTEGRAND

RESEARCH CORP.

Call or write for descriptive brochure and prices:
8620 Roosevelt Ave. • Visalia, CA 93291

209/651-1203

TELEX 5106012830 (INTEGRAND UD)

FAX 209/651-1353

We accept Bank Americard/VISA and MasterCard

IBM, PC, XT, AT trademarks of International Business Machines
Drives and computer boards not included

BUILDING HETEROGENEOUS NETWORKS

Telecom, and Sun Microsystems.

Novell's networks are server-based, rather than peer-to-peer, networks. Each network must have at least one server (although a few versions allow it to be non-dedicated), and only resources attached to the server can be shared.

Novell's VAX offering is a server-only implementation. PC users can share files

Macintoshes. But for many uses, the connectivity Novell does provide is more than adequate.

Novell's offerings will doubtless expand to cover a wide variety of media on many manufacturers' machines; where they now exist, they offer clean, pre-packaged solutions to many networking problems. However, since NetWare is based on a proprietary standard, there's no way to go to a third party or implement it yourself, and you will probably not have a choice of implementations for a given machine, as you might with a nonproprietary protocol. Finally, if you own large numbers of machines that will probably not be supported soon (e.g., Amigas or Atari STs), you may be forced to choose another solution altogether.

NetWare
*supports a wide variety
of media, including
ARCnet, Ethernet, and
Token Ring.*

on the VAX, use the VAX's printers, log onto the VAX with a terminal emulator, and even use a VAX's DECnet connection to access other VAXes. The VAX, however, cannot access files or peripherals on PC-based NetWare servers.

NetWare also supports the Macintosh, but with some limitations. PC-based servers running version 2.15 or higher of NetWare can act as AppleShare servers as well as IPX servers; Macs and PCs attached to the server can use the same files. The server can also control an AppleTalk printer (such as a LaserWriter) and allow clients on both the AppleTalk and IPX sides to access it. It's also possible to use a NetWare network to carry AppleTalk packets from one AppleTalk network to another; AppleTalk packets are encapsulated in IPX packets and routed through the Novell network.

NetWare makes no attempt to translate files between Macintosh and PC; if the formats are not compatible, it's the user's responsibility to find a way to convert them. Filenames are handled with a dual-directory approach; separate directories are maintained for each file system, and changing the name of a file on the PC side may not cause it to be changed on the Mac side (a special utility is needed to do this). The resource forks of Macintosh files are invisible to DOS.

Unfortunately, the PC-to-Mac connectivity is not complete. PC clients cannot use the NetWare server as a gateway to access files on an AppleShare server, nor can they communicate directly with

• **TOPS**—The brainchild of Nat Goldhaber and Michael "Flash" Pflumer, TOPS is a network operating system specifically designed for heterogeneous LANs. (The acronym TOPS, which stands for Transcendental Operating System, reflects this.) Their company, originally called Centram, was bought by Sun Microsystems, which runs it as a separate division.

TOPS is built on the AppleTalk protocol suite and uses the standard media supported by AppleTalk: LocalTalk cabling and Ethernet. In systems equipped with special hardware (a card called the FlashCard for the PC or an add-on called the FlashBox for the Mac), TOPS can also run FlashTalk, a sped-up version of LocalTalk.

Unlike NetWare or AppleShare, TOPS is a peer-to-peer network. Any computer can "publish" files and peripherals for use by others and can "mount" resources that other stations publish. TOPS supports two types of media: Apple's LocalTalk cabling system (with an optional fast protocol that requires special hardware) and Ethernet. Because the lower layers of the TOPS protocol suite are the AppleTalk protocols, Media Access Control (MAC)-layer bridges designed for AppleTalk (like the Kinetics Fast-Path) will work properly with TOPS. However, while Macintoshes equipped with a copy of TOPS can access AppleShare servers, ones that don't can't access a TOPS server.

Currently available are full-blown versions of TOPS for the IBM PC and Macintosh and a server-only version for the Sun. These are the only versions TOPS itself produces. However, third-party TOPS server software is available for VAXes running VMS and Unix, and

continued

We think that NetCommander is a better low-cost LAN alternative than any of these competitors.

Systemizer Plus
BayTech Model 24
Data Manager 4 x 4
FocalPoint Plus
Bytelink
Western Telematic INC-64

Buffalo SL
The Logical Connection
Equinox Alternet
Alliance
Rose Master Switch
Commix 32

Of course, you are entitled to a second opinion:



July 1989
NetCommander NC-16

"The clear choice for a highly complete and flexible system goes to the NetCommander NC16 from Digital Products. Aside from handling the usual tasks of device sharing and file transfers, this system also offers virtual disk drive capabilities that work well, and it can even provide such unique features as IBM 3270 access and automated tape backup. Its maximum speed of 115,200 bits per second gives it excellent throughput performance for large networks..."

"Data Switches: A Low-Cost LAN Alternative"
July 1989 PC Magazine



**DIGITAL
PRODUCTS, INC.**

the sub-LAN™ company

108 Water Street, Watertown, Massachusetts 02172
(617) 924-1680 / (800) 243-2333
FAX (617) 924-7814 / TELEX 312345

Novell is readying a driver that will let TOPS users access a Novell server.

What if you want to access files on some other type of machine from a TOPS workstation? One way is to use a third-party TCP/IP package that can coexist with TOPS. Two such products are TOPS Terminal (developed at the University of Oregon) and NCSA Telnet (from the National Center for Supercomputing Activities). Another way is to use a Sun running both TOPS and NFS (a file-sharing protocol that runs under TCP/IP) as an NFS gateway. If the Sun publishes a resource to which it has gained access via NFS, that resource becomes available on the TOPS network. It may also be possible to run TOPS on an IBM PC concurrently with other network software, thereby turning the PC into a gateway, but you'll have to experiment to see if this will work in your system.

- *NetBIOS*—The IBM PC NetBIOS (see "Understanding NetBIOS," January BYTE) is actually an Application Program Interface (API) rather than a network standard. This means that there is no written standard for the format of the

packets that travel across the physical medium (although some are emerging; see below). You must generally run the same manufacturer's NetBIOS at every station on a segment of a LAN to ensure that the nodes can talk to one another.

Many brands of network software, such as NetWare and TOPS for the IBM PC, provide NetBIOS emulation, which lets programs written for the NetBIOS API run on these networks. But NetBIOS was really intended for use in peer-to-peer networks based on MS-Net; the IBM PC LAN Program and CBIS's Network OS are two such products. MS-Net uses NetBIOS (which operates on the MAC and Session layers of the OSI model) and adds an Application-layer protocol called SMB (Server Message Block). This combination allows transparent sharing of files and peripherals among MS-DOS machines.

Because the lowest layers of NetBIOS implementations differ, there are three ways to use NetBIOS in heterogeneous networks. The first way is to use a NetBIOS implementation that's painstakingly reverse-engineered to use the same low-level protocols as IBM's products.

The second way is to buy a NetBIOS for the PC together with matching software for the non-PC machine (e.g., a VAX); the matched set of programs will, presumably, be designed to communicate correctly. Another way is to use the newly emerging "NetBIOS over TCP/IP" standard. This standard, set forth in two Internet documents (RFC 1001 and RFC 1002), presents a standard way of translating NetBIOS calls into TCP/IP transactions. Because TCP/IP is a nonproprietary protocol available on many machines, the latter solution is appealing; many organizations are embracing this standard and writing their own applications that communicate with PCs using TCP/IP over NetBIOS.

- *TCP/IP*—A protocol suite developed for use on a government and research network called the Internet, TCP/IP is the most widely implemented nonproprietary network protocol. It's the most common protocol at universities, which often have computers from hundreds of different vendors on the same network. TCP/IP networks at trade shows such as InterOp and UniForum, comprising

We've been in the
networking business
20 years, so you
can hook up a PC
in a couple of minutes.



many vendors' machines, have been assembled in a matter of days. [Editor's note: *For more about TCP/IP, see "The Glue for Internetworking" on page 221.*]

Unlike the products I've already mentioned, TCP/IP doesn't usually come as a "plug-and-play" solution. You will probably have to buy a version for each type of machine you want to connect from a different vendor, and you'll need to know how the protocol works in order to get the network up and running. But the extra diligence required to assemble a TCP/IP network pays off; you'll be able to connect virtually any machine that supports networking to any other.

TCP/IP packages typically come with several standard applications. These include TELNET, which lets you log onto a remote machine through the network; FTP (File Transfer Protocol), which lets you transfer files to and from another machine; and SMTP (Simple Mail Transfer Protocol), which transfers E-mail. You can share files via Sun's NFS and perform interprocess communications via Berkeley "sockets" or Sun's RPC (Remote Procedure Call) interface. The protocol suite also contains routing

and gateway protocols that let you connect your LANs to WANs; not all proprietary systems are designed to grow to this level of complexity.

TCP/IP is available on virtually every machine that runs Unix. There are several implementations for the IBM PC under DOS (from FTP Software, Wollongong, Excelan, Sun, and others), and even one (KA9Q, written by Phil Karn of Bell Labs) that's freely redistributable and comes with source code. IBM, known for its lack of support for protocols it does not control, has announced TCP/IP products for its mainframes. There's even an Amiga version of TCP/IP, which has been used to good effect by scientists at SLAC, Stanford's linear accelerator.

Several universities (e.g., Stanford) and a few commercial sources (Kinetics, InterCon, and others) have developed implementations of TCP/IP for the Macintosh. Apple already has a TCP/IP product called MacTCP, and sources on the Internet report that Apple has acquired the rights to a compatible NFS implementation developed at the University of Michigan. Kinetics' FastPath can

bridge AppleTalk and TOPS networks to Ethernets running TCP/IP; Cayman Systems' GatorBox can also do this and can provide a hardware gateway between AppleShare and NFS.

Assess Your Needs

There's no hard-and-fast solution to the problem of heterogeneous networks; designing them, installing them, and keeping them running requires patience, skill, and expertise. Which solution should you choose? The answer depends, of course, on your individual situation.

If you think your long-term needs will be met by a prepackaged solution, by all means use it; it may save you hours of shopping, mixing, and matching. But if no one package covers all the machines you want to connect, it will be well worth your while to look at more "universal" protocols such as TCP/IP, which enjoy widespread, if uneven, support from many vendors throughout the industry. ■

L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

digital

Two minutes and 5 seconds to be exact. That's all the time it takes after you install a networking card—something you have to do for any PC.

Let Digital, the world's leading computer networking company, put its experience to work for you. When you want to install, use, maintain or add on to a PC LAN, we make it fast and easy. And with our new family of PCLAN/Server™ 3100s and our networking software, we offer total PC integration. The kind of integration that lets you share files, applica-

tions, mail and printers, and lets you access minicomputers and mainframes. Plus, you get all the security and service you'd expect from the networking leader.

What are you waiting for? Contact your Authorized Digital Distributor now. Or call 1-800-842-5273 ext. 200 for more information by fax or mail.

Digital
has
it
now.

© Digital Equipment Corporation 1989. The Digital logo, Digital has it now and PCLAN/Server are trademarks of Digital Equipment Corporation.



Database Trends

247 A Brave New World?
by Fabian Pascal

259 Serving Up Data
by Mark L. Van Name
and Bill Catchings

267 Sharing the Wealth
by Ralph Davis

277 A Family of Models
by Joseph Dawson

291 The Data File

There's a world of difference between where databases have been and where they are going. Databases are the major source of information in a computer system. Whether that information is your personal tax records, a small business's inventory, or a major corporation's sales activity, it is stored in some kind of a database. How that database should be organized and structured is a matter of considerable debate.

This month's In Depth section discusses the current trends in the microcomputer database world. In "A Brave New World?" Fabian Pascal discusses the changes that have been occurring recently with databases and delves into the popular relational model and Structured Query Languages.

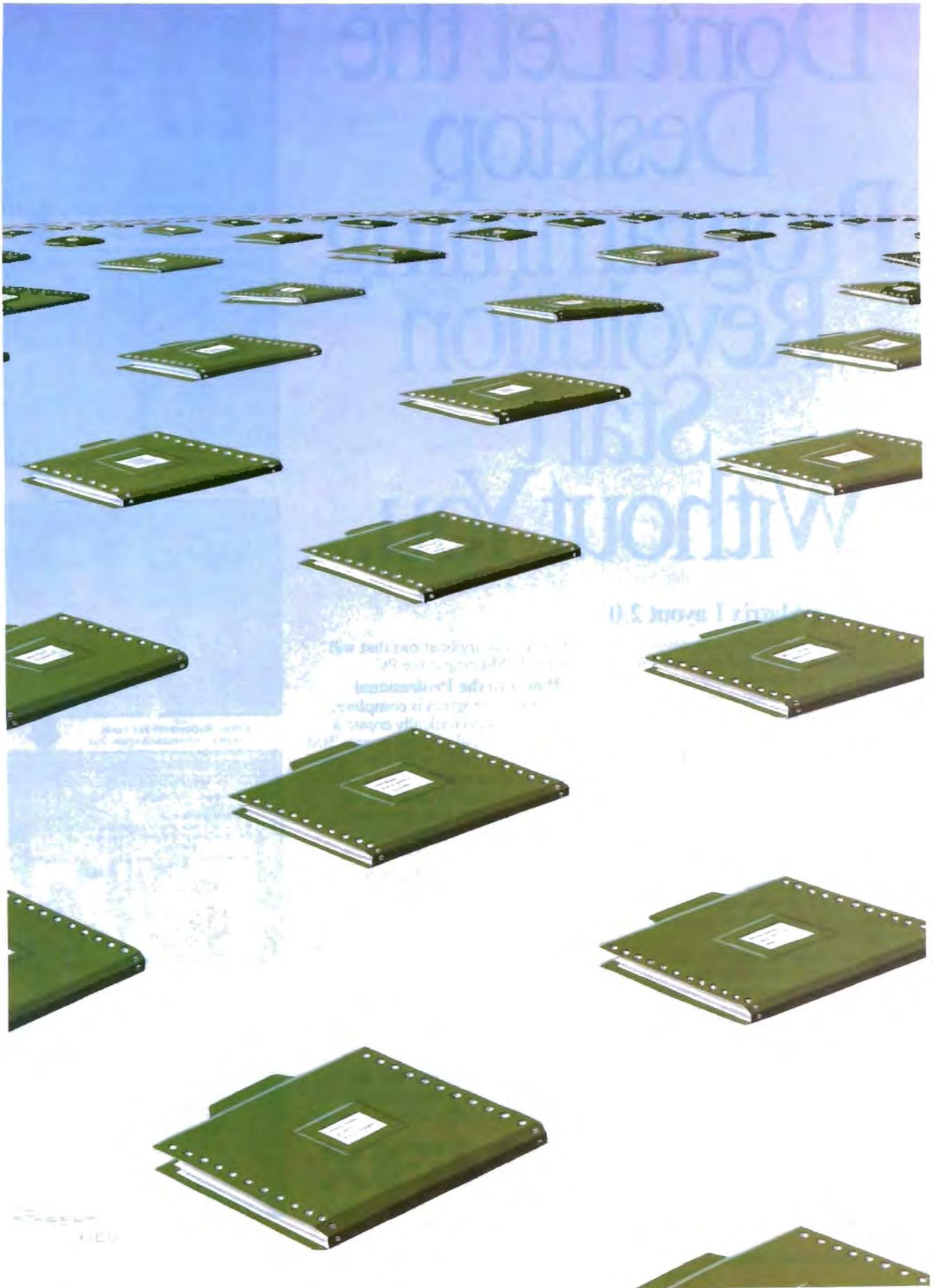
In the past, most microcomputer databases have been of the stand-alone variety. Recently, however, with the popularity and proliferation of LANs, the problems of database incompatibilities among different microcomputers have become more pronounced. Two major approaches to the database on a network have been developed. In "Serving Up Data," Mark L. Van Name and Bill Catchings describe one of these approaches: the database server. In "Sharing the Wealth," Ralph Davis describes the other: the distributed database.

Where are databases going in the future? Basic changes in technology may lead us into uncharted waters. One area where the mapmakers are already at work is object orientation. While still on

the drawing board, object-oriented databases are becoming more real every day. In "A Family of Models," Joseph Dawson describes some of the forms those databases may take.

And where is the In Depth section going in the future? As you read this, we are considering topics for In Depth coverage for the second half of 1990. So I'll turn that question around. Where do you think this section should go? What topics should we cover? What are your major concerns in computing? What do you want or need to know about? Please contact me at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "janetaz."

—Jane Morrill Tazelaar
Senior Technical Editor, In Depth



Don't Let the Desktop Programming Revolution Start Without You.

Presenting Matrix Layout 2.0

The Desktop Programming revolution has begun. More and more people are maximizing the productivity of their desktop computers without learning to write a line of code. It began with Matrix Layout. And continues with Layout 2.0.

More Power to the People

Matrix invented Desktop Programming to let you create your own programs right on your own PC. Now, Layout 2.0 makes it even easier to create your own powerful, professional-quality applications.

Start with Layout's tools window. Everything you'll need to build your program can be accessed by mouse or keystroke.

Next, use Layout's graphics and text tools to build a flowchart model of your program. Create your own windows, icons, and buttons. Cut and paste functions from other Layout programs. Or use the BlackBox Manager to add a BlackBox — a pre-built capability such as telecommunications or dBase support — to your Layout program. All, without writing a line of code.

Layout 2.0 is also a hypertext tool, allowing you to build Hypercard®-like cards, with text and graphics, and link them to related cards in any file. Use it to create cards for your flowcharts or to

create hypertext applications that will run on any IBM-compatible PC.

Power to the Professional

Once your program is complete, Layout 2.0 can automatically create a ready-to-run .EXE file for use by any IBM PC. Or have Layout 2.0 write it in Turbo C, Lattice C, Microsoft C or QuickBASIC. The result: you've got a professional, stand-alone program that does exactly what you want it to. Use it, share it, modify it. You've got the power.

And a Powerful Bargain

For just \$199.95 you get the entire Layout 2.0 package, including free technical support, and more programming power than you've ever had on your desktop. For more information, the location of your nearest Matrix dealer, or a copy of the Matrix Layout 2.0 VHS demonstration video (just \$9.95 for shipping & handling), call today.

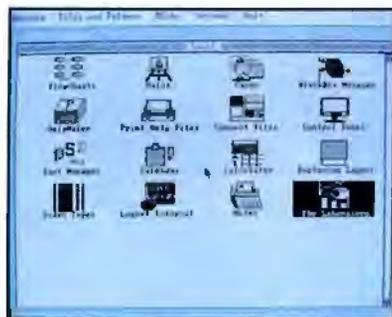
1-800-533-5644

(in Massachusetts, 617-567-0037)

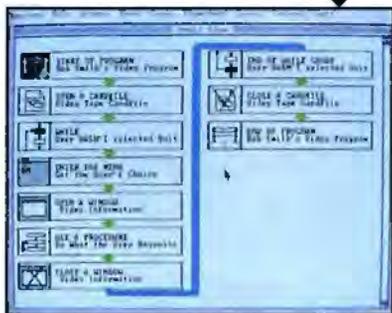
Join the Desktop Programming revolution. Order Matrix Layout 2.0, today!

MATRIX
MATRIX SOFTWARE TECHNOLOGY

BT 89/9



With Layout 2.0, getting started is as easy as choosing a tool.



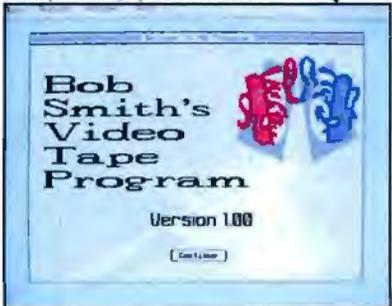
Design and build your programs by using a simple flowchart.



Create Hypercard®-like cards, linked to information in any file.



Use the Paint tool to create powerful graphics and buttons.



Layout creates finished, stand-alone programs for any IBM PC.

Matrix Software Technology Corporation • One Massachusetts Technology Center • Harborside Drive • Boston, MA 02128 • (617) 567-0037

Matrix Software: UK • Matrix House, Derford Business Park • Derford, Plymouth • Devon PL4 5QZ, England • 0752 786 363

Matrix Software: Europe • Geldenaalscheven 47 • 3030 Luven, Belgium • 018-202094
The following are registered and unregistered trademarks of the companies listed: Matrix Layout, Matrix Software Technology Corporation, Hypercard
Apple Computer, IBM, International Business Machines Corporation, dBase, Ashton Tare

Circle 176 on Reader Service Card

A Brave New World?

*Exploit the relational power and the graphical, multitasking,
and connectivity facilities of new database environments*

Fabian Pascal

Progress comes at a price. Fundamental changes are occurring in database management as they are in the entire personal computer environment. And as new developments proliferate in both arenas, the interaction between the two becomes more and more unpredictable. Where this volatility will end is unclear. What is clear, however, is that when the dust settles—if it ever does—the ensuing database market will be much different than it has been in functional scope, in the types of demands placed on vendors and users, and even in the structure of the industry.

Databases are the basic corporate information source. Data is generated by and used in financial and manufacturing transactions, decision support tools, text and graphical documents, desktop publishing applications, and so on. Regardless of its purpose and origin, however, multiple users must be able to share a lot of the same accurate, consistent, up-to-date information efficiently and securely, no matter what it is or where it is. It is the task of database management systems (DBMSes) to facilitate this function.



Tradition hasn't equipped database management programs to fulfill this task effectively, no matter how easy they are to use. Corporate data suffers from incompatibilities across different computing platforms and even within the personal computer environment itself. There is a proliferation of different products, most of which were originally designed to work in stand-alone mode.

They must properly address integrity, security, concurrency, and recovery issues, improve the power/ease-of-use ratio, minimize maintenance burdens, and maximize performance, especially over networks. Moreover, a variety of nondatabase software packages store and manage their own disparate data in different and unintegrated formats.

It's Tradition

Data management software has, to a large degree, been constrained by the 8088/DOS environment with its RAM (640K bytes) and disk (32 megabytes) limitations, single-user and single-tasking capabilities, and relatively sluggish processing speed and disk access. With the advent of the 80286 processor, enhancements and ways to

work around these limitations have been devised. But these aren't fundamental changes. Moreover, the user interface is character-based and command-oriented.

But while the environment imposed limitations, database technology itself also caused many weaknesses in and incongruities between products. In fact, many popular so-called DBMSes are not

continued

Table 1: *The set of features composing the original relational model. Notice particularly the five types of integrity constraints that ensure data accuracy and consistency.*

<p>A. Structural features</p> <ul style="list-style-type: none"> R-Tables <ul style="list-style-type: none"> • Base (stored) • View (virtual) • Query (derived) • Snapshot Domains Columns Keys <ul style="list-style-type: none"> • Primary (PK) • Foreign (FK) <p>B. Integrity features</p> <ul style="list-style-type: none"> • Entity integrity • Referential integrity • Domain integrity • Column integrity • User-defined integrity 	<p>C. Manipulative features</p> <ul style="list-style-type: none"> Basic operations <ul style="list-style-type: none"> • Assignment • Project • Restrict • Product • Union • Difference Derived operations <ul style="list-style-type: none"> • Join • Intersect • Divide Extended operations <ul style="list-style-type: none"> • Outer • Maybe • Domain override
---	---

DBMSes at all: They are *programmable filers* at the core, leaving most of the job of *managing* databases to the users and providing only unproductive tools to aid in the task.

First, except for the simpler tasks in accessing and manipulating data, you can't ask for the results you want directly. Frequently, you must create procedures (detailed sets of steps) that the system must follow internally to obtain those results. Moreover, where you want to perform a data operation—retrieval, update, or deletion—on multiple data records, you must iteratively loop the system over the records one at a time, keeping a count, until completion. In short, traditional database access usually requires some degree of programming skill.

Second, a great deal of the procedural detail consists of explicit references to internal storage structures, addressing mechanisms, and so on, which are irrelevant to logical database tasks. Thus, where traditional systems fail to support physical data independence for applications, they involve you in machine complexities and performance considerations, which most people are ill-equipped to handle and shouldn't have to bother with anyway.

Third, traditional database systems lack a theoretical foundation. Without the systematic functional guidelines that theory could have provided, products were developed ad hoc. The ensuing proliferation of different solutions to a general set of problems is a direct consequence. The products are proprietary:

Despite some similarities, each one approaches the same data tasks in its own unique way.

But Is It Practical?

Without objective criteria, you can't validate the functional correctness and completeness of products like these (see reference 1). As a result, you end up having to fill the gaps with programs of your own and accepting disruptive revisions that may result in backward incompatibilities. This is also why consistent product comparisons are difficult, and thus scarce. Data managers are often evaluated either against each other or against long arbitrary lists of features (see reference 2).

Often, you need technical personnel to mediate between end users and their data. Because the natural language of the end user differs from the procedural machine-oriented tools that traditional products provide, the communication between them is time-consuming, inefficient, and frequently ineffective. Procedural application development is difficult and error-prone.

When implementation details change, as they must for a variety of reasons, their exposure in applications imposes maintenance burdens. And because such details tend to vary across platforms, portability and distributivity of data and applications are limited. In fact, data sharing has been achieved with LAN file servers, which ship files around for DBMSes residing elsewhere on the network to process locally. This approach can be inefficient when the requesting

applications need only a few records. Moreover, with this approach, integrity, security, concurrency, and recovery can be difficult to manage.

Similarly, connecting microcomputers to other platforms has been limited to host links. Data files of different formats were transferred back and forth for processing and storage, accompanied by more or less explicit conversions and the problems that come with the resulting data redundancy.

Various attempts have been made to overcome these limitations within the constraints of the personal computer environment. Some products insulate applications from certain physical details (e.g., the use of indexes). However, the one-record-at-a-time approach inhibits this capability. In this approach, the overall purpose of the data operations isn't obvious to the database system, and, thus, it can't optimize them. In addition, there is neither information about its current state nor the intelligence on which to base optimizing decisions.

The Relational Model

In 1969, mathematician E. F. Codd, while at IBM, developed a relational theory of data, which he proposed as a universal foundation for database systems (see reference 3). His relational model, based on the set mathematics of relations and first-order predicate logic, covers the three aspects of data that any DBMS must address: structure, integrity, and manipulation.

Originally, the relational model was presented as a set of features (see table 1) whose meaning and implications, while obvious to Codd, were misunderstood or distorted by others. Therefore, he supplemented them with the now-famous Fidelity Rules (see table 2) to guide the implementation and evaluation of relational DBMS software. [Editor's note: *These are known as the 12 Fidelity Rules although there are 13 of them. They intentionally start with Rule 0.*] Since then, he has refined, clarified, and extended the model in many ways, but the initial features and rules remain as valid as ever.

A relational DBMS presents databases to the user as collections of tables—and nothing but tables. But these tables must obey a certain discipline. They must have unique rows (whose storage addresses or ordering are not necessary to access their data), and their cells must be single-valued. The DBMS (not the user) must ensure that all database tables comply with these requirements. When they do, it can apply mathematical operations

Table 2: The 12 Fidelity Rules (as emphasized by the author). Codd wrote these rules to clarify the features in table 1 (see reference 20).

0. Foundation Rule

Any system that is advertised as or claimed to be a relational DBMS must

- manage the database
- entirely through its relational capabilities.

1. Information Rule

All information in a relational database must be represented

- explicitly
- at the logical level
- in exactly one way
- by table values.

2. Guaranteed Access Rule

Each and every data value in a relational database is

- guaranteed to be
- logically accessible

by resorting to a combination of

- table name,
- column name, and
- primary key value.

3. Missing Information Rule

Missing value indicators

- distinct from
- empty character strings
- strings of blank characters
- 0, or any other numbers

must

- represent and
- support in operations
- at the logical level
- in a systematic way
- independent of data type

the fact that values are missing for

- applicable and
- inapplicable

information.

4. System Catalog Rule

The description of the database is represented

- at the logical level

- dynamically
- like ordinary data

so that authorized users can apply

- the same (relational) language to its interrogation.

5. Comprehensive Language Rule

No matter how many languages and terminal interactive modes are supported

- at least one language must be supported that is expressible as
- character strings
- per some well-defined syntax that supports
- interactively
- by program

1. data definition
2. integrity constraints
3. data manipulation
4. views
5. transaction boundaries
6. authorization privileges.

6. View Updatability Rule

The DBMS must have

- a way of determining
- at view definition time

whether a view can be used to

- insert rows,
- delete rows, or
- update which columns

of its underlying base tables and store the results

- in the system catalog.

7. Set Level Updates Rule

The capability of

- operating on whole tables

applies not only to retrieval, but also to

- insertion,
- modification, and
- deletion

of data.

8. Physical Data Independence Rule

Application programs and interactive operations should not have to be modified whenever changes are made in

- internal storage or
- access methods.

9. Logical Data Independence Rule

Application programs and interactive operations should not have to be modified whenever

- certain types of changes
- involving no loss of information are made to the base tables.

10. Integrity Independence Rule

Application programs and interactive operations should not have to be modified whenever changes are made in

- integrity constraints
- defined by the data language and
- stored in the catalog.

11. Distribution Independence Rule

Application programs and interactive operations should not have to be modified whenever data

- is first distributed or
- redistributed

on different computers.

12. Nonsubversion Rule

If a DBMS has a low-level (procedural) language, that language should not be allowed to

- subvert or
- bypass
- integrity constraints or
- security constraints

expressed in the high-level relational language.

and strict logic to them, as if they were "relations." This eliminates traditional deficiencies and offers significant practical benefits.

The tabular structure is simple and familiar. It is general enough to represent most types of data; it is independent of any internal computer mechanisms; and it is flexible, because you can readily restructure tables vertically, horizontally, or both ways, through either splitting or joining.

In fact, because table manipulation always yields results that are tables them-

selves, unlimited nesting of operations is also possible for relationally disciplined tables. Data manipulation by relational DBMSes consists of a well-defined, complete set of mathematical operations (see reference 4). If the DBMS supports the five basic operations and some useful combinations (see figure 1), data access no longer needs to be procedural.

At a high level, you can specify a data request as a result table, in terms of the operations that must be performed on other tables to derive it. The system then transparently translates these logical re-

quests into an efficient internal-access strategy. A relational DBMS can use information about the database (e.g., statistics) in its catalog (a set of tables dynamically maintained by the system) to optimize the logical operations.

The relational approach requires the system to enforce centrally (i.e., in the database) strict and comprehensive integrity constraints (the five types of integrity are listed in table 1) to ensure data accuracy and consistency. Thus, a relational DBMS relieves you of developing

continued

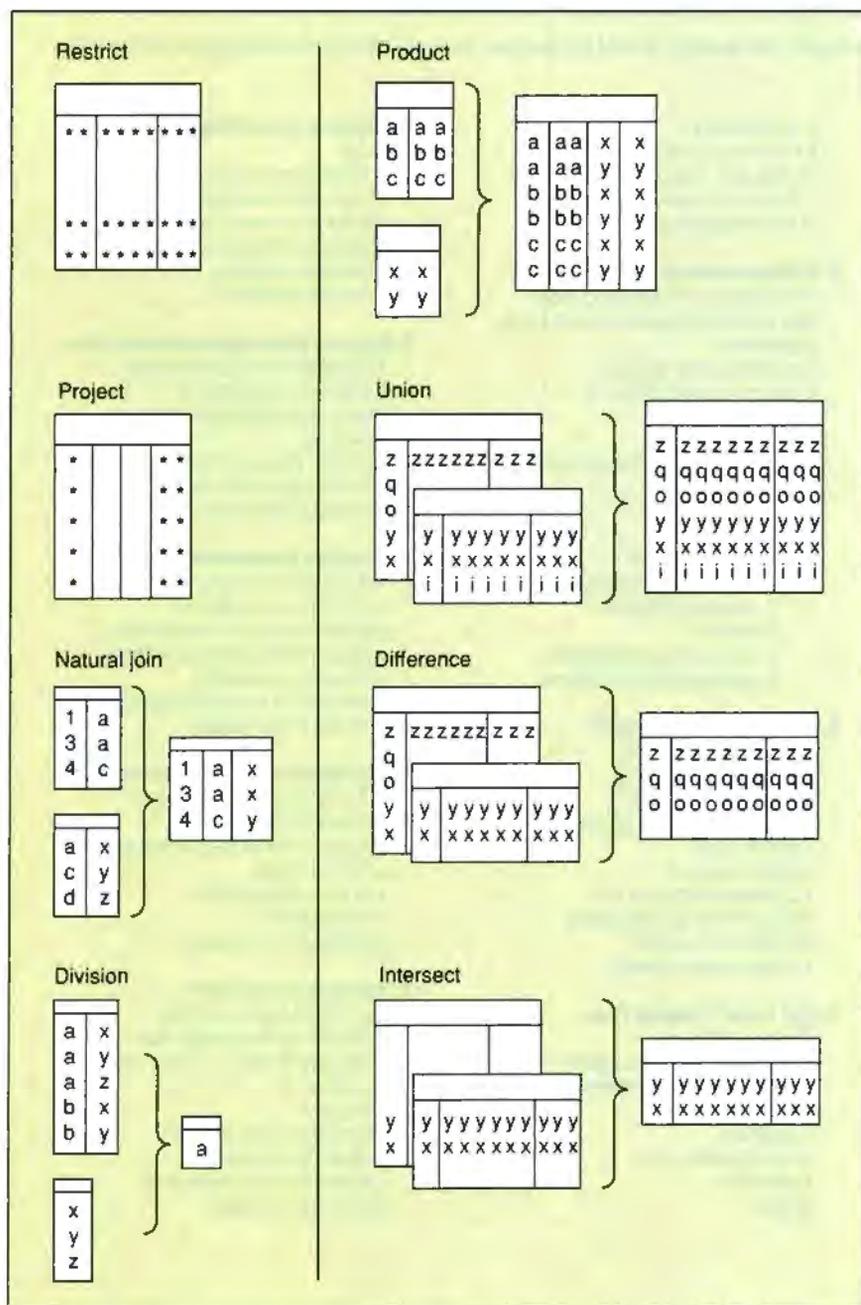


Figure 1: Table manipulation yields results that are tables themselves. Thus, if the DBMS supports the operations shown here, data access need no longer be procedural.

or maintaining integrity code in your applications and offers a level of productivity and reliability superior to that of traditional systems (see reference 5). In addition, the relational model also requires support of logical units of work (or multistatement transactions), as well as self-recovery from operational failures that can corrupt the database.

But for the practical benefits of the relational model to materialize, its struc-

tural, integrity, and manipulative features must be incorporated in the DBMS engine (or back end). The features are highly interdependent, and the lack of any one feature affects the support of the others. You can't provide all the intended benefits by arbitrarily implementing only some of the features or by simply adding an interface to nonrelational engines. The fidelity rules were devised to clarify this important point.

The mathematical and logical basis of the relational foundation makes it a natural candidate for a database standard. A standard based on the relational model would yield the best of both worlds: The products that complied would offer both relational fidelity and standard compatibility. The underlying database functions would be the same for all products, regardless of whether they are stand-alone or multiuser or what kind of front-end tools and applications they have. In addition, front-end tools such as spreadsheets and word processors could then all operate on databases, not on disparate files.

Structured Query Language

The only concrete expression of the relational model that has gained industry acceptance is Structured Query Language; SQL is now part of IBM's Systems Application Architecture (SAA) strategy. Four SQL dialects have been incorporated into IBM's DBMSes: DB2 (MVS), SQL/DS (VM), SQL/400 (OS/400), and Database Manager (OS/2 Extended Edition). Subsequently, SQL has been adopted as a standard by ANSI, the International Standards Organization, the Open Software Foundation, X/Open, and Federal Information Processing Standards. Some microcomputer implementations have been around for quite a while (see reference 6), but now there is a real stampede. Despite the rush to SQL, however, most of its pros and cons (especially for the microcomputer environment) are poorly understood (see reference 7).

SQL is a language for interacting with relational databases, *not* a full application development language. First, this keeps the well-defined, set-oriented database foundation distinct from the less precise, procedural character of existing programming languages. Second, it avoids creating yet another general-purpose language that, by trying to be everything to everybody, becomes too complex to master and invites compromises. Third, it eschews the lengthy political process that would be required to extend standard procedural languages such as COBOL and FORTRAN with relational database functions.

Using SQL

SQL statements are embedded in programming languages, where they retrieve sets of rows from the database, stepping a cursor through them one at a time and passing each to host-language variables for further processing. The

continued



No Other Company We Know Imprints a Seal of Quality on Every Piece of Equipment it Ships. This Seal Guarantees Our Customers that Every Component has been Hand Inspected and Electronically Tested for 72 Consecutive Hours or More.

Samsung amber high res 14" flat screen monitor with tilt and swivel base



All buttons and status lights easily accessible on front panel

Modern small footprint case with power supply

Keytronic enhanced 101 keyboard

The deal is straightforward. Every system is complete, tested and 100% guaranteed, built to meet the industry's highest standards. The components are from the most respected manufacturers and the system is future oriented to easily upgrade and expand

MULTIMICRO 386/20 for \$1889

The same features and high quality components

MULTIMICRO Custom Computers

We'll build whatever you need to the same exacting standards.

Our Warranty Is Simple

If anything goes wrong with your MultiMicro computer, we will repair or replace it for one year from date of purchase.

We're Proud of Our Components

Compare our 386/25mhz features before you purchase any other system:

- Intel 25mhz CPU chip is at the heart of our computer
- Our chip set is from Chips and Technology
- 80387/Weitek co-processor socket for future upgrade
- The best diagnostic and set up software from AMI
- 1mb of memory easily expandable to 8mb on the board
- Western Digital 1:1 interleave mfm controller for fast data transfer
- Seagate 32mb mfm hard disc with auto park provides substantial storage capacity at a fast 28ms access time
- Your choice of Teac high density 1.2mb 5.25" or 1.44mb 3.5" floppy drive
- Hercules compatible monographics card has 132 column capability. You also get color emulation and screen saver software

Our phone number is 415 979 0140
or Fax 415 979.0142

Call us anytime to place an order or discuss
your computer needs



We Want to be Your Computer Company

582 Folsom Street
San Francisco, CA 94105

All brand names are registered trademarks of their respective companies.

Table 3: Current versions of SQL lack important functions. For example, both the SQL standard and IBM's DB2 dialect of SQL comply only partially with the 12 Fidelity Rules.

	ANSI	IBM
0. Foundation Rule	P ¹	P ¹
1. Information Rule	Y	Y
2. Guaranteed Access Rule	N	P ²
3. Missing Information Rule	N	P
4. System Catalog Rule	N	Y
5. Comprehensive language Rule	P	P
6. View Updatability Rule	N	P ³
7. Set Level Updates Rule	P	Y
8. Physical Data Independence Rule	Y	Y
9. Logical Data Independence Rule	P ⁴	P
10. Integrity Independence Rule	P	P ⁵
11. Distribution Independence Rule	?	I
12. Nonsubversion Rule	?	Y

Y = full support
N = no support
P = partial support
I = intended support
? = unspecified

¹Reflected in rules 1-12.
²Key support, but allows duplicate rows.
³Only simple views updatable.
⁴Due to ³.
⁵Partial entity, referential integrity.

source code containing SQL is preprocessed to translate the embedded SQL statements into optimized database calls specific to the host language. Then the source code is compiled and executed in the regular way. Embedded SQL can be *static* (where the SQL statements are known and, therefore, can be preoptimized and precompiled) or *dynamic* (where the SQL statements are specified by users at run time and thus are optimized and compiled then).

Application Programming Interfaces (APIs) to SQL engines are also provided for programming languages. Here, the host language passes the SQL statements as string variables to the DBMS for execution, and the receiving program loops over the resulting sets in the traditional way.

The attraction of these approaches is that you can use SQL within familiar, standard (and thus portable) languages. However, the interface between procedural and set-level technologies is cumbersome and defeats many of the relational intentions.

There are attempts to make SQL more of a development language, either by extending it with programming constructs or by making dialects of SQL an integral part of a 4GL. These combinations are usually somewhat smoother, but stan-

dardization and portability are limited.

SQL is also incorporated in front-end tools other than programming languages, which, from a microcomputer perspective, is a more palatable alternative. Thus, in forms-based systems, you can inlay SQL statements in the forms. Or you can hide SQL altogether with menu-, prompt-, or form-driven capabilities such as query-by-example, query-by-form, or graphical interfaces. These guide you in specifying the table operations underlying SQL, leaving the system to generate and execute the appropriate SQL statements transparently. This approach requires good mapping between relational functions and these tools. This is the direction for the future, but most developers prefer, as an easier first step, to migrate whatever tools they already have to SQL engines. SQL's imperfections (see reference 8) and its questionable implementation in some products (see reference 9) do not help.

Fidelity vs. Compatibility

Weaknesses in the SQL language itself cause some of this variation and the consequent implementation problems. The ANSI standard was initiated after many SQL dialects had already been implemented. In their current versions, the standard and commercial dialects are re-

lationally incomplete (table 3 shows, for example, that the standard and the DB2 dialect comply only partially with the 12 Fidelity Rules). They also lack important functions and suffer from redundancy, arbitrary restrictions and inconsistencies, failure to obey simple rules of arithmetic, and on and on (see references 10 and 11).

The standard concentrates on syntax, leaving important aspects such as semantics, catalogs, data types, the programming interface, and concurrency control to the developers. The ANSI committee continuously revises the standard, but a large committee of vendors, each with vested interests in their own existing nonrelational systems or SQL dialects, cannot design a correct and coherent language. Consequently, most SQL developers extend their dialects beyond the standard to offer missing or advanced functionality (see reference 12). Meanwhile, the laxity of the standard is exploited by staking claims of compatibility for products that are not genuine SQL implementations (see reference 13). Some even claim relational features that are not truly so (see reference 14).

This creates significant difficulties for those who want to interface their tools to SQL DBMSes, and for those who must decide which products to choose—the exact problem the relational approach was intended to solve (see reference 15). Nevertheless, the fact remains that, however imperfect or incomplete, SQL is a relational data language whose dialects, although different in many ways, have more in common than (as well as advantages over) the proprietary, procedural data languages in existence (see reference 16).

Connectivity vs. Portability

It is the relational nature of SQL that has propelled it as the language of choice for connectivity. Its high level, set orientation, and support of physical data independence make possible many of the current developments in the database arena. Cooperative processing (as in the client/server approach), distributed databases, and parallel processing are all facilitated by relational technology.

Cooperative processing and database distribution among networked heterogeneous computers become possible not only because workstations can now communicate in a standard language with different remote database servers. These things are also possible because database functions, including integrity and security, are now centrally, relationally,

continued

Rupp Corporation Presents Power Products Showcase No. 20

Circle 252 on Reader Service Card



XIRCOM

The Xircom Pocket Ethernet Adapter allows you to conveniently connect any IBM compatible personal computer to an Ethernet or IEEE 802.3 local area network. This adapter connects externally to any parallel printer port, eliminating the hassles of installing an internal Ethernet adapter.

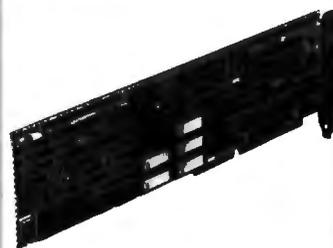
It's the only adapter that can easily be used with laptop computers and is also an ideal choice for workstations where board slots or power are at a premium. The Pocket Ethernet Adapter is also an economical choice for a group of in-

frequent network users because it can be quickly and easily moved from computer to computer. It contains no configuration switches, completely avoiding the problems of address and interrupt conflicts common with other Ethernet adapters. Drivers for Novell Netware version 2.0 and 2.1 are included.

Features:
Uses LPT port.
For all IBM compatibles.
Netware 2.x compatible.
IEEE 802.3 standard.

PRICE \$695

Circle 253 on Reader Service Card



PM3011 CACHING CONTROLLER

Up to 16MB of hardware implemented cache for ESDI, RLL of ST506 drives.

Product Profile: The PM3011 caching controller is the single most effective performance improvement tool available for disk-intensive applications. The PM3011 accesses data in as little as 0.5ms; that's 50 to 150 times faster than a random disk access.

Advanced Caching Algorithms: Such advanced caching features as disk read ahead and elevator sorting during cache write-back increase disk performance to levels unattainable by non-caching controllers. The controller's on-board 68000 microprocessor enables it to access the disk

drive at the same time as the computer reads or writes to the controller cache.

Compatibility: Since PM3011 caching controllers operate transparently to the operating system, special software drivers or ROM BIOS changes are not required.

Up to 16MB of Cache: The PM3011 Cache RAM is expandable from the on-board 512KB to 16MB with the optional Cache Expansion board. The cache is totally independent from system memory and does not require device drivers.

PM3011/70 Caching Controller With 512KB cache. \$1150

Circle 254 on Reader Service Card



FASTLYNX

Product Profile: FASTLYNX is the top of the line file transfer package designed by the pioneers of high speed file transfer, here at RUPP. It transfers information faster than any product of its kind: over 500,000 baud in parallel mode or 200,000 baud in serial mode.

Easy and Versatile
No file transfer program is easier to use than FASTLYNX. What other file transfer utility offers auto-port/auto-baud select, on-line reference guide and dual error checking with auto select.

Remote Install Capability
A file transfer utility should not only be extremely easy to use, it should also be

convenient. With our unique self cloning capability you no longer need to have FASTLYNX on both machines. Just download FASTLYNX thru the serial port and you're ready to go.

Printer and Disk Sharing
Another first, only FASTLYNX delivers both parallel and serial device drivers in one package along with both a serial and parallel cable. With our unique ultra-fast parallel device driver you can share printers effortlessly. You also get speedy direct disk access so you can run a program that resides in the remote computer, just like a mini network.

FASTLYNX \$149.95

*For pricing on RLL, ST506 controllers and other options please call

Call 212-517-7775
Fax 212-249-8243
Dealer Inquiries Welcome
Charge Cards Accepted: Amex, Visa, MC
Hours (EST) 9:00 to 5:00



Exceptional Computer Products

Rupp Corporation
835 Madison Avenue
New York City, NY 10021

Seven ~~Bit~~ Five easy ways to boost your BASIC



PROBAS™ Basic Programming Library

So who cares that BYTE magazine calls PROBAS a "Supercharger for QuickBASIC" or that PC Tech Journal says that PROBAS is a "high-quality, high-quantity package"? Who buys a product just because Jerry Pournelle said "Anyone doing serious QuickBASIC programming would do well to get [PROBAS]"? And who cares that Wayne Hammerly calls PROBAS "The greatest thing since sliced bread"?

Who?--Only those who want to write better, faster, slicker programs and save hundreds of programming hours in the process. With all of that hoopla out of the way, we are formally announcing the momentous release of PROBAS Version 3.1, now with over 400 assembly routines to make BASIC programs faster and more powerful than you ever dreamed with features like:

- A 1,000-page two-volume manual
- Full mouse support
- Extended and EMS memory support
- Full-featured windowing
- Moveable, resizable windows
- Screen snapshots (text & graphics)
- Virtual screens in memory
- Lightning-fast file I/O
- Critical error handling
- String, array, and pointer sorts
- Search directories and archives

Create dazzling screens in text, CGA, EGA, VGA, and Hercules graphics modes with windows that can overlay one another and be moved and resized on the fly. Store megabytes of string, data, or screen snapshots in extended or EMS memory. Draw complex text or graphic screens to memory and snap them on in an eyeblink. The PROBAS file I/O routines allow you to read or write huge chunks of data at a clip, far faster than with BASIC.

PROBAS also has over 300 other essential services, including handy string, date, time, directory, and array manipulation routines; string, screen, and data compression routines; valuable equipment and input routines; and faster replacements for many BASIC commands.

Whether you are a professional or a novice, PROBAS will boost your BASIC in ways you never thought possible. PROBAS allows the professional to write faster, tighter code in much less time and allows novices to quickly and easily write professional-quality programs that would be impossible with BASIC alone. The bottom line is PROBAS adds power and saves time. After all, how much is a few hundred hours of your time really worth?

For all DOS versions of QuickBASIC and BASCOM. **Just \$149.00!**



PROREF™ On-Line Help For PROBAS

PROREF provides on-line help for the routines in the PROBAS library. This hypertext manual links directly to the QB Advisor in QuickBASIC 4.5 so that the PROBAS reference becomes an integral part of your QuickBASIC on-line manual. Includes information and examples on PROBAS routines and helpful hints on programming in BASIC. **Just \$50.00!**



PROSCREEN™ Screen Management

PROSCREEN is a full-featured screen generator/editor that will save you more design and coding time than you ever thought possible. PROSCREEN treats screens like a word processor treats text to provide complete control over characters, colors, and placement. Design input screens with up to 130 fields, 19 pre-defined and 2 user-defined masks. Save screens to screen files or .OBJ files and use the tight BASIC/Assembly code that comes with PROSCREEN to access the screens. There's no kludgy code generator here! Access hundreds of input screens with less than 25k of total code. **Just \$99.00!**



PROMATH™ Mathematics Library

PROMATH is a collection of over 150 high-level routines that provide mathematical functions and operations for programmers who often work in mathematics, science, or engineering. Complex variables, real and complex matrices, real and complex trigonometric and hyperbolic functions and their inverses, solution of linear equations, integration, differential equations, Fast Fourier transforms, graphics support, and many other useful routines are provided.

For years Fortran has been the language of choice for scientific and engineering applications, but it lacks many of the useful features of QuickBASIC. PROMATH contains most of the Fortran mathematical and numeric functions and allows you to easily translate Fortran code to BASIC or write new programs in BASIC, while retaining Fortran's numerical prowess.

The PROMATH manual is over 200 pages and provides a complete description of each routine, including any algorithm and the mathematical formula the routine uses, shown in standard notation. For QuickBASIC 4 and BASCOM 6 only. **Just \$99.00!**



PROBAS™ TOOLKIT

The TOOLKIT is a collection of high-level BASIC and assembly modules that use the routines in the PROBAS library to save you even more hours of grunt work. Why spend hundreds of hours re-inventing the wheel when you can just plug in TOOLKIT modules like:

- Super-fast B-Tree indexing
- Ring, Bar, Pop-Up, Pull-Down menus
- Scroll-bar tag windows
- Dialog boxes with radio buttons
- Two mini-editors with word wrap
- BCD math routines
- Julian date & calendar routines
- Patch .EXE files
- Protected memory storage area

The TOOLKIT now supports EGA and VGA graphics modes for menus, windows, editors, calendars, and more. Complete with BASIC source code and an all-new comprehensive manual. The TOOLKIT requires the PROBAS library and helps conserve your greatest asset of all—time! **Just \$99.00!**

PROBAS™ TELECOMM TOOLKIT

The PROBAS TELECOMM TOOLKIT is a collection of high-level communications modules that you plug into your code to provide popular file transfer protocols, terminal emulations, login scripts and baud rates up to 115,200 baud. You get:

- Xmodem/Modem7/Xmodem-1k
- Ymodem (single and batch)
- CRC-16 and Checksum
- VT52, VT100, ANSI, BBS etc.
- Auto Dialer & data base
- Documented BASIC source

Why use clumsy SHELLs to complex terminal programs when you can plug just the communications routines you need into your code? Implement just the features and commands you want. Requires PROBAS. **Just \$75.00!**

Our thirty-day, money-back guarantee assures you the highest quality and our technical support staff is always ready to help.

HAMMERLY
COMPUTER SERVICES, INC.

9309 JASMINE COURT • LAUREL, MD 20707

(800) 343-7484

INT'L. ORDERS: (301) 953-2191 FAX: (301) 725-8147
BBS: (301) 953-7738

Add \$5.00 per item (\$8.00 Canada) for shipping per order, Europe: \$39.00 for 1st item plus \$5.00 for each additional item. Visa, M/C, C.O.D. (US Only) checks and approved POs accepted. Trademarks PROBAS, PROREF, PROSCREEN, PROMATH, Hammerly Computer Services Inc, QuickBASIC, BASCOM, Microsoft Corp.

effectively, and efficiently managed by those servers.

Only the data required by authorized applications is shipped over the network as sets, improving performance, preserving data reliability, distributing the processing load, and eliminating explicit import/export conversions. True distributed DBMSes will even decide which participating DBMS should perform an operation on distributed data, to optimize overall performance. Consequently, tools and applications running on

The trend toward SQL is accompanied by technological changes separate from database matters.

microcomputers will be able to operate transparently on databases residing on any platform, reducing the importance of portability.

It's a mistake to assume, however, that SQL's only value is as a standard connectivity language to link microcomputers to minicomputers and mainframes, and that it should be ignored in stand-alone or single-user PC environments (see reference 17). Easier-to-use tools and applications with forms, iconic, or object orientations can better exploit the relational features underlying SQL (see references 18 and 19). These can directly manipulate relational data as sets, rather than one row at a time, as with procedural tools. Because there is better affinity between these high-level development techniques and relational database functions, there is a great deal of synergy between these separate but simultaneously emerging technologies.

The Price of Progress

Progress, however, comes at a price. The trend toward SQL is accompanied by technological changes separate from database matters. There is continuous progress in hardware: 80386, 80486, RISC, parallel processing, WORM (write once, read many times), CD-ROM, and erasable optical storage. As a

new, multitasking operating system with a graphical user interface and large memory addressability, OS/2 is being positioned to take advantage of these advances and to offer easier interaction with the machine. There are also many new sophisticated microcomputer connectivity facilities (e.g., LAN Manager, LAN Server, and APPC).

While the ensuing environment no longer holds back DBMSes, it imposes certain burdens on developers and forces users to cope with multiple conceptual changes. These changes can easily overwhelm relational benefits. Moreover, the move from stand-alone, single-user systems to shared environments involves complexities that are unavoidable and similar to those experienced at the mini-computer and mainframe level.

Issues such as concurrency, security, and data and network administration, which are inherently complex and were ignored in traditional microcomputer database systems, must now be properly facilitated by database software and understood and managed by microcomputer users. Anything that can be done under these circumstances to simplify, systematize, and standardize at least the database management component is a critical improvement—hence the value of relational technology.

Misconceptions and Changes

A major obstacle to the acceptance of the relational model lies in the various misconceptions about the technology prevailing today. Some of the most common are as follows:

1. A relational DBMS is one that handles multiple files at a time.
2. The relational approach is theoretical, and, therefore, it has no practical relevance for users.
3. New technologies, such as object-oriented or semantic databases, are making the relational approach obsolete.
4. SQL is useful only for connecting microcomputers to minicomputer or mainframe data.
5. A SQL interface can offer full relational benefits while preserving compatibility with existing applications.
6. Relational DBMSes require that you learn and use SQL directly. This is more difficult than using traditional databases.
7. If a DBMS provides easy-to-use icons, menus, and screens, then you shouldn't care about the underlying database technology.
8. You can get the same full-relational

continued

Circle 128 on Reader Service Card



Unleash the BASIC Power of Hypertext!

Our latest BASIC-booster includes the first hypertext engine designed to be called from BASIC. With the **PROBAS HYPERHELP TOOLKIT** you can use the hypertext engine to put one or more manuals on-line with full hypertext search facilities. Imagine having one or more manuals on-line with all of the fantastic hypertext abilities in the QuickBASIC 4.5 compiler and then some:

- Choose single- or multi-window display
- Specify window colors and placement
- Move and resize windows with mouse or keys
- Sophisticated mouse and keyboard interface
- Up to 40 bookmarks to move between hyperlinks

In less than a dozen lines of code you can pop-up context-sensitive help at any time. Your users can then jump to related help, examples, or just browse the manual(s) in one or more windows that they can move or resize at will. The text will automatically wrap within the window to stay fully visible!

Create HyperCard Applications

Use the **HYPERHELP** engine to create full-blown hypercard applications. Create sophisticated multi-window, multi-thread hypercard stacks. Mix cards and manuals for total data integration. Moving from link-to-link or card-to-card is instantaneous and the speed will amaze you.

Adding hypertext to your applications takes less than about a dozen lines of BASIC code. Converting ASCII text to hypertext is just as easy—just put delimiters around keywords, hyperlinks, and items you want to display in boldface.

Multiple Help Subsystems

The hypertext engine is just a part of the **HYPERHELP TOOLKIT**. There is a wide selection of help subsystems with various displays, user interfaces, and memory requirements to suit almost any need. Want a small, window-oriented, keyword help system? It's in there! Need a Terminate & Stay Resident help system? It's in there! How about a lightbar indexing system that then pops-up the selected text? It's in there!

The **HYPERHELP TOOLKIT** gets its blinding speed by using the low-level routine in our **PROBAS** Professional Basic Programming Library. **HYPERHELP** requires the **PROBAS** Library. See our ad on the opposite page for information on **PROBAS**, shipping rates, and our **thirty-day money-back guarantee**.

Special Introductory Price—For a short time this powerful hypertext engine and collection of help subsystems is available for **just \$99.00!**



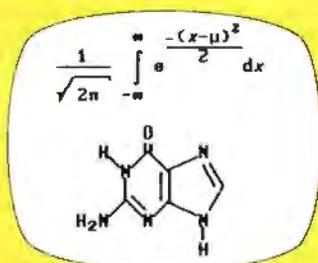
HAMMERLY
COMPUTER SERVICES, INC.
9309 JASMINE COURT • LAUREL, MD 20707
(800) 343-7484
INT'L. ORDERS: (301) 953-2191 FAX: (301) 725-8147
BBS: (301) 953-7738

Add \$5.00 per item (\$8.00 Canada) for shipping per order
Europe: \$39.00 for 1st item plus \$5.00 for each additional item. Visa, M/C, C.O.D. (US Only) checks and approved POs accepted. Trademarks **PROBAS**, **PROHELP**, **PROSCREEN**, **PRODATA**, **Hammerly Computer Services, Inc.**, **QuickBASIC**, **BASICOM**, **Microsoft Corp.**

ChiWriter

Powerful Scientific/Multifont Word Processing at a Reasonable Price

How are you currently producing your scientific documents? Are you using a "golf ball" style typewriter? A regular word processor, hand lettering the special symbols? Are you fighting against a "what-you-see-is-definitely-not-what-you-get" system with a special command language? Or are you using one of our competitors' expensive and inflexible programs? Find out how ChiWriter can solve your scientific word processing problems.



From an actual ChiWriter screen display

ChiWriter is a complete word processor, designed especially for scientific and foreign language text. Its features include: intuitive formula editing commands, automatic pagination, variable headers and footers, footnotes, box draw mode, a notepad window, and an integrated spelling checker.

Best of all, ChiWriter is completely "what-you-see-is-what-you-get." Even complicated formulas can be entered easily because the screen display corresponds exactly to the printout.

ChiWriter runs on IBM PC compatibles with 2 floppy disks or a hard disk, 384K RAM and CGA, Hercules, EGA, VGA or AT&T graphics. Support for all popular dot-matrix printers is included. The Laser Printer Support is required for HP LaserJet, DeskJet and PostScript printers.

In Short: An easy-to-use WYSIWYG package with powerful scientific/multifont word processing at a bargain price.

PC Magazine, July 1988

- | | |
|---|--|
| <input type="checkbox"/> ChiWriter Program | \$149.95 |
| <input type="checkbox"/> Laser Printer Support | \$74.95 |
| <input type="checkbox"/> WordStar/WordPerfect Converter | \$59.95 |
| <input type="checkbox"/> Chemistry Font Set | \$59.95 |
| <input type="checkbox"/> Russian Font Set | \$29.95 |
| <input type="checkbox"/> ChiWriter Deluxe (all of the above) | \$299.95 |
| <input type="checkbox"/> Conographic Font Set | \$149.95 |
| <input type="checkbox"/> MergeChi Mail Merge Program | \$29.95 |
| <input type="checkbox"/> Index Generator | \$59.95 |
| <input type="checkbox"/> Add \$5.00 for 3 1/2" Disk | |
| <input type="checkbox"/> Check here for 20% educational discount (school and university teachers and students only) | |
| <input type="checkbox"/> Shipping & handling | \$ |
| | \$5 U.S. & Canada, \$15 Europe, \$20 elsewhere |

Name _____

Address _____

City _____

State _____ Zip _____ Country _____

Phone () _____

Payment by Check Purchase Order VISA MC

Card # _____ Exp. _____ BY 9/89

Horstmann Software Design Corporation
4 N. 2nd St., Suite 500/P.O. Box 5039
San Jose, CA 95150-5039, USA
(408) 298-0828, FAX (408) 298-6157

horstmann software

benefits by mixing and matching any front-end tool with any SQL back end; the latter are simply becoming a commodity.

One example of the results of these misconceptions is an attempt I saw to retrieve 100 records from a database by issuing 100 separate SQL statements, each retrieving one row. Another example is discounting DBMS enforcement of integrity rules because "I do that myself anyway."

The relational approach is fundamentally different and shifts the burden of managing the database from users to the DBMS. Therefore, there are limits to the ability to extend traditional products or migrate existing applications to SQL DBMSes *as is* and still benefit from relational advantages. In addition, it's unlikely that the DOS environment will be able to support the increasing sophistication of DBMSes as their relational fidelity is enhanced.

Where Are DBMSes Going?

What is badly needed is an improved, fully relational SQL standard that leads, not follows, the market. There must be new kinds of tools that truly exploit both relational power and the graphical, multitasking, and connectivity facilities of the new microcomputer environment, without falling into the "mainframization" trap. And the complexities of con-

nectivity shouldn't overwhelm database management simplicity.

There are already signs that these fundamental changes in technology are restructuring the industry. A handful of SQL servers will emerge, with most other traditional DBMS vendors turning into front-end tool and application providers. There will be strategic alliances between technologies such as hardware, SQL, graphics and object orientations, communications, and so on, because no one vendor can hope to address all these elements in an optimal way. The emphasis will be on corporate rather than personal systems, and it will probably take several years until beneficial results will materialize for informed users.

Expect the first generation of front ends for SQL DBMSes under OS/2 to be mainly extensions of existing products. Take the opportunity, during this period, to educate yourself for the new DBMS world. It will be braver than what it was, but probably not as brave as it should be. And it will take knowledge, not merely experience, to exploit the implications. ■

Fabian Pascal is president of micro-paSQL, a Washington, D.C., consulting firm affiliated with Codd & Date International that specializes in relational database management and SQL on the microcomputer. You can reach him on BIX as "fpascal."

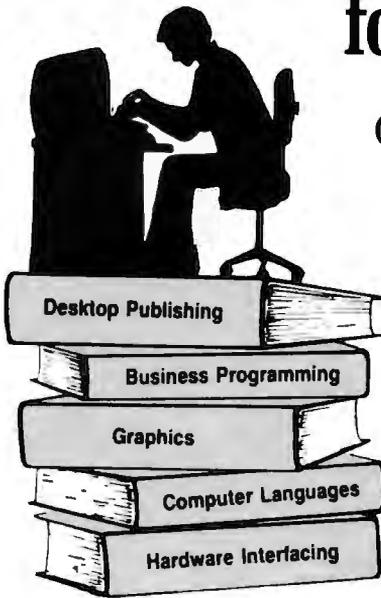
REFERENCES

1. Pascal, F. "How to Select a SQL Micro DBMS." *Relational Journal*, August 1988.
2. Pascal, F. "PC Magazine Goes Relational (or Does It?)." *CPCUG Monitor*, August and September 1988.
3. Codd, E. F. "A Relational Model of Data for Large Shared Data Banks." *Communications of the ACM*, June 1970.
4. Pascal, F. "Lay It on the Table." *DBMS*, June 1989.
5. Pascal, F. "Preserving Data Integrity," parts 1 and 2. *HP Professional* (in press).
6. Finkelstein, R., and F. Pascal. "SQL Database Management Systems." *BYTE*, January 1988.
7. Pascal, F. "RDBMS's Fight a Bum Rap." *Computerworld*, February 1989.
8. Codd, E. F. "Fatal Flaws in SQL," parts 1 and 2. *Datamation*, August and September 1988.
9. Pascal, F. "dBASE IV Breaks Codd's Rules." *DBMS*, February 1989.
10. Date, C. J. *A Guide to the SQL Standard*, 2nd ed. Reading, MA: Addison-Wesley, 1989.
11. Pascal, F. "SQL Redundancy and DBMS Performance." *Data Base Pro-*

- gramming and Design, December 1988.
12. Pascal, F. "Sybase Today, SQL Server Tomorrow." *Data Based Advisor*, April 1988.
13. Pascal, F. "R:base's SQL 'Implementation.'" *Data Based Advisor*, April 1988.
14. Pascal, F. "Referential Integrity's Integrity." *Data Base Programming and Design*, May 1989.
15. Pascal, F. "No Wonder Users Are Frustrated." *Data Base Programming and Design*, July 1989.
16. Pascal, F. "Relational Technology and SQL." *Focus Systems Journal*, July 1988.
17. Pascal, F. "Missing the Point." *Data Based Advisor*, February 1989.
18. Pascal, F. "A Metaphor of PC Tools Coming Up." *Data Base Programming and Design*, March 1989.
19. Pascal, F. "Graphic Treats for PC Users." *Data Base Programming and Design*, April 1989.
20. Codd, E. F. "The Twelve Rules for Determining How Relational a DBMS Product Is." *TRI Technical Report EFC-6/05-16-86*. San Jose, CA: The Relational Institute, 1986.

SELECT 5 BOOKS for only \$3⁹⁵

(values to \$133.75)



3131 \$24.95

When it's new and important in business or personal computing,
The Computer Book Club® has the information you need . . .
at savings of up to 50% off publishers' prices!



3028P \$19.95



3019 \$39.95
Counts as 2



3146P \$17.95



1860P \$16.95



2997 \$25.95



2897 \$28.95
Counts as 2



2852P \$17.95



2807P \$14.95



1648P \$16.95



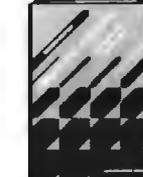
2870 \$24.95



3047 \$34.95
Counts as 2



8226 \$29.95
Counts as 2



9808 \$34.95



2767P \$21.95



3109 \$28.95
Counts as 2



2913P \$14.95



3119P \$21.95



3236P \$17.95



3237P \$34.95
Counts as 2



3207P \$19.95



2879P \$22.95



3070P \$24.95
Counts as 2



2856P \$18.95



2998P \$21.95



3068 \$39.95
Counts as 2



3232P \$17.95



2920P \$15.95



2809P \$18.95



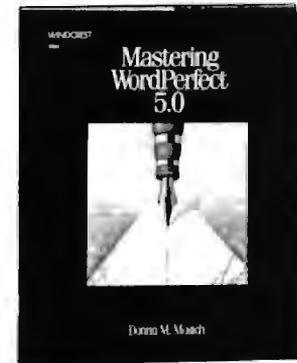
3026 \$22.95



2990 \$34.95
Counts as 2



3030P \$17.95



3084 \$29.95
Counts as 2

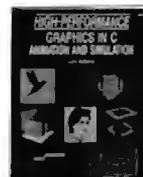
All books are hardcover unless numbers are followed by a "P" for paperback. (Publishers' Prices Shown)



The Computer Book Club®

Membership Benefits • Big Savings. In addition to this introductory offer, you keep saving substantially with members' prices of up to 50% off the publishers' prices. • **Bonus Books.** Starting immediately, you will be eligible for our Bonus Book Plan, with savings of up to 80% off publishers' prices. • **Club News Bulletins.** 14 times per year you will receive the Book Club News, describing all the current selections—mains, alternates, extras—plus bonus offers and special sales, with scores of titles to choose from. • **Automatic Order.** If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the reply form provided. As a member, you agree to purchase at least 3 books within the next 2 years and may resign at any time thereafter. • **Ironclad No-Risk Guarantee.** If not satisfied with your books, return them within 10 days without obligation! • **Exceptional Quality.** All books are quality publishers' editions especially selected by our Editorial Board. BY989

If card is missing, use this address to join: ©1989 THE COMPUTER BOOK CLUB®
Blue Ridge Summit, PA 17294-0820



3048P \$26.95
Counts as 2



2820P \$16.95



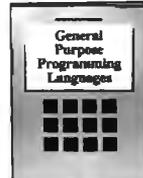
2841P \$16.95



3057P \$15.95

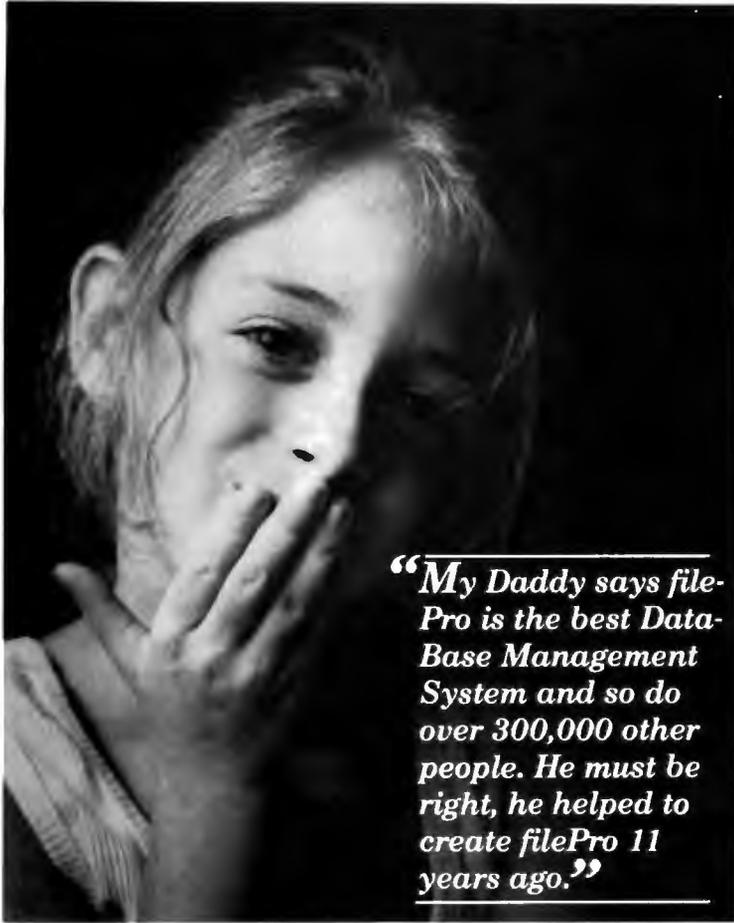


2850 \$25.95



8222P \$19.95

WANT To KNOW A Secret ?



“My Daddy says file-Pro is the best Data-Base Management System and so do over 300,000 other people. He must be right, he helped to create filePro 11 years ago.”

filePro is the software of choice in FORTUNE 1000 companies, government, thousands of businesses, and VAR's worldwide. The choice is simple when you want portability, a powerful development environment, a fast and efficient database engine and significant productivity when developing applications.

Yet, with all these customers and **file-Pro's** capabilities, we wondered why **filePro** wasn't as well known

as some other DataBase Management Systems. We found out that we had to tell more people about **filePro**, but calling all of you on the phone would take too long. So we decided to let you try **filePro** yourself.

Key Features:

- Total Portability from single-user to multi-user to networks. DOS to XENIX® to UNIX® to ULTRIX®.
- Full Screen Editor; Fast, Easy Layout for Screens & Reports.
- Development Environment, Powerful & flexible - great productivity.
- Relational Database Management System.
- Report Writer: Fast prototyping, and flexibility.
- Award Winning Manual - covers everything filePro offers - cover to cover.

...And Many More Features that will excite you.

“Small Is Better”



The Small Computer Company, Inc.
41 Saw Mill River Road, Hawthorne, NY 10532
(914) 769-3160

XENIX is a registered trademark of Microsoft. UNIX is a registered trademark of AT&T. ULTRIX is a registered trademark of Digital Equipment.

Clip coupon and send check or use your credit card. If you decide to buy **filePro** we'll reimburse the cost of the demo system.

Yes! Let me in on the secret!

Please send me a complete **filePro** demonstration system for only \$50.00.

Name _____

Phone _____

Company Name: _____

Address _____

City _____ State _____ Zip _____

Credit Card: MC VISA # _____

Check Enclosed Expiration Date: ___/___/___

DOS: _____ 386 XENIX _____
(Hardware) (Hardware)

UNIX: _____ 286 XENIX _____
(Hardware) (Hardware)

Your Demonstration System will be shipped within 3 weeks upon receipt of your order.

Serving Up Data

Can centralized data preserve the independence of individual users?

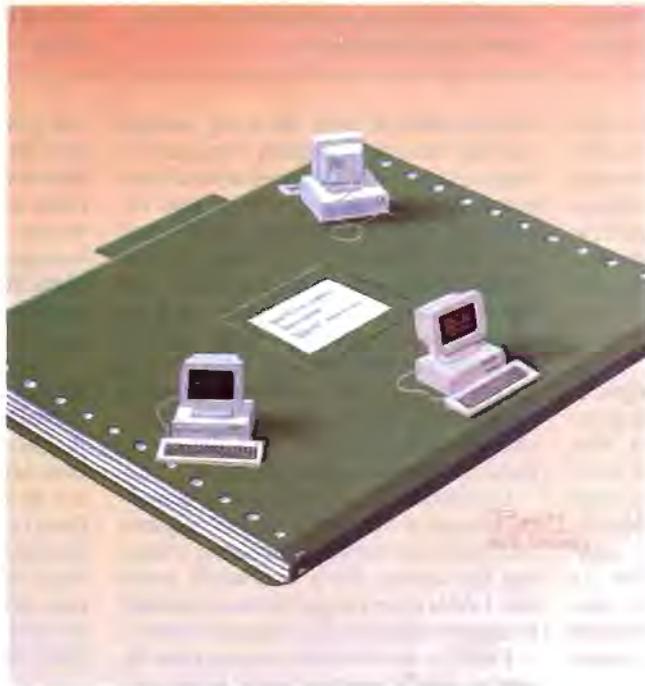
Mark L. Van Name and Bill Catchings

The database server offers many advantages over traditional stand-alone microcomputer database systems. Supporting multiple simultaneous users is perhaps its biggest asset, but the centralization of data on a LAN has other advantages as well.

By storing a single copy of each piece of information, the database server cuts down on data redundancy and inconsistency. Compare this with an office that uses several stand-alone systems: If you store the same data—employee names and addresses, for instance—at each of the sites, a change to any data item at one site creates an inconsistency. Having only a single copy of the data that everyone shares eliminates redundant copies. When there is a change, all users have access to it.

An Evolutionary Compromise

Essentially, the database server is an evolutionary compromise between the current stand-alone microcomputer database systems and the centralized database systems found on mainframes and minicomputers. Microcomputer databases have traditionally supported a single user on a single machine. The micro-



computer handled your entire workload, from database requests to front-end applications to screen I/O. If you wanted to share data with someone else, you either had to swap data disks or take turns using the same system.

By contrast, centralized mainframe and minicomputer database systems let many users share the data on a single machine simultaneously. The central com-

puter did all the database and application processing, and you sat at a dumb terminal.

The client-server architecture melds these two approaches. It uses a central server machine that handles all the hard-core database processing. Like the minicomputer and mainframe systems, the server maintains a single copy of the database and makes it available to all users. The server does not, however, run the actual database applications or other front-end programs. Those tasks stay with the individual microcomputers, which become clients of the central server. Each microcomputer executes its own application programs and handles its screen and keyboard I/O. When an application needs data from the database, it uses a local client library to create

a database request and send it across the LAN to the server. After the server retrieves the desired data or performs the requested operation, it sends the data back over the LAN to the client.

While this architecture spreads the processing between the client and server machines, it does not spread the data itself. Database systems that store their

continued

The Tie That Binds

Most database servers support SQL (pronounced "sequel"), a language that has long been the de facto standard for relational database systems. With an evolving ANSI standard and the support of IBM behind it, SQL is likely to be the dominant database language for servers for some time.

Inside SQL

The attraction of SQL is that it lets database applications issue multirecord requests to the server. The four primary SQL data-manipulation verbs—SELECT, INSERT, UPDATE, and DELETE—can all work on groups of records at a time. An application can, for example, issue a statement like

```
SELECT NAME FROM EMPLOYEE WHERE  
CITY = "St. Louis"
```

to retrieve the names of all employees who live in St. Louis. The statement goes to the server as a single request, and the server then performs all the pro-

cessing necessary to retrieve the appropriate records.

While the server could ship all the selected records back to the client, such a transmission would pose a problem for most applications, because conventional programming languages are designed to work with only one record at a time, not with groups of records. Consequently, ANSI SQL's programming interface provides operations that let clients retrieve the desired records one at a time. This approach obviously increases network overhead and runs counter to the notion of manipulating groups of records at once. Extensions to some versions of SQL enable programs to retrieve groups of records in a single call.

SQL also provides COMMIT and ROLLBACK functions that let programs manage transactions. In addition, SQL is a data-definition language with which you can define databases. It offers commands for defining database tables and fields, as well as the security controls on those items.

Flies in the Ointment

While SQL is unlikely to be supplanted, the language is not perfect. One problem is that no two versions—including the three from IBM—are exactly alike.

SQL also lacks features that many critics consider important parts of the relational model. For example, it offers no direct support for *primary keys*—groups of one or more fields that must be unique in every record of a given type. You can use SQL to enforce primary-key constraints, but there is no enforcement of the concept built into the language. This is particularly onerous because many different kinds of applications use unique record identifiers.

Still the Winner

Despite this and other problems, SQL is clearly the database server language of choice today. All the major announced database servers support SQL. Both its technical virtues and the market forces behind it make SQL likely to retain that crown for many years.

data across many different systems and manage the integrity of that collection of data are known as distributed database systems. A single, centralized database server faces a simpler task than a distributed database system because it doesn't have to worry about coordinating the data in multiple locations.

The Server's Demands

The server does, however, place significant demands on some underlying technologies. First, it requires a host with enough power to handle a multiuser database. While older microcomputers, such as the IBM PC XT and the early Macintoshes, lack the power to support complex servers, newer machines offer far greater processing capabilities. In fact, machines built around Intel's 80386 and Motorola's 68030 CPUs provide power rivaling that of minicomputers.

Some network vendors, such as Novell, are also opening their LANs to minicomputers, so the database server on a microcomputer LAN could well be a minicomputer. The server could also be a mainframe; IBM, for example, plans to make its OS/2 Extended Edition Database Manager capable of retrieving data from a mainframe DB2 database.

The processors alone, of course, are not the whole performance story.

Servers demand hard disks big enough and fast enough to support databases as large as those once relegated to minicomputers and mainframes. They also require operating systems such as Unix and OS/2 that take full advantage of the power of their advanced processors and disks. These operating systems provide the multitasking and memory space that advanced database systems need. While it's possible to build a database server on top of DOS, the limitations of one process at a time and 640K bytes of memory make DOS a poor server platform.

In addition, the LAN must be powerful enough to handle the load of requests and responses between the many clients and the server. Many commonly available LANs offer the performance needed to support multiple simultaneous users.

Finally, the database system must be able to handle multiple users while providing reasonable levels of performance, security, and integrity. Because minicomputer database systems have already had to face these problems, many of today's servers have their roots in the minicomputer world. Oracle and INGRES offer servers based on their minicomputer versions; Sybase built one of its first versions of the Sybase/Microsoft/Ashton-Tate SQL Server for the VAX.

It's too early to tell how important a

role OS/2 will play in this area. It does provide the kinds of services that these systems require and is thus poised to become an important platform for database servers. Currently, OS/2 cannot take advantage of some of the advanced features of the 80386 processor, such as hardware memory swapping. Vendors and users eagerly await an 80386 version of OS/2.

Despite this drawback, however, many vendors have announced OS/2 database servers. IBM has even indicated that its own OS/2 Extended Edition Database Manager will eventually be able to act as a LAN database server. Oracle from Oracle Corp., the SQL Server from Sybase/Microsoft/Ashton-Tate, SQL-Base from Gupta Technology, and several others are available today. These products and others like them may give OS/2 the *raison d'être* it so sorely needs.

Basic Server Services

One reason most servers are based on minicomputer database systems is the complexity of the tasks the servers must handle. Many current database systems lack the structure and capabilities necessary to support multiple users. A multiuser system creates demands rarely encountered in stand-alone environments.

A database server must be transparent

continued



How to match the best front end with the best back end.

You've invested in the best hardware, operating system and database products. You have a staff of programmers ready to go. But to build great looking applications with the sophisticated features today's users demand, you need a powerful front end development tool—JAM.™

JAM, the most advanced user interface management system on the market, does it all—from prototyping to implementation. And, because it works with any database

or file manager, you get the best front end *and* the best back end.

JAM is hardware independent, so it isn't limited to one computer, database or operating system. In fact, JAM runs on everything from PC's to super-minis, works under 7 operating systems and provides access to a host of database products. Using JAM you can create a consistent user interface across multiple systems and hardware platforms.



Create colorful screens and nested windows easily.

JAM works under the following operating systems:

- UNIX®
- VMS®
- RMX™
- MS-DOS®
- XENIX®
- VOS™
- AOS/VS™

JAM makes it easier than ever to design and revise complex applications. Using features like context-sensitive help, procedural command language (JPL), shifting and scrolling fields, extensive data validations, on-line testing, and a variety of visual attributes, you'll be amazed how quickly your applications spring to life.

JAM is fast, as well as flexible. Development time is reduced significantly thanks to JAM's powerful screen drawing utilities and comprehensive library of sub-routines. You can easily create and link together screens, windows, and menus to develop an application shell. Then simply attach the processing routines, and your application is complete.

Plus, if your back end is an SQL-compatible relational database like Oracle,® SQLbase,® Informix® or Britton Lee,™ you'll really appreciate JAM/DBi, JAM's optional database interface. With JAM/DBi, you can develop entire applications using only industry-standard SQL statements and JAM's authoring tools.

So if you're programming in a 3GL like C or FORTRAN, follow the lead of the many Fortune 1000 companies who have already discovered JAM.

JAM from JYACC. It gives you the best at both ends.

Call for more information about JAM and our demo diskette. **800-458-3313**
JYACC, Inc.
116 John Street
New York, NY 10038
212-267-7722 FAX No. 212-608-6753



Use SQL to retrieve and display data.

JAM

JYACC Application Manager. *The Composer for Sophisticated Applications.*

In the Real World

NetWare SQL is a database server from Novell. It can run on any NetWare server. While NetWare was once limited to microcomputers, newer versions allow VAXes and other mini-computers to act as servers. Client machines can run DOS, OS/2, or Mac OS.

Under NetWare SQL, a client database application sits atop a small stack of database client software. The application can be one developed especially to run with NetWare SQL or an existing application modified to use the server. Several client front ends to this server are available; the list includes Word-Tech Systems' dXML and Quicksilver, Concentric Data Systems' R&R for SQL, Lotus 1-2-3, and others.

An application frames its database requests using XQL, NetWare SQL's programming interface. XQL actually offers two different application pro-

gramming interfaces (APIs): XQLM and XQLP.

XQLM, the SQL Manager, offers a version of the SQL programming functions based on the ANSI SQL standard. XQLP offers what Novell calls its *relational primitives*—a set of proprietary, low-level database functions.

XQL uses a NetWare request interface, NSREQ, to communicate its requests to the server. NSREQ passes requests to the standard NetWare shell, which sends them across the network to the server. Under DOS, NSREQ runs as a piece of resident code; on OS/2, it's a dynamic link library.

The NetWare SQL server uses several different NetWare processes to handle requests. The first process to field a request is NWSSQL. There is one NWSSQL server process per active user. It handles some of the database

processing, but it uses Novell's Btrieve for its basic record management.

An NWSSQL process interacts with the BROUTER, the Btrieve message router. The BROUTER is an interprocess-communication program that sends requests from an NWSSQL process to the Btrieve process on the server where the data is stored. On a LAN with a single server, this function is obviously unnecessary, but it can be crucial on LANs with multiple servers.

The actual Btrieve server is the BSERVER program. BSERVER handles the basic data read and write operations and uses NetWare's Transaction Tracking System to support concurrent users. Unfortunately, Btrieve automatically locks entire tables unless the application issues explicit record locks. This approach can make locking a difficult task.

to client users. Like most microcomputer users, you probably have a favorite database. In the client-server world, you keep your familiar front-end application, but now it gets its data from the server, not from your local disk. Many database developers are moving rapidly to incorporate this feature into their products. Market leaders such as Ashton-Tate (dBASE IV) and Borland (Paradox) have already announced or delivered hooks to backend, SQL-based servers.

The server side is more complicated. First, a server must be able to handle requests in a form suitable for transmission across a network. To achieve reasonable performance, the server must minimize network traffic. That usually means a database language that lets the clients work with many records at once. Not surprisingly, nearly all of these servers are relational database systems that use the SQL language to manipulate data (see the text box "The Tie That Binds" on page 260). The client systems simply frame their requests in SQL; the server interprets those requests and chooses a reasonable strategy for executing them (see the text box "In the Real World," above).

More difficult problems arise from the need to support multiple users simultaneously. As long as you're only reading the data, there's no problem; the server can easily let many users read the same data at once. But when you start modifying data, the server must provide file-

and record-locking functions to ensure that each user is treated fairly. Fair treatment in database servers is based on a logical unit of work called a *transaction*.

Atomic Transactions

A transaction is a sequence of related operations that the database system guarantees to be *atomic*; that is, it ensures that all the operations in a particular transaction either execute successfully or abort. Take, for example, a transaction that transfers money from one account to another. The atomic nature of the transaction ensures that the components—debiting one account and crediting the other—either both succeed or both fail.

Most transaction-based database systems follow three basic rules. First, they support two ways for transactions to end. A transaction can terminate normally (a commit operation) or abnormally (a rollback operation). Abnormal termination means aborting every database operation in the transaction.

Next, the server must guarantee that any database changes that a transaction T makes are not visible to any other transaction until T commits those changes. If T does a rollback instead, the database appears essentially as if T never existed. By following this approach, the server stops other transactions from seeing T's changes in case T eventually aborts.

Finally, the server must deal with the fact that different transactions may start and stop at random times, including in

the middle of other transactions. Transactions that so overlap are known as *interleaved* transactions. The database server must execute interleaved transactions so that the result of their execution is *serializable*; in other words, that it is equivalent to executing those same transactions one at a time in some serial order. The server doesn't have to guarantee any particular serial order, but it must make the results of each interleaved execution equivalent to some serial order.

In addition, the server must meet these requirements in a way that provides reasonable overall performance. Locking entire files and executing the transactions one at a time, first-come, first-served, would certainly follow these transaction rules, but it would allow no simultaneous users. The database server has to automatically find the right balance of table (or file), block, and record locks to both obey these rules and maximize the number of users that can simultaneously share the available data.

Because the data is all in one place, the server must also guarantee its integrity in other ways. It must provide facilities for backing up the data and recovering it when the system crashes or the database is somehow corrupted. Problems can range from simple ones, such as when a client machine goes down in the middle of a transaction, to disk catastrophes that destroy all the server's data.

Atomic transactions often play a role
continued

**WE WANT TO MANUFACTURE YOUR PRODUCTS
OR
Name "ARA-TECH" will be OUTSTANDING
in Hightech Business**



OPTIMA VGA 1024 Plus
702Mx768 Res. / 16 Color
512 KB Memory
VGA Bus/Bus - 175, 150000/175

ADD-ON CARDS FOR IBM PC/XT/A
High quality at Unbeatable prices.

OPTIMA VGA 1024 I



*8 Bit, 512 KB
*1024x768 / 16 Color
*800x600 / 256 Color

OPTIMA VGA 800Z



*8 Bit, 256 KB
*800x600 / 16 Color
*640x480 / 16 Color

OPTIMA VGA 800



*8 Bit, 256 KB
*800x600 / 16 Color
*640x480 / 16 Color

OPTIMA VGA 1024Z



*16 Bit, 512 KB
*800x600 / 256 Color
*1280x760 / 16 Color

PRIMA EGA 480



*256 KB
*640x480 / 16 Color
*Paradise 480 Compatible

**OEM/DISTRIBUTOR/DEALER'S
INQUIRIES INVITED**

**End users; Call (818) 996-8801
for the dealer nearest you.**

PRIMA EGA 350



*256 KB
*640x350 / 16 Color
*Paradise 350 Compatible

*IBM is trademark of International Business Machine.
*Paradise is trademark of Paradise system.

ARA-TECH, INC.
18040 Sherman Way, Suite 105,
Reseda, CA 91335
Phone (818) 996-8801
FAX (818) 996-1946



Korea Factory
ARA INTERNATIONAL CO., LTD.
628-7 Dungchon-Dong,
Kangseo-Ku, Seoul, Korea
Phone (02) 691-8167
FAX (02) 691-9168

SOLUTIONS

Bigger—

Vfeature Deluxe™ lets your DOS system use hard disks it thought it couldn't, all in one bootable piece—no artificial partitions! Span two drives into C: and boot from it, use MFM, RLL, ESDI, or SCSI. Interleave selection, physical format, security options included. DOS 3.1-3.3 \$120

DUB-14™ PCB takes a different approach to drive expansion, stretches your AT's Drive Table to support the drive you choose—MFM, ESDI, RLL, up to 2048 cylinders! Comes with setup and low-level format routines, works with UNIX, XENIX, Pick, Novell, DOS. \$95

Faster—

Vcache™ speeds disk operations, stores data in RAM so it's there for you next time you need it—no waiting! Optional delayed sector write, lookahead buffer. Works with any type of memory, caches up to 15 Mb, bundles accelerators for your diskettes, screens, and keyboard. DOS 2 - 4. \$59.95

Vopt™ defragments disks for quicker access. Run it every day and keep your drive as fast as new! In a few seconds at boot time, Vopt arranges all your files neatly in contiguous clusters so you won't waste any time reading them back. Bundles timing and diagnostic utilities. DOS 2 - 4. \$59.95

Safer—

Vlock™ protects your system and its data from vandals and accidents. System access passwords control booting, activity menus decide who does what to which files, even locks out Ctrl-Break during boot! \$135

Easier—

Vtools™ is a slick set of disk management tools for DOS and OS/2. Display directories in whatever order you like, browse files and change or delete them, compare and update multiple versions, find and manipulate categories of files, and more! \$49.95

SEE YOUR DEALER OR CALL TOLL-FREE

1 (800) 284-3269



GOLDEN BOW SYSTEMS

2870 5TH AVENUE
 SAN DIEGO, CA 92103
 (619) 298-9349

FAX (619) 298-9950 TELEX 201520 GBS UR
 MC/VISA US shpg/hdlg \$3 CA orders add 7%

Vfeature, DUB-14, Vcache, Vopt, Vlock, and Vtools are trademarks of Golden Bow Systems.

in this backup-and-recovery function. You should periodically make complete backups of your server databases. The servers themselves typically maintain logs of completed transactions. When a single client transaction fails before completing, the server can effectively roll it back to remove its effects. When a catastrophe occurs, the server can use a recent complete backup of the database and its transaction log to bring the database up-to-date. The server first loads the backup and then uses the transaction log to apply the updates from all completed transactions; this operation is known as roll-forward.

What You Gain

Centralized data storage makes database backup easier. Instead of having to back up many different machines, you back up only the server. Clients needn't be concerned about backups.

Centralization can make database security a more manageable problem. Securing the data on a stand-alone microcomputer often means finding some way to limit access to the microcomputer itself, putting a password on the whole database, or removing the database when it's not in use. Most database servers offer more powerful security functions. SQL, for example, includes statements that let you specify exactly which users can perform which operations on which parts of the database.

The client-server architecture also has the potential of taking advantage of many different hardware and software architectures. You can use MS-DOS machines and Macintoshes—and all their familiar front-end software—as client machines. The server would probably be a more powerful system (e.g., a minicomputer or an 80386-based microcomputer). The server can also implement a more complex operating environment than the client machines because only data administrators need to use the server directly. Thus, the server software could run on a minicomputer under Unix.

Although similar in many respects to distributed database systems, database servers offer some advantages. Chief among these is the fact that several different database servers are commercially available today, and have been available for some time, while true distributed database systems are just beginning to appear. Database servers are also less complicated and require less communications overhead than distributed database systems—largely because a server doesn't have to manage data and data integrity across multiple sites.

What You Lose

There are, of course, some drawbacks to database servers. By their very nature they take control away from the individual microcomputer user and place it in the hands of the administrators of the server. Servers thus represent a move away from the independence of microcomputers and a step back toward the centralized control of minicomputers and mainframes. By contrast, both stand-alone and distributed database systems let you store data where it is used.

By placing all the data in one place, the client-server approach also makes the central server a crucial resource: Lose it, and you lose access to all its data. Since the database includes key data for all clients, its loss can be expensive. Even if the server is down for only a short time, its loss halts all database-dependent applications.

Database servers are complex programs that require a trained administrator. While even inexperienced microcomputer users can often manage their own local databases, a database server administrator must understand database design, data integrity and security, backup and recovery, and performance tuning. These are the same tasks you would face on a mainframe or minicomputer database system.

Finally, while the performance of a stand-alone microcomputer database system is reasonably predictable, the performance of a server can vary widely, depending on the amount of traffic on the network. Poor network or server performance can create a serious bottleneck. While most servers offer some performance tuning options, the server's limits and the network's speed establish an inherent performance ceiling.

Separation of Function

Different database servers may follow slightly different designs, but all emphasize the separation of function between client and server. This architecture will become increasingly common as LANs become more widespread and the need for a shared, consistent data store becomes more apparent. Database servers borrow the best aspects of centralized data management while still preserving most of the independence of individual users. ■

Mark L. Van Name, a BYTE consulting editor, and Bill Catchings are independent computer consultants based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

Reach for ultimate portability

Systems Start at \$790.00!



120 MBytes of power, speed and security in a revolutionary, removable hard drive.

At last, the Disk Pack gives you everything you've always wished for in a data storage system. The speed and high storage capacity of a hard drive. The ease and convenience of a floppy diskette. And the safety of a tape backup. All wrapped up in a state-of-the-art rugged unit, about the size of a paperback book. Designed to make your life a lot simpler and more secure.

True portability is here

Just picture this: With the Disk Pack you carry your whole work environment with you, wherever you go. All your files, all your data stay organized and configured just the way you created them. Between your office and remote sites. Or home. Or another department. You can even mail a Disk Pack. It's that rugged.

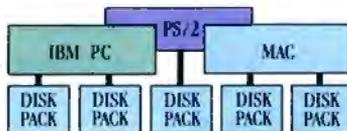


The Disk Pack frees you from the constraints of fixed computers. Your whole work environment fits in the palm of your hand.

Total security for your data

Simply slide out a Disk Pack module and lock away your entire business customer base and payroll figures in a drawer or safe. Same for lawyer,

banker or accountant sensitive data and Uncle Sam confidential information. All fully secured in a snap.



Get full data portability and security on the computer of your choice. Macintosh, PC Compatible or PS/2.

Blazing speed Rock-solid reliability Limitless expansion

Breakthrough technology makes the Disk Pack four to five times more reliable than other removable products. Access times as low as 13 ms make it one of the fastest hard drives on the market. The Disk Pack doesn't limit you to a single storage capacity either. You can interchange 20-, 40-, 80- or 120-MByte modules in your

system and between systems. Link modules up for a whopping Half-GByte + of on-line data. Store them for unlimited off-line data. And do lightning-fast data backups.

That's not all. The Disk Pack turns a shared computer into your fully personal machine within seconds. It's ideal for space grabbing applications such as color graphics, CAD, or music. One Disk Pack module does the job of 100 diskettes.

Ten times faster. And with a lot less hassle.

And thanks to the Disk Pack's unique architecture, you'll use it equally well on any Mac, Apple, PC-compatible or PS/2 computer. It's that advanced.

Outside the USA, contact IEF, Tel: (33) 1 45 57 14 14
217 Quai de Stalingrad 92134 Issy, France



The Disk Pack is ideal for data security. Lock it away and forget about accidental or intentional data loss.

For more information call

1-800-322-4744

IEF DISK PACK®

The new standard in data storage technology

MEGADRIVE

S Y S T E M S
11693 San Vicente Blvd, Suite 370
Los Angeles, CA 90049
Disk Pack is a trademark of IEF



YES! I want to know more about Mega Drive Systems' new data storage technology. Please rush me more information about the Disk Pack and your free booklet "20 Valuable Facts About Hard Disk Care and Maintenance" today.

Name _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone (____) _____

Mega Drive Systems, Inc.

11693 San Vicente Blvd, Suite 370
Los Angeles, CA 90049 (213) 556-1663

Number of Micros _____ Mac _____ PC _____

“Xerox this memo.” “FedEx this proposal.” “LapLink these files.”

When something becomes a standard, using it becomes second nature. That's true about LapLink. It's so effective that it has become the most popular laptop-to-desktop and desktop-to-desktop file transfer program ever.

And now Release III improves on the original with added power—while preserving the simple design that has made LapLink the choice of more major corporations.

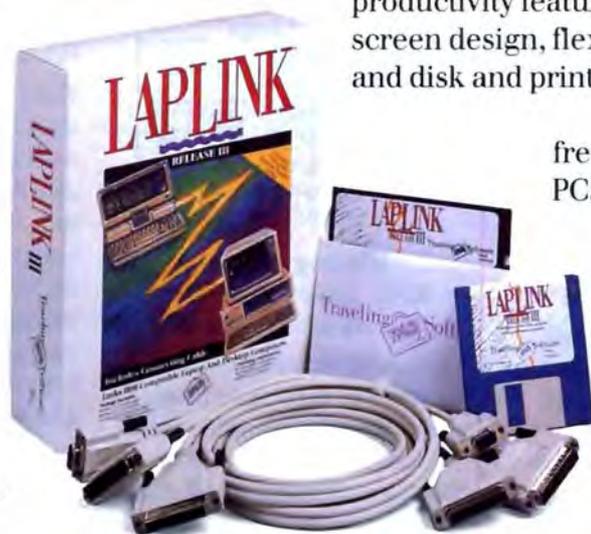
LapLink III offers both serial and parallel file transfer, and you can take advantage of parallel transfer speeds of 500,000 baud or higher. It comes with a “six headed” universal cable that provides you with everything you need to use both serial and parallel modes.

And LapLink III will even install itself automatically on a remote computer.

That's in addition to ease-of-use and productivity features like our popular split screen design, flexible transfer options, and disk and printer sharing.

For the same fast, error-free file transfers between PCs and Macintoshes, get LapLink Mac. And for more information about any Traveling Software product, call us at (800)662-2652.

LapLink III. The standard in file transfer software.



Suggested Retail Price \$159.95

LAPLINK III



Traveling Software, Inc.
11702 North Creek Parkway, Bothell, WA 98011
(206) 483-8088

Traveling Software Europe
Lords Court, St Leonards Road, Windsor
Berks, SL4 5DB, England
(44) 0753 831855

Sharing the Wealth

*Distributed database technology lets you store the pieces
of a large database where they are most needed*

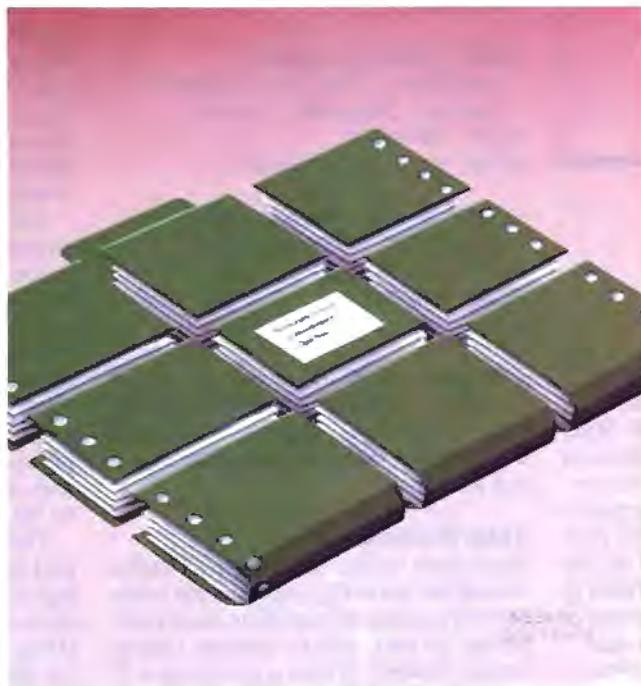
Ralph Davis

Over the past few years, rapid advances in network technology have made it easier to tie different types of computers together. In the past, the primary purpose of these connections has been sharing printers and disk drives. Now, distributed database technology lets disparate computers and database systems share another important resource: data.

The growth of distributed database technology has been closely tied to advances in relational technology. Because communications overhead is a critical factor in distributed technology, a database model capable of moving groups of records between sites was a prerequisite for a distributed database system. Moving single records incurs a much higher communications cost and is very inefficient. Thus, the maturation of relational database technology was an important step in making distributed database management systems (DDBMSes) feasible.

Describing the Distributed Database

Several factors differentiate a distributed database system from a loose confederation of autonomous sites:



- The data that makes up the logical database is stored at multiple sites connected by a network.
- At least one application takes a global view of the data.
- The global application accesses all the sites at least once.
- A global intelligence (i.e., a DDBMS) exists over and above all the local intelligences (i.e., DBMSes). Its job is to man-

age the distributed database as a whole. In a distributed environment, such things as query optimization, concurrency control, and transaction handling require a global intelligence.

Distributed databases give rise to some new database concepts that are important in assessing the benefits of a DDBMS and in gauging the complexity of implementing one. Three of the most important new concepts are fragmentation, replication, and allocation.

Fragmentation

Fragmentation describes how a single table is divided among network sites. You can fragment a table in several ways. A horizontal fragment of a table contains all its columns and a subset of its rows.

You create such a fragment by performing a relational restrict (SELECT) operation on a table. For example, if a corporation has a table EMPLOYEE listing all its employees and wishes to store the appropriate fragments at the actual work locations (indicated by the `EmpLoc` column), the following SQL SELECT statement creates the fragments:

continued

Table 1: The allocation schema of the EMPLOYEE table fragments. Note the implementation of the backup scheme.

LA	EMPBIO (LA) EMPSAL (LA) EMPBIO (NY) EMPSAL (NY)
PX	EMPBIO (PX) EMPSAL (PX) EMPBIO (LA) EMPSAL (LA)
CH	EMPBIO (CH) EMPSAL (CH) EMPBIO (PX) EMPSAL (PX)
AL	EMPBIO (AL) EMPSAL (AL) EMPBIO (CH) EMPSAL (CH)
NY	EMPBIO (NY) EMPSAL (NY) EMPBIO (AL) EMPSAL (AL) EMPBIO (CH) EMPSAL (CH) EMPBIO (PX) EMPSAL (PX) EMPBIO (LA) EMPSAL (LA)

```
SELECT Empssn, Empsalary,
       Empinctax, Empsstax,
       Emploc
FROM EMPLOYEE
```

In creating a horizontal fragmentation, you include all the columns (SELECT *) and use a WHERE clause to specify the rows. With vertical fragmentation, however, you use a field list to create a column subset and SELECT all the rows. You must include Empssn in both vertical fragments to identify each record. In fact, you must include it in all vertical fragments, both for locating the record and for reconstructing the unfragmented table.

Mixed fragmentation combines vertical and horizontal fragmentation. To illustrate, suppose that within the company's five regional offices, the same departmental jurisdictions apply as at headquarters. Thus, you still need to separate biographical information from tax and salary figures. You obtain this mixed fragmentation by combining the previous two SQL SELECTs. Therefore, for each location, you issue the following statements:

```
SELECT Empssn, Empname,
       Empstreet, Empcity, Empstate,
       Empzip, Empphone, Emploc
FROM EMPLOYEE
WHERE Emploc = location
```

```
SELECT Empssn, Empsalary,
       Empinctax, Empsstax,
       Empsttax, Emploc
FROM EMPLOYEE
WHERE Emploc = location
```

This gives you 10 fragments. At each regional office, the accounting department has access to the tax and salary fragment, while human resources can get to names and addresses.

Table Replication

Replication is the distribution of tables around the network. You replicate tables for two reasons: to maximize local availability of data and to provide backup copies of tables in case a particular network site fails.

In the example shown above, a copy of the entire corporate database exists at headquarters for access by top management. In addition, the regional offices sometimes need to query each other's tables. While they don't need to do this often enough to warrant keeping complete copies of the tables at all sites, they do want to be able to access the data even if the computer of the office that they are

querying is down. For this reason, each office backs up one other office, as follows:

- Phoenix backs up Los Angeles.
- Los Angeles backs up New York.
- New York backs up Atlanta.
- Atlanta backs up Chicago.
- Chicago backs up Phoenix.

Replication provides a great deal of security in the event of a crash at a node, but it can introduce integrity problems.

Allocation

Allocation is a combination of fragmentation and replication. The allocation process decides which sites store which fragments and is a key element in distributed database design. The guiding principle is to allocate fragments and tables to maximize local processing: You store data so that most applications need to access only locally stored data.

Table replication can increase the local availability of data. However, for frequently updated tables, replication degrades database performance, because all copies of a table must be updated to maintain the integrity of the distributed database. Table replication where the ratio of reads to writes is high, or where it's not critical that updates be cascaded immediately, can yield performance benefits by minimizing communications overhead.

The speed of the supporting network is an important consideration here. The decision of a company to replicate its full database at headquarters means that the regional offices must propagate all their updates to headquarters. To keep communications to a minimum, an overnight batch process provides updates to headquarters. Management can live with having access to yesterday's data so as not to impose too great a performance penalty on the regional offices.

The architecture of the network plays a part in this decision. By having yesterday's data replicated at headquarters, the executives can view it in a few seconds. If they had chosen instead not to replicate the data, but to work with a global view of the data (which would have to access the tables in the regional offices), then every time they made a query, the DDBMS would have to reconstruct the data in the regional offices and transmit it to headquarters. With a data transfer rate of 56 kilobits per second for its wide-area network (WAN), the time for query retrieval using a global view could be several minutes.

In a distributed database built on a

```
SELECT *
FROM EMPLOYEE
WHERE Emploc = location
```

If the company has offices in New York, Atlanta, Chicago, Phoenix, and Los Angeles, this statement breaks the EMPLOYEE table into five fragments.

A vertical fragment, on the other hand, involves a subset of the columns of a table and all its rows. Suppose the company keeps a copy of the entire corporate database at its headquarters in New York. Not all the departments in the company need access to all the fields in the EMPLOYEE table. Indeed, some of the fields, such as the employee's salary, should be accessible only to departments that need to know the information in them. The following SQL statements create two vertical fragments. The first fragment contains address information, and the second contains tax records and salary data:

```
SELECT Empssn, Empname,
       Empstreet, Empcity, Empstate,
       Empzip, Empphone, Emploc
FROM EMPLOYEE
```

high-speed LAN, however, the difference in retrieval time between a fully replicated database and a global view of the database is much smaller. Thus, local availability is not as important in deciding whether to replicate a table. Availability of the data in case a network node fails becomes the dominant consideration.

Distributed Architecture

Fragmentation, replication, and allocation determine the data architecture of a distributed database system. This architecture is divided into several layers, or schemata.

The global schema is a description of the tables in the database as if they all resided at a single site. With the EMPLOYEE table, the global schema contains one unfragmented copy of the table.

The fragmentation schema describes the logical fragmenting of the tables, without regard to where they are stored. The fragmentation schema for EMPLOYEE contains 10 fragments: two vertical fragments (called EMPBIO and EMPSAL) for each of the five regional offices.

The allocation schema maps the frag-

Table 2: The location mapping schema for the EMPLOYEE table. Note the backup scheme.

LA	EMPBIO [Emploc IN ('LA', 'NY')] EMPSAL [Emploc IN ('LA', 'NY')]
PX	EMPBIO [Emploc IN ('PX', 'LA')] EMPSAL [Emploc IN ('PX', 'LA')]
CH	EMPBIO [Emploc IN ('CH', 'PX')] EMPSAL [Emploc IN ('CH', 'PX')]
AL	EMPBIO [Emploc IN ('AL', 'CH')] EMPSAL [Emploc IN ('AL', 'CH')]
NY	EMPBIO EMPSAL

ments to their physical locations. Table 1 shows the allocation schema for the EMPLOYEE table.

The local-mapping schema maps the allocated fragments to physical objects known to the local DBMS. Table 2 shows how the tables are actually used to store the EMPLOYEE table.

With local-mapping transparency, an application must know not only the fragments of a table, but also the locations of the fragments. This level of transparency only shields applications when each site may be using a different local DBMS. For instance, if the Los Angeles office is using a nonrelational DBMS, then the DDBMS enables applications to refer to relational tables. If the fragments move, your applications must be rewritten.

Clearly, the level of distribution transparency that a DDBMS offers is a major factor in evaluating it.

Suppose the company in my example

transfers an employee from Chicago to Los Angeles. If the DDBMS offers fragmentation transparency, you can accomplish the transfer with a single SQL statement:

```
UPDATE EMPLOYEE
SET Emploc = 'LA'
WHERE Empssn = '111-11-1111'
```

In actuality, this statement breaks down into the following operations:

1. Add the employee to EMPBIO and EMPSAL in Los Angeles, and to the backup copies in Phoenix.
2. Update the Emploc column of EMPBIO and EMPSAL in Los Angeles and Phoenix.
3. Delete the employee from EMPBIO and EMPSAL in Chicago, and from the backup copies in Atlanta.
4. Update the employee's records in the headquarters copies of EMPBIO and EMPSAL.

(I ignore the fact that this is done as an overnight batch process. The update actually writes a record for overnight upload. I express the action here as a direct update to the tables in New York.)

The complete set of SQL statements required to relocate the employee is shown in listing 1. This entire transaction, consisting of 14 SQL statements, must execute in its entirety or not at all.

In a previous article in BYTE (see reference 1), I discussed the two-phase Commit protocol in the context of IBM's LU 6.2. This technique has gained wide acceptance as the best way to guarantee transaction integrity in a distributed database environment.

In the two-phase Commit protocol,

continued

A DOS
machine can easily
become a bottleneck
in the system.

ments to their physical locations. Table 1 shows the allocation schema for the EMPLOYEE table.

The local-mapping schema maps the allocated fragments to physical objects known to the local DBMS. Table 2 shows how the tables are actually used to store the EMPLOYEE table.

Distribution Transparency

Each layer of the architecture has an associated level of distribution transparency. The more distribution transparency a DDBMS offers, the more it shields users and applications from the actual storage structure of the data. The highest level of distribution transparency is fragmentation transparency. At this level, the entire database appears to users at all sites as if it were entirely resident at their sites. The DDBMS maps table references to the appropriate fragments. Changing

Distributed Data Integrity

Another essential feature in a DDBMS is the ability to protect the integrity of a distributed transaction. When a transaction consists of multiple operations, it's imperative that the DDBMS perform all of them or none of them.

Suppose the company in my example

Don't Move!

without telling

BYTE

Clip out form below
and mail to:

BYTE Magazine
P.O. Box 555
Hightstown, NJ 08520

At least 8 week before you move,
please give us your new address and/or
name change

(Please Print)

New address, name	_____
Name	_____
Address	_____
City	_____
	Apt. _____
	Zip _____
Current address, name	_____
Name	_____
Address	_____
City	_____
	Apt. _____
	State _____
	Zip _____

Print current name and address
(or affix the mailing label from your current issue of BYTE here)

Listing 1: The actual SQL statements that perform an employee transfer. The @ symbol followed by the table location is a common convention to differentiate local copies.

```
INSERT INTO EMPBIO@LA
SELECT *
FROM EMPBIO@CH
WHERE Empsn = '111-11-1111'
```

```
INSERT INTO EMPSAL@LA
SELECT *
FROM EMPSAL@CH
WHERE Empsn = '111-11-1111'
```

```
INSERT INTO EMPBIO@PX
SELECT *
FROM EMPBIO@CH
WHERE Empsn = '111-11-1111'
```

```
INSERT INTO EMPSAL@PX
SELECT *
FROM EMPSAL@CH
WHERE Empsn = '111-11-1111'
```

```
UPDATE EMPBIO@LA
SET Emploc = 'LA'
WHERE Empsn = '111-11-1111'
```

```
UPDATE EMPSAL@LA
SET Emploc = 'LA'
WHERE Empsn = '111-11-1111'
```

```
UPDATE EMPBIO@PX
SET Emploc = 'LA'
WHERE Empsn = '111-11-1111'
```

```
UPDATE EMPSAL@PX
SET Emploc = 'LA'
WHERE Empsn = '111-11-1111'
```

```
DELETE FROM EMPBIO@CH
WHERE Empsn = '111-11-1111'
```

```
DELETE FROM EMPSAL@CH
WHERE Empsn = '111-11-1111'
```

```
DELETE FROM EMPBIO@LA
WHERE Empsn = '111-11-1111'
```

```
DELETE FROM EMPSAL@LA
WHERE Empsn = '111-11-1111'
```

```
UPDATE EMPBIO@NY
SET Emploc = 'LA'
WHERE Empsn = '111-11-1111'
```

```
UPDATE EMPSAL@NY
SET Emploc = 'LA'
WHERE Empsn = '111-11-1111'
```

one site (known as the coordinator) controls the distributed transaction. The other sites (the participants) respond to its commands. The sequence of actions is as follows:

Phase 1

1. The coordinator writes a Prepare record to its local log file and then sends a Prepare to Commit record to all participants.

2. The participants, on receipt of the Prepare to Commit message, attempt to write all the information needed to process the transaction to their local logs. If this succeeds, they write a Ready record

to the log and send a Ready message back to the coordinator. If it fails, they abort their transaction and return an Abort message.

Phase 2

3. The coordinator evaluates the responses. If no participant has timed out or answered Abort, it writes a Global Commit record to its log and then sends the participants a Commit message.

4. The participants, on receipt of the Commit, write a Commit record to their logs, commit the transaction, and return an acknowledgment to the coordinator.

5. The coordinator writes a Complete record to its log.

This protocol is resilient in the face of network failures and site crashes.

Thus far, no single DDBMS implements all the features of the theoretical model presented here. For a description of an actual distributed database system and a demonstration of how you would use it to implement the example database, see the text box "DDBMS Meets Reality" on page 272.

Pluses and Minuses

Distributed database technology offers several important benefits. Distributed architecture reflects the geography of the business world, with global, decentralized corporations. Allowing local processing to be done at the local site serves this corporate structure much better than concentrating all processing at a central site. It also allows a smaller volume of transactions to be handled by smaller, less expensive machines.

In addition to reflecting the geography of today's business world, distributed databases can also correct some of the problems inherent in that geography. Decentralization brought with it a proliferation of incompatible hardware, operating systems, DBMSes, and communications protocols. A DDBMS can provide significant benefits by tying all these disparate local pieces into a unified global system.

Other important advantages include the increases in the reliability and availability of the system as a result of redundant data storage and the fact that a distributed system can easily accommodate incremental growth by simply adding new machines to the network.

Finally, intelligent use of parallel processing in the distributed environment may actually yield performance that is superior to centralized processing, in spite of the increased communications costs. In his book *The Ingres Papers*, Michael

continued

Tatung super VGA: 1024 x 768

NEC™ super VGA: ooooooooops!

Even the great ones slip every now and then. For instance, NEC's Multisync 2A™ is a good Super VGA monitor. But our Super VGA monitors give you more of what Super VGA is all about: **maximizing every ounce of potential a VGA card can offer... no matter what card is used.**

Both brands offer 100% VGA and 800x600 compatibility. But, with appropriate cards, our Super VGA monitors will deliver

40% higher resolution. That's just part of the picture. Along with superior image quality, Tatung Super VGA monitors are more versatile, incredibly reliable, and more affordable. Check the chart.*

Tatung Super VGA. You have to see it to believe it. And you can see it at your Tatung dealer. Or call for complete details. We'll send them along with the name of the Tatung Dealer near you.

FEATURES	NEC Multisync 2A	Our CM-1496X	Our CM-1498X
Max. Res.	800x600	1024x768**	1024x768**
CRT Size	14"	14"	14"
Dot Pitch	0.31	0.31	0.28
IBM 8514™ Compatible	NO	YES	YES
Sugg. Retail	\$799	\$749	\$799
Maximum Resolution w/Graphic Card (Partial List)			
ATI VGA Wonder™	800x600	1024x768**	1024x768**
GENOA Super VGA Hi-Res Model 5400™	800x600	1024x768**	1024x768**
RENAISSANCE GRX RENDITION II/256™	800x600	1024x768**	1024x768**
STB VGA EM-16™	800x600	1024x768**	1024x768**
TECMAR VGA/AD™	800x600	1024x768**	1024x768**

**Interlaced



We monitor the world.

Tatung Company of America, Inc., 2850 El Presidio St., Long Beach, CA 90810 (213) 979-7055
Tatung Science & Technology, Inc., 2060 Ringwood Ave., San Jose, CA 95131 (408) 435-0140
Outside California: (800) 421-2929 - Eastern Region: (609) 395-6770



Circle 284 on Reader Service Card

DDBMS Meets Reality

Distributed databases exist not only in theory but in fact. Two of the most talked-about systems are Ingres/Star and Oracle.

Ingres/Star is the distributed version of Ingres, one of the first relational database implementations. Its current version, release 6, represents a high level of development in distributed database technology.

Oracle also offers distributed processing, but it does not provide as high a level of support as does Ingres/Star. The distributed version of Oracle has no global intelligence overseeing the distributed database. Rather, it acts as a loose confederation of local databases linked by communications drivers.

Because of its superior support for distributed databases, I selected Ingres/Star to demonstrate how you implement a real-world distributed database.

Ingres Features

The distributed Ingres architecture consists of three components: network nodes and their associated local databases, the communications links between nodes (managed by Ingres/Net), and distributed databases that can incorporate tables from multiple local databases. These distributed databases are the purview of Ingres/Star.

You link tables from local databases into a distributed database with the REGISTER AS LINK or CREATE LINK commands. These also create tables in the distributed database. Ingres/Star stores the table in a local database and places a link to it in the distributed database.

A distributed database organizes multiple local databases into a single global entity. A user at any network node can log onto a distributed database and access tables in it as if they all resided right at the user's local site. Thus, Ingres/Star implements location transparency.

Ingres/Star designates the network node where you create a distributed database to be the coordinator node for that database. This node then tracks the location of all the tables in the distributed database and manages the global data-dictionary tables. The ADD NODE command makes other network nodes aware of the existence and location of the coordinator and lets users at those nodes log onto the distributed database without knowing where it's kept.

Strong Points

A critical piece of a distributed database management system is a first-rate distributed query optimizer. The task of the optimizer is to figure out how to process a distributed query most efficiently. It must break the query down into operations on local tables and then determine how to move the resulting tables around the network. A poor distributed optimizer can make disastrously wrong decisions. (In reference 3, Chris Date presents an example of a three-table join where processing time could range from 1 second to 2.3 days!)

Ingres/Star has a very sophisticated query optimizer that can analyze network conditions with a high degree of precision. For example, the Ingres/Net utility netu enables you to tell Ingres about the speed of each link in the network and the processing speed of the local CPUs. The Ingres/Star optimizer uses this data in its evaluation of processing strategy.

Ingres also provides gateways into a number of other database and file systems, including IBM's DB2, SQL/DS, IMS, and VSAM; DEC's RMS; Cullinet's IDMS/R; and Data General's DG/SQL. A distributed Ingres/Star database can include local databases using any of these systems; the distributed database still looks like a single Ingres database to its users.

Limitations

Ingres/Star does not permit multisite update transactions: It cannot guarantee that a transaction that has to update tables at more than one site will leave the database in a consistent state. This requires distributed applications to be less ambitious than they might otherwise be, and it also obliges database administrators to constantly monitor the database for any signs of inconsistency.

Ingres/Star also lacks support for fragmentation and replication transparency. As you saw, these are desirable features for a DDBMS because they give users an integrated view of the global database. With Ingres/Star, you don't need to know where table fragments reside, but you do need to know which fragment stores which data.

A Real-World Implementation

In the sample database, the EMPLOYEE table was fragmented horizontally and

vertically. Because Ingres/Star doesn't support fragmentation, to implement this database you have to decide whether to reintegrate the vertical fragments (EMPBIO and EMPBAL) or to treat them as discrete tables. The purpose of the fragments is to restrict access to tax and salary information; you can get the same effect by creating views and defining authorizations on the views. This simplifies the physical structure of the data and provides the desired logical fragmentation. To implement this pseudo-fragmentation, you create an EMPLOYEE table, an EMPBIO view, and an EMPBAL view. You also create an index, EMPNDX, on the Empssn column.

Next, you need to define links between the tables and the distributed database. The tables must have unique names; to preserve location transparency, you should assign names that emphasize logical function rather than physical location. One effective method is to use suffixes on base table names. For example, you could designate the New York EMPLOYEE table as employee_east, the Chicago table as employee_midwest, and so on. The table employee_hq stores the data uploaded from the regional offices, including a copy of New York's local data.

You use the Ingres/Net network utility netu to define five network nodes: New York, Chicago, Atlanta, Phoenix, and Los Angeles. Each remote node has its own local database, and New York has two: one for its local data and one for the global corporate data. The databases are called vi_hq, vi_new_york, vi_atlanta, vi_chicago, vi_phoenix, and vi_la.

You create the distributed database and the local database at the New York node with the following commands:

```
createdb vi_hq
createdb vi_new_york
createdb vi_ddb/d
```

The /d parameter indicates that the database vi_ddb is distributed, rather than local. Once a database is created, you enter

```
sql vi_ddb/d
```

to load the SQL interpreter and connect it to the new database. To enable transparent access to the database from the

nodes, you enter an ADD NODE command for every node on the network.

Creating the Local Databases

Once the distributed database is established, every node must create its local database with its tables and associated views and index and then link them into the distributed database. For example, the Chicago office would first create its local database (vi_chicago) and access it with the SQL interpreter. At this point, Chicago creates its local copies of the EMPLOYEE table, the EMPBIO and EMPAL views, and the EMPNDX index.

To link these objects into the distributed database, Chicago goes back into the SQL interpreter. This time it connects to the distributed database and uses the following REGISTER AS LINK commands to enter the local objects into the distributed database:

```
REGISTER TABLE
employee_midwest
AS LINK FROM EMPLOYEE
WITH NODE = CH,
DATABASE = vi_chicago
```

```
REGISTER VIEW empbio_midwest
AS LINK FROM EMPBIO
WITH NODE = CH,
DATABASE = vi_chicago
```

```
REGISTER VIEW empal_midwest
AS LINK FROM EMPAL
WITH NODE = CH,
DATABASE = vi_chicago
```

```
REGISTER INDEX empndx_midwest
ON employee_midwest
AS LINK FROM EMPNDX
```

Repeating these steps at all five regional offices completes the creation of the distributed database.

Replicating the Tables

In the theoretical design, the company implemented a circular backup scheme whereby each regional office maintained on-line backup copies of the tables for one other site. This introduces an additional level of complexity into the distributed database because every time a user updates a local table, the backup copy must also absorb the change.

Such complexity creates problems in three areas. First, transmitting the

Listing A: Ingres/Star SQL statements that upload updates to the headquarters database.

```
DROP TABLE employee_hq_backup

CREATE TABLE employee_hq_backup
AS SELECT * FROM employee_hq
WITH NODE = NY,
DATABASE = vi_hq

(If this step fails, we cancel the upload.)

DROP TABLE employee_hq

CREATE TABLE employee_hq
AS
SELECT * FROM employee_east
UNION
SELECT * FROM employee_south
UNION
SELECT * FROM employee_midwest
UNION
SELECT * FROM employee_mountain
UNION
SELECT * FROM employee_west
WITH NODE = NY,
DATABASE = vi_hq
CREATE INDEX empndx_hq ON employee_hq(Empssn)
```

changes to the backup site increases communications costs and degrades performance at the primary site. Second, someone or some application has to know about the duplicate copy of the table and take responsibility for propagating the update. Third, this system, by definition, eliminates efficient single-site update transactions—all updates involve two sites.

The first problem involves a trade-off. If you don't maintain backups, you increase performance and lower costs, but you also sacrifice availability and reliability. This is a management decision, not a technical issue.

The second problem is technical. If the DDBMS provides replication transparency, application programs need not worry about backups; the DDBMS handles all the complications. However, if it doesn't, applications must propagate the updates. If the replication strategy changes, so must the applications. Because Ingres/Star doesn't currently support replication transparency, the burden lies entirely with programs and users.

The third issue is critically important. If all transactions are multisite, you depend on the DDBMS to protect them. It must therefore implement some form of Commit protocol to protect their integrity. However, because Ingres/Star doesn't do this at present, you can't be sure that both the primary copy and the

backup will be updated successfully. Thus, it's better to err on the side of caution and not permit an interoffice query if the target site is down. The strategy of backing up each site's tables at one other site should be abandoned.

Collecting the Tables

Collecting the tables at headquarters presents no problems. In fact, it's quite easy, and any network node can do it simply by connecting to the distributed database. Listing A shows the SQL statements that perform the uploads. Because the update transactions use the DROP TABLE and CREATE TABLE statements, you should keep a backup copy of employee_hq (called employee_hq_backup) for protection in case the CREATE TABLE fails. Again, I emphasize that any node in the distributed database can execute this procedure.

That wraps up the Ingres/Star implementation of the sample database. Although the hypothetical design of the database had to be scaled back to accommodate Ingres/Star, the resultant system remains quite useful. Considering that Ingres/Star could have implemented this database even though the local database systems might be a mix of DB2, IMS, and Ingres, you begin to see the value of distributed database systems in a heterogeneous network environment.



Just Being Fast Isn't Good Enough... **Micronics 25 MHz and 33 MHz motherboards allow** **you to maneuver in the 386 fast lane!**

Some manufacturers push components and designs to improve performance and reduce their costs. Pushing components, even a little bit, creates the kind of heat and stress that cause systems to crash and data to be lost forever.

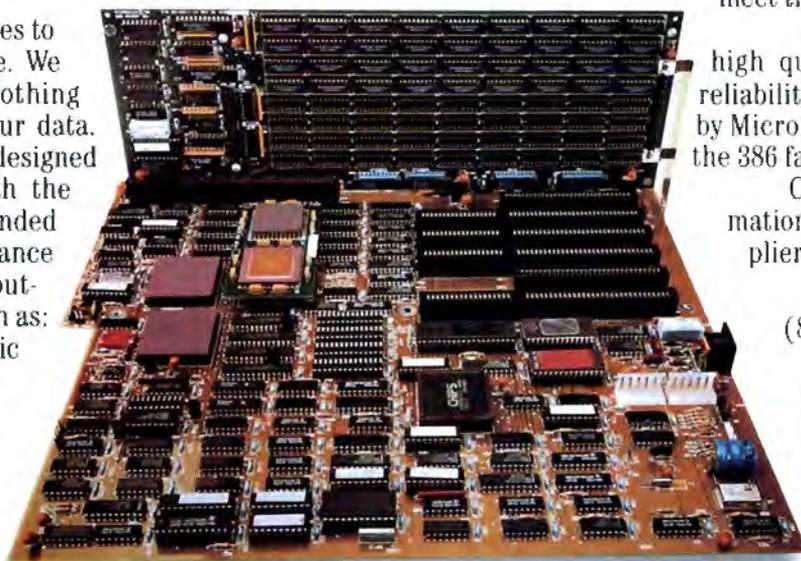
Micronics refuses to give in to this practice. We recognize there is nothing more valuable than your data. Our motherboards are designed and manufactured with the kind of reliability demanded by today's high performance computers. These computers require devices such as: cache memory, fast static RAM and coprocessors originally used only in mainframes. Advanced operating systems

including UNIX and OS/2 require high levels of design sophistication. Large databases, spreadsheets and multiuser applications also have complex critical timing requirements. Micronics motherboards are built to meet these needs.

Advanced engineering, high quality, and unequalled reliability: motherboards created by Micronics to help keep you in the 386 fast lane!

Call now for more information and the Micronics supplier nearest you.

National WATS
(800) 234-4386
California
(408) 732-0940
FAX
(408) 732-6048



MICRONICS
COMPUTERS INC.

Fully Utilizing the Power of the 386.

935 Benecia Avenue, Sunnyvale, California 94086

Circle 192 on Reader Service Card

These are the Ultimate Values from VNS!

*Advanced products, revolutionary prices, one year warranty
and 30-day money back guarantee.*

The New Model 220 VNS 286 20MHz \$1595.

Complete System Features:

- CPU 80C286-20MHz or 16MHz*
- 1MB memory expandable up to 4MB on board
- 40MB hard drive 28ms and 1.2MB 5¼" floppy drive standard
- High speed hard and floppy disk controller, 1:1 interleave
- Phoenix BIOS with built-in setup
- 101 key enhanced AT compatible keyboard (Tactile Click)
- 80287 math co-processor optional
- Real time clock calendar with battery back-up
- 2 serial, 1 parallel port standard
- 4-16 bit and 1-8 bit expansion slots available
- Fully XT/AT compatible
- DOS, OS/2, XENIX compatible

*VNS 286-16/20MHz now available with 20MB 28ms Hard Disk Drive \$1495.
VNS 286-12MHz with 40MB 28ms Hard Disk Drive \$1295.
VNS 286-12MHz with 20MB 28ms Hard Disk Drive \$1195.

The Powerful Model 320 32-Bit VNS 386 20MHz \$1995.

Complete System Features:

- CPU 80386-20MHz
- 1MB memory standard expandable to 8MB on board (16MB system total)
- 8/16/20MHz keyboard selectable
- 40MB (28ms) hard drive and 1.2MB 5¼" floppy drive standard
- High speed hard and floppy disk controller, 1:1 interleave
- Phoenix BIOS with built-in setup
- Super deluxe heavy duty tower case with 7 half height drive bays
- 101 key enhanced AT compatible keyboard (Tactile Click)
- 80387 or 80287 math co-processors optional
- Real time clock calendar with battery back-up
- 2 serial, 1 parallel port standard
- 1-32 bit, 5-16 bit and 2-8 bit slots available
- Fully XT/AT compatible
- DOS, OS/2, XENIX compatible

Compare feature by feature—then buy VNS™

Standard Features	286-Based Computers				386-Based Computers			
	VNS	IBM-50	Compaq Deskpro	Dell	VNS	IBM-80	Compaq Deskpro	Dell
Speed	20MHz	10MHz	12MHz	12MHz	20MHz ²	20MHz	20MHz	20MHz
On Board Memory	1MB	1MB	1MB	640K	1MB	2MB	1MB	1MB
Possible On Board Upgrade	4MB	NONE	13MB	4.6MB	8MB	4MB	16MB	16MB
Floppy	1.2MB (5¼)	1.44MB (3½)	1.44MB (3½)	1.2MB (5¼)	1.2MB (5¼)	1.44MB (3½)	1.44MB (3½)	1.2MB (5¼)
Standard Hard Disk	40MB (28ms)	20MB (80ms)	20MB (29ms)	20MB (40ms)	40MB (28ms)	115MB (28ms)	40MB (29ms)	40MB (29ms)
Available Hard Disk Upgrades ¹	86MB (\$395)	NONE	40MB (\$1399)	40MB (\$300)	300MB (\$1995)	314MB (\$6495)	300MB (\$6499)	322MB (\$4899)
Operating System Software	DOS 4.01 (\$45)	DOS 4.01 (\$120)	DOS 4.01 (\$120)	DOS 4.01 (\$119)	DOS 4.01 (\$45)	DOS 4.01 (\$120)	DOS 4.01 (\$120)	DOS 4.01 (\$119)
Price	\$1595	\$3595 ²	\$3199 ²	\$1699	\$1995	\$8995	\$6599	\$3699
Optional EGA Card/Monitor	\$395	—	—	—	\$395	—	—	—
Optional VGA Card/Monitor	\$495	\$595	\$699	\$400	\$495	\$595	\$1298	\$400
Additional 1 Meg On Board	\$299 (3 Meg) \$495	\$1695	\$799	— (3 Meg) \$1100	\$299 (3 Meg) \$495	\$1695	\$799	— (3 Meg) \$1100

1-Up to 300MB 2-Without Monitor 3-Available in Tower Case or Desktop



Use Your MasterCard or VISA

Circle 312 on Reader Service Card

**We Welcome Inquiries
from VARs and OEMs**

VNS America Corp.

**Order Now Toll-Free
1-800-444-7482**

796 Boston Post Road • Marlboro, MA 01752 U.S.A. • In MA 508-481-3726 • FAX: 508-481-2218

All prices subject to change without notice.

Working Hours: 9 a.m. - 8 p.m. E.S.T. Mon. - Fri.; Sat. 9 a.m. - 5 p.m. E.S.T.

A Family of Models

Can object-oriented databases be as successful as relational databases?

Joseph Dawson

When the dust from the great database debate settled in the early 1980s, the relational data model emerged as the sine qua non of database design technology. However, people found that the relational model is weak in handling certain types of applications: specifically, complex design applications such as CAD and computer-aided software engineering.

For instance, an electrical engineer's CAD software typically includes schema-capture editors, design-rule checkers, and circuit-layout programs: all subsystems that require massive amounts of persistent data. Such an application places demands on conventional databases that they cannot easily satisfy. These include the ability to model very complex data and evolve the database without affecting the current application base. Over the last few years, researchers have developed object-oriented database management systems to better meet the needs of complex applications.

Object Orientation

In an object-oriented programming environment, an object is an entity with a pri-



ivate memory and a public interface. You use messages to instruct an object to report on or alter its private memory. Messages are implemented by procedures (i.e., methods) that have special privileges in accessing the object's private memory. All objects belong to a class (i.e., a type) that defines the messages that the object can understand and respond to. A class inherits all the mes-

sages from its superclasses. In simple terms, an object consists of both private data and the methods that can act on that data.

Object-oriented databases are rooted in the same concepts as object-oriented languages, but they add characteristics such as persistence, concurrency control, resiliency, consistency, and the ability to query the database. You can program an object-oriented database with a computationally complete programming language and include more of the application execution in the database itself. By including more of the application code in the database (which is the locus of sharing), it becomes possible to share the application semantics embedded in the code. The database system can use additional knowledge

about these programs to optimize query processing and to control the concurrent execution of transactions.

Unlike the relational data model, a single object-oriented data model has yet to emerge. Instead, research continues on a number of models (see references 1 through 8) that share several high-level features. Development also proceeds on

continued

a few commercial products.

Despite the lack of a single data model, research into the design of object-oriented databases shares many common goals. One goal is to provide a system with tools for building extensions. You need extensibility because new applications often involve unpredictably complex forms of data that evolve over time. A fixed set of data-structuring primitives won't adequately support arbitrary new design data. Extensions add functionality to the data model at a level indistinguishable from the built-in primitives.

One way you can provide extensions is to create new types. A type is a template that indicates how you can manipulate the type's instances. In programming languages, type checking is commonly performed to ensure that the types of expressions match the context in which they are used. For example, when making an assignment, the type of the variable to the left of the operator must be compatible with the type of the expression to the right.

An important aspect of a type system is whether type checking is done at compile time or at run time. The Trellis/OWL language (see reference 9) developed by Digital Equipment Corp. combines strong typing, abstract data types, and inheritance. The resulting language also type checks at compile time.

Creating new types is not new to databases, but the idea that a type encapsulates its representation is. Earlier database models provided you with a fixed set of built-in types and a small set of type constructors (e.g., records). You could build new types with the type constructors, but these new types didn't allow for operations that were different from those defined by the type constructor (e.g., for records, the operations are the basic get-value and set-value operations on its fields). In other words, there is no way you can hide the representation of a new type.

Encapsulation lets you build a system from modules that you access through a well-defined interface. The abstract data-type approach defines the interface by a set of strongly typed operation (or method) signatures. It also requires that each type *T* define a representation *R* (some other data type). An instance of *R* must be allocated whenever an instance of *T* is created. This representation stores the state of the object. Only the methods are allowed to access the representation, so you can change the representation without disturbing the rest of the system—all you have to do is recode the methods.

You also characterize object-oriented data models by their ability to make references through an object's *identity* (which is something about an object that remains invariant across all possible modifications of its state). You can use this identity to point to an object. Pointers have been a part of most modern programming languages for some time and were a part of some early database models (e.g., CODASYL). By contrast, the relational model is value-based because it lacks this notion of identity.

Another object-oriented model feature is a typing scheme that includes some mechanism—dubbed *inheritance*—by which type definitions can be related to each other through a type lattice. The basic notion is that you modify type definitions incrementally by adding subtype definitions that modify the original type. The combination of the supertype and the subtype produces a completely defined new type.

Database Considerations

Object-oriented databases are first and foremost databases. As such, they must provide the features and functions you'd expect from modern database systems. Among these features are persistence, concurrency control, resiliency, consistency, and associative access.

Persistence is an object's ability to outlive the process that created it. A persistent object exists in a memory space that is not dependent on any single computational entity. This persistent memory space—the database—can store a large number of objects, more than will fit into the virtual memory of a process. It typically provides some special storage structures (e.g., B-trees) that allow you to search and access this collection of objects efficiently.

Many concurrent processes (i.e., transactions) can share the persistent memory space. The medium of sharing is usually the object. Concurrent access to the shared objects requires that operations from these transactions be synchronized so you don't obtain unexpected results.

A database must also be resilient or fault-tolerant in the sense that if a system failure occurs (whether hardware or software), inconsistencies are prevented. Most database systems approach resiliency by requiring that applications divide their work into transactions. The system will guarantee that a transaction either completes successfully or has no effect on the database at all. This guarantees that transactions behave as atomic units of work.

Each program accessing a database is a potential source of inconsistency. Database systems guard against these errors by describing a set of constraints that must be maintained by all program updates. A sample constraint might be "Employees cannot make more money than their managers." The system will block any program that attempts to violate a constraint. Constraints are usually captured as a predicate calculus-based language or set of rules. There is great interest in enriching the type systems of object-oriented databases to incorporate this type of constraint knowledge.

The final characteristic that an object-oriented database must address is associative access, or *queries*. A query is constructed from a set of operations that are defined on collection types (e.g., sets). These operations return new structures based on the original database. Relational databases have been very successful at achieving these capabilities. Much current research focuses on whether or not an object-oriented database can be as successful in this area.

The question is whether object-oriented databases can handle query optimization extensibly and in such a way that storage details are encapsulated or hidden from the interface. Since queries can contain arbitrary combinations of user-defined operations, it's difficult for an optimizer to discover equivalence-preserving transformations. The optimizer must be able to figure out when a transformation is less expensive than the original when the implementation is hidden.

Relating to the Relational

The relational model is the state of the art in the commercial database field. Therefore, it is worthwhile to explore how object-oriented databases differ from their relational counterparts.

Relational databases present you with a view of the persistent data space, consisting of primitive values of integers, reals, and strings, and structured values represented as tuples or sets of tuples (i.e., relations) over these primitive values. (A tuple is a one-dimensional table. A set of tuples constitutes a two-dimensional table.) This high-level view of data is very convenient for applications that primarily produce reports. It is a hindrance, though, for programs that are at the same level of complexity as a CAD system or program development environment. These programs require tight control over how storage is used. They often need to use data structures like stacks, queues, or streams of bytes. An object-

continued



CompuStar II



IT EATS IBM'S LUNCH... AND SERVES DELL FOR DINNER!

Introducing Wells American's CompuStar II. It's one *hungry* machine. Feed it the toughest applications you can dish out and it's ready for "seconds" before IBM, Dell and all the others even get started.

IT FEEDS ON THE COMPETITION.

CompuStar II's enormous appetite for devouring the competition comes from its unique, modular design. Interchangeable, plug-in CPU "modules" are available in 80286, 80386SX and 80386 configurations.

The modules are remarkably inexpensive — as little as \$750 for a '286 module, and incredibly powerful.* The 33MHz '386 module achieves a stunning MIPS rating! Best of all, for up to one full year after purchase, you can trade in the module you originally select toward the purchase of any of the other more powerful modules.

IT DEVOURS OTHER COMPACTS.

Unlike other small footprint micros, CompuStar II won't put your computer expansion needs on a diet. Each system features an amazing six bus slots — four of them available in a fully configured VGA system. That's 25% more than IBM or Dell gives you. Better yet, you can have up to 11 slots with CompuStar II's exclusive bus expansion chassis. No other compact system available offers this much room for growth. And no other comparably sized system can accommodate that growth better than CompuStar II.



BUS EXPANSION CHASSIS

Its whopping 200 watt power supply gives you more than twice as much reserve power as IBM or Dell.



And CompuStar II has more room for disk/tape drives — four compartments in all; three accessible from the front panel. IBM and Dell give you just three compartments and only two are accessible from the front. CompuStar II also accommodates 5 1/4" and 3 1/2" disk drives. IBM and Dell restrict you to 3 1/2" drives only.

IT'S ALSO WELL-MANNERED.

Worried about quality and reliability? Don't! Wells American has been making PCs longer than IBM or Dell! Each CompuStar II is money back guaranteed for 31 days, factory warranted for a full year and can be field serviced from hundreds of locations worldwide.

When you think about it, buying an IBM or Dell system instead of our new CompuStar II is sort of like eating hamburger when you could have had steak — and paid less for it. CompuStar II... from Wells American. It makes "mincemeat" of everything else.

To receive a CompuStar II product information kit, call 1-803-796-7800. VAR inquiries also welcome.



Corporate Headquarters: 3243 Sunset Boulevard • West Columbia, South Carolina 29169 • 803/796-7800 • FAX 803/796-7029

IBM is a trademark of International Business Machines Corporation. Dell refers to Dell Computer Corporation.

*CompuStar II's CPU performance is so incredible you won't believe it! Call or write for complete benchmark information. Certified FCC Class A. For business use only.

EZ-DOS

An alternative, user-friendly Disk Operating System for PCs.

INSTALL generates CONFIG/AUTO/EXEC files	EZ-DOS	DOS 3.3	DOS 4.01
File & directory password protection	Yes	No	Yes
On-line help for command syntax & usage	Yes	No	No
True graphic user interface (GEM Desktop)	Yes	No	No
Command line editing	Yes	No	No
Command history buffer up to 4K bytes deep	Yes	No	No
Full screen text editor with on-line Help	Yes	No	No
Maximum partition size (in megabytes)	512	32	512

There is no comparison

- EZ-DOS 4.0 \$79.00
- plus True BASIC..... \$99.00
- plus serial Mouse..... \$129.00
- plus T.BASIC & Mouse... \$149.00

2001 Sales, Inc.
 16580 Harbor Blvd., Ste. D
 Fountain Valley, CA 92708.

Tel: (714) 531-6551

Fax: (714) 531-8546

Dealer, Distributor & OEM Inquiries welcome.
 VISA and Master Card accepted.

oriented database lets you create abstractions that match the data structures that are needed for intricate tasks.

The relational data model is value-based, as opposed to earlier, identity-based data models like CODASYL. This distinction is based on the mechanisms that a data model provides for relating objects to one another—a fundamental part of any database model. A value-

If the clusters are set up properly, the number of disk faults declines.

based system expresses the relationship between two objects by embedding the same (or a similar) value in two or more related objects. An identity-based model can relate two or more objects independently of embedded values or the context in which they are embedded.

Object-oriented database systems share this identity-based characteristic with network models like CODASYL. However, this one similarity is not enough to conclude that the models are essentially the same. Object-oriented models add abstract data typing based on behavioral modeling (i.e., methods or operations) and an incremental modification mechanism in the form of inheritance, resulting in a model that is quite different from its network predecessors.

Although object-oriented systems can form references based on identity, this is not the sole basis for relationships in the model. A model such as Brown University's ENCORE (see reference 8) can relate objects through properties as well. A property is a reflection of the abstract state of an object. As such, a property P relates an object X to a set of objects S with no statements about how this relationship is computed. It could be computed by a direct reference to the identity of S (or its members) or by matching values for other properties as a join. Consider the following type definition:

Define Type Employee Properties

- name: String
- dept: Department
- projects: Set of Project

The dept property, which expresses the department that a given employee works in, could be implemented by an embedded object identifier that refers directly to an object of type Department. On the other hand, if the representations for both the Employee and the Department types are tuples in a relation, the dept property could be implemented by a relational query of the following form:

```
dept(e) = Project((Join(Select
    (Employee, name = name(e)),
    Department), Department))
```

In this way, an object-oriented database provides a framework for unifying value-based and identity-based access.

An object-oriented database must be able to define new abstractions and to control the implementation of these abstractions. From the above example, you can see that it's possible to combine both identity-based and value-based relationships at the implementation level while retaining the same abstraction at the logical level. The particular choice between these two may have an impact on the performance of certain queries.

Implementation Considerations

Due to the nature of the applications they support, object-oriented database implementations entail some unique problems. For many design applications, it's important to be able to traverse a graph structure efficiently. Tools like a design rule checker in an electrical CAD application require that, given one component, the system must be able to quickly reference the other components connected to it. If a program is working on a circuit board, it will often require the backplane that that board is connected to. Although you can view this kind of access as a degenerate query, other implementation techniques might be more useful for this type of access than techniques that have been designed for queries over large sets.

One way you can improve performance in this situation is to minimize the probability that traversing an edge in the graph will cause a disk fault. You can do this best with intelligent prefetching. Often a scheme is used that allows applications to create arbitrary-size collections of objects (called *clusters*) that are stored contiguously on the disk. Whenever any object in a cluster is accessed, the entire cluster is read (prefetched) into the memory of the application.

If the clusters are set up properly, the number of disk faults declines. Determining how to automatically configure a

set of clusters for a particular pattern of accesses will require more research.

When using an object-oriented database to serve a network of workstations, you designate one or more machines as object servers that will supply application programs with objects as needed. In such a system, you need to minimize workstation and server communications. The intelligent caching of objects in a manner related to clustering techniques is a useful way to reduce communications. The point is to keep objects as close as possible to their point of use.

Pointers to objects in programming languages are implemented by virtual memory addresses. For persistent objects, you must use pointers that are not dependent on the object's physical position, since there is no guarantee that the position will remain constant between uses by different processes. Instead, you would typically use some kind of system-generated surrogate. Dereferencing these pointers usually requires looking up the value in a hash table to locate the object on disk. Once the object is located and read into virtual memory, you'll need to eliminate the overhead inherent in this table lookup. Various schemes have been proposed for temporarily replacing the disk-based pointer with a virtual memory address and then swapping it back to the disk-based surrogate when the object is returned to the disk.

Another classic way to improve database performance is to introduce auxiliary access methods that can be used to limit the amount of searching required. Indexes have normally been used in this way to increase the system's ability to process queries efficiently. However, indexes on method results introduce problems for object-oriented databases. Unless you restrict the kinds of indexes that can be constructed, it's difficult to know when an index requires updating.

Index structures can be useful for managing large collections of objects or for handling very large objects (e.g., bit maps). The EXODUS storage system designed at the University of Wisconsin (see reference 2) constructs a tree for large objects, so you can retrieve smaller pieces more efficiently. The tree structure allows you to access a sequence of bytes from the middle of a large object without having to read the entire object.

Query Processing

A query is a high-level specification of a set of objects you want to access. You usually specify a query using a special language that allows you to describe what

continued

A MESSAGE TO OUR SUBSCRIBERS

FROM TIME TO TIME WE MAKE THE BYTE SUBSCRIBER list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE MAGAZINE

ATTN: SUBSCRIBER SERVICE

P.O. Box 555

HIGHTSTOWN, NJ 08520



McGraw-Hill Bookstore

POWER TOOLS for the mainframe professional



①. DB2 Version 2: Database Design and Administration

By Robert Heydt and Diane Heydt.
All the troubleshooting techniques, schematic illustrations, and working models you need to turn relational database theory into practical applications with DB2. 256 pages, \$29.95

②. A Visual Introduction to SQL

By J. Harvey Trimble, Jr. and David Chappell.
Quickly learn SQL through a unique graphical approach that clarifies complex areas and takes you step-by-step to increasingly powerful operations. 264 pages, \$24.95

③. VM / CMS: A User's Guide

By Paul Chase.
Take full advantage of VM / CMS—from communicating with peripheral devices to customizing the XEDIT environment—with this comprehensive tutorial. 264 pages, \$29.95

For the best computer books from all the best publishers, look to the McGraw-Hill Bookstore.

Published by John Wiley & Sons

McGraw-Hill Bookstore
1221 Ave. of the Americas
New York, NY 10020
(212) 512-4100



Please send me:

___ copies ① ___ copies ② ___ copies ③

Check, money order, or credit card only:

Visa AMEX MasterCard

Account No. _____

Exp. Date _____

Name _____

Address _____

City/State/Zip _____

Please add applicable sales tax, plus \$2.50 postage and handling

BYT9

The Professionals' Information Center — Since 1961

you want to retrieve without requiring a statement of how to go about doing it. It's the query processor's job to figure out the most efficient plan for retrieval. Query languages (i.e., fourth-generation languages) and their associated optimizers have been one of the major achievements of the relational approach.

Some proposed extensions to existing relational query languages embed object-oriented facilities in relational languages like SQL. Others propose a set of operations that you can apply to aggregate objects, thereby providing an object-oriented query algebra.

Non-first-normal-form relations (in which a cell in the relational matrix contains more than one value) address the problem of expressing complex objects with components that can be sets of objects. They extend the conventional relational model by allowing the value of an attribute (i.e., the contents of a cell) to be a record, a vector, or another relation. Object-oriented databases solve this problem, but they also introduce ideas of identity, data abstraction, and inheritance.

Queries in the object-oriented model can be cast as expressions involving spe-

It's the
query processor's job
to figure out the best
plan for retrieval.

cial methods defined on the types that are defined for aggregating objects (e.g., Set, List, and Tree). As a simple example, the type Set would define a method as follows:

```
Select(S1: Set(T), P:  
Predicate) -> S2: Set(T)
```

The predicate is a function of the form $P(t:T) \rightarrow \text{Boolean}$. The output argument S2 is a subset of all the elements of the first input argument S1 such that they satisfy the predicate P; that is,

```
Select(S, P) = { s | s in S and P(s) }
```

The Select operation would be part of a query language and is similar to the Select operation in the relational algebra.

Why is querying in an object-oriented model different from querying in the relational model? Because you can construct an algebra for expressing queries over sets of objects. One problem involves optimizing these expressions. In the relational model, queries are cast in terms of well-defined operators over very simple structures (i.e., normalized relations). In the object-oriented models, queries can involve operators for newly defined abstract data types. Each new type, by introducing new operations, creates a new algebra whose properties are unknown to the query optimizer. If you don't know the algebraic properties of these new operators, it's difficult to transform query expressions into alternative equivalent forms.

This problem has been addressed in the EXODUS project (see reference 10). Here, the optimizer is extended after being supplied with transformation rules to cover new data-model features. These

continued



Finally, OS/2 debugging help has arrived.

Introducing MultiScope™, an OS/2, multi-language, CodeView™-compatible debugger, like nothing you've seen before.

For a start, it provides 13 views of your program: Source—Data—Graphic Data—Assembly—Thread—Breakpoint—Watch—Register—Module—Call—Memory—Log—and Output.

Other unique features include: run-time and post-mortem debugging options; OS/2 text mode and Presentation Manager user interfaces; and even a graphical representation of your data structures! All for \$299.

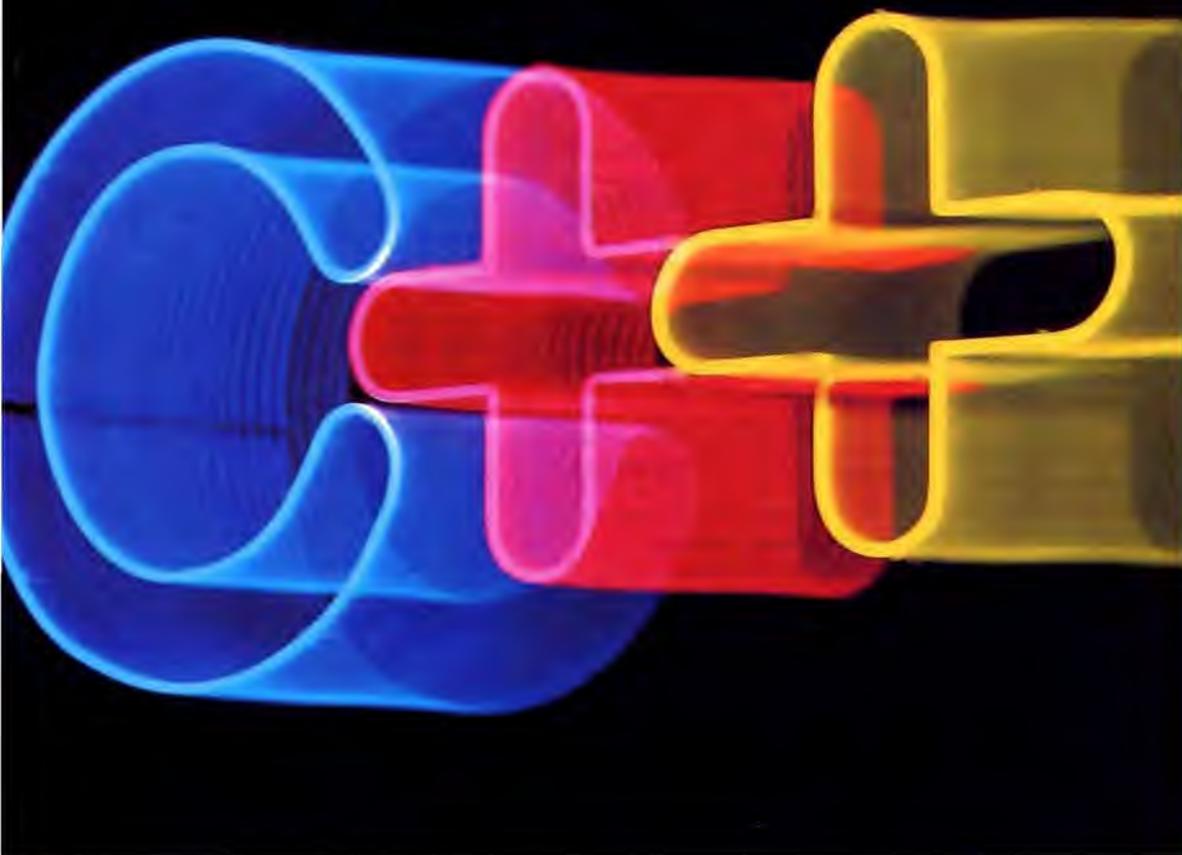
Call toll free 800-231-7717.

In CA 800-552-8885. Fax 415-792-8901.

MULTISCOPE™
DEBUGGER

From LOGITECH Software

Circle 169 on Reader Service Card (DEALERS: 170)



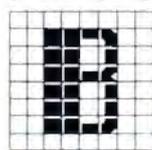
ZORTECH

Everyone agrees! C++ is the only logical way forward for the multitude of C programmers faced with the task of developing sophisticated applications for today's "Power Users".

C++ offers many advantages over all other languages, object oriented or not:

- ANSI C compatible
- Object oriented
- Major industry support
- Data-abstraction
- Strong type-checking
- User defined types
- Modular programming
- Data hiding

1 9 8 8



B Y T E

The Award Winning Zortech C++ Compiler has absolutely shaken the roots of the C compiler market by setting a new technological standard. It is the very first and only MS-DOS compiler to produce native code directly from C++ source files.

Zortech is at the forefront of C++ Compiler Technology with

an already impressive lead, maintained by continually enhancing product quality and support.

Since the launch of the C++ Compiler, Zortech has brought the power and efficiency of C++ to tens of thousands of users worldwide. We continue to develop tools for programmers of the next generation of high powered applications.

Please call or write for full details of our complete range of C++ products.

Zortech Incorporated 1165 Massachusetts Avenue, Arlington, MA02174
tel: 617-646-6703 fax: 617-643-7969

Zortech Limited 106-108 Powis Street, London SE18 6LU
tel: 01-316-7777 fax: 01-316-4138



rules transform query trees with operations for internal nodes and stored data for leaf nodes into equivalent query plans. A plan is also a tree with lower-level access routines as internal nodes and sequential data sets as leaf nodes.

Encapsulation of implementations by abstract types presents another problem for query optimization in object-oriented databases. Even if you could produce transformed versions of queries, you must be able to determine the relative costs of processing these query expressions. Processing costs are typically dependent on the underlying storage structures for the objects and their aggregates, which might be difficult to determine from the implementation of the methods.

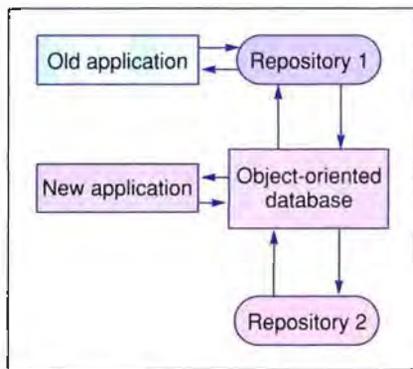
For example, if a given set *S* is implemented by a B-tree on some attribute *A*, then retrievals over *S* on attribute *A* will likely be relatively inexpensive. Knowing about the existence of such storage structures seems at first to be a violation of encapsulation.

Encapsulation is a principle of good software structuring that is important to preserve between application-level modules. The query optimizer is a trusted component of the database system; it can look inside an abstract data type and determine the implementation. There is still a question about how this can be effectively managed if the implementation can be based on other types. Graefe and Maier (see reference 11) have suggested a technique, called *revelation*, by which an abstract data type can reveal to the optimizer details about its implementation. This revealed behavior is given as expressions that are equivalent to pieces of the query in terms of the lower-level implementation types.

Transactions

To preserve the correctness of the database in the face of concurrently executing processes, database systems define an atomic transactions concept. Transactions are units of work that, when allowed to proceed concurrently, are guaranteed to produce results that are equivalent to the results produced by serial execution. Any interleaving of operations that preserves this property is considered *serializable*.

Many implementations have been proposed that guarantee serializable executions. Most are based on read/write semantics. That is, the reads and writes on a data item *X* are both defined to conflict with other writes on *X*. The data manager then decides when to schedule a read or write so that serializability is maintained.



An object-oriented database uses abstraction to ensure interoperability between older applications and newer ones. Older applications access their data repository as before. Newer applications take advantage of the abstraction mechanisms provided by the object-oriented database to access both old-style and newer repositories.

Object-oriented databases present an opportunity to improve on more traditional approaches. In the object-oriented approach, the database system knows more about the operations being performed. They are not simply reads or writes, but rather have more semantics. For example, for a queue data type, you would have operators like *enqueue* and *dequeue*. From one point of view, these can be considered a write and a read, respectively, but if you take the special semantics of these operators into account, you can achieve a higher degree of concurrency.

Suppose you have a queue object *Q* and two transactions, *T1* and *T2*. If *T1* has done an *enqueue* on *Q*, then *T2* would be prevented from doing a *dequeue* on *Q* by common read/write semantics until *T1* has committed. However, if you notice that, for nonempty queues, these two operations do not affect each other's results, you can allow them to proceed without conflict.

For cooperative applications like those seen in design environments, the notion of serializability is too strong a correctness criterion. Designers interact with many of the objects in their environment by using graphics-oriented editors. If you consider a session with an editor (or group of editors) as a transaction, serializability gets in the way. Designers do not serialize. Instead, they share information in incomplete states with each other.

Furthermore, a single transaction *T* might touch objects that are connected

through complex integrity constraints with a large number of other objects. If *T* is to check and adjust the state of these objects so that they remain consistent, then *T* must acquire locks (read and/or write) on all of them. This reduces the amount of concurrency possible between long design transactions. Researchers are beginning to propose schemes to allow users to customize the correctness criteria that the system imposes.

Distributed Objects

When supporting a network of design workstations, you must confront the additional problems presented by a distributed database environment. To simplify programming and preserve data independence, distributed databases strive for transparent distribution. You should be able to name the data the same way you would in centralized databases. The system is responsible for locating the required data items and updating them atomically. You only have to worry about logical issues. As the data is redistributed throughout the network, the programs remain invariant—the system generates new optimizations for processing queries that require data from different sites, depending on the current locations of the data.

In an object-oriented database, programs (more correctly, methods or operations) are often viewed as objects and thus can be moved around the distributed database just like any other object. When performing a computation or processing a query, the system has the choice of moving the data to the programs, or the programs to the data. When executing a method *M* on a very large object *X*, it's often more reasonable to move the method to the machine on which *X* resides.

You can also use caching strategies in a distributed system. As objects move from machine to machine, retaining local copies for some period of time can often shorten subsequent retrievals.

If object placement is not done carefully, the interpretive nature of distributed object-oriented systems can create acute performance problems. Late binding of method names to method bodies requires looking at several objects to determine what code needs to run. Minimizing communications by careful object placement and by using an intelligent planner makes a huge difference in the performance of a distributed object-oriented database. The planner determines the order of operations, the machines that perform them, and the location that receives the result.

continued

PARK A CAR ON YOUR DESKTOP.



Now you can have the best of both design worlds: the powerful Macintosh interface plus a workstation-quality graphics display, thanks to Truevision's HR graphics card. The HR card bridges the gap in today's computing marketplace by offering a non-interlaced, sharp 1280 x 960 pixel display at 8 bits per pixel. Its 256 colors (from

a 16.7 million color palette) give you tremendous flexibility for engineering drawings, scientific visualizations, or 3D modeling.

Truevision's HR card is QuickDraw™ compatible*, which means that you can run with virtually all Macintosh® software. And you may select the monitor of your choice from manufac-

turers like JVC, Philips and SONY®. There are two Truevision HR Cards: The HR 2M (\$3995) addresses a desktop up to 2048 x 1024 pixels and the HR 4M (\$5995) addresses a desktop up to 2048 x 2048 pixels. Take a test drive soon by visiting your Authorized Truevision reseller, or call us at **800/858-TRUE** to obtain literature.



The HR Graphics Card works with the Macintosh II, IIx and IIcx.

 **TRUEVISION®**
Truevision, Inc.
7351 Shadeland Station, Indianapolis, IN 46256

Circle 301 on Reader Service Card

INTERNATIONAL: Canada 416/499-9400 France 33-13-952-6253 Italy 39-2-242-4551 Switzerland 41-1-825-0949 U.K. 44-1-991-0121 West Germany 49-89-612-0010 Other International 617/229-8900. Suggested retail price is US domestic price, and is subject to change.

*All graphics cards with more than 1 MByte of memory require 32-bit QuickDraw. QuickDraw is a trademark and Apple, Macintosh and Mac are registered trademarks of Apple Computer, Inc. SONY is a registered trademark of Sony Corporation of America. Image courtesy of Electric Image. © 1989, Truevision Inc.

Networks made up of heterogeneous systems are a problem in a distributed environment because there is little control over the characteristics of the participating systems, yet these systems must work together. This heterogeneity can take several forms based on differences in the underlying data formats of the participating tools and systems, in the languages used for developing applications, and in how designers need to share information.

The abstraction mechanisms of object-oriented systems can be used to build bridges to existing data repositories, which become the implementation vehicle for new abstract types. The representation for this new type would be some data structure that the foreign data repository supports. Whenever a method of this new type is invoked, the method code would make a call to this repository to access the external representation. An old application would access and update persistent data the same way it always has, but a new application would access it through abstract types that are defined in the object-oriented schema (see figure). Although this might be somewhat slow, the ability to access data across different storage systems is often a requirement.

Other Features

The literature on object-oriented databases often discusses features that are not required to achieve true object orientation but are useful to a database system for CAD applications. These include version control, complex objects, and long (and cooperative) transactions. They appear in this context more for their applicability to design environments than to any inherent object-oriented nature.

A version management facility within an object-oriented database lets you look at an object as a set of snapshots over time. There are several concerns with implementing version management, however. One is the basic structure of a set of versions. A database must be able to handle situations where two or more processes propose to update the same object. One solution is to branch the versions, especially when these competing versions conflict on some basic assumptions. Additionally, you may want to provide a mechanism whereby branching versions can merge.

Another set of questions concerns how you reference the members of an object-version set. One method is to reference them statically by version number. Another is a dynamic mechanism that uses a function to return a specific version. This function might return different versions at different times.

Complex objects model objects that are built out of other objects. The crux of a complex-object facility is the semantics of the `part_of` relationship; that is, the relationship between the constituent objects and the complex object. Work in this area is concerned with allowing the database system to ascribe additional behavior to the `part_of` relationship that affects the behavior of other operations. For example, when an object is deleted, you want the objects that are *contained* (i.e., related by the `part_of` relationship) by it to be deleted also. For more detail on optimizing access to complex objects, see reference 12.

Non-first-normal-form relations address the problem of expressing complex objects with components that can be structured objects. They extend the conventional relational model by allowing the value of an attribute to be a record, a vector, or another relation.

The Sum of the Argument

Object-oriented databases are designed to meet the data-handling needs of complex design applications. While the data-modeling facilities of these systems resemble object-oriented programming languages, the database systems embed

persistence, concurrency control, recovery, consistency management, and a query language.

In addition, object-oriented databases might design the data model somewhat differently from their language counterparts to effectively support database features. An example of this is the way the model incorporates aggregates (i.e., sets) into the system. Sets form the basis for efficient queries.

The history of database management is filled with proposals for competing data models. Each model has its own set of strengths and weaknesses. The object-oriented approach can unify some of these dissimilar approaches by providing a model that is based on abstraction, and that allows type designers to use whatever technique best suits their applications as an implementation of basic functionality. Although many research questions remain unanswered, the object-oriented data model holds the promise of providing advanced data handling for today's increasingly complex application environments. ■

Joseph Dawson is a freelance technical writer and editor. He can be reached on BIX c/o "editors."

REFERENCES

1. Batory, D. S., J. R. Barnett, J. F. Garza, K. P. Smith, K. Tsukuda, B. C. Twichell, and T. E. Wise. "Genesis: An Extensible Database Management System." IEEE, Transactions on Software Engineering, 1988.
2. Carey, M. D., D. J. DeWitt, D. Frank, G. Graefe, J. E. Richardson, E. J. Shekita, and M. Muralikrishna. "The Architecture of the Exodus Extensible DBMS." First International Workshop on Object-Oriented Database Systems, Pacific Grove, California, 1986.
3. Dayal, U., F. Manola, A. Buchmann, U. Chakravarthy, D. Goldhirsch, S. Heiler, J. Orenstein, and A. Rosenthal. "Simplifying Complex Objects: The PROBE Approach to Modeling and Querying Them." German Database Conference, Burg Technik und Wissenschafts, Bad Münster am Stein-Ebernburg, FRG, 1987.
4. King, R. A. "Database Management System Based on an Object-Oriented Model." Expert Database Conference, Charleston, South Carolina, 1986.
5. Lecluse, C., P. Richard, and F. Velez. "O2, an Object-Oriented Data Model." ACM Conference on the Management of Data, p. 424, 1988.
6. Lyngbaek, P., and W. Kent. "A Data Modeling Methodology for the Design and Implementation of Information Systems."

International Workshop on Object-Oriented Database Systems, Pacific Grove, California, 1986.

7. Rowe, L. A., and M. R. Stonebraker. "The Postgress Data Model." Thirteenth International Conference on Very Large Databases, Brighton, U.K., 1987.

8. Zdonik, S. B., and P. Wegner. "Language and Methodology for Object-Oriented Database Environments." Nineteenth Hawaii International Conference on System Sciences, Honolulu, Hawaii, 1986.

9. Schaffert, C. "Trellis/OWL." Conference on Object-Oriented Programming, Systems, Languages, and Applications, Portland, Oregon, 1986.

10. Graefe, G., and D. J. DeWitt. "The EXODUS Optimizer Generator." ACM Conference on the Management of Data, San Francisco, California, 1987.

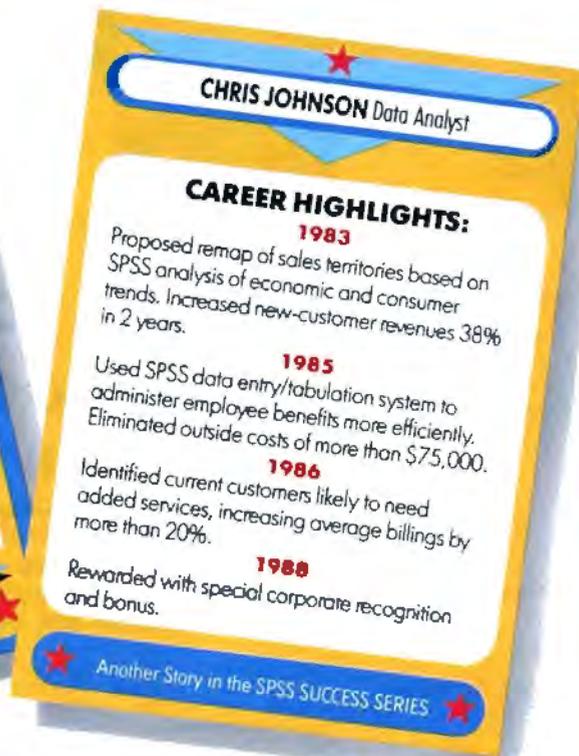
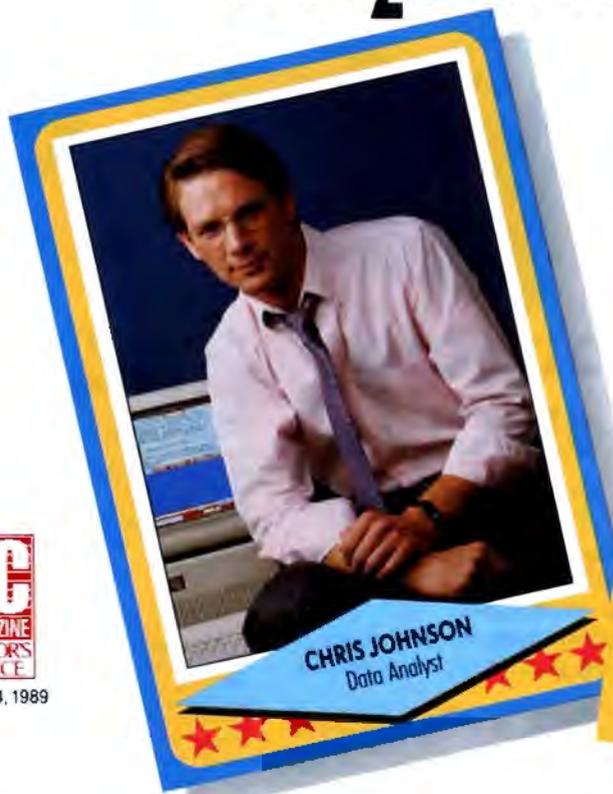
11. Graefe, G., and D. Maier. "Query Optimization in Object-Oriented Database Management Systems; A Prospectus." German Database Conference, Burg Technik und Wissenschafts, Bad Münster am Stein-Ebernburg, FRG, 1987.

12. Valduriez, P., S. Khoshafian, and G. Copeland. "Implementation Techniques of Complex Objects." Twelfth International Conference on Very Large Databases, Kyoto, Japan, 1986.

We'll take your stats and make you the most valuable player in your league.



March 14, 1989



Data analysis software from SPSS gives your PC a winning advantage.

It doesn't matter which field you play hardball in. With the right combination of equipment and ability, you can be a hero.

You get that ability with SPSS. Whether your equipment runs on MS-DOS™ or PC-DOS™ OS/2™ or a Macintosh™. So you turn raw data into useful facts. And yourself into a smarter decision maker.

With SPSS and its options, you can interface directly with data from your database, spreadsheet or other

application software. Then manipulate it in countless ways. From data entry to advanced statistics, forecasting, presentation and more.

Voted #1 by the fans.

When the readers of *PC Week* chose the top statistical software for "user satisfaction" (12/5/88), their choice was SPSS. And no wonder.

SPSS is designed not only for your computer's operating system, but also for its operator. With menu and help systems, plus an on-line statistical glossary. So you're always in control. For market research, sales analysis, quality control and more.

And you can always count on the training, support, and ongoing upgrades of SPSS. The team that's come through for over 1 million users since 1968.

Find out how SPSS can make you first in your micro league, by calling

(312) 329-3315.

We'll give you the numbers to really stand out in your field.

SPSS inc.

Best in the final analysis.

444 North Michigan Avenue, Chicago, Illinois 60611
SPSS International BV: Avelingen West 80,
P.O. Box 115, 4200 AC Gorinchem,
The Netherlands

Take any 3 books for only \$1⁰⁰ each



when you join BYTE Book Club[®] VALUES UP TO \$139.50

- Your one source for computer books from over 100 different publishers
- the latest and best information in your field
- discounts of up to 40% off publishers' list prices

OS/2 PROGRAMMER'S GUIDE. By E. Iacobucci. 1100 pp., illus., softbound. "Byte" magazine called it "a necessity." This giant reference explains all the basic functions you'll need, with emphasis on such new or different functions as multitasking and memory management. 881300-X Pub. Pr., \$29.95

UNIX UTILITIES. By R.S. Tare. 352 pp., illus., softbound. This practical manual shows how to make the best use of UNIX utilities. It covers more utilities than any other book of its kind and provides numerous examples of real applications. 628/84X Pub. Pr., \$27.95

TURBO LANGUAGE ESSENTIALS: A Programmer's Reference. By K. Weiskamp, N. Shammis, and R. Pronk. 496 pp., illus., softbound. Tired of guessing whether your syntax decisions are correct, or whether you've understood the user's manual? Get instant access to complete information on all four Turbo languages with this useful all-in-one reference. 584905-4 Pub. Pr., \$24.95

A PROFESSIONAL'S GUIDE TO SYSTEMS ANALYSIS. By M.E. Modell. 307 pp., illus. Detailed coverage of what you need to know—what questions to ask, how to conduct a cost-benefit analysis, how to document and validate your findings—to design the best systems for your user's needs. 426/325 Pub. Pr., \$34.95

ADVANCED GRAPHICS IN C: Programming and Techniques. By N. Johnson. 430 pp., illus., softbound. Now C programmers can write crisp graphics programs for the IBM-PC using the IBM EGA (Enhanced Graphics Adaptor) or the AT&T Image Capture Board (ICB). Includes GRAPHIQ, a complete C graphics toolkit. 881257-7 Pub. Pr., \$22.95

THE COMPUTER INDUSTRY ALMANAC 1989. By E. Juliussen and K. Juliussen. 788 pp., illus., softbound. If you can't get enough facts about the industry, then this is the book for you. Filled with pages of data on the top companies . . . the most influential people . . . the award winners . . . the salaries . . . the users' groups . . . the future . . . it's all here, in an easy-access format that's a delight to read. 584964-X Pub. Pr., \$29.95

ADVANCED TURBO C.* By H. Schildt. 397 pp., illus., softbound. Complete Turbo C mastery can be yours—from stacks, queues, linked lists and binary trees, to operating system interfacing, porting, debugging, and much more. Fully explains how to get the most from the power and speed of Turbo C. 881280-1 Pub. Pr., \$22.95

ADVANCED 80386 PROGRAMMING TECHNIQUES. By J.L. Turley. 509 pp., illus., softbound. Offering advanced techniques for serious programmers, this hands-on-guide covers advanced memory segmentation, the internal four-level protection hierarchy, multitasking, demand paging, system security, 8086/80186/80286 emulation, and intertask communication. 881342-5 Pub. Pr., \$22.95

THE WAITE GROUP'S MS-DOS BIBLE, Second Ed. By S. Simin. 522 pp., illus., softbound. Shows you how to start up your system, create and manage files, customize your keyboard, and become proficient in such advanced MS-DOS features as LINK, DEBUG, TSR programming and device drivers. 584702-7 Pub. Pr., \$22.95

EGA/VGA: A Programmer's Reference Guide. By B.D. Kliever. 269 pp., illus., softbound. All the practical guidelines are right here for learning the ins and outs of the Enhanced Graphics Adaptor—one of the most popular PC add-on boards available—and its PS 2 counterpart, the Video Graphics Array. It's filled with innovative programming techniques . . . tips for working around the bugs in the BIOS . . . and EGA/VGA BIOS calls not available elsewhere. 350/892 Pub. Pr., \$29.95

DATABASE SYSTEM CONCEPTS. By H. F. Korth and A. Silberschatz. 546 pp., illus. From fundamental concepts to advanced problem solving, this book provides a clear understanding of the design and use of database systems. Also demonstrates the best ways to protect data from unauthorized access and malicious or accidental alteration or destruction. 447/527 Pub. Pr., \$44.95

ARTIFICIAL INTELLIGENCE USING C: The C Programmer's Guide to AI Techniques. By H. Schildt. 412 pp., 37 illus., softbound. This hands-on guide shows you how to create your own AI applications and systems using C. After an introductory overview it provides coverage of expert systems, logic, natural language processing, machine learning, pattern recognition, and more, with ready-to-run programs illustrating each topic. 881255-0 Pub. Pr., \$21.95

PROGRAMMING USING THE C LANGUAGE. By R.C. Hutchison and S.B. Just. 519 pp., illus. Whether you want to understand programs in C written by others, or write better C programs of your own, this practical, authoritative book gives you the tools and guidance you need. Coverage includes program organization, sorting algorithms, recursion, linked lists, and more—with many sample programs. 315 418 Pub. Pr., \$29.95

HARD DISK MANAGEMENT with MS-DOS and PC-DOS. By D. Gookin and A. Townsend. 307 pp., illus. Shows you how to make the best use of your hard disk for all types of programs, with an emphasis on organization, data security, and enhancing performance. Easy enough for novices, yet sophisticated enough for power users, it's packed with helpful hints, proven shortcuts, and clear explanations. 583954-7 Pub. Pr., \$27.95

TRICKS OF THE UNIX MASTERS. By R.G. Sage. pp. illus. Many of UNIX's most interesting features have virtually been kept secret from users—until now! This master guide goes beyond the basics to show you the shortcuts, tools, tips, and tricks it could take years to discover on your own. 584637-3 Pub. Pr., \$22.95

SADT: Structured Analysis and Design Technique. By D. Marca and C. McGowan.
402/353 Pub. Pr., \$49.95
(Counts as 2 of your 3 books)

PROGRAMMING WITH TURBO PASCAL. By D. Carroll.
852908-5 Pub. Pr., \$39.95

HIGH-SPEED ANIMATION & SIMULATION FOR MICROCOMPUTERS. By L. Adams.
583855-9 Pub. Pr., \$20.95

PROGRAM TRANSLATION FUNDAMENTALS: Methods and Issues. By P. Calingaert.
584589-X Pub. Pr., \$36.95

HOW TO BE A SUCCESSFUL COMPUTER CONSULTANT. By A. R. Simon.
572/968 Pub. Pr., \$24.95

UNDERSTANDING & USING dBASE III* PLUS. By R. Krumm.
583940-7 Pub. Pr., \$22.95

32-BIT MICROPROCESSORS. Edited by H. J. Mitchell.
425/85X Pub. Pr., \$48.50

8086/8088/80286 ASSEMBLY LANGUAGE, Revised & Expanded. By L.J. Scanlon.
584839-2 Pub. Pr., \$21.95

NETWORKING SOFTWARE. By C. B. Ungaro.
606969-9 Pub. Pr., \$39.95

THE DATABASE EXPERT'S GUIDE TO SQL. By F. Lusardi.
390/061 Pub. Pr., \$39.95

PRINCIPLES OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS DEVELOPMENT. By D.W. Folsom.
536/147 Pub. Pr., \$44.95

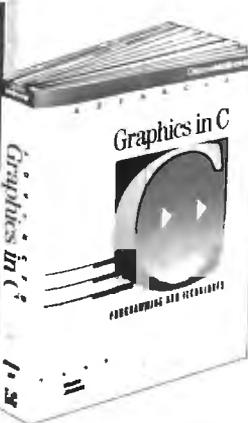
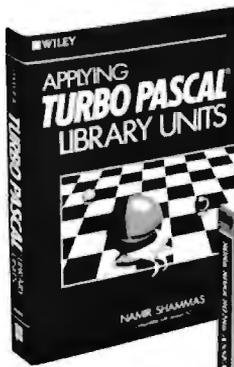
APPLYING TURBO PASCAL LIBRARY UNITS. By N. Shammass.
584791-4 Pub. Pr., \$22.95

DATA STRUCTURES USING PASCAL, 2nd Ed. By A. M. Tenenbaum & M. J. Augenstein.
583738-2 Pub. Pr., \$46.00

MICROCOMPUTER LANS: Network Design and Implementation. By M.F. Hordeski.
584580-6 Pub. Pr., \$28.95

OPERATING SYSTEMS. By M. Milenkovic.
419/205 Pub. Pr., \$42.95

IBM® PS/2® TECHNICAL GUIDE. By C.M. Halliday & J.A. Shields.
584831-7 Pub. Pr., \$24.95



123: THE COMPLETE REFERENCE. By M. Campbell.
681005-1 Pub. Pr., \$22.95

PROGRAMMING IN C, Revised Ed. By S.G. Kochan.
584701-9 Pub. Pr., \$24.95

QUICK C PROGRAMMING FOR THE IBM. By C. Townsend.
584659-4 Pub. Pr., \$22.95

STRUCTURED PROGRAMMING IN ASSEMBLY LANGUAGE FOR THE IBM PC. By W. C. Rynnion.
584827-9 Pub. Pr., \$43.25

TELECOMMUNICATIONS AND DATA COMMUNICATIONS FACTBOOK. By J. Abbatiello and R. Sarch.
606965-6 Pub. Pr., \$44.95

DATA TYPES AND DATA STRUCTURES. By J. J. Martin.
583689-0 Pub. Pr., \$45.00

WORDPERFECT®: THE COMPLETE REFERENCE. By K. Acerson.
881312-3 Pub. Pr., \$27.95

TROUBLESHOOTING AND REPAIRING THE NEW PERSONAL COMPUTERS. By A. Margolis.
583871-0 Pub. Pr., \$18.95

Any 3 books for \$1.00 each... if you join now and agree to purchase two more books—at handsome discounts—during your first year of membership.

MASTERING TURBO PASCAL 4.0, 2nd. Ed. By T. Swan.
584762-0 Pub. Pr., \$22.95

DESIGNING USER INTERFACES FOR SOFTWARE. By J.S. Dumas.
584641-1 Pub. Pr., \$31.00

68000 ASSEMBLY LANGUAGE PROGRAMMING, 2nd Ed. By L. Leventhal; D. Hawkins; G. Kane & W. Cramer.
583817-6 Pub. Pr., \$28.95

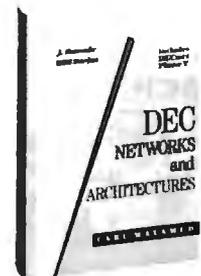
C CHEST AND OTHER C TREASURES FROM DR. DOBB'S JOURNAL. Edited by A. Holub.
584807-4 Pub. Pr., \$24.95

HARD DISK MANAGEMENT IN THE PC & MS-DOS ENVIRONMENT. By T. Sheldon.
565/562 Pub. Pr., \$24.95

FILE ORGANIZATION FOR DATABASE DESIGN. By G. Wiederhold.
701/334 Pub. Pr., \$42.95

USING TURBO C. By H. Schildt.
881279-8 Pub. Pr., \$19.95

New! BYTE LARGE SYSTEMS Books



IBM MAINFRAMES: Architecture and Design. By N.S. Prasad. 331 pp., illus. The only book that presents in one volume the underlying design concepts and implementation details of the full range of IBM machines. Includes the latest developments in 370 architecture... the 3090, 308X, 9370, 438X, and 3033... DASD, and more.
506 868 Pub. Pr., \$39.95

DEC NETWORKS AND ARCHITECTURES. By C. Malamud. 472 pp., illus. Covers the full range of DEC products and shows how to combine DEC computers with other architectures. Explores DNA, DECnet, interconnectivity with SNA, UNIX, and OSI, X windows, Postscript, graphics protocols, and more.
398 224 Pub. Pr., \$39.95

Here's how BYTE Book Club® works to serve you:

- **Important information . . . we make it easy to get!** Today, professionals who perform best are those who are best informed. For reliable, hands-on information, turn to the Byte Book Club. Every 3 or 4 weeks (12-15 times a year), members receive the Club Bulletin offering more than 30 books – the best, newest, most important books from all publishers.
- **Dependable service . . . we're here to help!** Whether you want information about a book or have a question about your membership, just call us toll-free or drop us a line. To get only the books you want, make your choice on the Reply Card and return it by the date specified. If you want the Main Selection, do nothing – it will be sent to you automatically. (A small shipping and handling charge is added to each shipment.)
- **Club convenience . . . we do the work!** You get a wide choice of books that

simply cannot be matched by any bookstore. And all your books are conveniently delivered right to your door. You also get 10 full days to decide whether you want the Main Selection. (If the Club Bulletin ever comes late and you receive a Main Selection you don't want, return it for credit at our expense.)

- **Substantial savings . . . and a bonus program too!** You enjoy substantial discounts—up to 40%!—on every book you buy. Plus, you're automatically eligible for our Bonus Book Plan which allows you savings up to 70% on a wide selection of books.
- **Easy membership terms . . . it's worthwhile to belong!** Your only obligation is to purchase 2 more books – at handsome discounts – during the next 12 months, after which you enjoy the benefits of membership with no further obligation. You or the Club may cancel membership anytime thereafter.

Fill out the card and mail today! If the card is missing, write to:

BYTE Book Club®, P.O. Box 582, Hightstown, New Jersey 08520-9959
For faster service in enrolling, call 1-800-2-MCGRAW

NO ADDED CHARGE ON CREDIT CARDS

FOR COMPUTER & ACCESSORIES

CALL TOLL FREE: 1-800-882-2802

FOR FAX, TYPEWRITERS & DICTATION EQUIPT.

CALL TOLL FREE: 1-800-223-7323

IN N.Y. STATE CALL: 1-212-947-5290

HOURS: Mon. Tru. Thurs. 9AM Till 6PM, Fri. 9AM Till 2:00PM, Sun. 9:30AM Till 5PM, Closed On Sat.

EXECUTIVE PHOTO & SUPPLY CORP.

LAPTOPS

DESKTOPS

PRINTERS

HARDWARE

SOFTWARE

EPSON

Equity LT

10MHz 640K 2-3.5 720K Drives.
Superw/te Backlit Display
w/Free Laplink
1044.95

Equity LT w/20MB Hard Drive 1687.00

SPARK by Datavue

Spark-EL 640K 2-3.5 Drives 1019.00

2400 Modern iDataView CALL

MITSUBISHI

286L w/2-1/4 Drives 1979.90

286L w/20MB Hard Drive 2359.75

286L w/40MB Hard Drive 2688.75

SHARP

PC-4502 w/640K, 2-Floppy Drives & Backlit Monitor 894.75

New! PC-4841 w/40MB H.D. 2398.75

TOSHIBA (sold in Store Only)

T-1000 CALL T-1200HB CALL

NEW! T-1800 CALL

NEW! T-5200 CALL

ZENITH

184-1 1439.00 184-2 2089.00

Supersport 286 Model 20 w/20MB Hard Drive 2799.75

286 w/40MB Hard Drive 3149.75

NEC

PROSPEED 386 3997.00

ULTRALIGHT 2MB 2399.75

PROSPEED 286 w/40MB CALL

SANYO

SLT-16 w/2-Drives 879.90

BONDWELL

Bondwell Laptop 286, 10MHz, 20MB Hard Drive w/1200 Modern, Rechargeable Battery & Case 2149.00

COMPAQ

New! DESKPRO 286, 12MHz, 1.2 Floppy Drive, 40MB Hard Drive w/VGA 2349.00
COMPAQ Portable III with 40MB Hard Drive 3849.00

AST

AST PREMIUM 286

10 MHz, 512K, 1.2 Floppy Drive, Seagate 40MB Hard Drive (40ms)
1569.75

New! AST BRAVO 286 8MHz, 1.2 Floppy, 40MB Hard Drive 1198.75

EPSON

EQUITY 1+, 1-360K Floppy Drive, 1-20MB Hard Drive CALL

COMPATIBLES

IBM-XT Compatible, 1-360 Floppy Drive, 1-20MB Hard Drive 709.95

IBM-AT Compatible, 12MHz, 512K 1.2 Floppy Drive, Seagate 40MB Hard Drive (28ms) 1154.75

VENDEX Headstart III CALL

Laptop Accessories

WORLD PORT 2400 Modem/Fax 454.75

New! DICONIX 150 Plus Printer 329.75

TARGUS Nylon Case 57.95

EPSON



FX-1050

9 Pin, Wide Carriage, 290 CPS
Draft (10cpi), 60 CPS NLQ, Advanced Paper Handling Capabilities
CALL

New LX-810 187.95
LQ-850 CALL LQ-950 CALL
LQ-1050 CALL LQ-2550 929.75
FX-850 CALL LQ-510 CALL

PANASONIC

KX-P 1181 175.75 KX-P 1191 214.75

KX-P 1124 324.00

PANASONIC Laser Printer 1319.00

TOSHIBA (Sold In Store Only)

NEW! Expresswriter 301 CALL

NEC

NEC 2200 307.95 NEC P5200493.95

NEC P5300 648.95

NEC LC-950 Postscript Laser 3069.00

OKIDATA

OKIDATA 320 339.00

OKIDATA 393 1019.00

OKIDATA Laserline 6 CALL

STAR

NX-1000 169.90 NX-1000C 189.00

PRINTER SALE!

CITIZEN Premier 35 Dasywheel 499.75

CITIZEN MSP Printers CALL

DICONIX 300 Narrow Printer 349.75

NEW! H.P. Deskjet Plus 689.90

H.P. Laserjet II w/Toner CALL

APPLE ImageWriter II 439.00

intel

INTEL 80287 10 214.75
INTEL 80387 20 369.99
INTEL 80387 33MHz 569.75
NEW! Logitech Bus Mouse 72.99
Logitech Scanman FPS2 199.75
DFI HS-3000 Plus Scanner 155.75
IO Engineering Cartridge 1 296.75
MICROSOFT Mach 20 315.75
MICROSOFT Mouse 99.95
PLUS 20MB Card 523.75
TOSHIBA 3 1/2" 720K Drive w/Kit 79.75

Display Cards & Monitors

PARADISE VGA Plus OEM 223.95

PARADISE Original VGA + 16 259.99

PARADISE VGA Professional CALL

VEGA V-Ram VGA 256K 439.75

New! HERCULES VGA Card 174.00

MAGNAVOX VGA Monitor 082 358.95

NEW! NEC Multisync IIA Monitor 498.75

NEC Multisync 3D 599.00

SEIKO 1430 Monitor 549.75

SONY 1302 Monitor w/Stand 633.50

IBM 8512 Monitor 4449.95

Modems/Fax Cards

New! HAYES Personal Modem 129.75

EVEREX 2400B Modem CALL

Zoom 2400 External Modem 117.75

SIERRA (Migent) Pocket Modem 105.00

US Robotics 9600 679.75

QUADRAM JI Fax Internal 4800 174.00

COMPLETE PC 9600 Fax 415.75

PRINTER RIBBONS

OKIDATA 292 Ribbon 5.49

EPSON Original EX-800/1000 Color/13.99

NEC P7/P3 Ribbon 4.59

DISKETTES

FUJI MF2/DD Rainbow 10.49

FUJI MF2 HD 26.49

MAXELL Diskettes CALL

FAX MACHINES

PANAFAX

UF-135 CALL UF-140 CALL
UF-145 CALL UF-150 IN STOCK
UF-250 IN STOCK UF-280 IN STOCK

SHARP

FO 220 CALL FO-300 CALL
FO 330 CALL FO-420 CALL
FO-450 CALL FO-700 CALL

Canon FAXPHONE

FaxPhone 8 CALL FaxPhone 15 CALL
FaxPhone 20 CALL FaxPhone 25 CALL
FAX 225 CALL FAX 270 CALL
FAX 350 CALL FAX 450 CALL
FAX 630 CALL FAX 705 CALL

RICOH

FAX-25E CALL FAX-35 CALL
FAX-65E CALL FAX-75E CALL

MURATA

M-900 CALL M-1200 329.90

M-1400 CALL M-1600 629.90

M-1800 CALL

PANASONIC

KX-F 80 CALL KX-F 100 CALL

KX-F 120 CALL KX-F 220 CALL

KX-F 320 CALL

TOSHIBA Price Break

3300 749.90 3700 1049.90

Model 30100 699.90

BROTHER

FAX 200 CALL

FAX 210 w/Answering Machine CALL

FAX PAPER

8 1/2" x 9" 49.85 8 1/2" x 14" 59.90

8 1/2" x 328" 74.95

FAX Cleaning Kit 29.95

TYPEWRITERS & Word Processors

SMITH CORONA



WORD PROCESSORS

PWP-2000 CALL PWP-3000 CALL
PWP-5000 CALL PWP-100C CALL
PWP-700LT Laptop CALL

TYPEWRITERS

XL-1500 CALL XL-4800 CALL
XD-5800 CALL XD-7800 CALL

WP & Typewriter Access.

PWP Start-Rite Kit 39.95

Typewriter Start-Rite Kit 39.95

Printwheels ea. 10.95

Multi Strike Film Dz. 74.95

Connectable Film Dz. 34.95

Left-Off Correcting Cassette Dz. 44.95

Over-Top Correcting Cassette Dz. 48.95

Date-Data Dz. 34.95

Corona/Calk 44.95

Sheet Feeder UPWP-5000 139.90

Panasonic

KX-W1000 Word Processor CALL

KX-W1500 Word Processor IN STOCK

KX-W1510 WP w/Sheetfeeder CALL

KX-R430 CALL KX-R440 CALL

KX-1500 Word Processor Typewriter CALL

Accessories CALL

brother

WP-60 Word Processor CALL

WP-75 Word Processor CALL

WP-90 Word Processor CALL

AX-25 CALL AX-25 CALL

Dictation Equipment

OLYMPUS

L-200 129.90 S-307 35.90
S-111 59.90 S-930 99.90
S-110 Transcriber 169.90
S-804 119.95 S-811 CALL
T-100 CALL T-2020 CALL

PANASONIC

RN-15 119.90 RN-35 179.90

RN-60 79.90 RN-105D 29.90

RN-108D 34.95 RN-115D 39.90

RN-125 59.90 RR-900 179.90

RR-970 249.90 RR-980 279.90

SANYO

TRC-8100 CALL TRC-5680 79.90

TRC-2550 149.90

TRC-5200 229.90 TRC-5020 179.90

TRC-4300 227.90 TRC-4030 178.90

TRC-8000A 227.90 TRC-8010A 165.90

TRC-8700 239.90 TRC-9070 185.90

TRC-9100 239.90 TRC-9010 199.90

SONY

M-100B 219.90 M-740 35.90

M-750V 49.90 TCM-5000EV 369.90

BM-12 CALL BM-17 CALL

BM-580 CALL BM-500 CALL

BM-75 CALL BM-80 CALL

BM-815T CALL BM-820 CALL

585 99.90 592 119.90

NT-11e 134.95 NT-V 199.95

NT-V1 219.90 NT-V11 247.90

MC-111 164.95 MC-IV 189.95

2595 119.90

205 319.90

510 399.90 505 329.90

MC-3000 299.90 MC-4000 379.90

2505 399.90 2510 334.95

NORELCO

585 99.90 592 119.90

NT-11e 134.95 NT-V 199.95

NT-V1 219.90 NT-V11 247.90

MC-111 164.95 MC-IV 189.95

2595 119.90

205 319.90

510 399.90 505 329.90

MC-3000 299.90 MC-4000 379.90

2505 399.90 2510 334.95

COPIERS

Canon ((PC))

PC-3 459.90 PC-5 II 459.90
PC-5L II Legal Size 639.90
PC-6 CALL PC-6RE 859.90
NEW! PC-7 Zoom Copier CALL
Black Cartridges 79.95
8 1/2" x 11" Paper (5000 sheets) 49.50

OLYMPUS

PC-3 459.90 PC-5 II 459.90

PC-5L II Legal Size 639.90

PC-6 CALL PC-6RE 859.90

NEW! PC-7 Zoom Copier CALL

Black Cartridges 79.95

8 1/2" x 11" Paper (5000 sheets) 49.50

CALCULATORS & DATABANKS

HP 10B Business 38.45

HP

The Data File

Desktop publishing may be the rage, and multimedia presentations the "next big thing," but no single software system is more important to a business than a reliable DBMS. Listed below is a sampling of the most powerful database systems available for personal computers. With few exceptions, the products listed adhere (to some degree) to the relational data model. They all provide you with a means to get a handle on your data. Items are arranged alphabetically by company name.

Acius, Inc.
20300 Stevens Creek Blvd.
Cupertino, CA 95014
(408) 252-4444
4th Dimension \$695
Multuser, customizable relational database for the Macintosh.
Inquiry 1181.

Advanced Data Servers
P.O. Box 4937
Boise, ID 83711
(208) 377-1906
SQL Mach 1 \$23,950
Hardware-based SQL database server with 4 megabytes of RAM, a 320-megabyte hard disk drive, a 150-megabyte tape backup system, and many connection options. Supports multiple operating systems and LANs.
Inquiry 1182.

Aker
19782 MacArthur Blvd.,
Suite 305
Irvine, CA 92715
(800) 345-6244
(714) 250-1718 in California
PC Magic
MS-DOS version \$299
Novell, 3Com, and IBM
networks version \$699
Fill-in-the-blanks database applications development system based on Novell's Btrieve.
Inquiry 1183.

Alpha Software Corp.
30 B St.
Burlington, MA 01803
(617) 229-2924
Alpha Four \$549
Menu-driven, fully relational database management and applications-development system for MS-DOS; dBASE-file-compatible.
Inquiry 1184.

American Databankers Corp.
5295 Camerson Dr.,
Suite 107
Buena Park, CA 90621
(800) 323-7767
Databases \$399
Multuser database development system for MS-DOS machines. Generates Turbo C and Turbo Pascal code.
Inquiry 1185.

ASAP, Inc.
1041 41st Ave., Suite E
Santa Cruz, CA 95062
(408) 476-3935
Universal Base Six \$395
MS-DOS stand-alone DBMS designed for personal applications.
Inquiry 1186.

Ashton-Tate Corp.
20101 Hamilton Ave.
Torrance, CA 90502
(213) 329-8000
dBASE III Plus \$695
Programmable DBMS for large MS-DOS data management tasks; can be used as a stand-alone or on a LAN.
dBASE IV \$795
Enhanced dBASE for MS-DOS and OS/2 with a faster, more powerful programming language and SQL emulation.
SQL Server \$2495
OS/2 LAN database server designed to act as the back end in a transaction-oriented, client/server environment. See Sybase.
dBASE Mac \$495
Macintosh version of dBASE.
Inquiry 1187.

Blyth Software, Inc.
3655 Campus Dr.
San Mateo, CA 94403
(415) 571-0222
Omni 5 \$695
Generates database applications for multiple users and a graphical user interface. Works as a stand-alone or on a LAN. Supports SQL and HyperCard.
Inquiry 1188.

Borland International, Inc.
1800 Green Hills Rd.
Scotts Valley, CA 95066
(408) 438-8400
Paradox 3.0 \$725
DBMS with a structured programming language, query-by-example, and fully integrated presentation graphics.
Paradox 386 \$895
Enhanced version of Paradox written to take advantage of the speed and addressing capabilities of the 80386. Use as a stand-alone or as a network server.
Inquiry 1189.

Caltex Software, Inc.
3131 Turtle Creek Blvd., Suite 11
Dallas, TX 75219
(214) 522-9840
D The Data Language
MS-DOS version \$795
80286 and Novell version \$1295
80386 version \$1595
Unix System V version \$1995
Advanced 4GL applications generator. Includes a full complement of development and data management tools.
Inquiry 1190.

Clarion Software
150 East Sample Rd.
Pompano Beach, FL 33064
(800) 354-5444
Clarion Professional Developer \$695
DBMS applications development environment for MS-DOS. Produces executable code; no run-time system required.
Inquiry 1191.

Condor Computer Corp.
1490 Eisenhower Place
Ann Arbor, MI 48108
(313) 971-8880
Condor 3 \$495
Stand-alone MS-DOS database system designed for nonprogrammers.
Inquiry 1192.

DataEase International, Inc.
7 Cambridge Dr.
Trumbull, CT 06611
(800) 243-5123
(203) 374-8000 in Connecticut
DataEase 4.0
single-user version \$700
three-user version \$750
five-user version \$995

Database development system for MS-DOS that uses menus and query-by-example to let nonprogrammers create applications. Supports stand-alone and LAN applications, and interfaces to graphics, cross-indexing, and imaging options. A developer package is also available.
Inquiry 1193.

Dome Software Corp.
655 West Carmel Dr.,
Suite 151
Carmel, IN 46032
(317) 573-8100
Dome \$25,000
Distributed database that ties Macintosh front ends with VAX hosts. Uses object-oriented development tools.
Inquiry 1194.

Fox Software, Inc.
27493 Holiday Lane
Perrysburg, OH 43551
(419) 874-0162
FoxBASE +
MS-DOS version \$395
80386 and LAN version \$595
FoxBase + Mac \$495
FoxBase + Mac LAN server \$695
dBASE-compatible DBMS with integrated compiler. Optional FoxGraph package available.
Inquiry 1200.

continued

Gupta Technologies, Inc.
1040 Marsh Rd.,
Suite 240
Menlo Park, CA 94025
(415) 321-9500

SQLBase Server
single-user version\$1295
multiuser version.....\$2995

Database server for MS-DOS and OS/2 that supports major LANs; includes SQLWindows. Options include SQLNetwork for connecting SQLBase Server to DB2 and Library for Clipper that lets Clipper applications run against SQLBase Server.
Inquiry 1195.

Information Builders, Inc.
1250 Broadway
New York, NY 10001
(212) 736-4433

PC/Focus.....\$1295
4GL database language and development system. Provides modules for graphics, statistics, and spreadsheets and links to large systems. Supports SQL queries. For MS-DOS, OS/2, all LANs, MVS, VM, VMS, and Unix.
Inquiry 1196.

Informix Software, Inc.
4100 Bohannon Dr.
Menlo Park, CA 94025
(415) 322-4100

Informix-4GL Rapid Development System from \$1495
Applications development system for MS-DOS and Unix based on 4GL technology.
Informix-SQL..... \$795
SQL-based DBMS features interactive queries, a report writer, and applications development tools.
Inquiry 1197.

InterSystems
1 Memorial Dr.
Cambridge, MA 02142
(617) 621-0600

M/SQL..... from \$2900
Combination MUMPS/SQL applications development system. For Sun SPARCstations.
Inquiry 1198.

Microrim, Inc.
3925 159th Ave. NE
Redmond, WA 98052
(206) 885-2000

R:base for DOS \$725
Menu-driven relational database system for one to three users. Supports Novell and 3Com networks. Options include a natural-language query generator, an extended report writer, programming interfaces, and utilities packages.

R:base for OS/2..... \$895
OS/2 version of R:base supports multiple sessions.

Compiler for R:base \$895
Advanced development version of R:base.

Runtime R:base
MS-DOS \$250
OS/2 \$300

Run-time system for R:base applications.
Inquiry 965.

mdbs, Inc.
P.O. Box 248
Lafayette, IN 47902
(800) 344-5832

MDBS IV from \$3900
DBMS designed to implement on-line transaction processing applications. For MS-DOS, OS/2, LANs, VAX/VMS, Unix, and VM.

KnowledgeMan/2 from \$695
Relational database incorporating 4GL and decision-support tools. For MS-DOS, OS/2, VAX/VMS, and LANs.
Inquiry 966.

Nantucket, Inc.
12555 Jefferson Blvd.
Los Angeles, CA 90066
(213) 390-7923

Clipper..... \$695
dBASE-compatible compiler and applications development system for MS-DOS.

McMax..... \$295
dBASE III Plus-compatible database system for the Mac.
Inquiry 967.

Novell
122 East 1700 South
Provo, UT 84601
(800) 453-1267

Btrieve
MS-DOS version \$245
DOS network, OS/2, Xenix,
80286, and 80386 version \$595
IBM PC network, multitasking
add-on \$345

Provides record and file management capabilities to BASIC, C, and Pascal programs.
XQL \$795
Develops applications that access relational databases. Requires Btrieve. Versions available for MS-DOS and OS/2.

NetWare SQL..... \$595
Database server for Novell Networks. Requires Btrieve.
Inquiry 968.

Odesta Corp.
4084 Commercial Ave.
Northbrook, IL 60062
(312) 498-5615

Double Helix II..... \$595
Icon-driven database for the Mac. Options available for multiple users and for use on VAX machines under VMS.
Inquiry 969.

Oracle Corp.
20 Davis Dr.
Belmont, CA 94002
(800) 345-3267

Oracle from \$1299
SQL-based relational database system compatible with SQL/DS and DB2 from IBM. Supports LAN client/server and distributed processing. Supports over 80 different platforms, including MS-DOS, OS/2, Xenix, Macintosh, many Unix systems, MVS, VM, Primos, and Wang VS.
Inquiry 970.

Powerbase Systems, Inc.
32100 Telegraph Rd.
Birmingham, MI 48010
(313) 540-2398

PowerBase..... \$349
Relational database designed for nonprogrammers. Supports stand-alone and networked MS-DOS applications.
Inquiry 970.

Precision, Inc.
8404 Sterling St.,
Suite A
Irving, TX 75063
(214) 929-4888

SuperBase 4..... \$695
Programmable DBMS with a graphical interface and the ability to manage text and graphics information. For Windows and GEM.
SuperBase 2..... \$295
Nonprogrammable version of SuperBase 4.
Inquiry 1199.

Progress Software Corp.
5 Oak Park
Bedford, MA 01730
(800) 327-8445

(617) 247-4500 in Massachusetts
Progress from \$1000
4GL applications development system for database applications. Portable across Unix, Xenix, Ultrix, MS-DOS, VAX/VMS, and LANs.
Inquiry 979.

Raima Corp.
3245 146th Place SE
Bellevue, WA 98007
(800) 327-2462

db_Vista III..... from \$695
Network model database system that uses relational access methods. Supported systems include MS-DOS, OS/2, Macintosh, Windows, Unix, BSD 4.2, Xenix, and VAX/VMS.
Inquiry 971.

Relational Technology, Inc.
1080 Marina Village Pkwy.
Alameda, CA 94501
(415) 769-1400

Ingres for microcomputers..... \$695
PC version of the famous relational database system.

Ingres/Star..... Call for pricing
Distributed version of Ingres. Ties together databases running on different machines and operating systems. Resides on a VAX or Unix machine.
Inquiry 972.

Revelation Technologies, Inc.
1180 Avenue of the Americas
New York, NY 10036
(800) 327-0216

Advanced Revelation from \$495
Database application package for MS-DOS that uses a central data dictionary.
Inquiry 973.

Small Computer Co.
41 Saw Mill River Rd.
Hawthorne, NY 10532
(800) 847-4740
(914) 769-3160 in New York

filePro Plus from \$995
DBMS and applications development system. Works with major network operating systems. For MS-DOS, OS/2, Unix, and Xenix.
Inquiry 974.

Sybase, Inc.
2910 Seventh St.
Berkeley, CA 94710
(415) 548-4500

Sybase from \$2500
SQL-based relational database server. Provides the back end to client applications that generate SQL queries. Supported systems include OS/2 (SQL Server—see Ashton-Tate), VAX/VMS, SunOS, and Unix System V 3.2.
Data Workbench from \$875
Sybase data-administration and decision-support software.
APT Workbench from \$895
Aids the development of Sybase client applications.
Inquiry 975.

Wordtech Systems, Inc.
P.O. Box 1747
Orinda, CA 94563
(415) 254-0900

dBXL \$249
Database system for MS-DOS that is fully compatible with dBASE III Plus.
dBXL/LAN \$599
Network version of dBXL.
QuickSilver \$599
Compiler for dBXL and dBASE III Plus.
Inquiry 976.

XDB Systems, Inc.
7309 Baltimore Ave.,
Suite 220
College Park, MD 20740
(301) 779-6030

XDB-SQL \$595
SQL-based database server software. For MS-DOS, Unix, and OS/2.
XDB Server \$1995
Permits client applications to access database without modification.
XDB-DBT II \$1500
Applications development system that emulates CICS, DB2, and IMS.
Inquiry 978.

Inclusion in the resource guide does not indicate that BYTE endorses or recommends either the product or the company. In addition, BYTE accepts no responsibility for any omissions, changes, or errors in the information listed.

BBS Sysops



Are you looking for ways to improve your board? Something that will set you apart from other boards in your area? Are your subscribers interested in microcomputers? Listen to this!

Announcing the Bulletin Board EXchange

The Bulletin Board Exchange allows you to become a publisher of MicroBYTES Daily, an on-line news service from BYTE. It is a custom package of news and features designed specially for local BBSes, and is available only to sysops.

Every Monday through Friday you get articles about developments in microcomputing, telecommunications and selected new product announcements. Get the latest news about MS DOS machines, Macintoshes, Unix workstations, Amigas, Atari STs, peripherals and software. All the stories are reported, written, and edited by the staff of BYTE Magazine, BYTEweek and BIX, and our world-wide network of reporters and editors.

Not only do you get a great resource for your subscribers, but you also get access to BIX which will cut your cost of exchanging information and conducting BBS network business.

All this is just \$49 a quarter.

Your one-year subscription to the Bulletin Board Exchange (billed quarterly) may be cancelled any time without further charge; just notify us. If you prefer, you may subscribe for three months only, at just \$69.

If you call BIX directly, you pay no hourly telecommunications charge. If you call using Tymnet, the rates are only \$2/hour on evenings and weekends and \$8/hour on weekdays. You may also purchase unlimited off-peak Tymnet for just \$15 a month in the U.S. (lower 48 states). International Tymnet access is provided by your local PTT.

Subscribe today.

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
1-800-227-2983
In NH (603) 924-7681



From top to bottom:
Elegance Model 1000,
20 and 25 MHz;
Elegance Model 2000,
20 and 25 MHz;
Elegance Model 3000
25MHz

The Dictionary Defines "ELEGANCE" as:
"Beauty of Style...Scientific Precision"

NORTHGATE Defines *Elegance*™ as

A Totally New Lineup of Five 80386-Class SuperMicro Computers Redefining the Standards For Power Computing!

FASTEST 386 EVER!
UP TO 16 MEGABYTES OF
MEMORY. A 256KB READ/
WRITE-BACK CACHE. UP TO
1.2 GIGABYTES OF SCREAMING-
FAST HARD DRIVE STORAGE.
16-BIT VGA DISPLAYS. THE
OMNIKEY KEYBOARD
AND CABINETS LIKE
YOU'VE NEVER SEEN BEFORE.
SIMPLY...

Elegance™



PHONE NORTHGATE NOW FOR FULL DETAILS AND PRICING

NORTHGATE COMPUTER SYSTEMS, INC.
13895 Industrial Park Blvd., Suite 110
Plymouth, Minnesota 55441

*If you need the ultimate in pure computing power, blended with every imaginable convenience and utility feature, Northgate's all-new Elegance Series is for you—
AT PLEASINGLY LOW PRICES!*

■ **At the top of the line—the Elegance 3000.** It's housed in a deluxe floor-standing cabinet with space for 10—Yes 10—half-height storage devices, with a tinker-proof locking, full-length front door panel. 250-watt dual fan power supply with thermistor sensor to automatically control ventilation requirements.

Just try filling the drive slots. Northgate gives you both 1.2 and 1.44 floppies standard. Hard drive selection is up to you. From our 80MB SCSI with 17MS speed to dual 600MB SCSI or ESDI drives for a maximum capacity of 1.2 gigabytes. Plenty of space left over for more floppies, optical drive, tape backup, etc.

■ **Inside lives the lightning!** The 16 megabyte capacity motherboard is hyper-enhanced with up to 256 Kbytes of 30 nanosecond cache. But it's not just a read cache as with most systems. *Our engineers have added to a write-back algorithm that adds another boost to the already scorching processor power.*

Recalculations of even the biggest spread sheets are amazingly quick. Large databases are short work with Elegance. CAD drawings appear as fast as you can release the ENTER key.

And if you're tired of going out to lunch while a desktop publishing or graphics program struggles through your current system. *Elegance will put you on a diet!* The speed of these systems cannot be believed without experiencing it for yourself.

Northgate will custom configure your Elegance System to your own needs. Options include 16-Bit VGA displays, tape backups to 150MB, a huge range of hard drives, network software and hardware, laser printers...just call.

Yes, Elegance Systems are not for everyone. Northgate has a broad line of top performance systems to meet any computer need. Our 286 family includes our PC Magazine, *Editor's Choice* 286/12 and both 16 and 20MHz complete systems. Northgate's entry level 386 system is our 16MHz selling for just \$2599.

Whatever your computer needs, you're further ahead with Northgate. Backed by our unique OVERNIGHT PARTS REPLACEMENT POLICY and supported by the industry's most qualified technical support staff, Northgate is truly "The New Leader in State-Of-The-Art Power Computing."

**Elegance Systems prices for 20MHz complete systems start at \$3,399.
For 25MHz systems, prices start at \$3,799.**

800-548-1993

HOURS: Monday through Friday 7 a.m. - 8 p.m. Central
NEW EXTENDED SATURDAY HOURS: 8 a.m. - 4 p.m. Central

Canada: 800-338-8383



FINANCING: Use the Northgate "Big N" revolving credit card instead of tying up Visa or MC credit. Millions in financing available, easy to qualify. OR. Lease a Northgate with up to five-year terms. Ideal when cash flow is important. Phone for details.

Northgate, Elegance, and OmniKey are trademarks of Northgate Computer Systems, Inc. All other products are trademarks or registered trademarks of their respective companies.

Prices and specifications subject to change without notice. Northgate reserves the right to substitute components of equal or greater quality or performance. All items subject to availability.

A BUS TOUR

*Why the big controversy over bus architectures,
and why should you care?*

George White

If you own a personal computer, you are more or less familiar with the computer's bus. These days, debates rage over the relative merits and weaknesses of the IBM PC AT bus versus IBM's new Micro Channel architecture (MCA) or the yet-to-be-released Extended Industry Standard Architecture (EISA). New 32-bit buses, like the Mac II's NuBus, are touted as surpassing older, 8-bit buses in speed and memory capacity. However, if you crack open your computer, you may be hard-pressed to locate the bus, since it is simply a collection of signals and their protocols, which are used to communicate between boards.

A bus is physically embodied in the connectors that carry its signals, and the logic on each board that implements the bus protocol and connection. Essentially, the three major types of buses are the system bus, the I/O bus, and the memory bus.

System, I/O, and Memory

Minicomputers and supermicrocomputers are often designed around a central common bus to which the CPU memory and the high-performance I/O are connected. This arrangement qualifies as a system bus in that it forms the backbone of the computer.

You find I/O buses at both ends of the computer spectrum. Very large computers often have an I/O bus in addition to a system bus. They may use a proprietary and specialized system bus along with an industry-standard I/O bus that allows support of various peripherals. Personal computers often use only an I/O bus, with the CPU and memory having a close nonbus connection.

A slot that accepts manufacturer-specific memory-expansion boards is not really a bus. The signals that pass to and from this slot are merely an extension of the DRAM chip signals and provide no generality (i.e., the slots are good only for DRAM boards that are manufacturer-specific). All 80386 microcomputers have 32-bit CPU-to-memory pathways, which are important features of these machines and provide much of their per-

formance. However, you cannot think of these pathways as buses, because they only provide a connection to a manufacturer-specific memory board.

Industrial-Strength Buses

Although it's getting harder to draw a line between personal computer buses and more "industrial" buses like Multibus and VMEbus, there are important distinctions. While multimaster capability is a novelty in personal computer buses, it's a necessity for industrial buses.

In any bus transaction, there is a master and a slave. The master initiates the transaction, and the slave responds. All industrial buses and the MCA provide general mechanisms to arbitrate the bus and turn mastership over to one of the boards in an add-in slot. The basic hardware is fairly simple; how the feature is used can vary widely. The basic use of a multimaster capability is to allow I/O cards to perform true direct memory access (DMA) and to access data from main memory independently of the central processor. In the XT and AT buses, there is generally only one master, the motherboard.

Outside the personal computer world, a bus without multimaster capability would not even be called a bus. On the other hand, the built-in DMA channels in personal computer buses are unheard of in industrial buses.

In general, the key distinction between an industrial or mini-computer system and a desktop system is the motherboard. Desktop systems have one—industrial systems do not. A VMEbus-based system starts out as an empty card cage. There is no presumption about what type of CPU the designers will use or whether they will construct a multiuser computer, RISC workstation, process-control system, or flight-simulator controller.

In the design of a personal computer, it makes sense to put as many functions as possible on the motherboard. Conversely, designers of industrial buses strive to minimize the centralized logic. Most industrial buses require only clock-generation logic. Futurebus manages to dispense with even this clock

continued

generation and requires no centralized logic at all.

Cost has been another issue separating these bus categories. Personal computer users are cost-sensitive, while industrial system users are more concerned about performance and reliability. As personal computers become more powerful and are increasingly used as servers and multiuser systems, designers and users find the issues of industrial buses becoming more important.

Which Bus to Ride?

Current systems are built on a wide variety of buses (with more being created all the time), each having certain higher-level properties.

Although not a technical property, the degree of a bus's openness is one critical feature. Many buses like Multibus I and II, VMEbus, NuBus, and Futurebus are IEEE/ANSI standards. Other buses are "open," but their futures are controlled by one manufacturer (e.g., IBM's MCA). Still others are de facto industry standards that no company can continue to unilaterally influence (e.g., the PC AT bus, the so-called "industry standard architecture," or ISA).

While the subject of form factors may be mundane, designers obviously cannot put as much logic on a small board as they can on a larger board. Therefore, the size of usable board space on a bus's add-in cards may limit the number of boards that a user will have to choose from. The other real estate issue is the type of connector, or connectors, from the bus to the board (see photo). The industrial buses (including the NuBus used in the Mac II) have long since gone to two-piece connectors rather than the less-reliable edge-card connectors used in personal computers.

While performance is important, raw speed is not always the most meaningful bus criterion. How fast a bus can theoretically transfer data in a peak burst may not be indicative of real performance. Performance also depends on the speed of bus arbitration, whether or not arbitration can be overlapped with the previous data transfer, and whether existing cards run at maximum bus speeds.

Although a few systems are bottlenecked by the data transfer rate of the I/O bus, more are likely bottlenecked due to the lack of intelligence on the cards plugged into the bus. Bus features like multimastering can encourage the development of intelligent I/O controllers that can contribute more than raw transfer speed.

All the industrial buses have IEEE specifications. This means that not only is there a tight specification for designers to follow, but the evolution of the bus has been taken away from one or two manufacturers and placed in the hands of a democratic body. While committees don't have a history of successfully inventing new ideas, they have been useful at codifying technology and thus providing stability of bus definitions.

The tightness of a bus specification is directly related to how easy a bus is to design to and how likely boards of different manufacturers are to work together. For example, although there is no solid specification for the AT bus, the mass market has created an evolutionary process that weeds out computers or add-on cards that don't work well with the large installed base of AT clones.

Several industrial buses, notably NuBus and Futurebus, have had *processor independence* as important objectives. This means that they are designed not to favor one CPU interface style over another, but rather to provide a more general model of communication. In contrast, the XT and AT buses are simply decoded versions of the processor signals from an Intel microprocessor.

Standard Features and Optional Packages

The basic purpose of a bus is to get bytes moved from one board to another in an efficient and standard way. Many features can be wrapped around this basic "truth." Some features are key to creating reliable, fully functioning systems, while others are bells and whistles.

Broadly speaking, *protocol* refers to the types of transactions that a bus supports. The basics are reading and writing, and, in fact, these are quite sufficient for most systems. Others might be block reading and block writing, operations that transfer multiple data items in one burst transaction. The Futurebus defines *broadcast* as a write to multiple slave boards, and *broadcall* as a read that performs an OR on the data from multiple slave boards.

Data width is a fairly basic feature; essentially, it tells you how many wires the bus has, each one leading to a bit in an address. A bus is generally 8, 16, or 32 bits wide. Most VMEbuses are 32 bits wide, but an allowable subset is 16 bits. NuBus and Futurebus are 32 bits wide with no subset. While the MCA is billed as a 32-bit bus, most MCA slots are 16-bit only.

One AT bus limitation is the size of the address space. With 24 bits of address space, only 16 megabytes of physical memory (2^{24}) can be used. That storage capacity seemed like a lot in 1983, but it will soon be limiting. All the industrial buses have a 32-bit address space, although the actual size of the address space can vary (VMEbus can be either 24 or 32 bits).

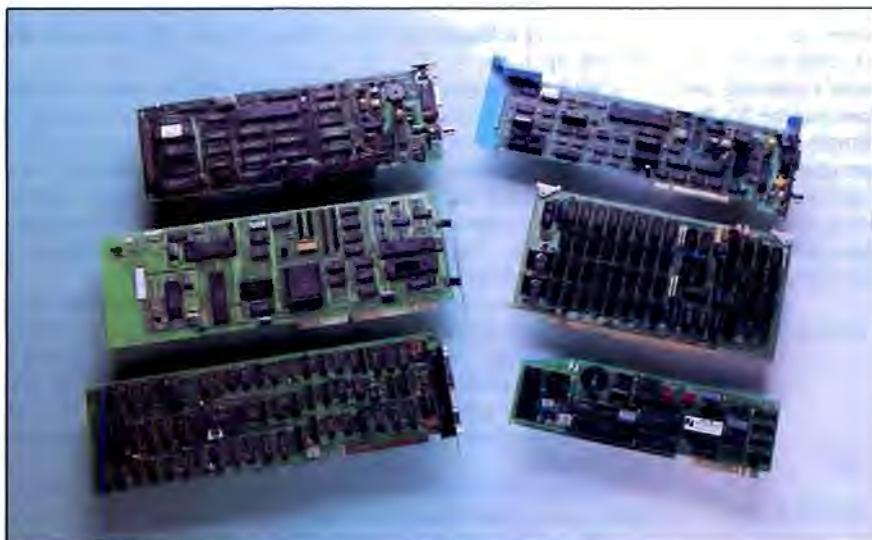
Formerly, when bus designers gathered, their most heated discussions concerned the issue of *synchronous* versus *asynchronous* buses. The first uses a single clock signal, propagated to all slots, to time all data and control information transfers. Typically, data and control lines are only valid on a certain clock edge. In an asynchronous bus, no central clock is used, and some form of handshake replaces the clock's function.

In a nutshell, asynchronous bus operations set no upper limits on the bus speed, while synchronous buses may make it easier for designers to develop more reliable, high-performance systems. NuBus and Multibus II are synchronous; VMEbus and Futurebus are asynchronous. The asynchronous school holds that synchronous buses are inherently limited by contemporary technology. The synchronous school thinks that pure, reliable asynchronous buses are difficult to invent and design to and that, in reality, the promised future performance gain is slight.

Since interrupts seem fairly basic and critical, it may come as a surprise that neither Multibus II nor Futurebus has them, and NuBus's interrupt line was only grudgingly added late in its design cycle. The standard idea of an interrupt is that a board pulls on a wire when it needs service from a single CPU. But what if you have more than one CPU? It would be nice to have a way for an I/O card to direct an interrupt to one of many CPUs in a system. The CPUs also need a way to interrupt the I/O cards and, in some cases, other CPUs on coprocessor cards.

The conventional interrupt line that the I/O board drives is quite limiting in that all devices that need to interrupt the CPU must be multiplexed onto a single line. More-advanced buses use the standard bus write transaction to convey the information that one board wants attention from another. This makes interrupts a special case of a memory write transaction, provides flexibility and directability, and eliminates special signals and hardware that would otherwise be needed. Of course, today's personal computers typically have a single CPU, but multiprocessor microcomputers are coming on strong.

Direct memory access is a feature of both personal computers and larger machines. However, the name does not mean the same thing in both realms. On the VMEbus, a controller board



Add-in boards (specifically, their connectors and the logic paths) represent the physical embodiment of computer buses. Shown here, clockwise from upper left, are boards representing six of the most popular microcomputer buses: the Mac II NuBus; the MCA; the S-100; the Apple II; the IBM PC 8-bit, and the IBM PC 16-bit. The industrial buses (including the NuBus used in the Mac II) have long since gone to two-piece connectors rather than the less-reliable edge-card connectors used in personal computers.

that is said to do DMA could arbitrate for the bus and act as bus master in transferring data from itself to memory, with no intervention by the main processor board. This simple feat would be hailed as a breakthrough example of multimastering in the personal computer world.

Personal computers have a fixed number of DMA channels on the motherboard. "Indirect" memory access would be a better name, since personal computer DMA is not really performed by the I/O board as much as by DMA chips on the motherboard.

In minicomputer systems, controllers are often developed that read control blocks from memory, perform the function indicated, put status information back into memory, and optionally interrupt the controlling CPU. Multimaster buses make this type of operation possible in microcomputers as well.

The Magic of Multiprocessing

The most sophisticated systems made possible by multimaster buses are those with true multiprocessor capabilities. Some people confuse multimaster with multiprocessor. Multimaster operation is necessary, but far from sufficient, to create a true multiprocessor. A true multiprocessor bus should also have an interrupt scheme that lets any board interrupt any other board; a particularly efficient arbitration method; and provisions for supporting multiple boards with caches.

Arbitration is an operation that keeps all the masters from trying to use the bus at once. The schemes for accomplishing this differ from bus to bus. Multibus I and VMEbus use arbitration schemes that involve daisy-chained signals. This is somewhat awkward in that any unused slots must have special jumpers inserted to continue the daisy chain.

In most modern buses, arbitration for a subsequent data transfer is carried out on a separate set of lines from those used for data transfer. This allows the overlapping of arbitration operations with data transfer. As a result, the arbitration phase adds no time to the resulting operation. When one data transfer is completed, the next one can start immediately. The MCA is the exception to this practice, performing arbitration in series with the data transfer. Thus, the arbitration phase adds to the total transaction time.

Caches are becoming more important in both the personal computer and supermicrocomputer markets. Processors are so fast that DRAM cannot keep up. A cache of static RAM is the only way to keep the CPU fed with data. Caches can be compli-

cated, and, in a multiprocessor system, they may be especially complicated. Some buses provide hardware support for what is called the cache coherency problem. Except for a handful of proprietary buses used in high-end computers, the Futurebus is the only open bus with this feature.

These are the features most often contrasted on current buses. If industrial buses and personal computer buses continue to converge, be prepared for the marketing of bus enhancements such as geographical addressing, broadcast transactions, and cache coherency.

A Bus Inventory

The S-100 was the first microcomputer bus used in machines from different manufacturers. It was used in systems such as those from CompuPro/Viasyn. The S-100 bus provided users with the ability to add both I/O and memory options to their systems and offered a sophisticated multimaster arbitration scheme not seen in personal computer buses until the MCA. In some ways, the S-100 was the precursor to both the industrial microcomputer buses (e.g., Multibus I) and the personal computer buses (e.g., Apple II).

An 8-bit bus at first, the S-100 was extended to 16 bits. An IEEE working group ironed out several minor reliability and interoperability problems, a process that resulted in the IEEE 696 standard. Following the tradition of the S-100, most IEEE bus standards developed since then have been assigned numbers ending in 96: Multibus I is IEEE 796, Futurebus is IEEE 896, VMEbus is IEEE 996, Multibus II is IEEE 1096, and NuBus is IEEE 1196. The S-100 community is alive and well and exploring ways to extend its bus to 32 bits.

Like many buses, Multibus (now called Multibus I) started as the product of one company, became open and used by others, and then took on a life of its own. Various industrial systems and commercial computers were built around Multibus, including the original Sun boards from Stanford and later Sun Microsystems. Although not consciously processor-independent (having been developed by Intel), it was general enough that designers had no problem creating many 6800 Unix-based computer systems around Multibus.

Like the S-100, Multibus was originally an 8-bit bus, expanded to 16 bits in a cooperative effort between manufacturers and an IEEE committee. The Multibus market and user community became the model for others that followed.

continued

Although the Apple II bus was not noteworthy as a bus per se, it introduced two important features. First, each board had a ROM at a fixed address relative to the board's starting address, with both an input routine and an output routine for the particular board. This scheme provided a simple but elegant BIOS that allowed device-independent I/O operation. The second innovation was simply the shape of the board and the placement of the I/O connectors. Rather than being more or less square and sliding into card guides on both edges, it was rectangular and had its I/O connections on its outside edge. The same basic scheme was later used in the IBM PC.

In a chronology of microcomputer buses, putting Futurebus

Outside of
the personal computer world,
a bus without multimaster capability
would not even be called a bus.

here seems odd. However, the Futurebus effort started in 1979, well before the IBM PC was announced and before the advent of the VMEbus. An IEEE Futurebus group was founded on the noble idea of developing a 32-bit bus *before* it was needed. The plan was to avoid the problems that come with an existing user base, a dilemma that faced the S-100 and Multibus I development groups. Those groups had to produce solidly engineered bus standards without unreasonably obsoleting the installed base. The Futurebus group started with a clean sheet of paper, was unencumbered by any installed-base compatibility constraints, and attracted input from bus experts worldwide.

Futurebus has not yet been designed into any commercial machines, although a very early version of the specification was used as the basis of a bus in a workstation once produced by Tektronix. Many research laboratories around the world have built prototypes of various versions of the Futurebus specification. The IEEE committee that created the Futurebus standard is now developing a standard called Futurebus+, which is gaining wider support, including support from the developers of VMEbus and Multibus II.

The best feature of the IBM PC bus is that a lot were built and sold, so it was subsequently widely cloned. It is poorly specified, is not particularly fast, and has its interrupt lines upside down (i.e., an interrupt request is indicated by a low-to-high transition on an interrupt request line rather than the other way around). But the PC bus is adequate for its target applications and has admirably achieved a critical bus feature: wide usage.

IBM upgraded its original PC XT bus for use with the PC AT. The data path was widened to 16 bits, and more address lines and interrupt lines were added. The AT bus provides crude multimastering that is little-used because it is awkward to implement and not a very high-performance method.

Several companies (not including IBM) are now upgrading the AT bus again to the EISA bus. This 32-bit bus supports multiple masters and automatic system configuration. It's not a completely open bus, since those who want access to the specification must sign a nondisclosure agreement. An estimated 200 firms, however, have paid for the spec, and with the advent

of the newly released Intel four-chip chip set, the bus wars are heating up.

VMEbus was announced in 1982 and soon became a winner in the industrial bus market. It's mainly a bus for supermicrocomputers, such as those from Sun Microsystems and MIPS Computer Systems. VMEbus has been used in industrial control applications and as the I/O bus for larger machines, such as those from Sequent Computer Systems. With the other buses now available, it's unlikely that standard office-environment PC-class machines will ever be built around VMEbus.

VMEbus used a two-piece connector with the Eurocard form factor. It had support for 32 bits, and three large organizations (Motorola, Signetics, and Mostek) endorsed it simultaneously. *Eurocard* is a term for a standard card-packaging system originally used in Europe. VMEbus, Multibus II, Futurebus, and the industrial version of NuBus all use Eurocard technology.

Although the VMEbus developers didn't have the lofty technical goals of the Futurebus developers, VMEbus filled a vacuum. There was a growing realization that the Eurocard packaging was superior to the standard edge-card scheme in general use in the U.S. and that a path to 32 bits would soon be needed. (In fact, VMEbus supports both 16- and 32-bit transfers. Early VMEbus systems used only the 16-bit option.)

The original "closed" Macintoshes (the 128K, 512K, and Mac Plus), which have no bus, demonstrated the desperate need for buses. Third parties developed a wide variety of add-in products, including memory expansion, coprocessors, and internal disks. These were installed in machines against Apple's wishes and in violation of factory warranties. The ingenuity and fearlessness displayed in providing Macs with these and other capabilities illustrate the importance of open buses.

Originally designed for high-end workstations and supermicrocomputer applications, NuBus has found its greatest success in the Mac II (a modified NuBus is also used in the NeXT computer). NuBus was created at MIT in 1978 as a bus for a high-end reconfigurable workstation. Later, a group at Western Digital transformed NuBus into its present state (except for its form factor). Texas Instruments subsequently bought the project and used the bus in its Explorer Lisp machine. NuBus was also used in the Lambda AI computer made by the now-defunct Lisp Machine, Inc.

Its use in the Mac II and NeXT computers puts NuBus at the intersection of the industrial and desktop buses. Although used in personal computers, it has the raw speed and features of Multibus II.

While PC-clone makers are developing EISA, IBM has bet on its MCA, an architecture that has proven to be controversial. The MCA's strong and weak points are the same: its incompatibility with the AT bus. In most technologies or markets, there is a time to break with the past in order to achieve an improvement in performance and features. The given in this process, however, is that the old must really be holding you back and the new must be a significant step forward. This is still an open question regarding the MCA.

The MCA's "new" features are primarily standard elements in industrial buses: multimaster arbitration, burst transfers, and sensible interrupts. Today, the MCA is being used predominantly in the IBM PS/2 product line.

Lining Up the Buses

Although the AT bus lacks auto-configuration and high-performance multimaster capabilities, it is adequate for most desktop applications. There has been a real need for bandwidth between

continued

Discover Parallel Processing!

Monoputer/2™

*The World's Most Popular
Transputer Development System*

Since 1986, the MicroWay **Monoputer** has become the favorite transputer development system, with thousands in use world-wide. Monoputer/2 extends the original design from 2 to 16 megabytes and adds an enhanced DMA powered interface. The board can be used to develop code for transputer networks or can be linked with other Monoputers or Quadputers to build a transputer network. It can be powered by the 20 MHz T414 or T800 or the new 25 MHz T425 or T800.

Parallel Languages

Fortran and C Make Porting a Snap!

MicroWay stocks parallel languages from 3L Logical Systems and Immos. These include one Fortran, two Cs, Occam, Pascal, and our own Prolog. We also stock the NAG libraries for the T800 and Rockfield's structural and thermal finite element package. A single T800 node costs \$2,000, yet has the power of a \$10,000 386/1167 system. Isn't it time you considered porting your Fortran or C application to the transputer?

For further information, please call MicroWay's Technical Support staff at (508) 746-7341.

Micro Way

Quadputer™

*Mainframe Power
For Your PC!*

MicroWay's **Quadputer** is the most versatile multiple transputer board on the market today. Each processor can have 1, 4 or 8 megabytes of local memory. In addition, two or more Quadputers can be linked together with ribbon cables to build large systems. One MicroWay customer reduced an 8 hour mainframe analysis to 15 minutes with five Quadputers, giving him realtime control of his business.

World Leader in PC Numerics

P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 617-934-2414 Australia 02-439-8400 Germany 069-75-1428



VGA 16-BIT

\$29900 Mfg. Sugg. Retail



SPECIFICATIONS:

- Hardware level compatible
- Supports TTL and Analog
- Resolutions up to 1024x768 (needs 512K)

DRIVERS SUPPORT:

Autocad, Framework II, Gem Desk Top, Ventura Publisher, Lotus 1-2-3, MS Windows, WordPerfect

FEEL THE WAVE!



**IOCOMM introduces the
KB-101WC**

Its new and innovative wave design takes the keyboard into the 21st Century, and beyond.

KEYBOARD SPECIFICATIONS:

- True mechanical key switch, allows for a true click
- AT/XT switchable
- 101-key
- Net Work compatible

DEALER & DISTRIBUTOR
INQUIRIES WELCOME.

**CALL NOW
(213) 644-6100**



12700 Yukon Ave., Hawthorne, CA 90250
(213) 644-6100 • Fax (213) 644-6088

the CPU and memory, but ad hoc manufacturer-specific CPU-to-memory paths have solved this problem. A few more power and ground pins would be nice, as would interrupt signals that aren't upside down. A written bus specification would also be helpful. However, in spite of these limitations, board and system designers have produced a wide variety of interoperative, reliable, satisfactorily performing products.

The MCA does offer advances over the AT bus. It has reasonable interrupt lines that are not upside down, allows multiple masters (as anything called a bus should), and has a reasonable number of ground signals. Although the MCA is a technical advance over the AT bus, from the point of view of the rest of the bus world, that isn't saying much.

Auto-configuration of the MCA is possible because of the Programmable Option Select registers that are addressed on a slot basis. On Futurebus, Multibus II, and NuBus, the equivalent to POS is called *geographical addressing*—a portion of a board's physical address space is tied to the slot where that board is physically located. Optionally, the MCA is a 32-bit bus. However, a board would generally be designed to plug into either a 16-bit or 32-bit slot, and since most MCA slots are 16-bit, the majority of MCA add-in cards are 16-bit, also.

Multimastering has real advantages if add-in cards make use of it. While not strictly needed for intelligent I/O cards (there are many for the AT bus), it does make intelligent I/O somewhat cleaner.

While NuBus is now viewed as a desktop machine bus, it was conceived as addressing the same technical needs and objectives as Multibus II and VMEbus. This concept gives it a unique position as the only bus designed for high-end applications that is also used in a mass-marketed product. Technically, it is a 32-bit, multimaster, DIN-connector, IEEE/ANSI-standard bus with auto-configuration. One missing feature is built-in support for cache coherency in multiprocessor, write-back cache systems. Of the buses mentioned, only Futurebus has such support.

The Bus Stops Here

Future high-end personal computers will have two conflicting needs: (1) advanced performance and features to support multiple processors and higher-bandwidth I/O, and (2) the availability of a wide variety of I/O options. The widest array of available options is provided by staying with the status quo, but additional performance and features require extra effort and bring up the possibility of incompatibility. The MCA takes one path through this problem, EISA another.

Some future needs, such as support for true multiprocessing, can be accommodated by specialized CPU-to-CPU-to-memory buses that can be independent of the I/O bus. A dual-bus approach can offer the benefits of both a popular I/O bus—which is not particularly fast—and an optimized intra-CPU and CPU-to-memory path.

The only example of a crossover bus is NuBus. Originally developed for supermicrocomputers or high-end workstations, it is now at home in the Macintosh and the NeXT machine. While several concepts from industrial buses, such as auto-configuration, two-piece connectors, and cache coherency, are likely to reach personal computers, the generality, form factor, and inherent additional costs of these buses will probably keep them off the desktop. ■

George White is a cofounder and president of Corollary, Inc. (Irvine, CA), a maker of multiprocessor PC systems. He was the chairperson of the IEEE 1196 NuBus committee. He can be reached on BIX c/o "editors."

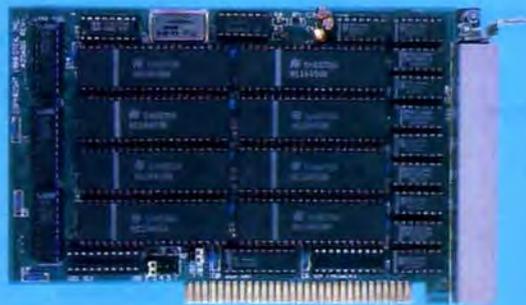
GTEK®
Announces

DYNAMEMORY™

GTEK, Inc. is proud to announce their new multi-channel serial I/O cards with **DYNAMEMORY**. **Dynamemory** allows the user to forget about how much memory he has to allocate to each channel to eliminate character overflow or bottlenecks. **Dynamemory** allows each channel to use as much or as little memory as necessary! This intelligence is built on-board each GTEK intelligent serial card. They are smart enough to allow you to perform many tasks without your having to write a control program — and they are DOS compatible!



The **PCSS-8X** is GTEK's original workhorse multi-channel serial I/O card. Thousands sold world-wide. The **PCSS-8X** provides 8 standard uarts arranged as either COM1/COM2, or memory mapped. The **PCSS-8X** has DB-25 connectors.



The **PCSS-8TX** is GTEK's workhorse multi-channel serial I/O card with compact RJ-11 telco jacks. The **PCSS-8TX** provides 8 standard uarts arranged as either COM1/COM2, or memory mapped.



The **MCSS-9IM** is GTEK's newest intelligent card for the Micro-Channel. The **MCSS-9IM** provides up to 9 serial channels and up to 1 Megabyte of memory. The **MCSS-9IM** comes with 32K of **Dynamemory**, and is user upgradeable to 1 Megabyte.



The **PCSS-8I** is GTEK's most popular intelligent serial I/O card. It provides 8 channels for PC/XT/AT/PS2-286 and is DOS Compatible. The **PCSS-8I** has 32K of **Dynamemory**, user upgradeable to 128K bytes.



The **PCSS-8IM** is the popular 8I card with *mucho* memory capability. The **PCSS-8IM** comes with 32K of **Dynamemory** and is user upgradeable to 2 Megabytes. Think about it — with **Dynamemory**, it's as if you had 32 Megabytes available (for 16 queues).

The MCSS-8TX is available! The MCSS-8TX is a Micro-Channel version of the PCSS-8TX. Call!

GTEK® INC.

DEVELOPMENT HARDWARE & SOFTWARE
P.O. Box 2310, Bay St. Louis, MS 39521-2310 U.S.A.
ORDER TOLL FREE 1-800-255-GTEK (4835) FAX: 1-601-467-0935
MS & Technical Support 1-601-467-8048

Order Now Toll Free
800-255-GTEK (4835)

All GTEK products have a full 1-year warranty and are manufactured by GTEK in the U.S.A.

GTEK is a Registered Trademark of GTEK, Inc., Dynamemory is a trademark of GTEK, Inc., PC/XT/AT/PS2 & Micro-Channel are Registered Trademarks of IBM Corp.

Circle 125 on Reader Service Card (DEALERS: 126)

High Resolution and Wide Screen for PCs and Apple Mac

FLEXSCAN[™] MODEL 9400

Increasing sophistication in the use of personal computers for general business applications, CAD and DTP has led to a growing demand for better resolution and larger display devices. Combining wide compatibility and functionality with the latest ergonomic design, the FLEXSCAN 9400, with a maximum resolution of 1280 dots × 1024 lines, will not only meet these requirements but those of the next generation of advanced business PCs.

Wide compatibility

With a wide Horizontal scan frequency range (30-65kHz), the FLEXSCAN 9400 is compatible with most signal sources, including standard VGA, extended VGA, 8514/A, Ultra Hi-Res Graphics controllers for PCs, as well as the Macintosh II and its Hi-Res Graphics Adapters. With the FLEXSCAN 9400, future compatibility is assured.

Latest Technology

By adopting a DBF (Dynamic Beam Forming) Electron Gun CRT, resolution, convergence and brightness in the screen corners have been improved over a standard CRT. By combining this with Dynamic Focusing Circuitry,



the FLEXSCAN 9400 will give a sharp and bright display image over the entire screen.

The 9400 also has 2 input terminals (BNC×5 and D-sub 9 pin) which can be easily selected from a front mounted switch. This convenient feature enables the professional user to have a one-monitor solution even if

he runs both Ultra Hi-Res and general business applications.

Ergonomics and Utility

The CRT of the 9400 has a special coating which not only reduces reflection but also the static electricity generated on the surface of the screen.

Specifications

CRT Trio Pitch	0.31mm(Dot)
CRT Size	20"(19V) 90° deflection
CRT Face Treatment	Dark face, Non-glare screen
Input Signals	Sync: Separate, TTL, positive/negative. Composite, TTL, positive/negative.
	Video: Separate, RGB, Analog 0.6~1.0Vp-p/75ohm positive Separate, RGB, Analog, Sync. on Green
Scan Frequency	H: 30kHz ~ 65kHz (Automatic adjustment) V: 55Hz ~ 90Hz (Automatic adjustment)
Standard Display Size	360mm × 270mm
Recommended Resolution	1280 dots × 1024 lines
Video Band Width	120MHz
Linearity	± 5% max. (for Horizontal scan frequency ranges 30 ~ 37/48 ~ 50/63 ~ 65kHz only)
Dimensions	496mm(W) × 561mm(D) × 471mm(H) (at tilt 0°)
Net Weight	37kg

NANAO[®]

NANAO USA CORPORATION

23510 TELLO AVE., SUITE 5 TORRANCE, CA 90505
PHONE (213) 325-5202 FAX (213) 530-1679

Specifications are subject to change without notice.

APPLE and Macintosh II are registered trademarks of Apple Computer, Inc.
PageMaker is a registered trademark of Aldus Corporation.
FLEXSCAN and NANAO are registered trademarks of NANAO USA CORPORATION.

Circle 203 on Reader Service Card (DEALERS: 204)

GRAPHICS FORMATS

A close look at GIF, TIFF, and other attempts at a universal image format

Gerald L. Graef

Despite telecommunications advances, many computer systems remain graphically isolated because techniques of storing and transferring graphics are not uniformly accepted. Not too long ago, most applications had their own proprietary formats. Whole companies existed (and still exist) on the sole service of translating images to run on different computers and even on different software on the same computers. But translation services cost money and time. A universal graphics format is much needed, but will it ever come about? Indeed, is it even possible?

Just about all graphics formats share some common elements. An image file must contain enough information so that the program you're using to view it can decode it. As a minimum, this consists of not only the image data itself, but also information regarding how the data is to be interpreted. Such information is often stored in a header. For many computer-specific formats, this merely entails specifying a graphics mode and an image size. A simple BASIC format such as BSAVE contains nothing more. But in other formats, this header may also contain information on the palette, aspect ratios, and even image-creation data.

Shape-Defined Formats

One of the simplest and most versatile graphics formats is

the shape-defined format. This format defines an image as a series of geometric shapes and patterns. CAD programs store images in this manner because it is usually not necessary for them to define color values for every pixel. The most common shape-defined format is the X3.110-1983 North American Presentation-Level Protocol Syntax (NAPLPS) standard defined by ANSI.

NAPLPS provides an extensive body of graphics abilities, including a large palette of colors, text scaling and rotation, and mosaic graphics as well as geometric shapes. Because these

shapes are relatively simple, NAPLPS can display them rapidly, and because images can be updated quickly, a limited animation capacity is inherent in the format. However, because NAPLPS relies on a set of defined shapes, it is difficult to take an existing image and store it in a NAPLPS format. This is especially true of images, such as scanned photographs, that have no readily apparent patterns. In these cases, NAPLPS could store a value for each pixel, but the format was not designed for this, and it would be extremely clumsy to do so in terms of speed and the size of the stored image.

RLE

One of the earliest graphics encoding schemes was run-length encoding. It is still

continued



LZW Compression

With the ever-increasing resolution and color density of today's computers, image compression has moved from the realm of luxury to necessity. A 256-color MCGA image (320 by 200 pixels) nominally requires 64K bytes; a 525- by 300-pixel, 18-bit color image (roughly equivalent to a National Television System Committee TV image) requires more than a third of a megabyte. Clearly, an efficient storage method is needed.

Many methods of data compression have been devised. Unfortunately, no one method is always the most efficient. A system that works well for fairly uniform images (e.g., paint program files) will more often than not achieve marginal, if any, compression on a "noisy picture" (e.g., a scanned photograph or a fractal).

One of the best compression algorithms available is LZW compression. The basic Lempel-Ziv & Welch algorithm is described in "A Technique for High-Performance Data Compression" by Terry A. Welch in *IEEE Computer*, vol. 17, no. 6, June 1984. This scheme provides rapid compression (on the order of 50K bytes per second on an 80386-based computer) while remaining relatively simple. Using LZW compression, an image can often be compressed by better than 50 percent and occasionally by as much as 90 percent. LZW relies on patterns in the data and therefore is weakest on random or chaotic data. Fortunately, however, few images are highly random; indeed, most scanners produce common patterns that LZW can exploit to perform very efficient compression. Prominent users of LZW include TIFF and GIF.

LZW uses a string table to store codes that represent strings of input data. At the start of the routine, the string table is initialized with the possible values of a single pixel. For 8-bit data, there are 256 such possibilities. As the data is compressed, the table is expanded to include longer strings. A simple pseudocode algorithm for encoding is shown below.

```
Initialize the string table
z=null string
```

```
for each character in the input {
  x=next character in input
  if z+x is in the string table
    z=z+x
  else {
    write string z to output file
    add entry z+x to string table
    z=x
  }
}
```

Expansion of a compressed image is somewhat more involved but is basically the reverse of the above process. The amazing part of LZW is that the string table itself does not need to be sent. It is resynthesized as part of the decompression process.

GIF and TIFF both employ two simple extensions to the basic LZW method. A potential problem with LZW is overflow of the string table. To circumvent this problem, support is made for a *clear* code. This code resets the string table to its initial state (i.e., with one entry for each possible pixel value). The program then begins the process of building the table anew.

The second extension is variable-length codes. For example, on a stream of 8-bit data, the first character sent will be a 9-bit code. When the 512th entry is made in the string table, the program switches to 10-bit codes. Similarly, starting at the 1024th entry, 11-bit codes are sent, and at 2048, 12-bit codes. Both GIF and TIFF limit themselves to 12-bit codes. This is generally considered the optimum balance of table size and compression ratios for typical PC files. (Obviously, a 2K-byte file would never need a table larger than 11 bits, but in order to minimize complexity, a 12-bit table is set as the standard rather than using a variable-length table.)

There are other compression schemes that achieve better results than LZW. They are, however, substantially more involved, often requiring two-pass encoding, and are usually less stable. LZW compression achieves very solid results while maintaining fair worst-case performance.

common today in many applications, including CCITT Group 3 1-Dimensional fax compression. RLE stores an image as a series of run lengths of individual values. It can achieve impressive compression ratios for relatively uniform images. Generally, however, Lempel-Ziv & Welch (LZW) compression (see the text box "LZW Compression" above) produces as good, if not better, results, although at the expense of simplicity and ease of implementation.

In CompuServe's RLE format, an image is stored as a series of code-word pairs: The first word represents a run length for the background color, and the second word provides a run length for the foreground color. For example, if 1 hexadecimal represents 1 pixel, 2h represents 2 pixels, and so on, then 3h 4h 1h 9h translates to 3 black pixels followed by 4 white, 1 black, and 9 white.

Another common run-length scheme is the Macintosh Packbits. A pseudocode algorithm for unpacking is shown below:

```
Loop until you have read in one line {
  n=next byte of input file
  if n is between 0 and 127, copy next
```

```
  n + 1 bytes to the output file
  else if n is between -127 and -1,
    copy the next byte -n + 1 times.
}
```

Packbits is simple to implement yet achieves good results and maintains a good worst-case behavior.

Although a format such as RLE is only monochrome, it is possible to store color or gray-scale images in a run-length scheme. Unfortunately, because RLE techniques rely on long stretches of repeated data, the more colors or gray-scale shades added, the less effective they become.

Hardware-Specific Formats

With the vast number of paint programs and computers on the market, many commercial formats have emerged. Because these formats are typically computer-specific, they use the most efficient storage mechanisms available on their hosts. However, this causes problems when images must be moved among different computers. Somewhere, an image must be

continued

Cure Hayes fever.



2400etc/e

V.42 compatible

Get fast relief from high prices with ATI's high-performance, error-free modem for a fraction of the price.



Allergic to high modem prices? Here's news that will clear your head, not your budget.

ATI® Technologies' 2400etc/e® external modem* meets the competition feature for feature...and then some! Remarkably, it costs just a fraction of the price.

Relief is fast. With MNP® level 5 data compression, the 2400etc/e's throughput speeds exceed 4800bps, thereby lowering transmission costs.

The 2400etc/e supports both V.42 and MNP error-control protocols for 100% error-free transfer. And it's fully

compatible with standard and extended Hayes® 'AT' command sets. Plus, ATI's easy-set front panel controls provide convenient access to frequently used commands.

Don't suffer from high prices. The ATI 2400etc/e external modem cures Hayes fever for only **\$299.**** And that's nothing to sneeze at.

You'll be relieved to know that the 2400etc/e's capabilities are also available in a high-performance internal modem, at an equally non-allergic price. Only **\$239.****

For more information, contact your supplier or

ATI Technologies Inc.
3761 Victoria Park Avenue
Scarborough, Ontario
Canada M1W 3S2
Tel: (416) 756-0718
Fax: (416) 756-0720



TECHNOLOGIES INC.
Technology you can Trust.

*Conforms to CCITT V.22, V.22bis, Bell 103 and Bell 212A standards. ®ATI and 2400etc are registered trademarks of ATI Technologies Inc. Hayes is a registered trademark of Hayes Microcomputer Products, Inc. MNP is a registered trademark of Microcom, Inc. **Manufacturer's suggested retail price.

Circle 27 on Reader Service Card

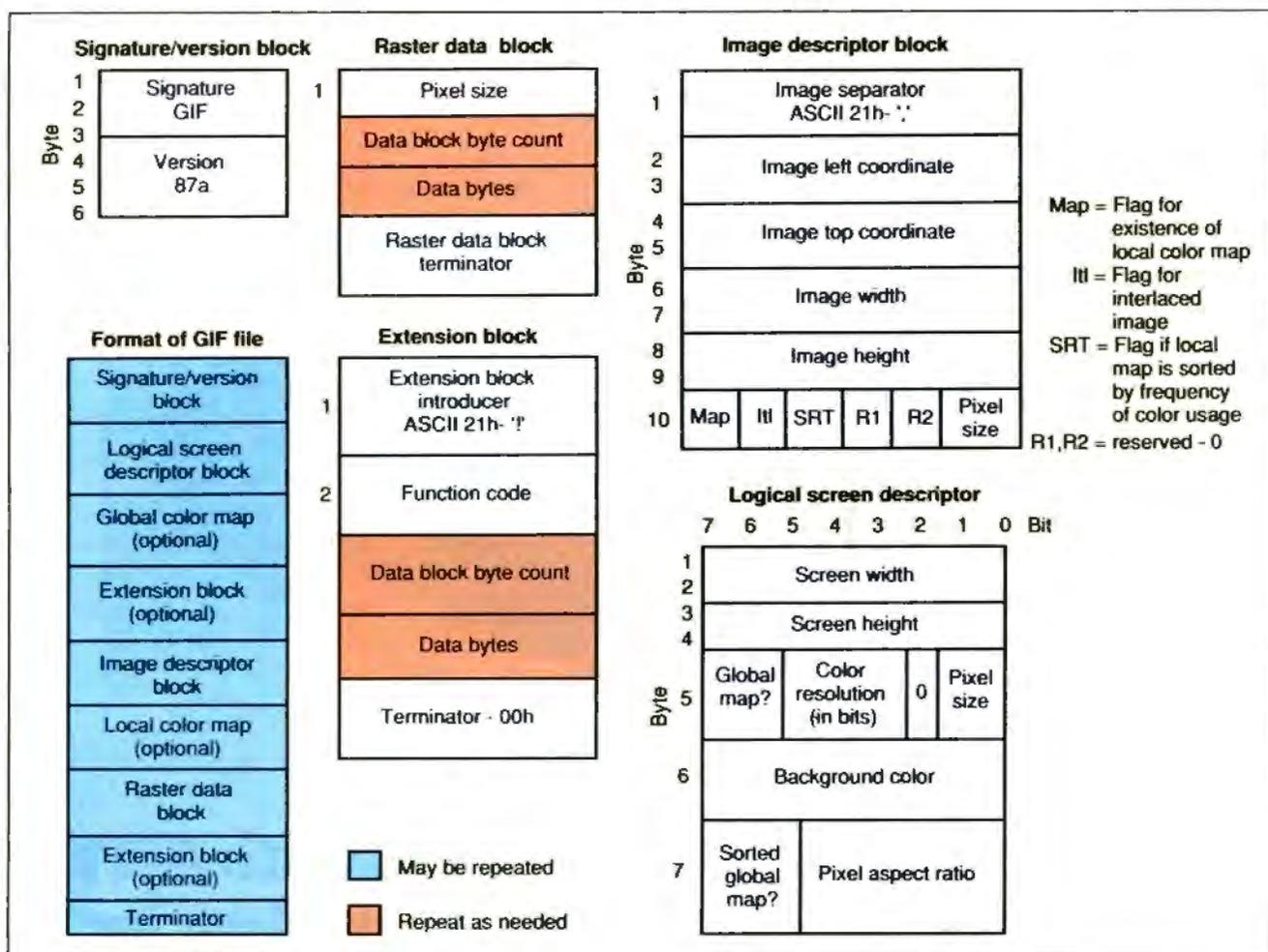


Figure 1: The GIF image format.

translated to fit into its new home. Many translation programs have appeared in recent years, but the introduction of an additional step in the process of moving images around is not particularly welcome. The alternative to translation is for application programs to recognize "foreign" formats and do their own translating. The number of graphics formats that currently need to be supported makes this option prohibitive, however.

Most hardware-specific formats make use of a positional structure. In such a scheme, the location of data in the file determines what the data means. For example, the header for a PC Paint file is 17 bytes long. The header starts with a 2-byte marker and is followed by the image size and offset, the number of bits per pixel, and so on. If you want to know what video mode should be used to display the image, you can immediately look at the thirteenth byte in the file. While this structure is very efficient, it is also resistant to change. And while this may not necessarily be bad, changes are inevitable in a long-lived program.

Suppose, for example, you must add a new field of data. Unless this data can be placed where it will not disturb old software versions, the best you can do is to assign a new version number to the data file, thereby prohibiting older software versions from reading it. Even if you can "hide" the new data, it may not be enough; if the new field was meant to replace an old field, problems will still arise.

One approach to alleviating this problem is to place a tag at the beginning of each data field. This tag tells the reading software what the following data is. You can then easily add new fields or even delete old ones. Old software can simply ignore fields it does not understand. While this does not eliminate all problems, it helps considerably by creating a flexible format that can readily be expanded to incorporate new features.

GIF

The Graphics Interchange Format was developed by CompuServe in 1987 to fill a need for a color-image transfer protocol. GIF was designed to support image dimensions of up to 64,000 pixels, 256 colors out of a 16-million-color palette, multiple images in a single file, rapid decoding for on-line viewing, efficient compression, and hardware independence.

The format itself makes some use of tag fields. Although most of the file information is stored in a positional header, the format switches to a tag structure thereafter. In GIF, the tag blocks (tag fields) are referred to as extension blocks. Currently, two extension blocks are supported, although the data block is also a tag field (the official documentation does not refer to it as such, however). The first extension block is a comment block for information on the image creator, software used, scanning equipment, and so on. The second extension block contains image control commands that define additional

control functions related to various aspects of image display.

Figure 1 shows the structure of a GIF file. Note that extension blocks can come before or after the image data. The number of colors or gray-scale shades available is stored as a 3-bit number. Hence, from 2 to 256 colors or shades (1 to 8 bits per pixel) can be displayed. The raster data is stored as codes that reference the active color table. A color-table entry has 1 byte for each color plane (red, green, and blue), allowing for a palette of over 16 million colors. This entry must then be interpolated to the nearest color value available on the reading computer.

GIF files may have several color maps. Most use a single global map, but this is not required. In addition to, or in place of, the global map, a local color map can be defined in the raster data block. This local map is used only for the data block it appears in. If a local map exists, the global map is not used.

GIF is geared toward the exchange of images among small systems. Because it is largely an end-user format, it supports an extra interlacing feature. In an interlaced image, the horizontal lines are stored out of order in such a way that the entire image is displayed in four passes over the screen. The first pass displays every eighth line, and each succeeding pass adds a line between previously displayed lines until the image is complete. This feature allows you right away to see the entire image partially completed, rather than a part of the image wholly complete and the rest of the screen blank. GIF has as yet found little use in applications software, and the software that does support it consists largely of conversion programs.

TIFF

Whereas GIF implements some of the tag-field approach to help circumvent obsolescence, the Tag Image File Format is based wholly on the concept. TIFF was developed jointly by Aldus and Microsoft as a common format for scanner vendors and desktop publishing software. Since its introduction, TIFF has grown to far exceed the expectations of its designers. As shown in figure 2, the initial header contains only 8 bytes. All information and parameters relating to the image are stored in tag fields. The current version of TIFF (5.0) includes 45 such fields; this number is misleading, however, because there are two separate tag fields to specify the image dimensions, as well as fields to identify the creating computer, model, make, artist, description, software, and date. Several necessary fields have default values and so need not be specified (although it is a good idea to do so in any case). Many of the tag fields are not necessary to produce images, although an image may become distorted without them. For example, TIFF provides fields that enable images of unusual aspect ratios to be displayed properly. Without the proper field data, the image will appear stretched.

TIFF is an all-encompassing format. It supports several compression schemes, special image-control functions, and many other features. Because TIFF is large, it requires extensive coding to develop a complete implementation. To help programmers deal with this complexity, version 5.0 defines four TIFF classes: TIFF-B for bilevel (1-bit) images, TIFF-G for gray-scale images, TIFF-P for palette-color images, and TIFF-R for RGB images. TIFF-X refers to a program that supports all four classes. These classes enable application programs to use only the features they need to perform properly. Each class has minimum fields that must be supported to ensure compatibility, and programs need not make use of the other fields.

TIFF files have no set order in which data must appear other than the initial 8-byte header. The image-file directory (IFD) contains a list of the fields present in the file. The directory-

continued

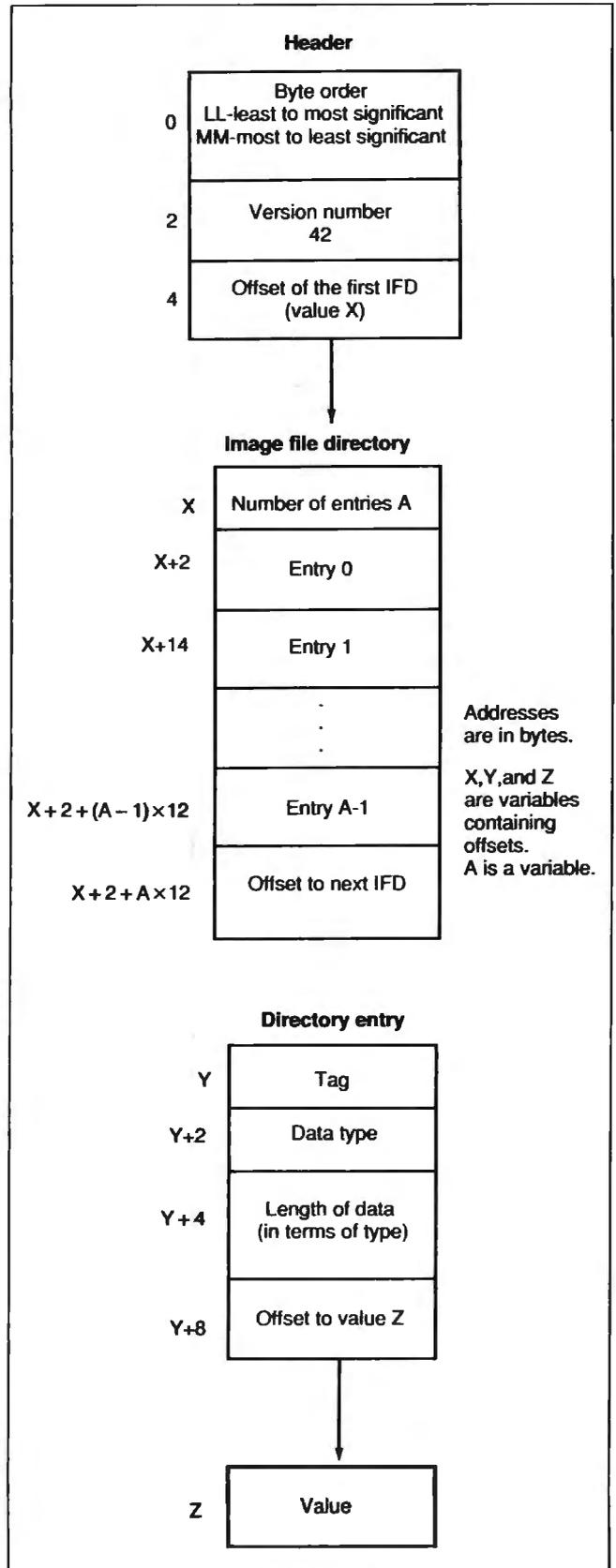


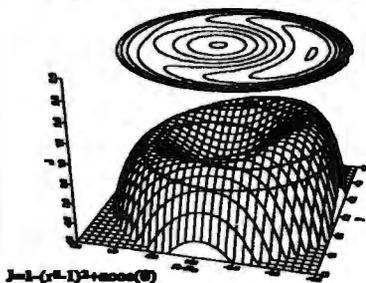
Figure 2: The TIFF image format.

GraphicTMC

"gives you all the C language routines you need to write an impressive scientific graphing program of your own. Highly recommended."*

PC Magazine

Orbits correspond to J-constant contours



IBM[®] PC version
 (with source code) \$395

Circle 259 on Reader Service Card

Macintosh[®] version
 (no source code) \$295

Circle 260 on Reader Service Card

For personal use only.

VTEKTM 4.3

DEC[®] VT100/102/52
 & Tektronix[®]
 4010/4014/4105
 Terminal Emulator

"its ease of use, high resolution graphics, emulation, and price make it a more attractive purchase than the other products."*

MINI-MICRO Systems
 Only \$150

Circle 261 on Reader Service Card

* Full reprints on request

Scientific Endeavors
 508 North Kentucky Street
 Kingston, TN 37763
 (615) 376-4146

entry offset points to the location in the file where the information is stored. This allows the data to be placed anywhere within the file. The actual image data is stored in "strips" that are found through an entry in the file directory. These strips can be of any width. The default is one strip containing the entire file, but to simplify buffering, the format specifications recommend that strips be about 8K bytes long. Because TIFF is a pointer-based format, it is necessarily more complex than GIF, but this greatly enhances the flexibility because field data can be written in any order.

TIFF, like GIF, supports multiple images in a single file (referred to as subfiles), although decoders are not required to process them. The last entry in an IFD is either 0000 for end of file or an offset to the IFD of the next subfile.

TIFF supports two methods of storing color data. TIFF-P is similar to GIF. A single field defines a color map for the image. The image data itself is then stored as codes relative to the color map. This method allows for efficient storage, although it is limited to 256 colors. The color map draws its entries from a 48-bit palette (TIFF's basic unit of structure is the 2-byte word; hence, 16 bits are present in each of the red, green, and blue planes). TIFF-R is used to define full RGB images. A pixel is represented by three 8-bit RGB values that provide over 16 million colors.

To facilitate the faithful reproduction of images on a range of equipment, TIFF supports several extra fields. These fields are typically of little use on hardware-specific formats and are generally missing from other hardware-independent formats. The ability to redefine the white point and the primary chromaticities is important when images are displayed on nonstandard equipment. For example, modern computer monitors no longer use the National Television System Committee chromaticities and white point, although television monitors often do. Another important ability is aspect ratio specification. Most computers have roughly the same aspect ratio, although there are notable exceptions—particularly the Macintosh. (GIF also supports the ability to vary aspect ratios.) In addition, you may wish to include a field that is relevant only to your applications. These fields can be registered with Aldus and Microsoft to ensure that they remain unique (the tag field number is a 16-bit value, so there is plenty of room for proprietary fields).

TIFF supports several different compression schemes. For most applications, the most useful is a variant of LZW compression. Also supported are CCITT Group 3 1-Dimensional Modified Huffman RLE and the Mac's Packbits.

Trading Images

For the foreseeable future, a great many graphics formats will remain. NAPLPS still rightfully enjoys a substantial following, although this will decrease as graphics abilities increase and processors become faster. You can expect to see TIFF continue to spread through applications across the land. Its power and flexibility make it especially attractive to commercial software developers. However, its complexity will probably keep it out of the realm of the casual programmer.

For the less-sophisticated computer enthusiast looking to trade images with friends, GIF is the likely choice, even though its limitation to 256 colors is already a hindrance to Amiga owners and others with high-color-resolution boards. From the programmers' point of view, graphics transfers will never be pretty, but end users will see spectacular results. ■

Gerald L. Graef is a programmer for a civil engineering firm in Milwaukee, Wisconsin. He can be contacted on BIX as "ggraef."



FREE

Air Express Shipping
You Pay The Ground Shipping
We Pay The Air Difference

WAREHOUSE DATA PRODUCTS

1-800-421-3135 WITHIN THE USA AND CANADA TOLL-FREE

Order Status,
Technical & Other
Info: (602) 246-2222
Fax: (602) 246-7805
Call for items
not shown

H A R D W A R E

MONITORS

Monochrome	
Hyundai Amber w/tilt	\$79
Samsung White	95
CGA	
Hyundai	249
Magnavox 8762 RGB	255
EGA	
Hyundai	349
Magnavox CM 9053	370

VGA	
Imtec	355
NEC Multisync 2A	519
Seiko 1430	599

Multisync	
Mitsubishi Diamondscan	499
NEC Multisync 3D	679
Princeton Ultra 16	843

ACCESSORIES

Curtis Ruby Plus	\$69
Emerson Surge Protector	69
Keytronics KB101	99
Logical Connection 256K	469
Mach III Joystick	30
Masterpiece	85
150 Watt Power Supply	69

LAPTOP COMPUTERS

Toshiba T-1000	\$699
Toshiba T-1200FB	1579
Toshiba T-1600	3359
Toshiba T-3100E	2839
All Other Models	Call

DIGITIZERS

Kurta Tablets IS/One 12 x 12	\$295
Summa Graphics 12 x 12	349

HARD CARDS

Plus Hardcard 20 MB	\$529
Plus Hardcard 40 MB	669

MICE/SCANNERS

Complete Hand Scanner 400	\$143
DFI Scanner	189
Logitech Bus NEW	79
Logitech Scanman Hi-Res	179
Microsoft Bus w/Paintbrush	99
PC Mouse II w/Paint	79

CO-PROCESSOR

INTEL	
80287	\$153
80287-8	219
80287-10	259
80387-16	399
80387-20	439
8087-2	139

FLOPPY DRIVES

Sygen for PS2	Call
Teac 5 1/4" 360K	\$79
Toshiba 3 1/2" 1.44 MB	109
Toshiba 3 1/2" 720K	89

BOARDS

AST Rampage 286 + 512K	\$489
AST Sixpac Plus w/64K	129
ATI Wonder VGA	433
Copy II PC Deluxe Board	109
DFI I/O XT/AT	45
Everex RAM 3000	89
Everex 2MB Above Board	59
Intel Inboard 386 AT	894
Intel Above 286. Plus w/512K	419
Intel Connection Co-Processor	739
Orchid Tiny Extra Turbo	279
WD Controllers	Call

COMPUTERS

AST	
Bravo 5	\$889
Model 140	2599
Model 140X	2299

ARC	
Pro Turbo 88	739
Pro Turbo 286 w/512	1209
Pro Turbo 286, 1 MB	1319
386 Skyscraper	2729

VIDEO BOARDS

AST VGA Plus	\$349
ATI EGA Wonder 800	229
ATI VGA Wonder	319
Everex Viewpoint 256K	249
Orchid Designer 800	232
Orchid Pro Designer w/256K	299
Paradise Autoswitch EGA 480	179
Paradise VGA Plus	259
Paradise VGA Pro	449
Vega Fastwrite	349

PRINTERS

NEC	
P5200	\$519
P5300	669

OKIDATA	
OKI 182 Turbo	235
OKI 320	349
OKI 321	479
OKI 391	649

PANASONIC	
1124	339
1190-I	189
1191-I	249

STAR MICRONICS	
NX1000	169
NX1000 Color	229

HYUNDAI Super-16TE

This compact, affordable PC XT offers speed & flexibility and includes ELECTRIC DESK & KEYWORKS.



\$699

- 18 Month warranty
- 10 MHz
- 640 KB base memory
- ATX Graphic Solution included (MDA/MGA/LGA)
- 360 KB Drive

- 101-key keyboard
- Parallel/Serial/Clock Calendar
- MS-DOS 3.3, GW-BASIC
- Other XT & AT models at similar savings

MODEMS

DFI INT	\$89
Everex 300/1200	69
Everex 2400 MNP INT	159
Everex 2400 MNP EXT	189
Hayes 1200	289
Hayes 2400	435
U.S. Robotics	
2400E	335
9600 HST	609
Sportster 1200 INT	79
Sportster 2400 INT	145

HARD DRIVES

Bernoulli B120X	\$1049
Bernoulli Carts	In Stock
Core Hard Drives	Call
MiniScribe	Special
Seagate 20 MB w/Cont	259
Seagate 30 MB w/Cont	279
Seagate 251-1 40MB 28 Mil	409
Seagate ST 125 w/Cont	319
Seagate ST 138 w/Cont	369
Seagate ST 251	369
Seagate ST 4096	585

S O F T W A R E

SPREADSHEETS

Lotus 1-2-3, 3.0 NEW	\$349
Lucid 3D	62
Microsoft Excel	224
Quattro	159
SuperCalc 5	305
Twin Advanced	69
VP Planner Plus	119

DATA BASE MANAGERS

Clarion Personal Developer	\$95
Clarion Pro Developer	379
Clipper	419
D Base IV	459
D Base IV Developers Ed	819
Data Perfect	283
Fox Base Plus 2.1	199
Genifer	189
Paradox 3.0	449
PFS: Professional File 2.0	165
Powerbase 2.3	169
Q&A 3.0	209
Revelation Advanced	469
R Base Compiler Ver. 1.0	580
R Base For DOS 2.1	459
Reflex	95
Relate & Report	99
VP Info	63

CAD & ENGINEERING

Autosketch Enhanced	\$61
DesignCad 2D 3.0	219
Easy Cad 2.05	119
Generic Cad Level 3	159
MathCad 2.0	245

DESKTOP PUBLISHING

Adobe Illustrator Window	\$409
Bitstream Fonts	119 ea.
Pagemaker Ver. 3.0	499
PFS: First Publisher 2.0	73
Ventura Publisher 2.0	479
Ventura Pro EXT	377

GRAPHICS

Corel Draw	\$275
PFS First Graphics	87
Grasp	82
Harvard Graphics 2.12	274
Printmaster Plus	29
Printshop	34
Show Partner Fx	199

INTEGRATED

Enable OA	\$415
PFS First Choice	89
Microsoft Works	89
Smart Software	439
Symphony 2.0	419

PROJECT MANAGER

Super Project Plus	\$255
Timeline Pro Ver. 3.0	364
Total Harvard Manager 3.0t	369

WORD PROCESSING

Grammatik III	\$49
Microsoft Word 5.0	225
Multimate Advantage II	285
PFS: Office Writer	245
PFS: Professional Write 2.1	129
Right Writer	49
SPF/PC 2.1	169
Will Maker 3.0	37
Word Perfect 5.0	209
Word Perfect Library 2.0	65
Wordstar Pro 5.5	229
Wordstar 2000 Plus	273
Xywrite III Plus	216

COMMUNICATION PROGRAMS

Brooklyn Bridge Universal	\$75
Carbon Copy Plus	106
Crosstalk XVI	99
Desklink	99
Lap Link 3	79
PC Anywhere III	69
Pro Com Plus	44

UTILITIES

386 To The Max	\$59
Allways	85
Battery Watch	25
Copy II PC	23
Copywrite	55
Core Fast	72
Desqview 2.2	79
Direct Access	49
Disk Manager	59
Disk Technician Advanced	108
Fastback Plus 2.0t	104
Fastfrax	29
Formtools	56
Formwork	85
H-TEST	49
Lotus Magellan	99
Mace Gold	81
Microsoft Windows 286	63
Microsoft Windows 386	125
Norton Advanced 4.5	79
Norton Commander 2.0	49
Org Plus Adv	79
PC Tools Deluxe 5.0	44
Q DOS II	49
QEMM 386	39
Sidkick Plus	125
Sideways	39
Software Carousel	43
Spinrite	49
XTree Pro	64

ACCOUNTING

Bedford Accounting	\$139
Check Write Plus	29
Dac Easy Acct. Ver 3.0	59
Dac Easy Light	42
Dollars & Sense	99
Managing Your Money 5.0	119
Peachtree Business Acct.	149
Peachtree W/PDQ	220
Quicken	30

DOS

MS-DOS 3.3	\$85
MS-DOS 4.01	89

LANGUAGES

Brammaker	\$79
Microsoft C 5.1	299
Microsoft Fortran	295
Microsoft Macro Assembler	99
Microsoft Quick Basic 4.5	65
Microsoft Quick C 2.0	65
Quick Pascal	45
Borland	
Turbo C 2.0	95
Turbo C Professional	165
Turbo Pascal 5.5	99
Turbo Prolog 2.0	95
Turbo Prolog Toolbox	65

USER FRIENDLY TERMS & CONDITIONS:

- We welcome international accounts.
- Volume discounts for corporate and institutional orders.
- We do not charge your credit card until your order is shipped.
- Shipping minimum is \$5.00. Arizona orders - 6.7% sales tax.
- Personal/company checks allow fourteen (14) days to clear.

- All shipments insured at no extra cost.
- All prices are subject to change without notice.
- We do not guarantee compatibility.
- No charge for Visa or MasterCard

- You pay our regular ground shipping rates (1-20 lbs.). We pay the air difference (excludes Alaska and Hawaii). Free air applies only to orders over \$100.
- Phone Hours: Monday thru Friday 5:30 a.m. - 6:00 p.m. MST
Saturday 9:00 a.m. - 5:00 p.m. MST
2727 W. Glendale Ave. • Phoenix, AZ 85051

BY 09

S E P T E M B E R

Display this month's
BIX activities

TUESDAY, 9/5, 9 PM EST. First Tuesday: "Hard Diskussions"

Let's talk about hard-drive partitioning, hard-drive management, backup and restore methods—and any other disk-drive problems and solutions you may have—at the *ibm.pc* conference. (join *ibm.pc/cbix*)

THURSDAY, 9/7, 8:30–9:30 PM EST. "Multitasking and Ada"

Randy Brukardt and Dan Stock of R.R. Software continue their discussion of the Ada language. What tasking capabilities does Ada provide? Will your operating system's multitasking features help Ada . . . or conflict with it? (join *janus.ada/cbix*)

IBM Exchange Opens

BIX has opened the IBM Exchange, with Barry Nance as editor. As with our other exchanges—the Macintosh, Bulletin Board, and User Group exchanges—its purpose is to better focus our activities and make the BIX system easier for you to use. The IBM Exchange conferences and their moderators are:

<i>ibm.pc</i>	John Fistere
<i>ibm.at</i>	Donald Osgood
<i>ibm.ps</i>	Matt Trask
<i>ibm.os2</i>	Dave Nanian
<i>ibm.dos</i>	Bill Bourn
<i>ibm.os.386</i>	Curt Franklin
<i>ibm.repairshop</i>	Dave Rifkind
<i>ibm.new.prods</i>	Jon Fleming
<i>ibm.exchange</i>	Jerry McReynolds
<i>ibm.utils</i>	Pete White
<i>ibm.other</i>	Tom Wagner

There are several new features in the exchanges, including:

Tutorials—Formal tutorial topics or threads are included as part of the regular exchange conferences.

BIX "strip maps"—These are narrative messages directing you to specific, related threads in multiple conferences. As such, they'll guide you through virtual single-topic discussions spread over several conferences or topics.

What's hot and what's not—Moderators will be posting narrative summaries of interesting current activity. Not exhaustive or inclusive, these summaries will only *supplement* regular digests by serving as quick pointers to what's hot.

Panels of experts—We'll be scheduling occasional group discussions by visiting experts, to be held in the regular conference areas. Not to be confused with CBix sessions, they'll be conducted over several days or weeks.

On-Line Hosts—You'll find host-moderators on duty in CBix to point you to specific information and help you use BIX. Check your digest topics to find out when the moderators will be on-line.

Digestive aids—The Exchange editor will prepare and post weekly digests highlighting what happened in the Exchange during the previous week.

New listings for the week—The Exchange editor also will post detailed descriptions of files uploaded to listings during the previous week, including the exact name and location of each file.

The Best of BIX—They're back, and you can find them on BIX. The traditional Best of BIX reports will be prepared by moderators and posted monthly in selected exchanges.

Help us help you, by sending us your opinions of the Exchanges and your suggestions on ways in which we can improve BIX in general. Please send them to "sysmgr." through BIXmail.

All-Month Conferences and CBix events

Unwind by the C—What better way to settle down from the August MacWorld convention than by picking up a good book? Especially if it's the Think LightSpeed C tutorial. Using the "Macintosh Programming Primer" by Mark and Reed (Addison Wesley) as the base text, we continue to work through the book interactively, from the basics to the more advanced. So no matter when you join the tutorial, you'll find the trail we left for you to learn from. (join *mac.novice tutorial*)

Blue Tuesdays—Every Tuesday in September (9 PM EST), drop in on this special CBix session conducted by IBM Exchange moderators. You and other IBM-users will discuss IBM PC programming, hardware, applications software, and more. (join the main CBix area, channel 1, band B)

Finally. An on-line service that doesn't nickel and dime you.

It's BIX's flat-fee service.

BIX is short for BYTE Information Exchange. The on-line information service that's yours for an unheard-of flat fee of just \$39 for three months* — an amount you could easily blow in just two to four hours with an hourly rate, on-line service. (Not to mention the fact that you'd be nickel-and-dimed for its monthly minimums.)

And here's another distinction: BIX is strictly for microcomputer pros; it contains no "fluff." As a subscriber, here's what you've got coming to you:

- All the information and ideas exchanged in more than 150 microcomputer-related conferences — a give-and-take in which you can participate.

- Microbytes Daily* — up-to-the-minute industry news and new product information.
- Plus support from hardware vendors and software publishers, access to extensive software libraries, and the use of our electronic mail service — which allows binary attachments.

Subscribe to BIX right now — using your computer and modem.

Set your telecommunications program for full duplex, 8 bits, no parity, 1 stop bit, or 7 bits, even parity, 1 stop bit. Now dial BIX at 617-861-9767, hit the return key, and respond as follows:

Prompt:	You Enter
login (enter "bix");	bix
Name?	bix.flatfee

You can charge your BIX subscription to major credit cards, or have it billed to your company. You may also purchase

unlimited off-peak access via Tymnet for just \$15 per month, or \$2 per off-peak hour.

For additional information, including your local Tymnet access number, call 800-227-2983 (in New Hampshire 603-924-7681).

**Based on a \$156 annual fee, billed quarterly — a subscription which you may cancel at any time without future quarterly charges. If you prefer, you may subscribe for a 3-month trial at just \$59.*

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983 • In NH 603-924-7681



When we started selling MKS products in 1986, the Tax Collectors were among the first to notice. They assessed our promise to bring the power and flexibility of a UNIX environment to the DOS desktop.

And then they came to call.

We're happy to report that the Tax People* quickly decided that MKS products were the perfect way to train users on UNIX operating systems using the PCs everyone was already familiar with. And the perfect way to speed development of new programs and procedures.

Get the new - but don't give up the old

The MKS Programming Platform gives programmers the best of both worlds - virtually unrestricted access to the power and flexibility of UNIX operating systems, and full DOS or OS/2 capabilities. With MKS your PC becomes a powerful and productive UNIX workstation, whenever you need it.

The Platform includes four proven members of the MKS family of software: *MKS Toolkit*, *LEX & YACC*, *RCS*, and *Make*.

The heart of the Platform is the *MKS Toolkit*. It provides a complete set of utility programs and over 150 commands compatible with UNIX System V.3. It also includes the MKS Korn Shell, a command interpreter, MKS Vi editor, and the MKS AWK programming language.

Next is *MKS LEX & YACC*, which work together as a

highly efficient program generator, simplifying the creation of languages and compilers for DOS and OS/2. The set is completed with *MKS RCS* (Revision Control System), which gives total control of text file revisions, and *MKS Make*, which provides an efficient way to automate the production and maintenance of any size project.

All together they are the most efficient, most productive, and friendliest way to cross the bridge between DOS or OS/2, and UNIX.



Beyond multiple platform support

The Programming Platform performs on standard PC networks like Novell NetWare and PC NFS with the illusion of a complete UNIX timesharing system. This means you can hook your PC to PC NFS, allowing it to be used as a UNIX workstation.

MKS is an active participant on the POSIX standards committee, and we track the shell and utilities standard to the fullest extent. We take care to build the underlying POSIX kernel functionality on DOS and OS/2 into MKS software before moving utilities. That's why the Platform gives you 100% UNIX and POSIX compatibility, with no surprises.

Ideal training tools

Fast, painless training is another benefit of the Programming Platform. Developers can use their familiar PC keyboards while moving effortlessly to UNIX on the desktop, and exposure to new commands and functionality becomes part of the novice's working day.

The Taxman adds it up

When you stack up all the advantages of the Programming Platform - access to powerful development tools, time-saving management functions, full portability, easy training, and our unwavering dedication to the POSIX standard - it's no wonder that the people with the toughest jobs to do, like the Taxman, turn to MKS.

To learn more about The Programming Platform and other MKS productivity and development tools, call us today. Maybe we can make your job a little less taxing.

After Long Investigation, The Taxman Came To Talk To Us

30 day money-back guarantee

MKS Programming Platform prices are:

DOS \$665
OS/2 \$1225

In Continental USA call 1-800 265 2797
Outside Continental USA call 1 519 884 2251
Fax 1 519 884 8861

Authorized MKS Dealers:

Belgium 2 736 6064
England 364 53499 or
1 833-1022 or
0763 73455
Netherlands 20-14 24 63
West Germany 551-792488 or
061 214908 or
721 886 664

Head Office:

35 King Street North
Waterloo, Ontario
Canada, N2J 2W9

More Power to You

*We're not allowed to use their official name. But you know who we mean.
MKS is a trademark of Marital Korn Systems, Inc. Other trademarks have been cited and MKS acknowledges them.

THE UNIX SHELL

More than just a collection of commands, the Unix shell is often used to build applications

Greg Comeau

The Unix shell in its various forms is the user's interface to the computer's operations. One reason for Unix's popularity is its support of a rich command set. The Unix shell (or `/bin/sh`) is the most popular tool of this group of commands. It is defined as a "command programming language," implying that it is only a sequential command executor, much like those found under non-Unix machines. However, this doesn't do the shell justice. It is a full-fledged programming language supporting looping and logic constructs, variables, functions, parameters, and features unique to Unix (such as pipes) that allow it to be a true and consistent operating-system interface.

The Unix shell supports both terminal and file processing: You can use it either interactively or by inserting programs into files called *shell scripts*. You can execute commands or shell constructs, such as loops, directly from the keyboard or from a script. Thus, you have immediate access to a simple command spawner or to more complex capabilities. And if you're writing shell-script programs, the shell's interpretive nature lets you create and modify scripts in a quick, easy, and reliable environment. This dual quality makes the shell very popular.

Although there are many flavors of Unix shells, the

Bourne shell is currently the only one that comes standard with all Unix systems. Therefore, I'll concentrate on the Bourne shell (`/bin/sh`), while also covering some of the important features found in other shells.

How Does It Work?

The Unix shell is an interpreter, analyzing each command line separately. Shell scripts are simple text files created with an editor, such as `ed` or `vi`. For example, if you placed the statement

```
i=100
echo i has the value of $i
```

into a file named `f1`, you would have a simple shell script that initializes the variable `i` and then displays its value in text with the `echo` command. (Although shell scripts are text files, the shell typically requires that they be both readable and executable. To make a text file executable, you would issue the command `chmod u+x f1`, where `f1` is the name of the text file.)

Input to the shell can take the form of a command from the Unix command set, a built-in shell command, or a control-flow command. At the lowest level are the commands, consisting of words separated by spaces, such as

continued



ls /usr/bin. The first word is the command name or path name you want to execute; the others are the arguments to be supplied to that command as it executes. The shell waits for each command to terminate and then sets an exit status that it and other programs can act on, perhaps by printing an error message or by branching to some other section of script.

The shell also lets you compound commands with the pipe. You type two simple commands separated by a pipe sign, the | character, to indicate that the output of the first is to become the input of the second. For example, to count the number of files in your directory, you enter ls /usr/bin | wc -l, where ls creates a list of files and wc -l counts the number of lines in the

You can export your local variables into the environment list with the export command. Many commercial applications require that you specify temporary file-directory names or even options by using environment variables. This is a convenient way to pass information to them. For example,

```
$ TEMP_PATH=/usr/tmp
$ OPTIONS=-dbj
$ export TEMP_PATH OPTIONS
$ app # some application using these
variables
```

[Editor's note: The \$ is the Bourne shell prompt and implies that the following line is entered directly to the shell.]

You may want to provide default values for environment variables and place them in the .profile file of your home directory. Then, each time you log in, the shell looks for the file and sets the environment variables. This feature is useful because in many situations the variables remain fixed throughout the log-in session.

The shell also provides several odd-looking variables that contain special information related to how your shell functions. They let you easily accomplish many commonly needed tasks:

- \$# contains the number of parameters passed to the shell;
- \$- contains flags set on shell start-up or by the set commands;
- \$? holds the return code (in decimal) of the last foreground command executed;
- \$\$ has the process ID number of the shell—handy for creating temporary filenames;
- \$! contains the process ID number of the last background command executed; and
- \$0 has the name of the currently executing command.

Some shell variables are called *positional parameters*. When a shell script is invoked from the command line or by another shell script, it can provide arguments to the called program. For instance, if you create the script args.sh

```
echo Number of args is $#
echo 1=$1
echo 2=$2
echo 3=$3
echo 4=$4
```

and execute it by entering args.sh on the command line, you would get Number of args is 0 and nothing in the arguments. If you execute the same script as args.sh a b c d e f, you would get this result:

```
Number of args is 6
1=a
2=b
3=c
4=d
```

Notice the variables \$1 and \$2. These variables assume the values of each of the respective arguments when the shell calls the script. For instance, \$3 takes on the value of the third argument, the c. This capability comes in handy when you individually process command options or filenames.

The variable \$* represents all the positional parameters at

continued

The Bourne

shell will let you combine groups of simple commands and pipes into compound commands and "super" commands for more power.

ls output to obtain the number of files in the directory.

When you enter ls by itself, its default standard output is directed to your terminal. When a command is executed, by default it looks to the terminal for *standard input*. However, you can connect the standard output of any one command (ls) to the standard input of any other command (wc) with the pipe. Thus, the shell lets you combine groups of simple commands and pipes into compound commands and "super" commands for more power.

Shell Variables

The shell also lets you create variables much like those found in most popular programming languages. All shell variables are character strings that can be either converted or treated as other data types. Also, because you don't need to declare shell variables, they are created dynamically.

In the simple shell script above, the first line contains an assignment to a variable i. (Notice the lack of spaces on this line.) The statement will assign the text "100" to i. This adds the newly created variable to your shell's local environment. As long as it is not one of the shell's readonly variables, you can change the variable at will.

Besides the variables that your program creates, there's also an inherited variable environment list that your shell and programs can receive from other applications or shells, or by default from the system. Among these are

- PATH—a list of colon-separated directory names providing search paths for commands;
- HOME—usually the user's home directory;
- PS1—the primary command-line prompt for the shell (this is typically a \$, but you can customize it as necessary);
- MAIL—the location of E-mail;
- TERM—the type of terminal display currently in use; and
- SHELL—the path name of the currently executing shell (this variable is typically set to /bin/sh).

We'll give you 30 days to plug our product.



Try our multi-user/multi-channel communication boards (and our promises) for 30 days with no risk.

You're looking at multi-user systems. You want high performance. High reliability. Great service and technical support. And real value. Trouble is, that's what every board company promises.

But whose promises can you afford to stake your reputation on? Ours. Because only DigiBoard dares to let you try us in the real world. With no risk.

With DigiBoard you can order any DigiCHANNEL multi-channel communications board and evaluate its performance

DigiBoard
Plugging you into tomorrow

for a full 30 days. Choose basic boards or the industry's fastest intelligent boards. PC-Standard or Micro Channel. Four, eight or 16 ports. Even a Synchronous option on some models.

While you're evaluating the performance of our boards, we hope you'll benchmark our technical support too. Customers tell us it's as great as our engineering. But enough talk. The only way to see how good we are is to try us. And now, you can plug us in without risking a penny. Just plug into your nearest DigiBoard distributor.

Ask your DigiBoard distributor for our FREE booklet, *How to Do Multi-User Right*.

NATIONAL DISTRIBUTORS

SOFTSEL COMPUTER PRODUCTS, East 800-645-7779, Central 800-645-7775, West 800-645-7778;
ARROW ELECTRONICS INC., COMMERCIAL SYSTEMS DIVISION, 800-323-4373 U.S., 516-391-1762 NY.;
INGRAM-MICRO D., 800-642-7631; ROPEC DISTRIBUTORS, 800-223-7081 Request Ann Brady

CANADIAN DISTRIBUTORS

CDI COMPUTER DISTRIBUTION, 604-984-0641; EMU DATA SYSTEMS LIMITED, 519-837-2444;
SOFTSEL COMPUTER PRODUCTS, 800-268-1220; INGRAM-MICRO D., 416-738-1700

REGIONAL DISTRIBUTORS

MULTI COMPUTER PRODUCTS, South East Region, 800-456-8584
ICOM SYSTEMS INC., Central Region, 312-506-1444;
MP SYSTEMS, Central & Western Regions, 800-624-1688 U.S., 800-322-6411 CA
AIS INC., Central Region, 800-950-2471;
COMPUTER SOURCE INTERNATIONAL, North East Region, 800-222-5022;
TRICOM, North East Region, 800-TRICOM-1; REDLAW, South East Region, 305-791-5450

DigiBoard Inc., U.S. 800-344-4273, MN 612-922-9055

Circle 95 on Reader Service Card

Unix Tools for DOS

Charles Herring

Some Unix commands have found their way onto DOS machines, where they perform functions similar to existing DOS commands. They are being used instead of their DOS counterparts for several reasons. For one, as DOS systems have grown in size and complexity, few DOS commands have been extended to reflect the growth of the systems. Unix is a more mature operating system, designed to manage more complex tasks, and Unix commands thus offer more options than their DOS counterparts. Also, Unix commands were designed to work with each other.

Many users who are familiar with Unix, who simply prefer the Unix commands to DOS, or who are using both Unix and DOS and want a consistent interface, have brought the Unix commands over.

Basic Commands

Many implementations of Unix commands in the DOS environment do not perform exactly the same or have the same options as their Unix counterparts. The commands in the following list should have the same basic function and options in any implementation:

ls

ls (list files) is the Unix counterpart of the DOS DIR command. It lists information about files and directories. DIR has two display options: /w for wide-column display and /p for pause. ls has many output format options; some implementations have over 20.

By default (BSD Unix) the files in the current directory are displayed in a sorted multicolumn format. Most versions of ls include the a, l, and t options. Most versions also support an option (-R), similar to the DOS TREE command, to list directories and files recursively.

mv

Moving files from a directory or disk to another location is a frequent task. Under DOS, this requires the use of both the COPY and the DELETE commands. The mv (move) command does this in a single action. There are two forms of the mv command:

```
mv file1 file2
mv files directory
```

The first form is equivalent to RENAME (i.e., file 2 will be renamed to file 1). The second form moves (copies and then deletes) the specified files to a directory. Some implementations of mv also permit directories to be renamed.

rm

DOS machines have been called upon to perform ever more complex tasks, and the directory structures have grown quite large. Managing these directories can be awkward using the DOS RMDIR command to remove directories. First, RMDIR requires the directory to be empty of files. This requires the use of the DELETE command before RMDIR can be used. Second, the directories must be removed one at a time. Thus, removing

deeply nested directories is inconvenient.

The rm (remove) command was developed to remedy this problem. rm removes files and directories. The -r option causes rm to recursively remove all files and directories in the specified directory path. For example, rm -r wp *.* will remove all files under wp. Because of the potential devastation to forgotten files in the path, the -i option should be used whenever a recursive rm is invoked. This option interactively queries the user for affirmation on deleting each file.

Advanced Tools

Unix tools read their input from the standard input and write their data to the standard output. Tools that change the data/text fed to them in this way are called *filters*. Two commonly used filters are pg and pr, which paginate files for the screen and printer, respectively.

Other commonly used but more advanced tools are sed (a character stream editor), grep (a pattern pass filter), and awk (a report generator).

grep

grep is a filter that uses regular expressions to match input lines. Each line of input data matching the regular expression is sent to the standard output. grep is invoked on the command line as follows:

```
grep [-options] regular-expression files
```

grep has a number of options that can be included on the command line. For example, -i causes grep to ignore case in pattern matching.

One of a family of three pattern-matching filters, grep uses a limited form of regular expression that does not permit alteration (|), zero or one occurrence (?), one or more occurrences (+), or parentheses for grouping.

An example use of grep would be to find all occurrences of the include statement in a C application:

```
grep ^#include *.c > include.txt
```

The regular expression ^#include matches all lines in the C source files that begin with #include. The metacharacter ^ in a regular expression specifies that the pattern, #include in this case, must be at the beginning of the line.

grep is used to search for a pattern of characters in text files. Programmers find it very useful in performing tasks such as locating all occurrences of a given variable name across many source code files.

awk

awk is a pattern-matching programming language designed for text processing and report generation. It can be used to generate simple reports or to write complex programs. awk was developed in 1977 by Alfred Aho, Peter Weinberger, and Brian Kernighan of AT&T Bell Laboratories (awk is an acronym for Aho Weinberger Kernighan). It began as an experiment to integrate and generalize the grep and sed utilities. However, because of

its popularity, it was greatly expanded, and an enhanced version was released in 1985.

awk is an interpreted language like BASIC or dBASE III. Its programs are stored in text files. The basic format of an awk statement is `pattern { action }`. When an awk program is run, lines are read from the input data file. Each line is then separated into fields. If the current line matches the pattern, the action is executed. An awk statement can consist of only a pattern or an action. A pattern alone will print each input line that it matches. An action alone will be applied to every input line. The action part can consist of any number of statements.

The simplest form of a pattern is the expression. An example of an expression is `$1 == "Name"`. This pattern will match any input line whose first field (`$1`) is the string "Name". awk also supports regular expressions.

The `{ action }` part of the basic awk statement follows the pattern and can be a single statement or many statements separated by new lines and semicolons. The action can consist of expressions and control statements. The control statements are analogous to C control statements and include the following:

```
if (expression) statements
if (expression) statements else statements
while (expression) statements
for (expression ; expression ; expression) statements
do statements while (expression)
```

In addition to expressions and control statements, awk offers many built-in functions for arithmetic and string operations as well as arrays.

awk is a powerful and fun-to-use language. It can be used to write simple one-line filters invoked from the command line or to write an assembler. It serves as a good introduction to the C language and can be used as a prototyping language.

Unix Shells for DOS

In Unix, a shell is the user interface to the operating system just as `COMMAND.COM` is in DOS. The shell executes user commands and provides a job control language similar to the DOS batch facility.

At least two commercially available Unix shells are available that transform your DOS machine into a Unix look-alike. Of course, they do not implement multitasking, multiuser, and networking, but they do provide a full complement of Unix commands and tools.

MKS Toolkit by Mortice Kern Systems and PolyShell by PolyTron each provide all the basic Unix tools, including some very sophisticated ones such as awk. As Unix has evolved, many different shells have been developed. The MKS Toolkit implements the features of the Korn shell, the newest in the family of shells, developed at AT&T. PolyShell is compatible with the Bourne shell as found on Berkeley Unix (BSD).

Charles Herring is a computer scientist living in Champaign, Illinois. He has completed an M.S. in computer science and has a special interest in simulation software. He can be reached on BIX c/o "editors."

once. For instance, if you were to create another script called `allargs.sh`

```
echo Number of args is $#
echo All the arguments are: $*
```

and run it as `allargs.sh a b c d e f g`, you would get the following output:

```
Number of args is 7
All the arguments are: a b c d e f g
```

This can be useful when outputting values or iterating through a group of values in a `for` loop.

In the Loop

Table 1 shows the built-in commands for looping and control-flow logic that the shell supports. (Note that the Bourne shell doesn't support a `goto` command.)

Listing 1 shows a shell script that uses all these constructs. It is the beginning of a file management application. In most cases, the `test` command (or the `[expr]` command, for short) is used as the command target to control branching in `while` and `if` statements. Only if the commands in the target produce an exit status of zero is the body of a `while` loop or the then part of the `if` statement executed.

The `test ([])` command is useful for evaluating various expressions. It returns a zero exit status on successful completion or a nonzero exit status when an error has occurred; therefore, it is often the target command. In the first line, the script checks to make sure that the number of arguments (`$#`) is not equal to zero before continuing. You can use any command you want as the command target as long as it returns a predictable exit status.

If you execute the script without any arguments, it will print an error message and terminate itself with the built-in `exit` command (table 2 contains a list of the shell's built-in commands). The script can also specify its exit status as `hold`, so its invoker can determine whether it failed.

The `getfile` shell function in listing 1 behaves much like a subroutine since it is called and can return a value. However, I'm only interested here in printing a string and reading a value. Notice that you can pass parameters to shell functions; within functions, they perform just like positional parameters.

The `for` loop iterates through each argument individually by implicitly assigning each argument to `i`. The variable named `i` is assigned each word in the "in" list one at a time. In this case, the list contains all the parameters passed to the program.

Another powerful shell statement is the `case` statement, which allows the flow of logic to continue to one of many choices. The shell evaluates `i` and compares it to each of the text patterns until a match is found. It then executes the command from that pattern to the next `;;` and then jumps to the next statement after the `esac` keyword.

The `while [1]` construct tells the script to loop forever. (This can be shortened to `while true`.) The statements and commands within this loop will continue to execute until you enter a valid response to the deletion request. When you do, a `break` statement is executed, and the shell transfers control to the end of the loop.

Other Features

The Unix shell's I/O capabilities are extensive. For example, you can use

continued

- < to take standard input from a specified file;
- > to send standard output to a specified file;
- << to read shell input until a specified point and treat the resulting text as the standard input;
- >> to append standard output to a specified file;
- <&n to duplicate the standard input from the file descriptor *n* (file descriptors are numbers; for example, 0

- is standard input, 1 is standard output, and 2 is standard error);
- >&n to duplicate the standard output from the file descriptor *n*;
- <&- to close the standard input; and
- >&- to close the standard output.

If you use MS-DOS, you're already familiar with a subset of these, because MS-DOS borrowed its use of redirection from the Unix shell. But redirection is much more powerful in Unix.

In general, Unix shell commands execute synchronously. A command is spawned for execution, and the shell waits for its completion. Synchronous processing is also termed *foreground processing*. The shell (and Unix, of course) also allows background or asynchronous processing, which is invoked by appending an & to the command.

There are a few steps that the shell goes through to analyze the words on a line. In addition to the variable substitutions it performs on seeing a \$ character, it also uses wild-card substitutions. The following are the wild-card metacharacters and their meanings:

- * matches any characters in a filename;

Table 1: Shell commands for looping and control-flow logic.

1. while *command* do *commands* done
2. for *variablename* in *word1* . . . *wordN* do *commands* done
3. if *command* then *commands* *f1* or
if *command* then *commands* elif *command* then
commands *f1* or
if *command* then *commands* else *commands* *f1*
4. case *word* in *pattern1*) *commands* ;; . . . *patternN*)
commands ;; esac
5. shellfunction() { *commands* }

Listing 1: A partial file-management application showing the use of the Unix shell's built-in commands for looping and control-flow logic.

```
if [ $# = 0 ]
then
echo "$0: No options supplied!!"
exit 1
fi

getfile()
{
echo "$1\c"
read somefile
}

for i in $#
do
case $i in
-p)
getfile "Enter name of file to print:"
echo pr $somefile
;;
-d)
getfile "Enter name of file to delete:"
while [ 1 ]
do
echo "Are you sure you want to delete $somefile? \c"
read ans
case $ans in
y|Y|yes|YES)
rm $somefile
break
;;
n|N|no|NO)
echo NOT rming $somefile
break
;;
*)
esac
done

;;

# put other cases here

*)
echo "$0: Error processing arguments"
exit 1
;;
esac
done
```

Table 2: Special built-in shell commands.

:	Sets a zero exit status—the null command.
. <i>file</i>	Allows named file to be executed by the current active shell as a subroutine.
break	Breaks out of a for or while loop.
continue	Jumps to the end of a for or while loop and continues to the next iteration.
cd	Changes the directory of the process being executed.
eval	Allows you to execute input data as a command.
exec	Causes another program to overlay the current script.
exit	Terminates a shell script with an explicit exit status.
export	Allows you to transport named variables to the environment of commands that the current shell is executing.
read	Reads data from the standard input into named variables.
readonly	Allows you to treat named variables as constants.
set	Used to configure the current state of the shell. Also used to set positional parameters explicitly rather than having them as explicit arguments to the script/shell.
shift	Causes \$1 to take on the value of \$2, \$2 to take on \$3, and so on.
test (or [<i>expr</i>])	Used in testing expressions and setting an exit status for various logic-branching constructs.
trap	Allows the shell or script that set the trap to execute a specified compound command upon receipt of specified interrupt signals.
ulimit	Sets or queries the maximum file and/or pipe size.
umask	Provides a mechanism to communicate to Unix default file-protection bits so that you don't mistakenly create security problems.
wait	Waits for "child" processes that have run in the background to terminate.

- `?` matches a single character in a filename;
- `[char-list]` matches a specified list or range of characters; and
- `![char-list]` matches any characters *not* in the specified list or range.

Here's what happens when you use the `echo` command to demonstrate an incomplete list of permutations using these metacharacters:

- `$ echo *` outputs all the filenames in the current directory;
- `$ echo *.c` outputs all the `.c` files in the current directory;

Two other popular shells are the C-shell and the Korn shell. Both these alternatives to the Bourne shell offer benefits.

- `$ echo ex*.c` outputs all the `.c` files in the current directory with names beginning with `ex`;
- `$ echo f?` outputs all files beginning with the letter `f` and followed by any one character; and
- `$ echo [a-m]*` outputs all files beginning with a letter from `a` through `m`.

Once the files that match the desired pattern are found, the matches for the wild-card argument are sorted and become replacements for the word in the argument list.

Another type of processing that occurs as the shell generates arguments is called quotation deciphering. This occurs at five levels.

1. No quoting, which performs variable substitutions and wild-carding as necessary; for example, if you enter `echo The value of PATH`, the response will be `The value of PATH`.
2. `'expr'`, where the shell picks up the single-quoted string literal and won't perform any variable substitutions or wild-carding; for example, the input `echo '*'` will produce the output `*`, and `echo 'The value of PATH is $PATH'` will result in `The value of PATH is $PATH`.
3. `\one-char`, which quotes the character following the `\` without expansion; for example, `echo The value of $PATH is $PATH` produces `The value of $PATH is :/bin:/usr/bin`.
4. `"expr"`, which performs variable and command substitution; for example, entering `echo "The value of PATH is $PATH"` results in `The value of PATH is :/bin:/usr/bin`.
5. `'command-expr'`, which executes the command and replaces the argument with the command's standard output (called *command redirection*); for example, if you enter `echo "The value of PATH is $PATH" > /tmp/tst` followed by `echo 'cat /tmp/tst'`, then the output will be `The value of PATH is :/bin:/usr/bin`.

Shortcomings

The Unix shell is an interpreter, and as such, it has both advantages and disadvantages. On the minus side, shell scripts typi-

cally don't execute very quickly. In addition, they are text files and must be distributed in source code form.

Because scripts are simple text files, you can't use them to provide or enforce the security mechanisms available under Unix (see "Safe and Secure?" by Patrick Wood, May BYTE). Security is a capability available only by first activating an executable binary file that has the `setuid` bit set. Another such bit, the `sticky` bit, which is used to enhance system performance, is not an option with shell scripts either.

There are shell script translators that circumvent these shortcomings by rendering C source code from the shell script. You can compile this program to produce a fast and secure binary object file without rewriting your shell script prototype.

A Shell Collection

The Bourne shell is not the only shell available under Unix. Two other popular shells are the C-shell (`csh`) and the Korn shell (`ksh`). Both these alternatives offer several benefits that will appeal to users.

With `csh`, which was originally developed under the Berkeley Standard Distribution derivative of Unix, you have the ability to obtain a "history" of previously executed commands and review them and also the ability to re-execute and/or edit commands or their arguments from the history. The BSD prompt is `%`.

The Korn shell (a superset of the Bourne shell developed at AT&T) supports history and editing in a way that is similar in concept but different in implementation. The Korn shell uses the `termcaps` database to allow scrolling through the command history in a terminal-independent manner. Also, editing newly entered commands or commands that already exist in the `ksh` history can assume a `vi` or `emacs` (two popular line editors) mode. (The default Korn prompt is `$`.)

Besides the interactive benefits of `csh` and `ksh`, their general makeup is similar to that of the Bourne shell. They all have loops, logic constructs, variables, and so on. However, their grammars vary slightly. Both `csh` and `ksh` support arrays. They also support arithmetic capabilities; however, `ksh` is superior in this respect.

Job control is one of several other features that the Bourne shell doesn't support. Using job control in an interactive shell, you can control the execution of background processes, including termination, temporary halting, and background-foreground switching. This is useful if you want to create your own batch-processing environment.

Shelling the Future

Unix shells have begun their migration into the MS-DOS world. For instance, MKS (Mortice Kern Systems) of Canada has been providing a Korn shell for the past few years with reasonable AT&T Korn-shell compatibility. In addition, Comeau Computing offers CCsh for MS-DOS.

Migrations of these and other tools to OS/2 should occur in the near future. These tools provide one stepping-stone into an era of open systems and connectivity. ■

BIBLIOGRAPHY

- Kochan, Steven, and Patrick Wood. *Unix Shell Programming*. Indianapolis, IN: Sams/Hayden Books, 1987.
- Unix System V User's Manual*. AT&T, 1988.

Greg Comeau is CEO of Comeau Computing, an independent software development and consulting firm specializing in programming tools and training for the Unix, C, and C++ marketplace. He can be reached on BIX as "comeau."

Top Performers.



H.I.M.S. 386SX/16 MHz

- INTEL 80386SX MICROPROCESSOR RUNNING AT 16 MHz
- SOCKET FOR 16 MBH 80387SX MATH COPROCESSOR
- 5.25" 1.2 MB OR 3.5" 1.44 MB DISKETTE DRIVE
- DUAL DISKETTE AND HARD DISK DRIVE CONTROLLER (1:1 INTERLEAVE)
- 1 MB 80 NS MEMORY (OR 2 MB, 4 MB EXPANDABLE TO 16 MB)
- 40 MB HARD DISK 38 MS, 800 KB DATA TRANSFER RATE
- HI-SPEED 2 SERIAL PORT(S), 1 PARALLEL PORT
- 101 ENHANCED TACTILE "CLICK" TOUCH KEYBOARD
- 200 WATT SWITCHING POWER SUPPLY
- 8 EXPANSION SLOTS (2x FAST SLOTS/6 BIT, 1x 8BIT, 5= 16 BIT)
- HI-PERFORMANCE 16-BIT VGA CARD (800 x 600) OR OPTIONAL (1024 x 768)
- 6 LAYER H.I.M.S. (U.S.A.) MOTHER BOARD
- LATEST AMI 386 BIOS (BUILT-IN DIAGNOSTICS, SETUP, AND HARD DISK FORMATTING UTILITY SOFTWARE)
- 10 YEAR BATTERY WITH CLOCK CALENDAR
- DISK CACHE AND EMS UTILITY SOFTWARE
- H.I.M.S. SMALL FOOT PRINT, 4 BAYS CASE

\$1895

HEAVY FRAME IMAGE 16 MHz WITH NO MONITOR

HARD DISK DRIVE	1 MB	2 MB	4 MB
160 MB 22 MS (FORMED BTL)	1995	2150	2395
160 MB 22 MS (FORMED BTL)	2195	2375	2595
120 MB 28 MS ESDI 1 MB DTR.	2050	2785	3050



H.I.M.S. PAGE MODE SERIES 16 AND 20 MHz 386

- INTEL 80386 MICROPROCESSOR RUNNING AT 16 MHz (OR 20 MHz)
- SOCKET FOR 20 MHz INTEL 80387 OR 20 MHz WEITEK 3167 MATH COPROCESSOR
- 5.25" 1.2 MB OR 3.5" 1.44 MB DISKETTE DRIVE
- DUAL DISKETTE AND HARD DISK DRIVE CONTROLLER (1:1 INTERLEAVE)
- 1 MB OR (4 MB OPTIONAL) 80 NS PAGE MODE MEMORY
- 66 MB 23 MS HARD DISK 800 KB DATA TRANSFER RATE
- HI-SPEED 2 SERIAL PORT(S), 1 PARALLEL PORT
- 101 ENHANCED TACTILE "CLICK" TOUCH KEYBOARD
- 230 WATT POWER SUPPLY (110/220) FCC, UL, CSA, TUV APPROVED
- 8 EXPANSION SLOTS (2x 32/16 BIT, 1x 8-BIT, 6x 16-BIT)
- HI-PERFORMANCE 16-BIT VGA CARD (800 x 600) OR OPTIONAL (1024 x 768)
- 6 LAYER H.I.M.S. (U.S.A.) MOTHER BOARD
- LATEST AMI 386 BIOS (BUILT-IN DIAGNOSTICS, SETUP, AND HARD DISK FORMATTING UTILITY SOFTWARE)
- 10 YEAR BATTERY WITH CLOCK CALENDAR
- DISK CACHE AND EMS UTILITY SOFTWARE
- 5-BAY STURDY DESKTOP CASE (0.6 BAY VERTICAL CASE OPTIONAL)
- FCC CLASS B ON TOWER & DESKTOP

\$2395 ADD \$150 FOR 20 MHz

HEAVY FRAME IMAGE 20/16 MHz WITH NO MONITOR

HARD DISK DRIVE	1 MB	4 MB
160 MB 22 MS 800 KB BTL	2395	2895
120 MB 28 MS 1 MB DTR. ESDI	2750	3250
160 MB 16 MS 1 MB DTR. ESDI	3095	3595
200 MB ESDI 14 MS 1 MB DTR.	3950	4450



H.I.M.S. PROFESSIONAL SERIES CACHE PRO 386 20, 25 AND 33 MHz

- INTEL 80386 MICROPROCESSOR RUNNING AT 20 MHz (OR 25 AND 33 MHz OPTIONAL)
- SOCKET FOR 80387 OR WEITEK 3167 MATH CO-PROCESSOR
- 64 K 25 NS CACHE UPGRADABLE TO 256 K, READ AND WRITE CACHE WITH WRITE BACK CACHE
- PAGE MODE MEMORY ARCHITECTURE
- 1 MB 80 NS MEMORY UPGRADABLE TO 2, 4, 8 MB ON MOTHER BOARD, 16 MB WITH 32-BIT MEMORY CARD
- 5.25" 1.2 MB OR 3.5" 1.44 MB DISKETTE DRIVE
- DUAL DISKETTE AND HARD DISK DRIVE CONTROLLER, 1:1 INTERLEAVE
- HI-SPEED, 2 SERIAL, 1 PARALLEL PORT
- 250 WATT HEAVY DUTY POWER SUPPLY
- 101 ENHANCED TACTILE "CLICK" TOUCH KEYBOARD
- 8 EXPANSION SLOTS (1x 32 BIT, 1x 8 BIT, 6x 16 BIT)
- LATEST AMI 386 BIOS (BUILT-IN DIAGNOSTICS, SETUP, AND HARD DISK FORMATTING UTILITY SOFTWARE)
- HIGH PERFORMANCE 16-BIT VGA CARD (800 X 600) OR OPTIONAL (1024 X 768)
- 6 LAYER H.I.M.S. 64256 CACHE MOTHER BOARD
- 66 MB 23 MS HARD DISK 800KB DATA TRANSFER RATE
- 6 BAY VERTICAL OR 5 BAY DESKTOP CHASSIS (SUPER VERTICAL CLASS B ON DESKTOP OR TOWER)
- 100 CLASS B ON DESKTOP OR TOWER
- DISK CACHE, EMS UTILITY SOFTWARE

**20 MHz \$2695 • 25 MHz ADD \$495
33 MHz ADD \$1295**

CACHE PRO 386/25 MHz WITH NO MONITOR

HARD DISK DRIVE	1 MB	4 MB
160 MB 22 MS 800 KB BTL	2950	3495
120 MB (ESDI) 28 MS 1 MB DTR.	3350	3895
160 MB (ESDI) 16 MS 1 MB DTR.	3695	4450
200 MB (ESDI) 14 MS 1 MB DTR.	4550	5150

COMPANY

H.I.M.S. TECHNOLOGIES has been manufacturing hi-performance computers in California under private label for a number of years, and now H.I.M.S. is manufacturing under its own label the same hi-performance computers. 286, 386SX, 386 Page Mode and Cache 386 to satisfy your needs in price, performance and after the sale service, which seems to be a missing feature with most of our competitors. Just compare our competition and you will find the obvious, then add our One Year On-Site Service at no extra cost ... SURPRISE!

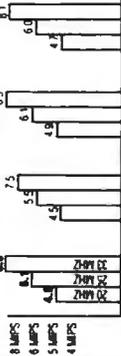
PRODUCT

H.I.M.S. manufactures a complete breadth of 286, 386SX, Page Mode 386 and Cache 386 systems. H.I.M.S. is the only company currently supplying the industry with 386 Cache Pro in vertical, super vertical or desktop with FCC Class "B" approval. How about our 256K Write Back Cache Design at down to earth pricing? You can actually afford the high speed luxury! All the H.I.M.S. Systems can be custom configured to fit your needs, so call our expert sales executives to discuss your specifications. All H.I.M.S. Systems come assembled, tested and burned-in from the Factory for 72 hours at 60 Centigrade. The Hard Disk is pre-compiled and formatted. H.I.M.S. carries a wide variety of options like Video Cards for CAD/CAM and desktop publishing, printers, monitor's 14" to 25", Opto magnetic drives, math coprocessors, plotters, pointing devices and software.

SERVICE

All H.I.M.S. computers come with a One-Year On-Site Service included. This gives you an immediate back-up just in case a problem may arise a technician can be in your location within 4 to 8 hours from our 414 service locations, including Puerto Rico and Canada. All products are made in the U.S.A.!!

H.I.M.S. TECHNOLOGIES is the Price, Performance and after sales service leader in the Fast Group.



800-367-2924

H.I.M.S. TECHNOLOGIES

368 Montague Expressway • Milpitas, CA 95035

Phone: (408) 946-9711 • FAX: (408) 946-9744

IBM, COMPAQ, ALR, EVEREX, UNIX, XENIX, NOVELL ARE TRADEMARKS OF THEIR RESPECTIVE COMPANIES.

Circle 130 on Reader Service Card

Rock Solid. H.I.M.S.

LAPTOP TECHNOLOGY REDUX

Major innovations in small peripheral devices increase the laptop's utility

While some engineers work to make computers bigger, faster, and more powerful, others are striving to make them more portable. In June, at a trade show called Portable Computing '89, I got a look at some of the most interesting new technological developments in laptop computing. By the way, I wrote this installment of Under the Hood almost entirely on a laptop.

Display Technology: Color on the Horizon

Laptop displays used to be small and difficult to read. Nowadays, virtually every model has a high-contrast supertwist display, and most have backlighting. Resolutions range from those of the IBM CGA (many machines) to monochrome VGA (Compaq's SLT and a few others), but none, so far, have had color.

This will soon change, however. Sharp Electronics is now demonstrating the PC-8000, a portable computer with a 20-MHz 80386, a 40-megabyte hard disk drive, and a VGA-compatible 640- by 480-pixel LCD color screen. The screen, which will also be sold as a component to other manufacturers, is capable of showing 512 distinct colors. The colored areas are arranged in stripes (similar to the way the phosphors are arranged on the surface of a Sony Trinitron TV tube), and the resolution is eight lines per millimeter. (Since it takes three lines—one of each color—to make a single pixel, the effective dot pitch is on the order of 0.375 mm—not much greater than that of a good CRT.)

The PC-8000's display uses double-layer supertwist nematic (D-STN or DST) liquid-crystal technology (see figure 1). As the name implies, the display has two layers of liquid-crystal material. The rear layer, called the "driven" layer, does most of the work: It contains the active cells that control the opacity of each pixel. But if this were the only layer, a phenomenon called the *birefringence effect* would cause the color of the light passing through the cells to be distorted, particularly when the cells were only partially opaque.

The second layer, which is always transparent and doesn't have electrodes, contains more liquid-crystal material and is oriented so as to neutralize the color-distorting effects of the first. The result is an array of pixels that appear to change from nearly complete opacity to a neutral gray to clear without significant color distortion.

The image on Sharp's DST display isn't very legible without a backlight. Sharp uses a "hot cathode" fluorescent tube to provide illumination. Unfortunately, this means that machines using this technology will require significant amounts of power; they probably won't run off batteries, at least at first.

A Big Blue Rising Sun

Toshiba and IBM are also working on an impressive flat-panel color display technology. The two companies have been showing off a 9- by 11-inch color LCD screen that uses active matrix technology (see figure 2). The IBM/Toshiba color display is one of the highest-resolution LCD screens developed to date. Each pixel of the display consists of four separate cells or dots (red, green, blue, and white) instead of the usual three, allowing a total of 16 (2⁴) possible colors. The white cell helps the display to achieve high contrast without markedly increasing the size of the pixels. The cells are controlled by thin-film transistors (TFTs) made of amorphous silicon, and

they can switch on and off at a rate of 60 Hz, making large, flat-panel TVs possible. The dot pitch of the display is 0.40 mm—again, not much bigger than a pixel on a good CRT.

The display is backlit by a fluorescent tube; the light passes through a polarizing filter and then through the liquid-crystal cells, which can change the angle of polarization of the light, depending on whether the associated transistor is on or off. Finally, the light reaches the front polarizer, which allows it to pass only if it has not been "twisted" by the liquid-crystal material.

Amorphous semiconductors are a relatively new technology, first used in solar cells and nonvolatile memories. They aren't always as efficient as crystalline semiconductors, but they're easier to produce in bulk. This makes them an excellent choice for large displays, where yield is more important than efficiency.

Limiting the number of colors to 16 (each cell fully on or fully off) helps to mask differences in the gains of the individual TFTs. But engineers are working on ways to ensure enough uniformity among the 1.5 million transistors of the display to allow a wider range of colors.

This is the best current technology, but it's expensive and difficult to produce in quantity: There are four transistors in each of the 375,000 pixels, and every one of these transistors has to work for the display to pass muster.

People who see the IBM/Toshiba display are often tempted to reach around the back to assure themselves that it's really not a CRT. Alas, it may be a year or two before the technology demonstrated in this display is commercially available. In the meantime, Toshiba and Zenith—like Sharp—are showing laptops based on more conventional LCD technology. So is Mitsubishi, although its offerings will initially be available only in Japan. There's no telling who will be first to market, but it's clear that

continued

within a year there will be lots of color laptops to choose from.

Small Drives, Large Capacities

Laptops now have at least as many storage options as desktop models have. Compact 3½-inch hard disk drives that weigh less than floppy disk drives are

available from Conner Peripherals and other companies, and 2½-inch hard disk drives are now in systems like the new Agilis (see "The Ever-Shrinking, Ever-Expanding Laptops," August BYTE).

Many manufacturers, however, are opting to make their machines smaller and lighter by providing nonvolatile

RAM disks instead. The 4¾-pound NEC UltraLite has a 1-megabyte or 2-megabyte RAM disk with a separate battery that keeps it alive even when the main battery runs out. (It also uses ROM cartridges to hold some programs.) The Toshiba T1000 weighs in at 6½ pounds and has an optional 760K-byte nonvolatile

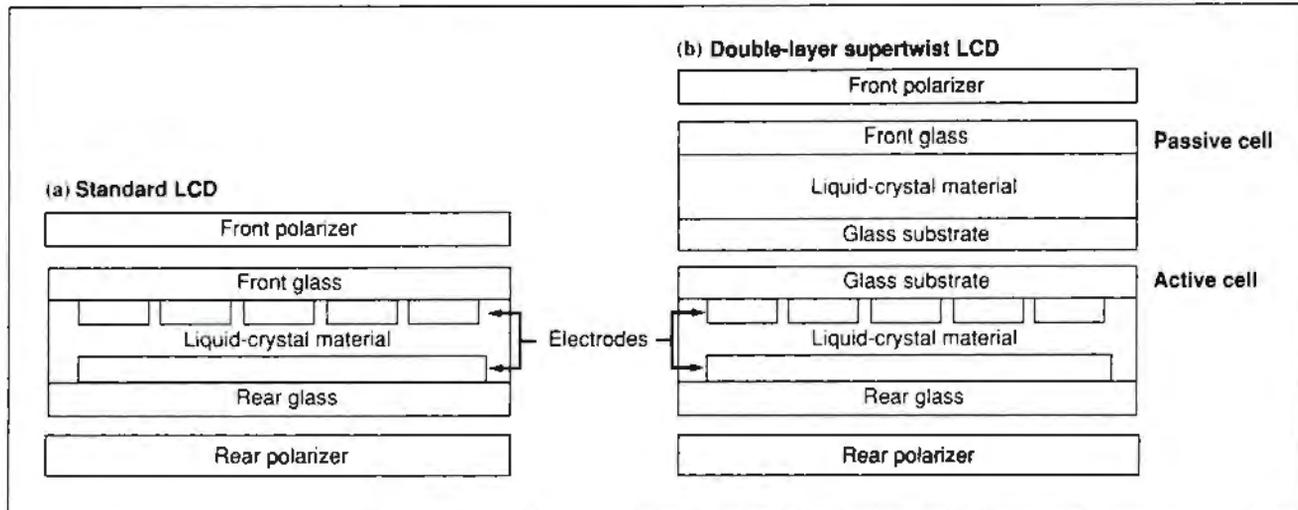


Figure 1: The major difference between the standard LCD (a) and the double-layer supertwist (DST) display (b) is the addition of a passive liquid-crystal layer in front of the active LCD layer. The additional layer reduces color distortion.

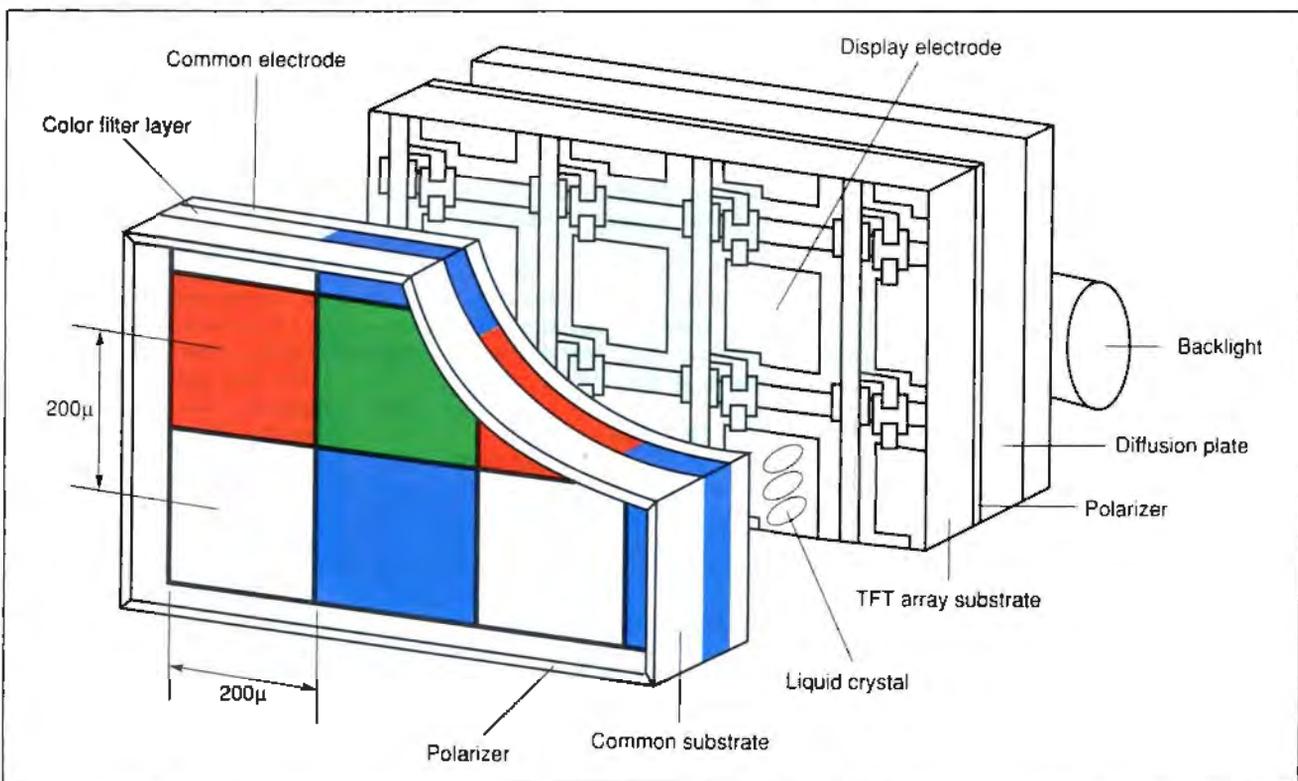


Figure 2: IBM and Toshiba are jointly developing a high-resolution color LCD screen. The 14-inch display contains 1.5 million color dots. Four dots (red, green, blue, and white) combine to form a single pixel. Since a dot is either completely on or completely off, there are 16 possible colors.

RAM disk.

Even more interesting and capacious are the new high-capacity floppy disk drives on the way from Insite Peripherals and Brier Technology. To understand how these drives manage to store 20 megabytes or more on an ordinary floppy disk, you must first know that the storage capacity of flexible media is normally limited by two factors: the maximum density of the bits on each track and the accuracy with which you can position the head. Insite Peripherals and Brier Technology have taken different approaches to the same problem: replacing the "open-loop" stepper motors of conven-

tional floppy disk drives with more accurate positioning systems that can accommodate irregularities and eccentricities in the disk. They also use run-length-limited (RLL) encoding (see the February Under the Hood) to increase the bit density.

Insite's Floptical drives use standard 3½-inch floppy disks with special laser markings etched into their surfaces (see figure 3). Light from an infrared LED is focused on the disk; an optical servo system dubbed *diamond tracking*, very much like the one used in compact disks, follows the markings. The very precise

continued

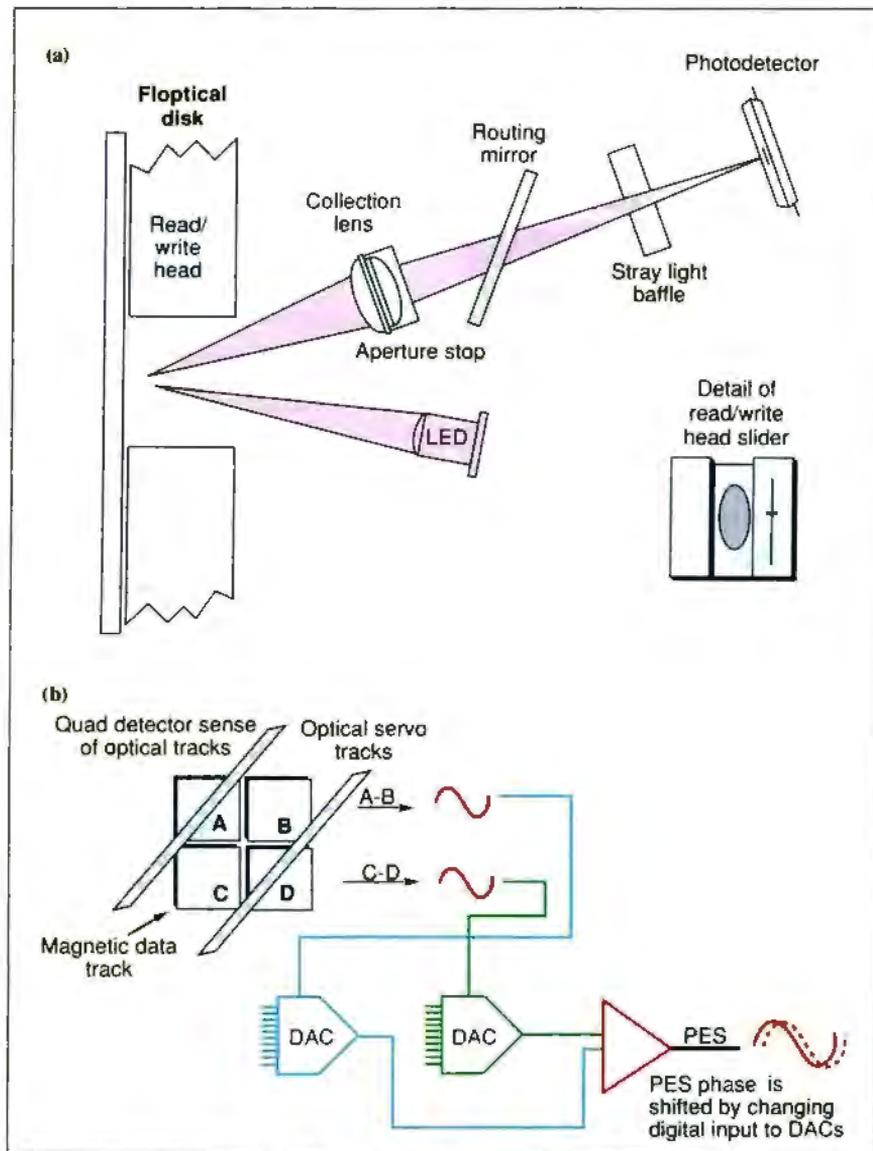


Figure 3: (a) The Floptical disk technology increases data density by using an optical track to generate precise tracking of the read/write head. (b) Alignment of the head to optical servo tracks is accomplished with a Phase Error Signal shift technique using multiple digital analog converters.

The No. 1 disassembler in Japan...



is made in the U.S.A.

DASM® has dazzled the computer-savvy Japanese with its fully symbolic disassembler: typically 98%+ in the interactive mode; 90%+ in default mode. Now we'd like to show American corporate programmers why we're No. 1 in Japan. For a free brochure, or better yet, to place your order direct, just call 1-800-437-5200 ext. 300. The price? \$250.00 or 32,000¥.



Jb
Software

Takes as input: 80286 and below EXE, COM & BIN files up to ≈ 200K. Needs: MSDOS vs 2.0+; 150K user memory; one 5¼" disk drive.

positioning obtained in this way allows the tracks to be packed much closer together than they can be on a standard floppy disk drive. The track density of the Floptical media is 1250 tracks per inch; a standard floppy disk, by comparison, has 45 to 135 tpi. The Floptical's bit density is 24,145 bits per inch (bpi).

Brier's Flextra drives use special two-layer magnetic media and a servo technique called T³, for Twin Tier Tracking (see figure 4). An embedded, unerasable

magnetic layer deep below the surface contains servo information, while the upper layer carries the data.

In addition to the special servo technique, Brier also uses *multizone recording* to fit more data on the disk. The disk is divided into three ring-shaped zones; tracks in the outer zone contain 48 sectors, those in the middle 40, and those on the inside only 32. Most conventional disk drives store the same amount of data on each track; this means that the total

capacity of the disk is limited by the capacity of the innermost (and shortest) track. Changing the number of sectors per track lets Brier exploit the additional circumference of the outer tracks. The rated bit density of the Brier drives is 26,000 bpi. The track density is 777 tpi for the two lower-priced models, and 1555 tpi for the more expensive one. (Insite's literature makes a conflicting claim that the maximum track density for a magnetic system is less than 1000 tpi.) Brier's intermediate model can also read—but not write to—IBM-compatible 3½-inch disks.

Insite's drive has a formatted capacity rating of 20.8 megabytes and an average seek time of 65 milliseconds. Brier's specs are better: The high-end model boasts a formatted capacity of 43.2 megabytes, with an average track-to-track seek time of 29 ms. (The higher capacity is probably due to the multizone recording technique, while the higher speed is most likely due to smaller head size and weight.)

Insite's media can be made from standard 3½-inch floppy disks by a special machine that Insite plans to sell to third parties. Brier's disks, on the other hand, must be specially manufactured. Therefore, Floptical disks (which are expected to sell for \$10) will probably be about half the price of Brier's media.

Both drives use SCSI interfaces, so they should be compatible with a wide variety of machines. Both also weigh around 2 pounds, so either one should be able to fit into a laptop without imposing an excessive weight penalty.

Peripheral Issues

Finding peripherals that will work with a particular brand of laptop can be a problem. Some of the larger laptops and luggage have IBM ISA-compatible slots, but few small, battery-powered units do. Some machines can be fitted with an expansion chassis, but since these are low-volume items, they're generally quite expensive—and they're hard to take on the road. And when a manufacturer does provide an expansion bus, chances are it's a unique design. (So far, only Yamaha has designed its laptops to use a connector that's compatible with another machine's—in this case, the Toshiba T1100+'s). Slot configurations even differ among different units from the same manufacturer; my T1000, for instance, won't take expansion cards that fit the rest of the Toshiba line.

All this incompatibility hurts laptop users by keeping peripheral prices high.

continued

8051 68HC11
THE LEADING IN-CIRCUIT EMULATOR TECHNOLOGY.

See us at
Systems 89, Munich
Hall 014,
Stand D02

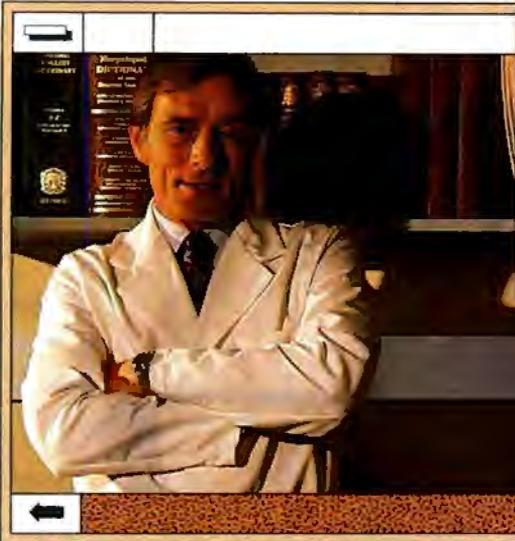
Nohau EMUL-PC,
the PC based in-
circuit emulators
which find bugs
other emulators
can't.

- Very easy to learn and use.
- Source Level Debugging in C or PL/M.
- 48 bits wide 16K deep trace buffer.
- Complete 8051 family and 68HC11 family support.

CALL TODAY
FOR YOUR
FREE VIDEO
AND SOFT-
WARE DEMO
(408) 866-1820.

NOHAU
Nohau Corporation
51 E. Campbell Ave
Campbell, CA 95008
Tel: (408) 866-1820
Fax: (408) 378-7869

Australia (02) 654 1873, Austria (0222) 38 76 38, Benelux +31 1858-16133, Denmark (02) 65 81 11, Finland 90-452 1255, France (01)-69 412 801, Great Britain 0962-73 31 40, Israel (03) 48 48 32, Italy (011) 771 00 10, Korea (02) 784 784 1, New Zealand (09) 392-464, Portugal (01) 83 56 70, Sweden, Norway (040) 92 24 25, Singapore 065 743-2086, Spain (93) 217 2340, Switzerland (01) 740 41 05, Taiwan (02) 7640215, West Germany 01831-1687, USA FAX (408) 378-7869.



**"It's a simple formula.
The more power under the
hood, the faster you go. Well,
I just found a 386 PC with a
Ferrari engine."**

ZENITH INNOVATES AGAIN™

Racing at 8.2 MIPS,* Zenith shatters the 33MHz speed barrier with one of the fastest Intel386™ workstations ever built.

Even after you see it, you still might not believe that any 386/33 workstation can deliver such unprecedented speed and reliability as Zenith Data Systems' Z-386/33. But it's true.

Up to 30% faster than many 25MHz desktops, Zenith's Z-386/33 even exceeds the limits of other 33MHz systems. In fact, its super-fast processor, disk and memory subsystems give you uncompromising performance. So you can blaze through the most demanding scientific, engineering and manufacturing applications at an almost unheard of 8.2 MIPS.

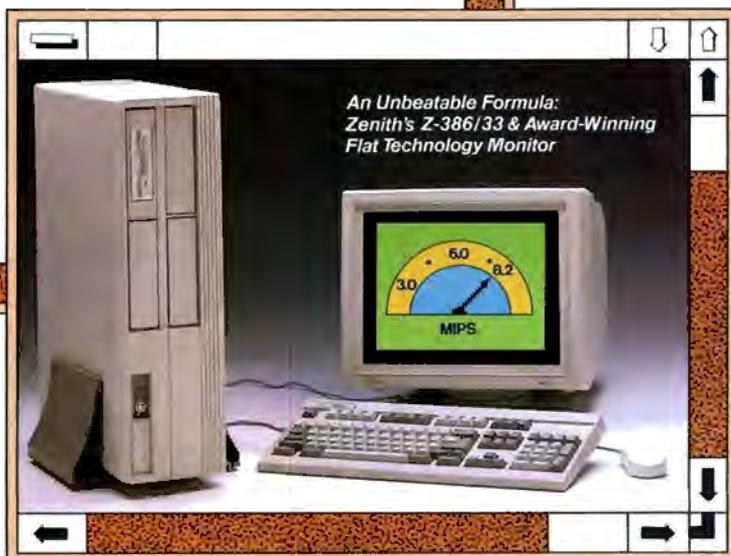
For those who need 25MHz power, there's the Zenith Z-386/25. It, too, gives you high-powered file serving, CAD/CAM/CAE, multi-tasking and multi-user capabilities. And each lets you take advantage of thousands of industry standard peripherals as well as such advanced operating environments as MS OS/2® and SCO™ Xenix®.

Both 32-bit powerhouse workstations also let you add hard drives and up to 64MB of memory to keep pace with your growing needs. Plus, they come standard with MS-DOS®. And all hard drive models even include Microsoft® Windows/386.

So if you need a faster workstation—or the *fastest*—shift into overdrive with Zenith's Z-386/25 or Z-386/33 today. For the name of your nearest Zenith Data Systems authorized dealer, call: **1-800-553-0350.**

ZENITH | data systems

THE QUALITY GOES IN BEFORE THE NAME GOES ON®



Graphics simulate Microsoft® Windows, a product and trademark of Microsoft Corporation. MS-DOS, MS OS/2, Microsoft Windows/386 and Xenix are registered trademarks of Microsoft Corporation. SCO is a trademark of The Santa Cruz Operation, Inc. Intel386 is a trademark of Intel Corporation.

*Source: Power Meter™ V1.5, The Database Group, Inc., Upland, CA. MIPS: Millions of Instructions Per Second.

© 1989, Zenith Data Systems

IEEE 488

Interfaces & Software

Hardware

IEEE interfaces for PC, AT, 386, PS/2, Macintosh, HP, SUN & DEC. Converters from IEEE to RS-232, RS-422, modem, Centronics, SCSI, digital I/O and analog I/O. IEEE extenders, expanders & buffers.

Software

IEEE device drivers for DOS, UNIX, Macintosh & SUN. Drivers for Lotus 1-2-3 & Symphony. Macintosh IEEE desk accessory. PC menu-driven analysis.

Support

Free applications support. 30 day money-back guarantee. Two year warranty. IEEE seminars available.

Call for your FREE
Technical GuideDemo disks & application
notes available


(216) 439-4091

Telex 6502820864 • Fax (216) 439-4093
Hitech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146
London (0121) 961287 • Paris (11) 84 03 78 • Milan (02) 41 23 161
Brussels (02) 3488402 • Linköping (013) 110940 • Helsinki (09) 521 528
Munich (089) 790020 • Zurich (01) 8219454 • Vienna (0222) 254626
Copenhagen (01) 8303533 • Oslo (02) 490711 • Copenhagen (02) 945209
Madrid (91) 4027068 • Lisbon (01) 4101 820
Melbourne (03) 5793622 • Toronto (416) 6744444



COMPANY INFORMATION

Brier Technology
(Flextra disk drive)
2363 Bering Dr.
San Jose, CA 95131
(408) 435-8463
Inquiry 1081.

Holmes Microsystems
(PFIDO)
2620 South 900 West
Salt Lake City, UT 84119
(801) 975-9929
Inquiry 1082.

IBM
(Forthcoming IBM/Toshiba high-resolution color LCD screen)
Research Division
P.O. Box 218
Yorktown Heights, NY 10598
(914) 945-3037
Inquiry 1084.

Insite Peripherals
(Floptical disk drive)
2363 Calle del Mundo
Santa Clara, CA 95054
(408) 946-8080
Inquiry 1083.

Sharp Electronics Corp.
(PC-8000, JX-100 Handheld Color Scanner)
Sharp Plaza
Mahwah, NJ 07430
(201) 529-9500
Inquiry 1085.

Toshiba America, Inc.
(Forthcoming IBM/Toshiba high-resolution color LCD screen, T1000, T1000+)
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
Inquiry 1086.

Xircom
(Pocket Ethernet adapter)
22231 Mulholland Hwy., Suite 114
Woodland Hills, CA 91364
(818) 884-8755
Inquiry 1087.

What's really called for is a standard laptop bus—something like Hewlett-Packard's HP Interface Loop, which was developed for HP's calculators. Until the industry agrees on such an interface, however, peripheral makers will be forced to find clever ways to connect peripherals using existing ports.

One such peripheral is Xircom's Pocket Ethernet adapter. This device,

which attaches to a laptop's parallel port, lets you hook into an Ethernet-based LAN. You can do everything you can do on any other network station, including uploading and downloading data and executing programs. While some software (e.g., LapLink) lets you do the same thing, nothing can quite compare with the convenience of having the resources

continued

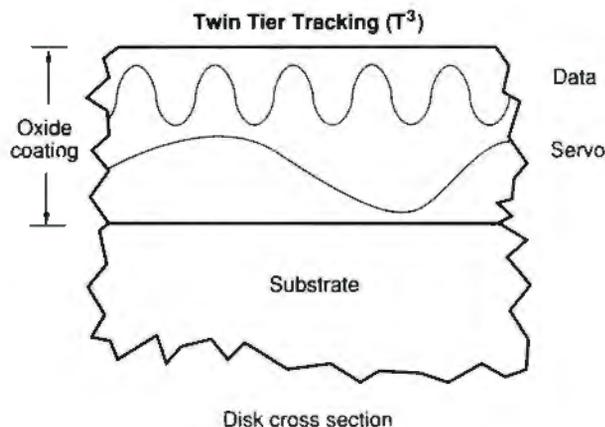


Figure 4: Brier's T^3 (Twin Tier Tracking) Servo System uses two layers of magnetic information. The deeper layer is permanent and provides the tracking information.

Our Swans make waves.

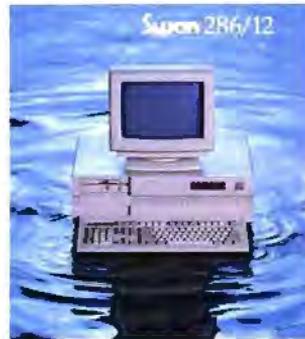
You're looking at a flock of Swans that are making waves in the computer industry. Waves that have many competitors running for safer ground. Don't let their low price fool you. Compatibility, reliability, performance and unsurpassed customer satisfaction have made Swan a bird of prey. No wonder. Just look at what Swan has to offer:

- 30-Day satisfaction guarantee
- Toll-free technical support
- Full one-year warranty
- Fast, sure delivery
- Sorbus® on-site service option

Capture a Swan and put it to work for you in your home or office. All Swan computers offer the top-rated Phoenix ROM BIOS to assure 100% compatibility. Just plug it in — and take off.

Standard Features	XT10	286/12	386SX	386/20D
CPU	8088-1	80286	80386SX	80386
Speed (MHz)	10/4.77	12/6	16/8	20/8
BIOS	Phoenix	Phoenix	Phoenix	Phoenix
Norton SI Rating v 4.0	2.1	11.2	17.6	22.0
Standard Memory	640K	512K	1MB	1MB
Shadow BIOS	—	—	Yes	384K
Memory Upgrades	—	1MB	2/3/5/6/8MB	2/4/8/10/16MB
Coprocessor Support	8087	80287	80387SX	80287 or 80387
Expansion Slots: 32-bit	—	—	—	1
Expansion Slots: 16-bit	—	6	6	4
Expansion Slots: 8-bit	8	2	2	3
Dual HD/FD Controller	w/HD systems	Yes	Yes	Yes
Device Bays (Expanded/Internal)	2 Exp./2 Int.	3 Exp./2 Int.	3 Exp./1 Int.	3 Exp./2 Int.
Serial Ports	1	1	1	2
Additional I/O Ports	1 Par./1 Game	1 Parallel	1 Parallel	1 Parallel
Power Supply	150W	200W	200W	200W
Keyboard (Touch & Click or Silent)	101 Key	101 Key	101 Key	101 Key
Additional Features	Clock Calendar w/Battery Backup and Setup/Utilities Disk			
3.5" Floppy Drive	Optional	Your choice	Your choice	Your choice

MS-DOS & GW BASIC add \$89



When Add-Ons Begin to Add Up... Call Swan Toll-Free 1-800-468-9044

Swan brand name peripherals inherit all the quality and value you find in Swan computers. And Swan Technologies keeps good company ... with unsinkable values from the world's leading software and hardware manufacturers. Call us for our catalog of other great Swan values.



PRINTERS

1180 (192 cps, 80 col, 9-pin)	\$179
1191 (240cps, 80 col, 9-pin)	\$Call
1124 (192cps, 80 col, 24-pin)	\$Call
1582 (180cps, 132 col, 9-pin)	\$389
1595 (240cps, 132 col, 9-pin)	\$449
1524 (240cps, 132 col, 24-pin)	\$569
4450 (11ppm laser printer)	\$1375



LaserJet Series II	\$1749
• 8 ppm/512K	\$Call
LaserJet Series IID	\$Call

PC HARD DRIVES



KL320 20MB (40 ms) Bare/Kit*	\$219/\$259*
KL330 32MB (40 ms) Bare/Kit*	\$249/\$299*



ST-225 20MB (65 ms) Bare/Kit*	\$219/\$259*
ST-238 30MB (65 ms) Bare/Kit*	\$249/\$299*
ST-125 20MB (40 ms) Bare/Kit*	\$249/\$299*
ST-151 40MB (24 ms)	\$439
ST-157R 48MB (28 ms)	\$349
ST-251-1 40MB (28 ms)	\$439
ST-4096 80MB (28 ms)	\$599

*Kit Price - includes cables, controller and mounting screws.

To order: No surcharge on Discover, Visa, MasterCard or AMEX
 • Your credit card is not charged until your order is shipped
 Shipping: 1% or \$5 minimum for UPS Ground. Call for shipping charges on Express Air, APO, FPO, AK, HI and all foreign orders
 • If part of your order is backordered, the remainder will be shipped UPS Ground. • Allow 2 weeks for personal and company checks to clear • ALL SALES ARE FINAL (except Swan products — items returned must be as new, without modification or damage. Sorry — shipping charges and upgrade fees are not refundable.) • Defective items replaced or repaired at our discretion. • PA deliveries add 6% sales tax. • Prices and terms subject to change without notice. Open: 9a.m.-11p.m. Mon-Fri., 10a.m.-8p.m. Sat., 12p.m.-8p.m. Sun.



Swan MODEMS

- Hayes® compatible • Auto answer/dial
 - Include PC Talk III software
- | | |
|-------------------|-------|
| 2400 bd internal* | \$99 |
| 1200 bd internal | \$69 |
| 2400 bd external | \$149 |
| 1200 bd external | \$89 |

* includes Bit Com v. 3.5 software

Swan VIDEO CARDS

- Switchable Card • Hercules® to CGA
 - Parallel Port
- | | |
|--------------------------------------|-------|
| EGA Card • EGA/CGA/ITL | \$169 |
| • 640 x 480 Resolution | \$169 |
| VGA Card • Register-level compatible | \$199 |
| • 256K RAM • 17 VGA Modes | \$199 |

SOFTWARE



Carbon Copy Plus from Meridian	\$112
dBase IV from Ashton-Tate	\$459
Deluxe Option Board from Central Point	\$109
Excel v 2.1 from Microsoft	\$Call
Fastback Plus from Fifth Generation	\$104
Lotus 123 v 2.01/3.0 from Lotus	\$299/\$Call
Norton Advanced Utilities from Norton	\$79
Paradox 3.0 from Borland	\$449
PC Tools Deluxe v 5.1 from Central Point	\$49
Q&A from Symantec	\$209
Turbo C Professional from Borland	\$159
Ventura Publisher from Xerox	\$Call
Windows 386 from Microsoft	\$129
WordPerfect 5.0 from Word Perfect	\$219

XT10	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	CGA	EGA	VGA
Single Floppy	\$699	\$869	\$1098	\$1198
Dual Floppies	\$779	\$949	\$1178	\$1278
*w/32MB (40ms) Hard Drive	\$979	\$1149	\$1378	\$1478
Base System, No Video — \$549				
286/12	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	EGA	VGA
w/32MB (40ms) & 1:1 Interleave	\$1399	\$1448	\$1798	\$1898
w/48MB (28ms) & 1:1 Interleave	\$1499	\$1548	\$1898	\$1998
w/80MB (28ms) & 1:1 Interleave	\$1849	\$1898	\$2248	\$2348
Base System, No Video — \$999				
386SX	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	VGA Mono	VGA Color
w/32MB (40ms) & 1:1 Interleave	\$1899	\$1948	\$2098	\$2398
w/48MB (28ms) & 1:1 Interleave	\$1999	\$2048	\$2198	\$2498
w/80MB (28ms) & 1:1 Interleave	\$2349	\$2398	\$2548	\$2848
w/167MB (18ms) ESDI w/1:1 Interleave	\$2994	\$3043	\$3193	\$3493
Base System, No Video — \$1499				
386/20D	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	VGA Mono	VGA Color
w/48MB (28ms) & 1:1 Interleave	\$2499	\$2548	\$2698	\$2998
w/80MB (28ms) & 1:1 Interleave	\$2849	\$2898	\$3048	\$3348
w/150MB (18ms) ESDI w/1:1 Interleave	\$3494	\$3543	\$3693	\$3993
Base System, No Video — \$1999				

* Includes Single 360K Floppy Drive

† Upgrade from 12" to 14" Flat Screen, add \$49

Call Toll-Free 1-800-468-9044 & Ask For Our Free Catalog



S=BT11

of an entire LAN at your disposal.

The Pocket Ethernet adapter comes in two varieties—one for thin Ethernet (cheapernet) and one with a standard communications connector. The unit is packaged with an IPX driver for Novell's NetWare. There are no NetBIOS or TCP/IP packages available at this writing, though with luck there may be by the time you read this.

A peek inside the Pocket Ethernet adapter reveals a standard National Semiconductor Ethernet chip and a custom application-specific IC that handles the interface to the serial port. Presumably, this same ASIC can be used to drive other chips for other types of networks; according to president Dirk Gates, Xircom is now working on a Pocket Token Ring adapter that will interface to a microcomputer in the same way.

Another very clever peripheral that should be available by press time is the PFIDO (Printer/Fax Input Device with Output) from Holmes Microsystems. This gadget weighs less than 4 pounds and measures only about 10 by 2¼ by 3 inches, yet it's a complete monochrome scanner and thermal printer in a single

unit. It attaches to the serial port of your laptop and is meant to work with an internal fax card on an NEC, Zenith, or high-end Toshiba portable. (Alas, there doesn't seem to be any provision for an external fax modem, so other portables—and my T1000—may not be able to use this device.)

Most of us have seen those little handheld scanners that scan a monochrome image into just about any machine through a serial port, but Sharp has come up with something even more useful: A miniature 4- by 6-inch color flatbed scanner. Dubbed the JX-100 Handheld Color Scanner, it does color separations using three filters and a single charge-coupled device sensor.

The output can be specified at 1, 2, 4, or 6 bits per pixel, and it runs off 12 volts, either from batteries or from an AC adapter. Combined with one of the new flat-panel color displays, this device should let you do serious color desktop publishing on the road.

Finally, the laptop industry has been abuzz lately with rumors about a patent dispute concerning—of all things—laptop computer hinges. GRiD Systems,

now owned by Tandy, patented certain key aspects of the hinges it used to make its original clamshell-style laptops. Tandy, now in control of the patent, is said to be approaching other laptop vendors and demanding that they pay license fees. It's not clear whether laptop prices will rise as a result, but the dispute, like many patent issues, bears watching.

As you can see from the variety of technological developments under way, there's no single direction in the laptop world. Still, there is a common thread: Makers of laptops and laptop peripherals are pushing their resources and ingenuity to the limit to make their products smaller, lighter, and more convenient to use. Even if you don't own a laptop, you can expect to reap the benefits of these efforts in future computer products. ■

L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

IMMEDIATE GRATIFICATION!

You need it *now*, not a month from now...
and you need it to be right.

**PROTOTYPES
DEMOS
TUTORIALS
PRESENTATIONS**

Proto

FINISH

PROTOTYPES • DEMOS • TUTORIALS • PRESENTATIONS

Screen design. Screen Capture. Music Module.
4th Generation Language.
Programmer's Utilities. \$299.95

(505)821-9425

800-777-1437

Requires IBM PC, PS/2, or compatible.



NEW FOR TURBO C PROGRAMMERS

Three Serious Tools

at a ridiculously low price.



Take advantage of this special introductory price. Reg. price \$179.00

The Working Toolbox Software Program comes complete with an extensive 310 page manual loaded with examples and a 30-day money back guarantee. This ridiculous price is good until October 1, 1989.

THE WORKING TOOLBOX

THE WORKING ISAM

- Stores data in B+ Trees
- Maximum of 256 indexes
- RAM buffers for high speed
- 6 types of indexes available
- Multi-field indexing
- All indexes stored in one file
- Automatic Recovery
- FREE SOURCE CODE

THE WORKING SCREEN PAINTER

- Friendly interactive environment
- Data entry and display
- Box & line drawing supported
- Multi color screens at a glance!
- SUPER FAST SCREENS
- Writes C source code ready to be compiled under any memory model

THE HANDY LIBRARY

- Great functions for easier programming and professional results
- Intelligent data entry and display
- Overlapping windows
- Pop Up. Pull down and bar menus with one function call!
- All memory models supported
- Date conversion functions

Don't waste any more time, order now! Special introductory price of \$79.99 plus S & H. Call (our toll-free number) or fax your order.

Be Aware Inc.

5197 N.W. 15th St., Suite 120, Margate, FL 33063

No Royalties! ORDER NOW ONLY \$79.99

1 800-423-1611 or 305-970-0372

or FAX 305-735-3459

Turbo C is a registered trademark of Borland International.

KAYPRO COMPUTERS

Rugged, Reliable, Reputable



KAYPRO XT

\$549

Base System with Single Floppy, No Video

XT Computer	Video Options (includes monitor & video adapter)		
	14" Flat Mono	True .31 Dot Pitch VGA	True .31 Dot Pitch VGA Plus
Dual Floppies	899	1399	1599
20 MB Hard Drive, single floppy	1150	1649	1849
30 MB Hard Drive, single floppy	1210	1699	1899



1MB RAM

KAYPRO 286/12

\$999

Base System with Single 1.2MB Floppy, No Video

286/12	Video Options (includes monitor & video adapter)		
	14" Flat Mono	True .31 Dot Pitch VGA	True .31 Dot Pitch VGA Plus
Disk Drive Options			
20MB (40ms)	1499	2049	2249
40MB (28ms)	1799	2449	2649
70MB (28ms)	1949	2549	2749

All Kaypro computers feature:

- A rugged, American-built chassis with vinyl-clad case
- A reliable, one-year limited warranty
- A reputation of 37 years in aerospace electronics; 8 years in the computer business

Standard Features	XT	286/12	286/16	386/20
CPU	8088/V-20	80286	80286	80386
Speed (MHz)	4.77/10.0	6/12	8/16	20
Standard RAM	640KB	1MB	1MB	1MB
Keyboard	101 Key	101 Key	101 Key	101 Key
Clock/Calendar	Lithium Battery Back-up			
Expansion Slots (16-Bit)	-	6	6	4
Expansion Slots (8-Bit)	8	2	2	3
Serial Ports	1	1	1	1
Parallel Ports	1	1	1	1
Additional I/O Ports	1 Game	-	-	-
Device Bays	4	6	6	6
Power Supply	150W	200W	200W	200W
Operating System*	Free	Free	Free	Free

Ask about Kaypro's full line of high-performance microcomputers, including the new 80386, 33 MHz machine.

30-Day Money-Back Guarantee

CALL TOLL-FREE

1-800-289-9899

FAX: 619-259-4713

Phone: 619-481-3953

Hours: Mon. - Fri., 8:00 a.m. - 4:30 p.m. P.S.T.
 Payment: MasterCard, Visa, or Cashier's Check preferred. Terms available on approved credit.
 Shipping and Handling: Within U.S.A., 3% minimum for UPS Ground. Call for shipping charges with alternate carriers.
 Sales Tax: California residents, add 7%.

Dealer and Corporate Inquiries Welcome

KAYPRO
COMPUTERS

533 Stevens Avenue
Solana Beach, CA 92075



1MB RAM

KAYPRO 286/16

\$1399

Base System with Single 1.2MB Floppy, No Video

286/16	Video Options (includes monitor & video adapter)		
	14" Flat Mono	True .31 Dot Pitch VGA	True .31 Dot Pitch VGA Plus
Disk Drive Options			
20 MB (40ms)	1699	2249	2449
40 MB (28ms)	1999	2649	2849
70 MB (28ms)	2149	2749	2949



1MB RAM

KAYPRO 386/20

\$2299

Base System with Single 1.2MB Floppy, No Video

386/20	Video Options (includes monitor & video adapter)		
	14" Flat Mono	True .31 Dot Pitch VGA	True .31 Dot Pitch VGA Plus
Disk Drive Options			
40MB (28ms)	2799	3349	3549
70MB (28ms)	3099	3649	3849
150MB (28ms)	3849	4395	4595

Prices, terms, and specifications subject to change without notice.
 *Each Kaypro computer is shipped with DR DOS 3.4 by Digital Research, Inc., an MS DOS-compatible operating system that runs up to 25% faster.

Unmatched pricing and performance from VNS.

The Economical VNS 286

A Complete* 12 MHZ High-Speed VNS 286 System
with 40MB (28MS) Hard Disk

Complete System Features:

- 80286 CPU, 8/12 MHZ Dual Speed, Keyboard Selectable
- High-Speed RAM, 512K Expandable to 4MB on the Motherboard
- Phoenix BIOS
- 40MB Hard Drive, 1.2MB Floppy Drive
- Ultra High-Speed Floppy, Hard Disk Controller 1:1 Interleave, 800KB/Sec Transfer Rate
- High Resolution 12" Amber Display with Tilt and Swivel Base, Compatible Graphics Controller
- Full 101-Key Enhanced Keyboard, Pleasant Tactile-Click Feel
- Two Serial and One Parallel Printer Ports and One Mouse Port (IBM PS/2 Compatible)
 - 3-16 Bit and 1-8 Bit Free Expansion Slots
 - Clock Calendar with Off-Board Battery Backup
 - 80287 Support, up to 10 MHZ
 - Meets FCC Requirements

\$1295.



Standard System without Hard Disk \$995

Lowest Cost Upgrades

- Additional 512K Memory... \$155.
- Additional 1.5MB Memory... \$395.
- EGA Upgrade... \$295.

Also Available with a 20MB Hard Drive — \$1195.

Five Additional Reasons to Call VNS America Now...

- Produced by High Technology Manufacturing Processes
- Supports 3.5" and 5.25" Floppy Disks
- Phoenix BIOS
- Early Shipment
- 100%-Compatible with Your Budget

*Complete: includes 12 MHZ high-speed VNS 286 System with 40MB hard disk drive, monitor and keyboard.

VNS America Corp.

796 Boston Post Road
Marlboro, Massachusetts 01752 U.S.A.
In Massachusetts 508-481-3726
FAX: 508-481-2218

Circle 313 on Reader Service Card

Use Your MasterCard or VISA

Call 9 a.m. to 8 p.m. EST Mon.-Fri.
9 a.m. to 5 p.m. EST Sat.

Order Now Toll-Free
1-800-444-7482



STALKING THE 8-BIT SPECTRUM

Here's how to get around a prickly problem when using color palettes

During the day-to-day grind of computer processing, the fruits of the Information Age can occasionally toss you some bad apples. For example, that report you downloaded is in a format that your word processor refuses to recognize. Or the first thing your hot new graphics application does is bomb and blow a 10-mega-byte black hole in your hard disk's volume directory. At times like these, those special-purpose utilities you bought earn their money. Unfortunately, there comes a time (guaranteed by Murphy) when you become blessed with a problem whose characteristics are so unique that there's no ready-made solution.

Such problems, by their very nature, tend to occur with crucial information. Your only hope in this type of jam is to be intimately familiar with your computer and how it works. That's because you have to take control of the situation by cobbling together a unique repair tool to work around the problem. Whether or not you save the work depends solely on what you know. This month I want to relate a problem I encountered on the Mac II, and how I fixed it.

While doing some graphics work, I discovered that, at times, the set of colors that belonged to a scanned image file weren't the same colors that showed up when the file was imported into a graphics application. Worse, the Mac, in its efforts to display the best possible colors for the front window, hampered conventional rescue efforts.

The solution was to craft an unconventional tool: a Mac function key that lets me capture the original image colors and



save them to a file, allowing me to restore the image later by applying the stored colors to the file. Since I only dabble in art, this problem was not a crippling one for me, but it was probably devastating for professional artists. Solving it provided me with plenty of experience working with the Mac's internals. Before discussing the fix, I should explain how the Mac handles color.

The Mac and Color

Everything appearing on a Mac SE/30's or Mac II's screen is rendered by graphics software called Color QuickDraw. It represents colors in an internal format that uses a byte for each primary color: red, green, and blue (RGB). These 3 bytes of color information provide the Mac with the capability of displaying up to 2^4 , or 16,777,216, possible colors.

You may have noticed the word *possible* in that last sentence. Doesn't Apple's newly introduced 32-Bit QuickDraw work with 32-bit pixels that contain 24

bits of color information, allowing the Mac to display this many colors? That's true, but remember that a computer's display is a combination of software and hardware. So even though 32-Bit QuickDraw might be willing, the hardware might not be.

Quite often you'll be using a video board that manages only 8 bits of color information, which limits you to 256 colors. Why is this? After all, most D/A converter (DAC) hardware can generate the wide range of colors if necessary. However, it's a different matter for a display board to have enough video RAM to hold an image composed of 24-bit pixels, and here the major obstacle quickly becomes cost. Boards with the several megabytes of video memory required to accomplish this cost thousands of dollars. Compare this to the price of a typical 8-bit-deep video board, which is about \$700. Unless you've won the state lottery, I'm willing to bet you're seeing a

continued

lot fewer colors on your Mac monitor.

If 256 colors seems limiting, remember that they can be any of the possible 16.8 million. Realistic images are possible if the proper colors are selected: Warm colors for flesh tones, say, or lots of green hues for a forest scene. This sleight of hand, where an 8-bit value can represent a 24-bit pixel, is handled by a set of Color Manager routines and the display hardware.

The Color Manager uses a color lookup table (CLUT) that maps QuickDraw's internal 24-bit RGB value to an 8-bit index value. It's this value that QuickDraw writes to the video board's RAM. When the pixel is displayed, the video hardware uses its own copy of the CLUT to map the pixel's index back into a 24-bit value that's sent to the DACs. Like much of the information on the Mac, these color tables can be saved in a resource on disk called `c1ut`.

So far, so good. But what happens if there's more than one window on the screen, as is often the case under Multi-Finder, and each window's image has its own unique set of 256 colors? A set of Palette Manager routines determines

how to share the limited number of colors. The Palette Manager does the best it can for all the windows, but it gives preference to the frontmost window, since that's the active one and typically the one you're most interested in. It makes these judgment calls based on information contained in data structures called color palettes. Of course, color palettes can be stored in a `pltt` resource. Stay acquainted with color tables and color palettes; I'll be getting back to them.

To facilitate the sharing of images among applications, Apple has defined a version 2 picture format (termed PICT) that describes color images as a sequence of Color QuickDraw commands. (An earlier pre-Mac II version 1 picture format dealt only with black-and-white images.) As an image is drawn, the Color QuickDraw commands can be recorded into the data fork of a file whose type is set to PICT so other Mac applications can recognize it.

The image can also be written into a (you guessed it) PICT resource, but in this case, it can't be stored on the fly. The entire image must be built in mem-

ory before the Resource Manager can write it to a file. Wherever it's saved, an image's data can be read and "played back" from within different applications by using the appropriate Color QuickDraw calls. The PICT format and Color QuickDraw thus allow images to be treated as objects that can be displayed, selected, and copied to other documents without regard to how the image was made.

The Problem: Colors That Run

With all this software working in concert to properly render color graphics on the Mac II's screen, you might be wondering where things could go wrong. Remember that the image pixels, whether living in video RAM or on a disk file, are composed of 8-bit indexes. The PICT format also contains a copy of the color table so that these indexes can be translated back to 24-bit RGB values as required.

When an image is loaded into memory, the Color Manager updates both Color QuickDraw's and the video hardware's CLUTs from this color table, and the image reproduces accurately. But

continued

Turbo Pascal Tools to Help You Program Faster and Easier

A Multi-User B-Tree Toolkit



Write powerful network compatible databases faster and easier using **B-Tree Filer 5.0**. You'll have the fastest, safest, most flexible databases - no rigid structure, no TSR hassles, no running out of files. And they're compatible with Novell, 3Com, MS-NET, and others.

You get: ■ Fixed and variable length records ■ Two billion records per database ■ Up to 100 indexes per file ■ Flexible record locking ■ Fail-safe mode with journaling ■ Units for sorting, browsing, reindexing, and network control.

B-Tree Filer includes full source code, documentation, technical support, and you pay NO royalties.

B-Tree Filer 5.0 is only \$125. (single user)
With network support, only \$175.

"A Superbly Crafted Toolbox"



Turbo Professional 5.0 is a library of more than 600 state-of-the-art routines optimized for Turbo Pascal 5.0. It includes complete source code, comprehensive documentation, and powerful and useful demo programs.

You get: ■ TSR management ■ Menus and windows ■ BCD ■ Large arrays and more. *New Routines!* Complete mouse support ■ Window-oriented text editor ■ Scrolling data entry screens ■ Versatile pick lists ■ On-line reference guide, and more.

"Turbo Professional...a superbly crafted toolbox... [makes] the hard stuff so easy."

Kent Porter, Dr. Dob's Journal, 4/88

Turbo Professional 5.0 is only \$125.

Analytical Tools to Help You

Write Better Programs



You'll write better Turbo Pascal 5.0 programs easier and faster using the powerful analytical tools of **Turbo Analyst 5.0**. You get an integrated development environment with: ■ File Browser ■ Mouse support ■ Hotkey access to the compiler, debugger and the analytical tools.

The tools include: Pascal formatter, Program structure analyzer, Program lister, three Execution profilers, and Unit disassembler.

"Turbo Analyst...a valuable tool for every Turbo Pascal programmer. The Program Structure Analyzer...a timesaver.

The integrated environment...impressive."

Namir Shamma, Turbo Tech Report, 7/88

Turbo Analyst 5.0 is only \$99.

Satisfaction guaranteed or your money back within 30 days. Turbo Pascal 4.0 or 5.0 is required. Shipping and taxes prepaid in U.S. and Canada. Elsewhere add \$15 per unit. For more information call (408) 438-8608.

TURBO
POWER

TurboPower Software P.O. Box 66747 Scotts Valley, CA 95066-0747

Call toll-free for credit card orders.

1-800-333-4160

Continental U.S. and Canada

NINE REASONS TO BUY CLIPPER WITHOUT A MOMENT'S HESITATION!

The Clipper language offers two compelling reasons to adopt it as your application development standard: open architecture and .EXE file generation. Clipper 5.0 boasts seven more. We think you'll be convinced before you reach number nine.

1 Open Architecture.

Clipper is both powerful and easy to use, with the most comprehensive command and function set available. Want more? Extend the Clipper language with user-defined functions written in Clipper, Assembler, C and other languages.

2 User-defined Commands.

Even more extensibility is available in Clipper 5.0. Support for user-defined commands allows you to tailor your command set to a specific business or industry.

3 .EXE File Generation.

Clipper's compiler yields stand-alone .EXE files for unrestricted distribution, requiring no LAN-PACKS™, no run-time modules and no licenses of any kind!

4 Break the 640K DOS Limit!

Improved memory management in Clipper 5.0, made possible by an exclusive version of Pocket Soft's .RTLink™, lets you run applications larger than 640K, without overlays!

5 Faster Development.

.RTLink features faster linking time and incremental linking, so only the changed object files get re-linked when you compile.

Clipper

5.0

GET IT FIRST, GET IT FREE!

6 Faster, Smaller Code.

Compiler directives allow more efficient execution with less code needed to accommodate varying PC configurations.

7 Multi-dimensional Arrays.

Accurate modelling of actual circumstances is enhanced by the power of multi-dimensional arrays.

8 New Documentation, Including an On-line Guide.

New and expanded documentation will make you immediately productive in Clipper 5.0. And you can access it all on-line through the included Guide to Clipper™ and Norton Guides™ Engine.

9 You Can Get It First!

Buy the current version of Clipper after June 1, 1989, register your copy, and be among the first to get Clipper 5.0—*Free!* You'll even save \$100 off the suggested retail price of Clipper 5.0.

So, don't hesitate! Give us a call for the name of your nearest authorized dealer, and make your commitment to Clipper, today.

Clipper®

The Application Development Standard

213/390-7923

 Nantucket®

Nantucket Corporation, 12555 West Jefferson Boulevard, Los Angeles, CA 90066. 213/390-7923 FAX: 213/397-5469 TELEX: 650-2574125. Nantucket, the Nantucket logo and Clipper are registered trademarks of Nantucket Corporation. Other brand and product names are used for identification purposes only and may be trademarks or registered trademarks of their respective holders. Entire contents copyright © 1989 Nantucket Corporation.

if this information is lost, the Mac II doesn't know what RGB values to use to reconstruct the image. In such a case, the Mac uses what it has: a set of 256 default system colors. While this default color table carries a wide range of colors, there may not be nearly enough warm shades or green hues available for the images mentioned earlier. When this happens, some of the scene's colors get rendered in other hues, frequently producing horrific results.

How could this occur? As long as an application uses Color QuickDraw to display the image, there's no trouble. However, some graphics applications use their own routines to read in the image data so that they can manipulate it in their own internal format. Then the application extracts the color table from the PICT file so that it can make sense of the colors. Now you can see where there might be a problem.

I used PixelPaint 1.0 to tinker with

color images that I scanned on a Howtek scanner. Although the images looked great in the scanning application, they often looked ghastly when imported into PixelPaint. It turns out that PixelPaint 1.0 expects to find the color table information in a custom COLR resource attached to the file. You're all set if the PICT file contains the COLR resource that PixelPaint expects. But if you get a PICT file from an application that doesn't attach this extra resource to it, you're in trouble. Certain scanning software just doesn't supply the extra—or correct—color resources. (Some scanning software covers all bets, saving not only the image, but also COLR, clut, and pltt resources in a file.)

My first attempt at a workaround for this problem of colors getting away was to use Bill Steinberg's Klutz desk accessory (*klutz* being a pun on *clut*). This spiffy DA lets you examine the current color table, modify certain colors in it if you wish, and then save the table to a file. Even better, when the time is right, you can have Klutz reload the file and then adjust the Mac II's colors to those stored in the file.

My plan of attack was to scan in an image, activate Klutz, and save the image's color table. Then I'd save the image in a PICT file. Next, I'd launch PixelPaint and load the PICT file. Then I'd start Klutz, load the color table file (forcing the default colors to those I had captured in the scanning application), and finally save the image. PixelPaint would, of course, add the modified colors to a COLR resource as it saved the file. It might be a clunky way to nail the colors down, but at least it should solve the problem.

What looked good in concept was flawed in execution. When I was ready to capture the image's colors using Klutz, something odd happened. Some of the colors changed to new, bright hues, mangling the scanned image. Now what? I didn't have a clue until I realized that about six of the new colors matched the colors of the Apple logo in the menu bar. Remember the Palette Manager? It adjusts the display's colors, giving priority to the frontmost window. The frontmost window was no longer the image window, but now the Klutz DA, including the Apple logo in the menu bar.

Every time I captured the color table with Klutz, the Palette Manager methodically contaminated the color table with the Apple logo colors. Tinkering with the offending colors within Klutz didn't do any good, because the Palette

continued

OCULUS™ - 10

A real time video digitizer for the VGA adapter.

OCULUS™ - 10 lets you:

- Grab images of moving scenes into your computer.
- From all standard cameras and VCR'S
- In either Monochrome or full, true colors
- With VGA resolution

Contrary to competing products which take several seconds to scan an image, OCULUS™ - 10 grabs most images in 1/20th of a second or less. Our software updates them on your VGA board at a rate of up to 6 images per second. OCULUS™ - 10 gives you full freedom for:

- Digitizing images of live subjects
- Framing
- Focussing
- Selecting scenes from video recordings

Images can be saved in formats compatible with most electronic publishing and graphics software packages.

OCULUS™ - 101 A half-size add-on board for IBM compatible micro-computers: PC, XT, AT, 386, and PS/2 models 25 and 30. The price? An unbelievable

\$695.





ACTUAL UN-RETOUCHED PHOTOGRAPHS OF IMAGES GRABBED BY OCULUS™ - 10



CORECO

SUPPLIERS OF HIGH QUALITY
IMAGE PROCESSING PRODUCTS
SINCE 1983

CORECO INC
8001 11th Street, San Diego, CA 92121
Tel: 619-591-1111 Fax: 619-591-1112

Please rush me an OCULUS™ - 10 board, with utility software and Coreco's 3 months warranty for \$695 (US currency) plus \$15 for shipping.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE _____

METHOD OF PAYMENT: VISA MASTER CARD EFT

CARD # _____

SIGNATURE _____

Specifications
On-board memory: 128 Kb
A/D converter: flash, 8 bits

FRAME-GRABBING TIMES:

Monochrome:
320 x 200, 4 bits: 1/50 second
320 x 200, 8 bits: 1/20 second
640 x 480, 4 bits: 1/30 second

Color: 320 x 200: 1/20 second

Super VGA mode soon available.

IBM, IBM PC, XT, AT, PS/2 are trademarks of International Business Machines Corporation.

DEALER INQUIRIES WELCOME.

**Turn your favorite
C compiler into a
powerful database
manager with the**

C/Database Toolchest



The **C/Database Toolchest™** adds sophisticated file management functions to your Power C™, Turbo C®, QuickC®, or Microsoft® C compiler. With the **C/Database Toolchest™**, your data requires much less disk space than with programs like dBASE®, and you can access your data much faster. Of course the full power of C provides you with an unlimited amount of programming flexibility.

The **C/Database Toolchest™** includes three major components:

- 1) An advanced B+tree library gives you instant access to your data.
- 2) A high-level ISAM library provides you with an easy-to-use C interface, and

3) A complete database manager (with C source code included) shows you how to create impressive applications.

You also receive a comprehensive 350 page manual and a utility for converting dBASE® files.

The **C/Database Toolchest™** supports features that you'd expect to find only in products costing ten times as much. Advanced features include variable length records, variable length keys, multiple keys per index, and multiple indexes stored in a single file. Your data files can contain an unlimited number of records, and each record can be as large as 32K bytes in length.

About the only thing that the **C/Database Toolchest™** doesn't do is cost you a lot of money. We've kept our price low so you can manage your budget as easily as your data.

Now Only \$19.95!

Order now by calling our toll free number or mail the coupon to:

Mix Software
1132 Commerce Drive
Richardson, TX 75081

1-800-333-0330

60 Day Money Back Guarantee
Not Copy Protected ■ Royalty Free
For technical support, please call:
1-214-783-6001



Order Coupon

Name _____
Street _____
City _____
State _____ Zip _____
Telephone _____
Paying By _____ Money Order _____ Check _____
 _____ Visa _____ MC _____ AX _____ Disc. _____
Card# _____
Exp. Date _____
Disk Size _____ 5 1/4" _____ 3 1/2"

Qty	Product	Price	Subtotal
_____	C/Database Toolchest	\$19.95	_____
_____	C/Database Library Source	\$10.00	_____
_____	B+tree & ISAM library source code	_____	_____
Add Shipping (\$5 USA, \$20 Foreign)			
Texas Residents Add 8% Sales Tax _____			
Total Amount of Your Order _____			B

Listing 1: The complete source listing for the Capture CLUT FKEY. It's compiled into a resource of type FKEY and then pasted into the System file.

```

#include "EventMgr.h"
#include "FileMgr.h"
#include "MacTypes.h"
#include "MemoryMgr.h"
#include "pascal.h"
#include "StdFilePkg.h"
#include "QuickDraw.h"
#include "WindowMgr.h"
#include "Color.h"
#include "SetUpA4.h"

#define NIL      0L

/* Coords for output file dialog box */
#define PUT_FILE_X 100
#define PUT_FILE_Y 100

/* number indicates the window uses color */
#define HAS_COLOR 0xC000

/* Indicates the graphics port is a direct device */
#define DIRECT_DEVICE 16

/* bytes per RGBColor entry */
#define BYTES_IN_RGB 6

/***** main *****/
main()
{
    int          i;
    OSType       file_Creator, file_Type;
    OSError      file_error;
    short        refNum;
    int          oldVol;
    unsigned char out_Name;
    SFPutFile    out_Reply; /* Reply from SFPutFile */
    int          out_vRefNum;
    FileInfo     tempFileInfo;
    Point        where; /* Top left corner of file dialog */
    int          err;
    int          numberOfColors;
    CTabHandle    thiscolorTab;
    CGrafPtr     the_Window;

    /* Custom resource for PixelPaint */
    typedef struct our_Colors {
        int          colorCount;
        RGBColor     colorData[];
    } our_Colors, **our_ColorHandle;

    /* Handle for custom resource */
    our_ColorHandle dummyTable;

    RememberA0();
    SetUpA4();

    /* Start our REAL code */
    /* Get CGrafPtr to active window */
    the_Window = (CGrafPtr)FrontWindow();
    /* Save current volume */
    GetVol(NIL, &oldVol);

    /* Window present? */
    if ((the_Window != NIL) &&
        /* Uses color? */
        ((the_Window).portVersion >= HAS_COLOR) &&
        /* Uses a CLUT? */
        ((the_Window).portPixMap).pixelType != DIRECT_DEVICE) &&
        /* Uses a CLUT? */
        ((WindowPeek)the_Window->windowKind != dialogKind))
    {
        /* Lock the color table handle down */
        HLock((**the_Window).portPixMap).pmTable);

        /* Stash # of colors */
        numberOfColors =
            (**the_Window).portPixMap).pmTable).ctSize;

        /* Get handle to the color table */
        thiscolorTab = (**the_Window).portPixMap).pmTable;

        /* Make a copy of it */
        err = HurdToHand(&thiscolorTab);

        /* Copy successful, continue */
        if (!err)
        {
            dummyTable = (our_ColorHandle) NewHandle((BYTES_IN_RGB *
                (numberOfColors + 1)) + 2);

```

```

/* Did we get the memory? */
if (!MemError()) /* Yes */
{
    /* Stuff count into header */
    (**dummyTable).colorCount = numberOfColors;
    /* Copy the RGB values */
    for (i = 0; i <= numberOfColors; i++)
    {
        (**dummyTable).colorData[i].red =
            (**thiscolorTab).ctTable[i].rgb.red;
        (**dummyTable).colorData[i].green =
            (**thiscolorTab).ctTable[i].rgb.green;
        (**dummyTable).colorData[i].blue =
            (**thiscolorTab).ctTable[i].rgb.blue;
    }
    where.v = PUT_FILE_X;
    where.h = PUT_FILE_Y;

    /* Ask for filename */
    SFPutFile(where, "PSave color info as:", "", NIL,
        &out_Reply);
    /* Get a valid response? */
    if (out_Reply.good) /* Yes */
    {
        /* Make the destination volume current */
        SetVol(NIL, out_Reply.vRefNum);
        /* and create the file with its creator
            and type specified */
        file_error = Create(out_Reply.fName,
            out_Reply.vRefNum, 'PIXR', 'PX05');
        /* Now write resource map to it */
        CreateResFile(out_Reply.fName);

        /* Process result from Resource Manager */
        switch(ResError())
        {
            case dupFNErr:
                /* File already exists, wipe it out */
                file_error = FSDelete(out_Reply.fName,
                    out_Reply.vRefNum);
                file_error = Create(out_Reply.fName,
                    out_Reply.vRefNum, 'PIXR', 'PX05');
                CreateResFile(out_Reply.fName);

            case noErr:
                /* No problem! Open the resource fork */
                refNum = OpenRFPPerm(out_Reply.fName,
                    out_Reply.vRefNum, fsWrPerm);
                /* Add custom resource */
                AddResource(dummyTable, 'COLR',
                    999, "\PCustom Colors");
                /* Add the color table */
                AddResource(thiscolorTab, 'clut',
                    999, "\PColor Table");
                /* Close the file */
                CloseResFile(refNum);
                break;

            default:
                /* Unknown error, try to abort cleanly */
                CloseResFile(refNum);
                /* Announce that there was a problem */
                SysBeep(50);
                break;
        } /* end switch */
        /* end if out_Reply.good */
    }

    /* Release memory for the custom resource */
    DisposHandle(dummyTable);
} /* end if !MemError */
else
    SysBeep(50);

DisposHandle(thiscolorTab);
} /* end if !err */
else
    SysBeep(50);

/* Release the color table handle */
HUnlock((**the_Window).portPixMap).pmTable);
} /* end if the_Window */
else /* No window, or bogus type */
    SysBeep(50);

/* Clean up */
/* Back to the volume we started on */
SetVol(NIL, oldVol);
RestoreA4();
} /* end main */

```

WHETHER REPORT.

Whether you're a software developer writing new applications for the IBM or Mac, or a PC user securing proprietary data files, software and data protection has never had a brighter silver lining. For a number of very good reasons.

Beginning with the 'whether-expert' Rainbow Technologies. And ending with its Software Sentinel family of hardware keys. Starring five models that fit virtually any software program or data file you need to protect.

There's the best-selling SentinelPro for the IBM PC/XT/AT, PS/2 and compatibles, and even the Atari ST. Known worldwide for its virtually unbreakable security. And its ASIC technology. And its invisible operation. A close relation, the Sentinel-C stands at-the-ready for custom configurations and multiple software packages.

In the Apple market, security-minded Mac software developers turn to Eve. For completely transparent operation and world-class security of the protected software. Just by plugging Eve into the Mac ADB connector.

PC users wanting a low cost, user-friendly solution to the problem of securing sensitive data can call on the DataSentry. Using a proprietary Rainbow algorithm or DES, the DataSentry encrypts data files on individual PCs, protects modem transmissions and secures data on local area networks.

Rainbow's latest protection strategy is the SentinelShell—that lets users place a 'shell' around existing, off-the-shelf programs. Because access can be limited to those issued a key, libraries, universities and corporations can very simply guard their software investments.

Whatever your whether, Rainbow Technologies has the software and data protection products that make the difference. For more information, call 714-261-0228 in the U.S., or contact Rainbow Technologies Ltd. in the United Kingdom for the distributor nearest you. Whethercasters are standing by.

- Runs under DOS, OS/2 and Xenix
- Algorithm technique (Never a fixed response)
- External parallel port installation
- Minimal implementation effort
- Higher level language interfaces included
- 100 times faster than fixed-response devices (1 ms)
- ASIC design for reliability

SentinelPro™



- Protects multiple packages with one device
- 126 bytes of non-volatile memory programmed before shipment of the software
- Rainbow supplies a unique adapter for programming the unit
- Higher level language interfaces included
- Runs under DOS, OS/2 and Xenix
- External parallel port installation

Sentinel-C™



- For the Macintosh SE and II
- Complies with Apple Desktop Bus Interface requirements
- Rainbow-assigned developer passwords to prevent tampering by other developers or sophisticated "hackers"
- 7 locks per key, usable individually or in combination, on one or up to seven applications

Eve™



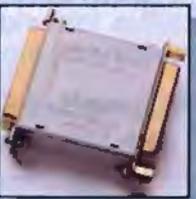
- Completely user-installable
- Pocket-sized external device
- Menu-driven, user-friendly interface
- Single- or multi-user security system
- Audit trail, log-on identifiers and automatic encryption/decryption of entire directories
- Secures data transmitted by modems
- Prevents recovery of data by utility programs

DataSentry™



- Runs under DOS on IBM PCs and compatibles
- Protects without requiring access to the source code
- Completely transparent to the end user
- User-friendly software
- Pocket-size key attaches quickly to any standard PC parallel port
- ASIC design for reliability

SentinelShell™



RAINBOW TECHNOLOGIES

18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY, U.K., Tel: 0753-41512, Fax: 0753-43610

© 1989 Rainbow Technologies. All product names are trademarks of their respective manufacturers.

Manager simply reassigned them elsewhere in the color table. It didn't take too long to realize that I couldn't use Klutz to fix the problem.

A Keyboard Fix

An unconventional problem requires an unconventional solution. Ideally, I wanted to keep the window with the image frontmost, or else the Palette Manager would get into the act. Yet I had to have some way to save its colors. The answer was, in a sense, obvious: Since pointing and clicking with the mouse changes the window order, and thus wreaks havoc with the color tables, don't use it. Use the keyboard instead to trigger the color capture process. A function key was what I needed.

The occasional Mac user might wonder where the function keys are on a Mac. It's not that they're hidden, it's just that there are no physical function keys on a Standard Mac keyboard. (The function keys on an Extended keyboard are there primarily for those who run a DOS emulation; they normally serve no other purpose.) A Mac function key is actually a combination of keystrokes: the Com-

mand key, the Shift key, and a number key pressed simultaneously. The Mac OS intercepts these key combinations and executes snippets of code that perform specific actions. Mac function keys are called FKEYs, based on the name of the resource (FKEY) that the code is stored in.

Apple has defined the actions for FKEYs 1 through 4. Most Mac users know that Command-Shift-1 ejects the floppy disk from the internal drive, Command-Shift-2 ejects a floppy disk from an external or second drive, Command-Shift-3 dumps the Mac screen to a MacPaint file, and Command-Shift-4 dumps the screen to an Imagewriter. FKEYs 5 through 9 and 0 are unassigned. However, these empty "slots" can be put to use if you plug in an FKEY resource whose resource ID number matches one of the unassigned values. Thanks to the flexibility of the Mac OS, I can install my own FKEY and use it to capture the color information.

A Close Look at the Solution

Needless to say, I wandered down a lot of blind alleys—and got mugged in quite a

few of them—before I got it right. I called the FKEY "Capture CLUT" and wrote it in Symantec's Think C version 3.0. Listing 1 tells the whole story, but allow me to cover some of the important details by following the sequence of operations that Capture CLUT uses to grab a color table.

When the FKEY starts, it uses the Window Manager's `FrontWindow()` trap to select the frontmost window on the screen. Now, to start some safety checks, first check for the presence of a window. `FrontWindow()` does the work by returning a NIL if there isn't a window.

Check that it's a color window. Why would this be a problem on a Mac II, since it uses color? Well, when the Mac II was first introduced, it was able to run existing Mac software because it supported conventional QuickDraw (black-and-white) windows as well as the Color QuickDraw windows. It's possible for both types of windows to be sharing the screen. The ability to support two different drawing environments at the same time is a hazard. Technically, both windows are the same depth in the video



Many so-called storage subsystems are no more than a collection of third-party components thrown together in a box.

At Storage Dimensions, we think a total storage solution means a lot more.

A Complete Solution From Start To Finish.

At Storage Dimensions, we design our subsystems using a "total systems" approach.

We start by developing our own software, firmware and host adapters. We also engineer and test all components to ensure they work together in *your* application environment.

And we finish the job with responsive service and knowledgeable technical support.

This means you get an easy-to-use mass storage solution designed to meet *your* mass storage needs.

What Makes A Total Solutions Company?

- Completely Integrated Solutions
- High-Quality Disk Drives
- In-House Software Development
- In-House Controller Design
- All Components Tested as a System
- Responsive, Knowledgeable Technical Support
- Comprehensive Documentation
- Full One-Year Systems-Level Warranty
- Financially Strong Company

Total Storage Solutions.

board's memory, but down in the window management data structures, things are quite different for monochrome and color.

Conventional windows use a drawing mechanism called a *graphics port*, or *grafPort*; for Color QuickDraw it's a *color graphics port*, or *cGrafPort*. The data structures of these graphics ports are the same size, and much of the information is identical, but certain entries in *cGrafPort* are handles pointing to color information associated with the port. To locate and extract the color table from the front window, Capture CLUT relies on these entries to hold valid information.

If you were to accidentally trigger Capture CLUT with a *grafPort* window (rather than a *cGrafPort* window) in the front position, Capture CLUT would be working with gibberish. This often pitches the Mac into the abyss of the Odd Address and Illegal Instruction, and it reacquaints you with either your debugger or the infamous bomb box. You can safely determine the type of window that you're using by examining the graphics port's *portVersion* value. The high 2 bits are set (C000 hexadecimal) when

you're using a color window.

Oddly enough, the recently introduced 32-Bit QuickDraw poses a hazard as well. Since 32-bit pixels by themselves are large enough to hold actual color information, they are used by the video board's DAC hardware directly. Video boards using 32-bit pixels in this way are called *direct devices*. They obviously don't require color lookup, so there's no valid information in the window's color table—another opportunity for information to trip Capture CLUT into hyperspace. To avoid this possibility, you examine the window's *pixelType*. If *pixelType* has a value of 16, the window is associated with a direct device, and you should abort the attempt to use the color table.

Finally, check to see if the window is a dialog box. Dialog boxes typically carry text-only information or alert you to a problem requiring a response. I've designed Capture CLUT to ignore this window type. For whatever reason, if the frontmost window doesn't pass muster, you beep the Mac to signal a problem and return the thread of execution to the host application.

The Real Work

Capture CLUT locks the window's color table in memory using the Memory Manager's *HLock()* trap. This lets you extract the number of colors in the table and make a copy of it, while preventing the Mac's Memory Manager from hustling it off to a different part of RAM if an operation triggers memory relocation. Use the general-purpose copy routine *HandtoHand* trap to make a duplicate of the table in memory, letting it deal with allocating the memory it needs. Check the error code returned by *HandtoHand* to see if it was successful. Again, if there was trouble, beep and bail out of the operation.

Now, to tackle that custom resource, start by using *NewHandle()* to allocate memory for a data table structure that's designed to resemble the COLR resource. I determined the format of COLR by conversing on BIX and spelunking in ResEdit. The amount of memory to request depends on the depth of the screen. Again, check to see if you got the memory you need. If you did, Capture CLUT copies the number-of-colors value to

continued



Complete Subsystems For DOS, NetWare® and Macintosh®.

With Storage Dimensions' broad line of storage solutions, you get the performance you need, and the choices you want—from 45 megabytes to 2.6 gigabytes, in internal and external configurations. With support for all popular interfaces.

Plus, our subsystems install easily in minutes, are 100%

compatible with your operating environment, and deliver exceptional reliability.

Hard Disk And Optical Subsystem Families.

Product Family	Application	Capacity Range	Interfaces Supported
SpeedStor™	PC/MS-DOS	120 MB to 2.6 GB	ESDI, SCSI, ST412, RLL
LANStor™	Novell NetWare	115 MB to 2.6 GB	ESDI, SCSI, ST412, DCB
LaserStor™	Write-Once Optical PC/MS-DOS & Mac	786 MB (DOS) 732 MB (Mac)	SCSI
MacinStor™	Apple Macintosh	45 to 650 MB	SCSI

Get Your Mass Storage Needs In Line. Call (408) 879-0300.

Don't trust your valuable data—or your business—to an incomplete storage solution. Call the company that does it right from the start.

More In Store.™



2145 Hamilton Avenue, San Jose, CA 95125

Across The Line.

©1989 Storage Dimensions
SpeedStor, LANStor, LaserStor and MacinStor are trademarks of Storage Dimensions

SOME ASSEMBLY REQUIRED

BLAST... Complete Communications, ONE Software Package.



PC, MAC, UNIX, XENIX, VAX, and more. 30 popular operating systems. Connect and manage file transfers around the office or around the world.

RIGHT OUT OF THE BOX

Use regular modems, V.32, new high speed modems, X.25, LANs . . . BLAST makes them all compatible.

FOR INSTANT NETWORKS

Link two computers or 2000 . . . with

- One easy, identical interface
- One set of commands
- One powerful script language
- One reliable program

WITH ALL THE FEATURES

- Bulletproof file transfer
- Terminal Emulators - VT 100/220, etc.
- Scripting for customized routines
- PC to PC Remote Control
- Fully automated operation
- Unbeatable noise resistance

IN GOOD COMPANY

- Over 50,000 users worldwide
- Top-Notch technical support

Call 800-24-BLAST

APPLE	MACINTOSH
IBM PC-XT/AT/PS/2	MS-DOS, SCO, XENIX, UNIX V
UNIX Systems	UNIX V.3, 4.2, 386
DEC	VMS, REXX, RPL, ULTRIX
DATA GENERAL	DOS, MPOS, DOS, AOS/VIS
IBM	VOS, UNIX, XENIX
HEWLETT-PACKARD	MPE, RTE, UNIX
IBM	VPC/RS/486/150
PRIMO	PRIMO
UNIVIS	STOS, CTOS, UNIX
WANG	VS OS, MS-DOS
... plus many more	

BLAST

Communications Research Group

5615 Corporate Blvd. • Baton Rouge, Louisiana 70808
(504) 923-0888

the dummy table, followed by the color table's RGB values.

You've got the goods, and Capture CLUT asks where you want to store them. It uses SFPutFile() to put up a dialog box prompting you for the volume and filename in which to stash the color table. When this dialog box becomes the frontmost window on the screen, the Palette Manager might monkey with the screen colors. But that's no problem, since you've already captured the color table before the SFPutFile() window is up front.

After typing a filename, tapping on Return or clicking on OK proceeds to create the file. Use the File Manager's Create() function to make a file whose attributes are type PX05, with a creator of PIXR. These attributes match those that PixelPaint uses when it searches for a color table to load. Then use the Resource Manager trap CreateResFile() to build a resource map in memory that will be used for writing to the file's resource fork.

Again, check for errors. If a file with that name already exists, use the File Manager's FSDelete() function to ask if you want to replace the file. Use AddResource to assign the color table to the file while setting its resource type (clut) and resource ID (999). And you're done except for cleaning up.

Call CloseResFile(), which has the resources written to the file and then closes it. Dispose of any memory you allocated and unlock the color table. Be careful where and how you free the memory for the dummy table and color tables. Nothing causes the Mac to crash and burn faster than deallocating a block of memory that you never had to begin with.

Two Caveats

You should note two important things about Capture CLUT right away. First, there's no initialization code. Some specialized FKEYs execute minimal setup code to perform a specific task, but for the problem I'm trying to fix, Capture CLUT relies heavily on information within the application's environment. That means the last thing you want to do is mess with it.

It also means that this FKEY relies on the host application to have initialized certain Managers if it's to operate properly. Since Capture CLUT examines the data structures of a window, the Window Manager should have been initialized. The SFPutFile() dialog box requires that the Dialog Manager and TextEdit be set up. It's a rare application that doesn't

have a window or menu bar, or doesn't use the SFGetFile() or SFPutFile() functions to deal with files, so you're pretty safe assuming that this initialization has been done. Nevertheless, be aware of the remote possibility that Capture CLUT could crash an application if this initialization hasn't been done.

Second, notice that Capture CLUT does error checking. Since the FKEY kicks in right in the middle of a working application, it's a good idea to verify that your operations worked properly. If you don't, you stand a good chance of damaging the application's environment, causing it to crash. As an added bonus, if the application has files open when it crashes, there's the risk of trashing the Mac II's hard disk. Needless to say, I have little use for something that destroys my computer system with just a few keystrokes. The file I/O checking could be beefed up, but it's been more than adequate for my work.

This is not to say that an FKEY is an unreliable way to deal with a problem. For starters, you don't need to write a lot of initialization code or try to implement an elaborate event loop that typical Mac and OS/2 applications require. As the listing shows, all that's required is a short, linear piece of code. As for handling errors, you can avoid a lot of trouble simply by coding defensively. But that's a truth that applies equally to applications as well as FKEYs. Finally, you can invoke the FKEY from within any application at any time, and that's usually when trouble pounces on you: while you're trying to do some work, not at the Desktop.

It's true that you need to know a lot about the Mac before you can begin programming it. I've used no less than the Window Manager, Color Manager, Resource Manager, File Manager, and Memory Manager just to write a simple FKEY. But also notice the rich set of functions that the Mac provides: for this FKEY, 18 that make heavy use of data structures maintained by the Mac OS. It's both the Mac's weakness and its strength. This complex but versatile environment lets you write short pieces of code that accomplish a lot.

I had Think C compile the code and then generate a code resource of type FKEY, with a resource ID of 6. This ID number tells the Mac OS to execute the Capture CLUT code when Command-Shift-6 is pressed. I also had Think C set the output file's type to FKEY and creator to CWFK, so that most FKEY installation utilities would recognize it.

continued

**NOW! Larger Data Sets,
Upgrades Available**

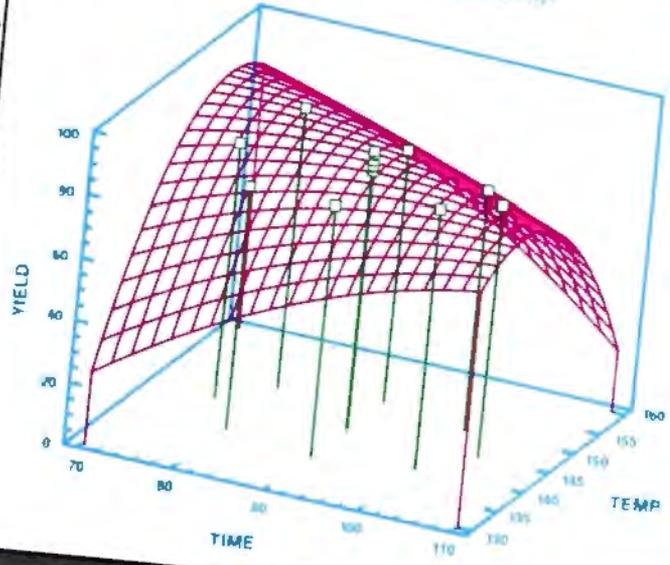
MODEL FITTING RESULTS FOR: YIELD

INDEPENDENT VARIABLE	COEFFICIENT	STD. ERROR	T-VALUE	SIG. LEVEL
CONSTANT		747.932209	-6.3183	0.0018
time	-3977.847583	3.288094	5.4325	0.0018
time^2	17.862499	0.008136	-2.6386	0.0386
temp	-0.021469	9.614533	4.6802	0.0000
temp^2	44.997508	0.032546	-3.8300	0.0000
time*temp	-0.124651	0.020297	-4.8037	0.0000
	-0.0975			

FURTHER ANOVA FOR VARIABLES IN THE ORDER

SOURCE	SUM OF SQUARES	DF	MEAN SQ	F
time	15.3890909	1	15.389091	
time^2	15.6011921	1	15.601192	
temp	1.0765657	1	1.076566	
temp^2	60.4298606	1	60.429861	
time*temp	95.0625000	1	95.062500	
Model	187.559209	5		

CHEMICAL YIELD AS A FUNCTION OF TIME AND TEMPERATURE
POINTS REPRESENT ACTUAL OBSERVATIONS



BRAINS & BEAUTY

STATGRAPHICS®. Sophisticated Data Analysis and Gorgeous Graphics — In An Easy-to-Use PC Statistics Package.

Get the best of both worlds with STATGRAPHICS — sophisticated data analysis *and* a dazzling array of graphics in an easy-to-use PC statistics package.

Powerful Statistics. Realize the full potential of your analytical skills. STATGRAPHICS gives you over 250 statistical procedures including ANOVA, regression analysis, quality control procedures, experimental design, multivariate techniques, nonparametric methods, exploratory data analysis, forecasting, time series analysis, and more.

Incredible Graphics. Turn the "Ho-Hum" into the "Ah-Ha!" STATGRAPHICS includes over 50 types of graphs that allow you to analyze your data visually and communicate your results brilliantly!

Easy To Learn and Use. Enter your data using our full-screen editor, or import data directly from your ASCII, dBASE®, Lotus®, or DIF files. STATGRAPHICS is completely menu-driven and includes online HELP, a self-paced tutorial,

handy reference cards, and a user's guide complete with examples and sample data sets. No wonder *InfoWorld* said STATGRAPHICS "makes interactive data analysis and knock-your-socks-off graphics easy!"

Why compromise? Get the power of sophisticated data analysis *and* gorgeous graphics with STATGRAPHICS — all for only \$895.* For more details or to order today, call:

(800) 592-0050 ext. 400

In Maryland, (301) 984-5123;
Outside the U.S., (301) 984-5412 for
the name of the dealer nearest you.

Ask about our money-back guarantee!



STSC STSC, Inc.
2115 East Jefferson Street
Rockville, MD 20852

Circle 275 on Reader Service Card

* Suggested retail price in U.S. and Canada. International prices vary. STATGRAPHICS, dBASE, and Lotus are registered trademarks of Statistical Graphics Corp., Ashton-Tate, and Lotus Development Corp., respectively.

BYTE BACK ISSUES FOR SALE

	1987	1988	1989
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Inside the IBM PCs			
Applications Software Today			



Issues
Available

Rates (postage and handling included):

1987-'89 BYTE Issues	\$6.00*	BYTE 1988 Index	\$5.00
BYTE '83-'84 Index	\$4.00	1985 Inside The IBM PCs	\$4.00
BYTE 1985 Index	\$4.00	1986 Inside The IBM PCs	\$5.00
BYTE 1986 Index	\$4.00	1988 Inside The IBM PCs	\$6.00
BYTE 1987 Index	\$5.00	Applications Software Today Special	\$4.00
*June 1988 (Benchmarks)	\$3.00		

The above prices include postage in the US. Please add \$.50 per copy for Canada and Mexico; and \$2.00 per copy to foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

Please indicate which issues you would like by checking (✓) the boxes. Send requests with payment to:

BYTE Back Issues, One Phoenix Mill Lane, Peterborough, NH 03458 (603) 924-9281

Check enclosed Charge: VISA MasterCard

Card # _____

Exp. Date _____

Signature _____

Name _____

Address _____

City _____

State _____ Zip _____

All orders must be prepaid. Please allow four weeks for domestic delivery and twelve weeks for foreign delivery by surface mail.

However, I used ResEdit 1.2 to paste the resource into the System file. For those using ALSoft's Master Juggler or Fifth Generation Systems' Suitcase II to manage FKEYS, I've tried Capture CLUT with both, and it works without a hitch.

Using It

My rescue operations had deviated from my original plan. Once the scanning application is done, I save the image as a PICT file. If the order of windows has changed, I select the window whose colors I want to capture by clicking on it, bringing it to the front. Then I fire the FKEY. The dialog box comes up. I type a descriptive filename into it, press Return, and Capture CLUT is done.

I quit the scanning application, and, using ResEdit 1.2, I copy the COLR resource from the file made by Capture CLUT. Then I paste it into the PICT file's resource fork. When I launch PixelPaint 1.0 and open the file, the image is rendered in the colors it deserves. The type and creator of the file made by Capture CLUT are recognized by PixelPaint, so I can also load a ready-made palette of colors to work with. If a graphics application uses a clut resource, I can use ResEdit in the same way to copy it into a PICT file and modify the ID numbers of the resource. The paint application does the rest when I open the file.

Today, Things Are Better

I made heavy use of Capture CLUT when color applications were evolving rapidly on the Mac II. I rarely use it now, because the software has matured to the point where many applications use the color table in the version 2 picture format. For example, PixelPaint 2.0 now imports PICT files and renders the colors properly, even if the COLR resource is absent. Not only that, but 32-Bit Quick-Draw corrects a number of Palette Manager bugs. The color mashing interaction I had observed with Klutz and PixelPaint 1.0 no longer occurs. Nevertheless, Capture CLUT was highly useful during that interval when matters of color were being sorted out.

The greatest value of Capture CLUT is that I learned a lot about how the Mac works, and this knowledge can be applied to other Mac problems. ■

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

PRODUCT SHOWCASE

■ BUYER'S MART
■ BYTE BITS

■ PRODUCT SPOTS
■ MICRO PRODUCT CENTER



NEC V20 & V30 CHIPS

Replace the 8086 or 8088 in Your IBM PC and Increase its Speed by up to 30% Price

UPD70108-8 (5MHz) V20 Chip	\$5.49	\$5.95
UPD70108-9 (8MHz) V20 Chip	\$9.49	\$7.95
UPD70108-10 (10MHz) V20 Chip	\$13.29	\$10.95
UPD70116-8 (8MHz) V30 Chip	\$9.99	\$7.95
UPD70116-10 (10MHz) V30 Chip	\$16.99	\$15.49

7400

Part No.	1-9	10+	1-9	10+	
7400	SALE	15	7474	SALE	25
7401	SALE	29	7475	SALE	39
7404	SALE	15	7476	SALE	35
7405	SALE	35	7483	SALE	59
7406	SALE	29	7485	SALE	45
7407	SALE	25	7486	SALE	29
7408	SALE	35	7489	SALE	135
7410	SALE	15	7490	SALE	39
7411	SALE	19	7493	SALE	35
7414	SALE	25	7495	SALE	29
7416	SALE	19	74107	SALE	13
7417	SALE	19	74121	SALE	25
7420	SALE	15	74173	SALE	25
7427	SALE	13	74125	SALE	35
7430	SALE	15	74147	SALE	149
7432	SALE	29	74150	SALE	1.10
7436	SALE	25	74151	SALE	13
7442	SALE	29	74152	SALE	1.35
7445	SALE	59	74161	SALE	59
7446	SALE	89	74173	SALE	59
7447	SALE	89	74174	SALE	59
7448	SALE	1.95	74175	SALE	2.25
7473	SALE	29	74193	SALE	69

74LS

74LS00	SALE	15	74LS139	SALE	29
74LS02	SALE	15	74LS151	SALE	29
74LS03	SALE	15	74LS152	SALE	25
74LS04	SALE	19	74LS154	SALE	1.10
74LS05	SALE	19	74LS157	SALE	35
74LS06	SALE	59	74LS161	SALE	29
74LS07	SALE	59	74LS163	SALE	25
74LS08	SALE	29	74LS164	SALE	25
74LS09	SALE	59	74LS165	SALE	65
74LS10	SALE	15	74LS166	SALE	69
74LS11	SALE	29	74LS173	SALE	35
74LS14	SALE	29	74LS174	SALE	29
74LS20	SALE	15	74LS175	SALE	29
74LS21	SALE	19	74LS181	SALE	29
74LS22	SALE	19	74LS182	SALE	69
74LS30	SALE	15	74LS193	SALE	69
74LS32	SALE	19	74LS194	SALE	45
74LS38	SALE	25	74LS221	SALE	49
74LS42	SALE	49	74LS240	SALE	45
74LS47	SALE	85	74LS241	SALE	49
74LS73	SALE	25	74LS244	SALE	49
74LS74	SALE	19	74LS245	SALE	59
74LS75	SALE	25	74LS257	SALE	29
74LS76	SALE	39	74LS259	SALE	89
74LS83	SALE	59	74LS273	SALE	69
74LS85	SALE	59	74LS281	SALE	49
74LS86	SALE	29	74LS287	SALE	29
74LS90	SALE	29	74LS373	SALE	59
74LS93	SALE	29	74LS374	SALE	49
74LS123	SALE	35	74LS393	SALE	69
74LS125	SALE	49	74LS554	SALE	99
74LS132	SALE	29	74LS569	SALE	5.35
74LS138	SALE	49	74LS588	SALE	2.99

74S/PROMS*

74S00	SALE	19	74S188*	SALE	1.49
74S04	SALE	19	74S189	SALE	1.48
74S32	SALE	19	74S240	SALE	1.39
74S74	SALE	19	74S244*	SALE	75
74S112	SALE	25	74S277*	SALE	1.49
74S124	SALE	1.25	74S281*	SALE	1.49
74S138	SALE	49	74S373	SALE	95
74S153	SALE	25	74S374	SALE	99
74S163	SALE	75	74S387*	SALE	1.29
74S174	SALE	25	74S472*	SALE	2.49
74S175	SALE	25	74S511*	SALE	2.49

CD-CMOS

CD4001	SALE	19	CD4051	SALE	59
CD4002	SALE	19	CD4052	SALE	59
CD4007	SALE	25	CD4053	SALE	59
CD4011	SALE	19	CD4060	SALE	65
CD4012	SALE	25	CD4069	SALE	29
CD4013	SALE	29	CD4070	SALE	29
CD4015	SALE	49	CD4071	SALE	22
CD4016	SALE	29	CD4072	SALE	22
CD4017	SALE	49	CD4073	SALE	22
CD4018	SALE	59	CD4081	SALE	22
CD4020	SALE	59	CD4083	SALE	26
CD4021	SALE	59	CD4084	SALE	89
CD4024	SALE	45	CD4093	SALE	25
CD4027	SALE	35	CD4503	SALE	69
CD4028	SALE	49	CD4511	SALE	69
CD4029	SALE	69	CD4520	SALE	75
CD4030	SALE	65	CD4522	SALE	75
CD4042	SALE	59	CD4528	SALE	69
CD4046	SALE	65	CD4538	SALE	65
CD4047	SALE	65	CD4543	SALE	65
CD4049	SALE	29	CD4584	SALE	79
CD4050	SALE	29	CD4585	SALE	69

EEPROMS

2816A	2048b	350ns	(9V/15V) 5V Read Write	3.25
2816A	2048b	750ns	(9V/15V) 5V Read Write	5.49
2817A	2048b	350ns	5V Read Write	6.95
2864A	8192b	250ns	5V Read Write (N/A) (N/A) 13.95	
2864A	8192b	300ns	5V Read Write (N/A) (N/A) 13.95	
2865A	8192b	250ns	5V Read Write (N/A) (N/A) 12.95	
52E13	2048b	350ns	(21V) 5V Read Only	1.49

MICROPROCESSOR COMPONENTS

Z80, Z80A, Z80B, SERIES		8000 SERIES Continued		8000 SERIES Continued	
Part No.	Price	Part No.	Price	Part No.	Price
Z80	1.19	8155-2	3.49	8286	2.29
Z80A	1.29	8155-5	3.49	8741	9.45
Z80A CTC	1.65	8156	2.95	8742	12.95
Z80A DART	4.95	8205	9.49	8748 (25V)	7.95
Z80A PIO	1.89	8211	6.95	8748B (HMOS(II)21V)	9.95
Z80A SIO	2.95	8212	2.29	8749	9.95
Z80B	0.95	8204	1.39	8751H (3.5-12MHz)	36.95
Z80B CTC	4.95	8204	1.49	8755	13.95
Z80B PIO	3.95	8208	1.49	88296-10 (10MHz) (CC-489)	9.95
Z88B1B1	8.95	8208	1.49	88287 3 (5MHz)	10.95
8000 SERIES		8243	1.75	88287 8 (8MHz)	20.95
8031	3.95	8251A	4.55	88287 10 (10MHz)	25.95
8031C	4.95	8251A (For IBM)	6.95	88386 16 PGA	27.95
8035	1.49	8253	1.89	88387 16 (16MHz) 395.95	
8039	1.95	8253	1.89	88387 25 (25MHz)	569.95
8052AHEBASIC	24.95	8253-5	1.95	88386 (8MHz)	9.49
8080A	2.45	8253-5	1.95	88386 (16MHz)	9.95
8085A	2.45	8255A	2.95	88386 (32MHz)	9.95
8085A-2	3.50	8255A-5	2.95	88386 (64MHz)	9.95
8085A-3	3.50	8255A-5	2.95	88386 (128MHz)	9.95
8087 (5MHz)	99.95	8255A-5	2.95	88386 (256MHz)	9.95
8087-1 (10MHz)	164.95	8259-5	2.25	88386 (512MHz)	9.95
8087-2 (8MHz)	134.95	8274	3.95	88386 (1024MHz)	9.95
8088 (5MHz)	4.95	8274	3.95	88386 (2048MHz)	9.95
8088-2 (8MHz)	6.95	8279-5	2.95	88386 (4096MHz)	9.95
81	4.95	8282	3.49	88386 (8192MHz)	9.95
8155	2.49	8284	1.75	88386 (16384MHz)	9.95

STATIC RAMS

Part No.	Function	Price
2018-12	2048b 120ns	3.25
2102	1024b 135ns	89
2112	256b 450ns MOS	2.49
2114N	1024b 450ns	99
2114N-2L	1024b 200ns Low Power	49
2114	1024b 200ns CMOS	49
2107	256b 450ns CMOS	2.49
6116P-1	2048b 100ns (16K) CMOS	2.49
6116P-3	2048b 150ns (16K) CMOS	2.49
6116LP-1	2048b 100ns (16K) LP CMOS	3.49
6116LP-3	2048b 150ns (16K) LP CMOS	3.49
6256P-10	8192b 100ns (64K) CMOS	9.95
6256P-15	8192b 150ns (64K) CMOS	9.95
6256LP-10	8192b 100ns (64K) LP CMOS	14.95
6256LP-12	8192b 120ns (64K) LP CMOS	14.95
6256LP-15	8192b 150ns (64K) LP CMOS	14.95
6514	1024b 350ns CMOS	3.75
4256P-10L	32 768b 100ns (256K) Low Power	26.95
4256P-15L	32 768b 150ns (256K) Low Power	26.95
4256P-10	32 768b 100ns (256K) LP CMOS	26.95
4256P-15	32 768b 150ns (256K) LP CMOS	26.95
62256LP-12	32 768b 120ns (256K) LP CMOS	26.95
62256LP-15	32 768b 150ns (256K) LP CMOS	26.95

DYNAMIC RAMS

421000A8-10	1 048 576b 100ns 1MEGx8 SIM	269.95
421000A8-10	1 048 576b 100ns 1MEGx8 SIP	269.95
421000A8-10	1 048 576b 100ns 1MEGx8 SIM	419.95
421000A8-10	1 048 576b 80ns 1MEGx8 SIM	269.95
421000A8-10	1 048 576b 80ns 1MEGx8 SIP	269.95
421000A8-12	16 384b 120ns	6.95
421000A8-15	16 384b 150ns	6.95
4116-15	16 384b 150ns (MMS290N-2)	4.99
4128-15	131 072b 150ns (Piggyback)	4.49
4164-100	65 536b 100ns	3.49
4164-120	65 536b 120ns	2.95
4164-150	65 536b 150ns	2.95
41256-60	262 144b 60ns	9.25
41256-80	262 144b 80ns	9.25
41256-100	262 144b 100ns	9.25
41256-120	262 144b 120ns	9.25
41256-150	262 144b 150ns	9.25
41264-12	64Kx4 120ns Video RAM	12.95
41454-10	65 536b 100ns	12.95
41454-12	65 536b 120ns	12.95
41454-15	65 536b 150ns	12.95
51256-10	262 144b 100ns Static Column	14.95
81256A8-10	262 144b 100ns 256b SIP	14.95
81256A8-10	262 144b 100ns 256b SIM	14.95
511000P-80	1 048 576b 80ns (1 Meg)	20.95
511000P-10	262 144b 100ns (1 Meg)	24.95
511000P-12	262 144b 120ns (1 Meg)	24.95
511000P-15	262 144b 150ns (1 Meg)	24.95

EPROMS

1MS2516	2048b	450ns (25V)	6.95
1MS2532	4096b	450ns (25V)	5.95
1MS2532A	4096b	450ns (12.5V)	4.49
1MS2564	8		

SPECIAL! Monochrome Text Card

Sperry Monochrome Display Adapter

- IBM PC/XT Compatible
- Use for Text only
- Great for Network Servers and Dedicated Work Stations

TEXT.....\$12.95



COMPUTER ACCESSORIES

DFI Handy Scanner and 3 Button Mice for IBM PC/XT/AT

FREE DPE Software with HS3000!

The HS3000 offers a full 4 inch window at 400dpi resolution. Scan photos, logos, drawings, etc. Can be used with today's most popular applications.

- HS3000 Handy Scanner\$179.95
 DMS200 200DPI 3-Button Ser. Mouse\$39.95
 DMS200S 200DPI 3-Button Ser. Mouse with Dr. Halo Software\$59.95



HS3000 Pictured

IBM Compatible Cases and Power Supplies

- JE1030 Pictured
 JE1010 Flip Top Standard PC/XT Case.....\$39.95
 JE1018 Side Baby AT Case.....\$59.95
 JE1030 150 watt PC/XT Power Supply.....\$59.95
 JE1032 200 watt Baby AT Power Supply.....\$89.95
 JE2010 Tower Case w/250 watt Pwr. Supply.....\$279.95
 JE2014 Flip Top Baby XT Turbo Case.....\$69.95
 JE2019 Flip Top Baby AT Case.....\$69.95



JE2010 Pictured

Datronics 2400/1200/300 Baud Pocket Size Modems

- 2400 Baud Pocket-Size Modem...Only \$149.95!
 2400P Pictured
 1200P 1200/300 Baud Pocket Size Modem With ProComm Software.....\$89.95
 2400P 2400/1200/300 Baud Pocket Size Modem With ProComm Software.....\$149.95



TEST EQUIPMENT

Metex Digital Multimeters

- Metex General Specs:
 • Handheld, high accuracy
 • AC/DC Voltage, AC/DC Current, Resistance, Diodes, Continuity, Transistor hFE • Manual ranging w/overload protection
M3650 B & M4650 only:
 • Also measures frequency and capacitance
M4650 only:
 • Data Hold Switch
 • 4.5 Digit



M4650 Pictured

- M3610 3.5 Digit Multimeter.....\$49.95
 M3650 3.5 Digit w/Freq. & Capacitance\$69.95
 M3650B Same as M3650 w/Bargraph.....\$79.95
 M4650 4.5 Dig w/Freq. Capacitance and Data Hold Switch\$99.95

Jameco 16MHz 80286 NEAT Computer Kit With 2 Megabyte RAM

- Fully IBM AT Compatible
- Free! QAPLUS Diagnostic Software Included!
- Free! PC Write Word Processing Software Included!
- 2Mb RAM Included, Expandable to 8Mb
- 8 or 16MHz Operation
- AMI BIOS ROMs Included
- Flip-Top Case w/200 Watt Power Supply
- 1.2Mb Disk Drive
- 18.0 Norton SI Rating
- 101-Key (Enhanced) Keyboard



SAVE \$190.55

Shown with VGA Option (not included)
 JE2055 Monitor and Adapter Card.....\$599.95 (See Below)

- JE3013 16MHz IBM AT Comp. Kit...\$1199.95 \$949.95
 EZDOS EZ-DOS: MS/PC-DOS Comp. Operating System.....\$49.95
 EZDOSP Same as above with TrueBASIC.....\$69.95

IBM COMPATIBLE DISPLAY MONITORS

- AMBER 12" Amber Monochrome\$99.95
 HD55H 14" RGB 640x240\$249.95
 TM5154 EGA 14" 720x350.....\$299.95
 JE1059 EGA Monitor & Card\$479.95
 TM5155 14" Multiscan 800x560.....\$479.95
 QC1478 14" VGA 720x480.....\$449.95
 JE2055 VGA Monitor & Card\$599.95



SALE!

QC1478 Pictured

JAMECO IBM PC/XT/AT COMPATIBLE CARDS

- JE1043 360K/720K/1.2Mb/1.44Mb Floppy Disk Controller Card (PC/XT/AT).....\$49.95
 JE1050 Monochrome Graphics Card w/Parallel Printer Port (PC/XT/AT).....\$59.95
 JE1052 Color Graphics Card w/Parallel Printer Port (PC/XT/AT).....\$49.95
 JE1055 EGA Card w/256K Video RAM (PC/XT/AT).....\$159.95
 GC1500 Orchid 8-Bit VGA Card w/256K Video RAM (PC/XT/AT).....\$249.95
 GC1501 Orchid 8-Bit VGA Card w/256K Video RAM (PC/XT/AT).....\$349.95
 JE1060 I/O Card w/Serial Game, Printer Port & Real Time Clock (PC/XT).....\$59.95
 JE1061 RS232 Serial Half Card (PC/XT).....\$29.95
 JE1062 RS232 Serial Half Card (AT).....\$34.95
 JE1065 I/O Card w/Serial Game and Parallel Printer Port (AT).....\$59.95
 JE1071 Multi I/O Card w/Controller & Monochrome Graphics (PC/XT).....\$119.95
 JE1077 Multi I/O Card w/360K/720K/1.2Mb/1.44Mb Floppy Controller (AT).....\$79.95
 JE1081 2Mb Expanded or Extended Memory Card (zero-K on-board) (AT).....\$99.95

SEAGATE HALF-HEIGHT HARD DISK DRIVES

- ST225 20Mb Drive only (PC/XT/AT).....\$224.95
 ST225XT 20Mb w/Controller (PC/XT).....\$269.95
 ST225AT 20Mb w/Controller (AT).....\$339.95
 ST238 30Mb Drive only (PC/XT/AT).....\$249.95
 ST238XT 30Mb w/Controller (PC/XT/AT).....\$299.95
 ST238AT 30Mb w/Controller (AT).....\$389.95
 ST251 40Mb Drive only (PC/XT/AT).....\$379.95
 ST251XT 40Mb w/Controller (PC/XT).....\$419.95
 ST251AT 40Mb w/Controller (AT).....\$489.95
 ST251-1 40Mb Fast 28ms (Drive only).....\$469.95

Your One-Stop Center for Hard Disk Drive Needs!



ST225XT Pictured

Seagate 60Mb, 80Mb & 120Mb Hard Disk Drives Also Available!

HARD & HARD/FLOPPY DISK CONTROLLERS

Computer Type	MFM Hard		RLI Hard		MFM Hard/Floppy		RLI Hard/Floppy	
	Part No./ Price	Part No./ Price	Part No./ Price	Part No./ Price	Part No./ Price	Part No./ Price	Part No./ Price	
8088 (PC/XT) 3:1 Interleave	XTGEN \$79.95	ACB2072 \$89.95	JE1044 \$129.95	.....	.....	.....	.....
80286 (AT)/386 2:1 Interleave	1003VMM1 \$129.95	1003VSR1 \$189.95	1003VMM2 \$149.95	1003VSR2 \$199.95	.....	.....	.....
80286 (AT)/386 1:1 Interleave	1006VMM1 \$149.95	1006VSR1 \$199.95	1006VMM2 \$179.95	1006VSR2 \$219.95	.....	.....	.....

IBM PC/XT/AT COMPATIBLE 3.5"/5.25" DISK DRIVES

- 352KU 3.5" 720Kb (PC/XT/AT)\$109.95
 356KU 3.5" 1.44Mb (PC/XT/AT)\$129.95
 JE1020 5.25" 360Kb (PC/XT/AT) Black\$89.95
 JE1021 5.25" 360Kb (PC/XT/AT) Beige\$89.95
 JE1022 5.25" 1.2Mb (PC/XT/AT) Beige\$99.95



JE1022 Pictured

MOTHERBOARDS

20MHz 386 Only \$749.95!

All w/OK RAM (except JE3027)

JE3520 Pictured



- JE1001 Jameco 4.77/8MHz 8088 (PC/XT).....\$89.95
 JE1002 Jameco 4.77/10MHz 8088 (PC/XT).....\$99.95
 JE3005 Jameco Baby 8-12MHz 80286 (AT).....\$279.95
 JE3010 Jameco Baby 8-16MHz 80286 (AT).....\$379.95
 JE3020 AMI Baby 16MHz 80386 (AT).....\$999.95
 JE3025 AMI Baby 20MHz 80386 (AT).....\$1199.95
 JE3026 AMI Full-Size 25MHz 80386 (AT).....\$1999.95
 JE3027 AMI Full-Size 33MHz 386 w/4Mb (AT).....\$4299.95
 JE3520 Jameco Baby 20MHz 80386 (AT).....\$749.95
 JE3525 Jameco Baby 25MHz 80386 (AT).....\$1499.95

SUPER SONY SALE

720Kb 3.5" Floppy Drive

• For use with IBM PC/XT/AT and compatible computers • Double-sided, double density • 135TPI • 160 tracks • Rotation speed 300rpm • Size 4" W x 6" D x 1" H

- MPF11 720Kb Drive\$59.95
 SMK 5.25" Mounting Kit.....\$14.95



PROTOTYPING PRODUCTS

Jameco Solderless Breadboards



Part No.	Dim. L" x W"	Contact Points	Binding Posts	Price
JE21	3.25 x 2.125	400	0	\$4.95
JE23	6.5 x 2.125	830	0	\$7.95
JE24	6.5 x 3.125	1,360	2	\$12.95
JE25	6.5 x 4.25	1,660	3	\$19.95
JE26	6.875 x 5.75	2,390	4	\$24.95
JE27	7.25 x 7.5	3,220	4	\$34.95

COMPUTER ACCESSORIES

Jameco IBM PC/XT/AT Compatible Keyboards



- JE2017 Pictured
 JE1015 84 Key Standard AT Layout\$59.95
 JE1016 101 Key Enhanced Layout\$69.95
 JE2016 111 Key Enhanced w/Solar Calculator\$79.95
 JE2017 104-Key Enhanced w/Trackball\$99.95

Colorado Memory 40Mb Tape Back-Up for IBM PC/XT/AT

- DJ10 40Mb Tape Back-Up and Tape.....\$299.95
 TB40 40Mb Tape Cartridge.....\$24.95

ENGINEERING/DATA BOOKS

- 21035 Sams TTL Cookbook (88).....\$14.95
 21398 Sams CMOS Cookbook (88).....\$19.95
 22453 Sams Op-Amp Cookbook (88).....\$21.95
 270645 Intel 8-bit Controller Hndbk (89).....\$19.95
 270646 Intel 16-bit Controller Hndbk (89).....\$19.95
 270647 Intel 32-bit Controller Hndbk(89).....\$19.95
 400041 NSC Linear Data Book Vol 1 (88).....\$14.95
 400042 NSC Linear Data Book Vol 2 (88).....\$9.95
 400043 NSC Linear Data Book Vol 3 (88).....\$9.95
 ICM89 1989 IC Master (3 Volume Set).....\$119.95

1355 Shoreway Road
 Belmont, CA 94002
 24 Hour Order Hotline (415) 592-8097
 FAX's (415) 592-2503 or (415) 595-2664
 Telex 176043 - Ans. Back. Jameco Bimt
 IC Data Sheets - 50c each
 Send \$2.00 Postage for a FREE 1989 Catalog
 ©1989 Jameco Electronics 9/89
 IBM is a registered trademark of International Business Machines



\$20.00 Minimum Order - U.S. Funds Only
 CA Residents Add 6%, 6.5% or 7% Sales Tax
 Shipping - Add 5% plus \$1.50 Insurance
 (May vary according to weight)
 Terms: Prices subject to change without notice
 We are not responsible for typographical errors.
 We reserve the right to substitute manufacturers.
 Items subject to availability and prior sale.
 Products pictured may only be representative.
 Complete list of terms/warranties is available upon request

24-Hour Order Hotline (415) 592-8097 • The Following Phone Lines Are Available From 7AM - 5PM P.S.T.:

• Customer Service (415) 592-8121 • Technical Assistance (415) 592-9990 • Credit Department (415) 592-9983 • All Other Inquiries (415) 592-7108

Build your own computer, it's fun and easy...

Jameco is pleased to announce the introduction of two new 80386-based computer kits. We offer the JE3550 starter kit for those just entering the world of 386 computing and the JE3555 power user kit for the serious enthusiast. These kits feature superior Jameco 386 motherboards with the Chips and Technology Chip Set for incredible speed, design reliability and full IBM compatibility. For more detailed specifications on the Jameco 386 motherboards see page 350 inside this advertisement. Each kit comes with complete step-by-step assembly instructions to help you set up your new system.

Using only a screwdriver, you can have your 386 computer system assembled and ready to run in only an evening! Included free with every Jameco computer kit is Diagsoft's QAPLUS diagnostic software and Quicksoft PC Write Word Processing Software. If you are ready to upgrade from your present computer system or simply want to enter the world of 386 computing, a Jameco 386 computer kit will help you learn more about how your computer works and save you money at the same time!

Jameco 20MHz 80386 Kit

- Fully IBM Compatible
- 60Mb Hard Disk Drive
- 80386-20 CPU, optional 80387-20 Math Coprocessor Capability
- 1 Megabyte RAM Included, Expandable to 8 Mb On-board, 16Mb w/optional expansion board (see next page)
- Parallel, Serial, Game Ports
- 8/16/20MHz Keyboard Switchable Operation
- AMI BIOS ROMs Included
- Free! QAPLUS Diagnostic and PC Write Software Included!
- Save \$259.45 (60 lbs.)



Shown with Multiscan Option (not included)
JE2056 Monitor and Adapter Card \$779.95
(See page 352)

Part No.	Description	Price
JE3520	Jameco Baby 20MHz 386 Motherboard..... (Zero-K RAM - includes AMI BIOS ROMs)	\$749.95
JE2019	Baby AT Flip-Top Case	69.95
JE1016	Enhanced 101-Key XT/AT Compatible Keyboard	69.95
JE1077	Multi I/O with Floppy Controller	79.95
JE1032	200 Watt Power Supply	89.95
JE1022	5.25" 1.2Mb DSHD Disk Drive (Gray Faceplate)	99.95
1006VSR1	RLL Hard Disk Controller Card with 1:1 Interleave	199.95
ST277	Seagate 60Mb Hard Disk Drive	409.95
41256A9A-10	1 Megabyte RAM (4 ea. 100ns 256K x 9 SIP modules)	279.80
Save \$259.45		Regular List
JE3550	20MHz 386 Kit w/60Mb Hard Drive	\$1789.95

Jameco 25MHz 80386 Power User Kit

- Fully IBM Compatible
- 120Mb Hard Disk Drive
- 80386-25 CPU, optional 80387-25 or Weitek 3167 Math Coprocessor Capability
- 4 Megabyte RAM Included, Expandable to 16Mb on the expansion card (included)
- High Density 3.5" and 5.25" Floppy Disk Drives
- Parallel, Serial and Game Ports
- 8/16/25MHz Keyboard Switchable Operation
- AMI BIOS ROMs Included
- Free! OAPLUS Diagnostic and PC Write Software Included!
- Save \$279.45 (65 lbs.)

With 120Mb Hard Drive!



Shown with M9070S Multiscan Monitor @ \$1199.95 and GC1501 VGA Card @ \$329.95 (not included) both items sold separately (See page 352)



Part No.	Description	Price
JE3525	Jameco Baby 25MHz 386 Motherboard (Zero-K RAM - includes AMI BIOS ROMs and 16Mb Expansion Card)	\$1499.95
JE1016	Enhanced 101-Key XT/AT Compatible Keyboard	69.95
JE1077	Multi I/O with Floppy Controller	79.95
JE1022	5.25" 1.2Mb DSHD Disk Drive (Gray Faceplate)	99.95
356KU	3.5" 1.44Mb Floppy Disk Drive	129.95
1006VSR1	RLL Hard Disk Controller Card with 1:1 Interleave	199.95
JE2010	Tower Case with 250 Watt Power Supply	279.95
ST4144	Seagate 120Mb Hard Disk Drive	699.95
421000A9A-80	4 Megabyte RAM (4 ea. 80ns 1Meg x 9 SIP modules)	919.80

Save \$279.45 **Regular List** **\$3979.40**

JE3555 25MHz 386 Kit w/120Mb Hard Drive..... **\$3699.95**

• REFER TO CODE 4039 WHEN ORDERING • CALL (415) 592-8097

Jameco's new 386 motherboards utilize the latest Chips and Technology 386 Chip Set for outstanding performance and speed at low prices. Both boards feature an XT footprint which makes them ideal for those users who want to upgrade their current systems to 386, but do not want to replace all of their peripherals or case.

JE3520 Features:

- 8/20 MHz selectable operation - Fully IBM AT Compatible
- Expandable to 8Mb on board using 100ns 1Mb SIPs (also uses 256K SIPs), 16Mb using the optional JE3530 memory card
- Near zero wait state using interleaved memory
- 80387-20 Math Coprocessor capability
- 8 expansion slots - one 32-bit (for optional memory card), five 16-bit, two 8-bit
- Norton SI Rating of 22.0
- Shadow RAM for BIOS and fast video performance
- Adjustable bus speeds and wait states
- Includes rechargeable battery pack
- Includes AMI BIOS ROMs
- Size: 8.5" x 13"; Weight: 3 lbs.; One-Year Warranty

JE3525 Features:

- 8/25 MHz selectable operation - Fully IBM AT Compatible
- Expandable to 16Mb on the memory card (supplied) using 80ns 1Mb SIPs (also uses 256K SIPs)
- Uses Intel's 82385 Cache controller for near zero wait states
- 80387-25 or Weitek 3167 Math Coprocessor capability
- 7 expansion slots - one 32-bit (for memory card), four 16-bit, two 8-bit
- Norton SI rating of 30.5
- Shadow RAM for BIOS and fast video performance
- Adjustable bus speeds and wait states
- Includes rechargeable battery pack
- Includes AMI BIOS ROMs
- Size: 8.5" x 13"; Weight: 3 lbs.; One-Year Warranty

1-Year Warranty!

NEW! Jameco 20 and 25MHz 80386 Baby Motherboards



JE3520 Pictured

Part No.	Description	Price	Price
JE3520	Jameco 20MHz 80386 AT Compatible Baby Motherboard (Zero-K RAM)	\$799.95	\$749.95
JE3525	Jameco 25MHz 80386 AT Compatible Baby Motherboard w/16Mb Memory Card (Zero-K RAM)	\$1699.95	\$1499.95
JE3530	Jameco 8 Megabyte 32-bit Plug-in Memory Card for JE3520 (Zero-K RAM)	\$149.95	\$129.95

AMI 80386 motherboards are known for their quality, speed and reliability. BYTE magazine called the AMI motherboards "superior". These boards feature 64K of high speed static cache RAM and Video BIOS shadow RAM for exceptionally fast video performance.

AMI 16, 20, 25 and 33MHz 80386 Motherboards

NEW, 33MHz 386!

"Our benchmarks demonstrate the superiority of the AMI-type motherboard..."
- Quoted from BYTE Magazine October 1988

JE3020 and JE3025 Features:

- 8/16MHz (JE3020) or 8/20MHz (JE3025) selectable operation - Fully IBM AT Compatible
- Expandable to 2Mb on-board using 100ns (120ns for JE3020) 256K DRAMs and 10Mb with the JE3030 daughterboard option
- Near zero wait state
- 80387-16 (JE3020) and 80387-20 (JE3025) or Weitek 1167 Math Coprocessor capability
- 8 expansion slots - one 32-bit (for optional memory card), six 16-bit and one 8-bit
- Norton SI rating of 18.7 for the JE3020 and 24.2 for the JE3025
- Shadow RAM for BIOS and fast video performance
- Built-in setup and diagnostics
- Includes AMI BIOS ROMs
- Size: 8.5" x 13"; Weight: 3 lbs.; One-Year Warranty

JE3026 and JE3027 Features:

- 8/25MHz (JE3026) or 8/33MHz (JE3027) selectable operation - Fully IBM AT Compatible
- JE3026 does not include RAM, the JE3027 comes populated with 4 Megabyte RAM
- Expandable to 8Mb on-board using 70ns (80ns for JE3026) 1Mb chips and 1Mb SIMMs. Expandable to 24Mb using JE3030/3031 (not included)
- When 4Mb DRAMs and SIMMs become available, the JE3026 is ready for them allowing expansion to 32Mb on the motherboard and 48Mb using the JE3030/3031 optional combination
- Near zero wait state
- 80387-25 (JE3026) and 80387-33 (call for availability) (JE3027) or Weitek 3167 Math Coprocessor capability
- 8 expansion slots - one 32-bit (for optional memory card), six 16-bit and one 8-bit
- Norton SI rating of 30.3 for the JE3026 and 39.1 for the JE3027
- Shadow RAM for BIOS and fast video performance
- Built-in setup and diagnostics
- Includes AMI BIOS ROMs
- Size: 12" x 13.75"; Weight: 3.25 lbs.; One-Year Warranty



JE3025 Pictured

1-Year Warranty!

SALE, New Lower Pricing!

Part No.	Description	Price	Price
JE3020	AMI 16MHz 80386 AT Compatible Baby Motherboard (Zero-K RAM)	\$1199.95	\$999.95
JE3025	AMI 20MHz 80386 AT Compatible Baby Motherboard (Zero-K RAM)	\$1499.95	\$1199.95
JE3026	AMI 25MHz 80386 AT Compatible Full-Size Motherboard (Zero-K RAM)	\$2299.95	\$1999.95
JE3027	NEW! AMI 33MHz 80386 AT Compatible Full-Size Motherboard (Includes 4 Megabyte RAM) ..	\$4499.95	\$4299.95
JE3030	AMI 8 Megabyte Daughterboard for JE3020, JE3025 and JE3026 (Zero-K RAM)		\$249.95
JE3031	AMI 8 Megabyte 32-bit Plug-In Memory Card for the JE3026 and JE3027 (Zero-K RAM)		\$269.95

• QUALITY COMPONENTS • COMPETITIVE PRICING • PROMPT DELIVERY • (415) 592-8097

8088 AND 80286 MOTHERBOARDS

1-YEAR WARRANTY!

12MHz 80286 Motherboard IBM AT Compatible

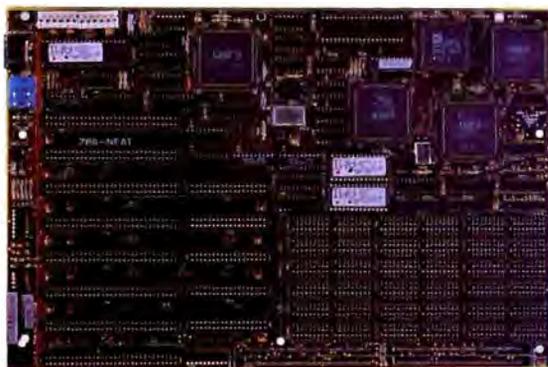
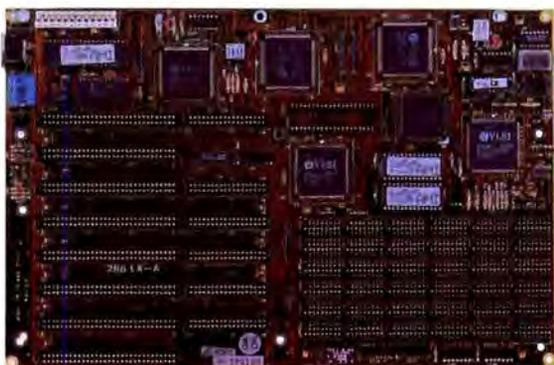
SALE!

- Expandable to 1Mb RAM using 256K DRAM chips
- Expandable to 4Mb RAM using 1Mb DRAM chips
- Uses 100ns DRAMs
- Battery-backed clock/calendar
- 8 or 12MHz hardware or keyboard selectable operation
- Front panel LED indicators supported
- Six 16-bit and two 8-bit expansion bus slots
- AMI BIOS ROMs included
- 12 MHz Intel CPU
- Selectable wait states (0 or 1)
- 80287-8 Math Coprocessor capability
- Norton SI rating of 13.7
- Size: 13" x 8.75"
- Weight: 2.25 lbs.

16MHz 80286 NEAT Motherboard IBM AT Compatible

SALE!

- Expandable to 1Mb RAM using 256K DRAM chips or 4Mb using 1Mb DRAM chips
- Additional 1Mb with 256K DRAM SIPs or 4Mb with 1Mb DRAM SIPs for a total of 8Mb
- Uses 100ns DRAMs
- Battery-backed clock/calendar
- 8/16MHz selectable
- Front panel LED indicators supported
- AMI BIOS ROMs included
- Five 16-bit and three 8-bit expansion bus slots
- 16MHz CMOS Harris CPU
- Supports all NEAT functions including shadow RAM, EMS 4.0 RAM re-mapping, selectable wait states, memory interleaving, etc.
- 80287-10 Coprocessor capability
- Norton SI rating of 18.0
- Size: 13" x 8.5"; Weight: 2.25 lbs.



JE3005 8/12MHz 80286 Motherboard... ~~\$299.95~~ **\$279.95**

JE3010 8/16MHz 80286 NEAT Motherboard... ~~\$399.95~~ **\$379.95**

COMPUTER KEYBOARDS

1-Year Warranty!

111-Key Enhanced Keyboard with Calculator for IBM PC/XT/AT and Compatible Computers



Benefit from increased productivity with Jameco's new JE2016 keyboard with built-in solar powered calculator!

- XT/AT Switchable • 111-Key Enhanced Layout • 12 Function Keys • LED Indicators for Num Lock, Caps Lock, and Scroll Lock • Large Return Key • Separate cursor/keypad • Tactile touch keyswitches • Color: Beige • Manual Included • Size: 19.5"W x 7.6"D x 1.5"H • Weight: 3.6 lbs.

JE2016 **\$79.95**

104-Key Enhanced Keyboard with Trackball for IBM PC/XT/AT and Compatible Computers

• Fully Microsoft Mouse and Mouse Systems Compatible • 200 DPI Resolution



The JE2017 combination keyboard and trackball will enable you to use your mouse-based computer applications with greater ease and efficiency!

- XT/AT Switchable • 104-Key Enhanced Layout • 12 Function Keys • LED Indicators for Power, Num Lock, Caps Lock, and Scroll Lock • Large Return Key • Separate cursor/keypad • Tactile touch keyswitches • Color: Beige • Manual and software drivers Included • One open serial port required for operation • Size: 18.6"W x 7.5"D x 1.75"H • Wt: 4 lbs.

JE2017 **\$109.95** **\$99.95**

84-Key Keyboard

for IBM PC/XT/AT and Compatible Computers

IBM's original AT Style layout!

- XT/AT Switchable
- 84-Key AT Style Layout
- LED Indicators for Num Lock, Caps Lock, and Scroll Lock
- Large Shift and Return Keys
- Tactile touch keyswitches
- Color: Beige
- Manual Included
- Size: 19.5"W x 7.5"D x 1.33"H
- Weight: 4.6 lbs.



JE1015 **\$59.95**

101-Key Enhanced Keyboard

for IBM PC/XT/AT and Compatible Computers

Our most popular keyboard!

- Automatically switches between XT or AT
- 101-Key Enhanced Layout
- 12 Function Keys
- LED Indicators for Num Lock, Caps Lock, and Scroll Lock
- Separate cursor/keypad
- Tactile touch keyswitches
- Spec. Included
- Color: Beige
- Size: 19"W x 8"D x 1.33"H
- Weight: 4.6 lbs.



JE1016 **\$69.95**

• REFER TO CODE 4039 WHEN ORDERING • CALL (415) 592-8097

Jameco's 8088 and 80286 IBM PC/XT/AT compatible kits allow you to build your own computer and come with complete step-by-step assembly instructions. **FREE Word Processing and Diagnostic Software included! NOW AVAILABLE . . . Jameco's new System Tech Manual and DOS.** Computer tool and maintenance kits also available. Please note: JE3008 and JE3013 shipped in 1 box (43 lbs. total) - JE3002 and JE3003 shipped in 2 boxes (55 lbs. total)

12MHz 80286 Computer Kit

- Fully IBM AT Compatible
- Free! QAPLUS Diagnostic Software Included!
- Free! PC Write Word Processing Software Included!
- DOS Available
- 80286 CPU, optional 80287-8 Math Coprocessor Capability
- 512K RAM Included.
- 8 or 12MHz Keyboard Switchable Operation
- Clock/Calendar
- AMI BIOS ROMs Included
- Save \$156.55



Shown with EGA Option (not included)
JE1059 Monitor and Adapter Card \$479.95
(See page 352)

Part No.	Description	Price
JE3005	8/12MHz Baby 80286 Motherboard (Zero-K RAM - includes AMI BIOS ROMs)	\$279.95
JE1016	Enhanced AT Style Keyboard	69.95
JE2019	Baby AT Flip-Top Case	69.95
JE1077	Multi I/O Card with Universal Floppy Controller	79.95
JE1022	5.25" DSHD Disk Drive (Gray Faceplate)	99.95
JE1032	200 Watt Power Supply	89.95
41256-100	512K RAM (18 chips)	116.80

SAVE \$156.55 SALE! Regular List \$806.50
JE3008 12MHz 80286 Computer Kit **\$799.95 \$649.95**

16MHz 80286 NEAT Computer Kit

- Fully IBM AT Compatible
- Free! QAPLUS Diagnostic Software Included!
- Free! PC Write Word Processing Software Included!
- DOS Available
- 80286 CPU, optional 80287-10 Math Coprocessor Capability
- 2 Megabyte RAM Included, Expandable to 8 Megabyte
- 8 or 16MHz Keyboard Switchable Operation
- Clock/Calendar
- AMI BIOS ROMs Included
- Save \$190.55



Shown with VGA Option (not included)
JE2055 Monitor and Adapter Card \$599.95
(See page 352)

Part No.	Description	Price
JE3010	8/16MHz 80286 NEAT Motherboard (Zero-K RAM - includes AMI BIOS ROMs)	\$379.95
JE1016	Enhanced AT Style Keyboard	69.95
JE2019	Baby AT Flip-Top Case	69.95
JE1077	Multi I/O Card with Universal Floppy Controller	79.95
JE1032	200 Watt Power Supply	89.95
JE1022	5.25" DSHD Disk Drive (Gray Faceplate)	99.95
511000P-10	2Mb RAM (18 chips)	350.80

SAVE \$190.55 SALE! Regular List.....\$1140.50
JE3013 16MHz 80286 NEAT Kit.....**\$1199.95 \$949.95**

8MHz 8088 Computer Kit

- Fully IBM PC/XT Compatible
- Free! QAPLUS Diagnostic Software!
- Free! PC Write Word Processing Software Included!
- DOS Available
- 256K RAM Included, Expandable to 640K
- 4.77 or 8MHz Switchable Operation
- Parallel Printer Port
- AMI BIOS ROM Included
- Save \$102.66



• Please note, PC Write will require 512K RAM for operation.

Part No.	Description	Price
JE1001	4.77/8MHz 8088 Turbo Motherboard (Zero-K RAM - includes AMI BIOS ROM)	\$89.95
JE1040	360K Floppy Controller	29.95
JE1010	Flip-Top Case	39.95
JE1015	XT/AT Compatible Keyboard	59.95
JE1030	150 Watt Power Supply	59.95
JE1050	Mono/Graphics Card w/Printer Port	59.95
JE1020	5.25" DSDD Disk Drive (Black Faceplate)	89.95
AMBER	12" Monochrome Amber Monitor	99.95
41256-150	256K RAM (9 chips)	53.01

SAVE \$102.66 SALE! Regular List.....\$582.61
JE3002 8MHz 8088 Turbo Kit **\$499.95 \$479.95**

10MHz 8088 Computer Kit

- Fully IBM PC/XT Compatible
- Free! QAPLUS Diagnostic Software Included!
- Free! PC Write Word Processing Software Included!
- DOS Available
- 640K RAM Included
- 4.77 or 10MHz Switchable Operation
- AMI BIOS ROM Included
- Multi I/O Card
- Save \$109.82



Part No.	Description	Price
JE1002	4.77/10MHz 8088 Turbo Motherboard (Zero-K RAM - includes AMI BIOS ROM)	\$99.95
JE1015	XT/AT Compatible Keyboard	59.95
JE1031	Mini 150 Watt Power Supply	69.95
JE2014	Turbo Flip-Top Case	69.95
JE1021	5.25" DSDD Disk Drive (Beige Faceplate)	89.95
JE1071	Multi I/O w/Controller and Graphics	119.95
AMBER	12" Monochrome Amber Monitor	99.95
4164-120	Parity RAM (2 chips)	5.70
41256-120	512K RAM (18 chips)	111.42
41464-12	128K RAM (4 chips)	33.00

SAVE \$109.82 SALE! Regular List\$759.77
JE3003 10MHz 8088 Turbo Kit **\$699.95 \$649.95**

• QUALITY COMPONENTS • COMPETITIVE PRICING • PROMPT DELIVERY • (415) 592-8097

Nanao 16" Multiscan Monitor
for IBM PC/XT/AT, PS/2 and Compatible Computers

NEW!

The M9070S, 16 inch multiscanning color monitor, provides you with the display potential to take full advantage of today's and tomorrow's workstations. The M9070S offers compatibility with IBM PC/XT/AT, PS/2, Apple Macintosh II and AT&T PC6300. The M9070S was designed to be used with a wide range of graphics boards (including the GC1500 & GC1501 VGA cards), and personal computers, including VGA, EGA, PGC, Mac II and the SuperMac Spectrum. The Nanao FLEXSCAN technology provides a wide range of scanning to fulfill your computing requirements, including Desktop Publishing, Business Graphics, CAD/CAE and much more. The monitor is equipped with an XF (Extended Field) gun to obtain brightness and sharp focus for high performance and high resolution (up to 1,280 x 800) in a compact package at a reasonable price. Monitor comes with tilt/swivel base, manual and cable.

Specifications: • CGA/EGA/VGA/PGC Compatibility • Color, White or Amber Switchable • Non-glare, tinted display, unlimited color display • Input: DB9-pin (TTL) & DB15-pin (Analog) • Hor. Scanning freq. 20-50kHz • Ver. Scanning freq. 50-80kHz • Resolution: 1,024 x 768, max: 1,280 x 800 • Dot Pitch: 31mm • Bandwidth: Analog-60MHz, TTL-30MHz • Size: 15.75"W x 17"D x 15"H • Weight: 39 lbs. • One-Year Warranty.

M9070S 16" Multiscan Monitor.....\$1199.95



Casper 14" Multiscan Monitor and Orchid 16-Bit VGA Card Package
for IBM PC/XT/AT and Compatible Computers

SALE!

The TM5155 monitor is designed to take full advantage of newly developed graphics adapters including the GC1500 and GC1501. The TM5155 can operate in several different display modes to run today's most popular software. Monitor comes with tilt/swivel base, manual and cable.

FREE! ColorIX VGA Paint Demonstration Disk enclosed with every JE2056!



TM5155 Specifications: • CGA/EGA/VGA/PGC Compatibility • Input: DB9-pin (TTL) & DB15-pin (Analog) • Hor. Scanning freq.: 15.5-40kHz • Max. Resolution: 800 x 600 • Bandwidth: 40MHz • Size: 15"W x 15"D x 13.5"H • Weight: 35lbs. • One-Year Warranty

Part No.	Description	Price
TM5155	14" Multiscan Monitor.....	\$479.95
GC1501	16-Bit Orchid VGA Card.....	\$349.95 \$329.95
JE2056	TM5155 Multiscan Monitor & GC1501 Card SAVE \$30.00!	\$779.95

Quadrant 14" VGA Monitor and Orchid 8-Bit VGA Card Package
for IBM PC/XT/AT, PS/2 and Compatible Computers

SALE!

The QC1478 VGA monitor is capable of very high resolution (up to 720 dots horizontal resolution) and meets the requirements for compatibility with a large number of today's VGA cards including the GC1500 and GC1501. Monitor comes with tilt/swivel base, manual and cable.

FREE! ColorIX VGA Paint Demonstration Disk enclosed with every JE2055!



QC1478 Specifications: • VGA Compatibility • Non-glare, tinted display, unlimited color capability • Input: DB15-pin High Density connector (Analog) • Scanning freq.: 31.5kHz • Resolution: 720 x 480 (max.) • Bandwidth: 30MHz • Size: 14.17"W x 14.84"D x 14.25"H • Weight: 26 lbs. • One-Year Warranty

Part No.	Description	Price
QC1478	14" VGA Monitor.....	\$449.95 \$399.95
GC1500	8-Bit Orchid VGA Card.....	\$269.95 \$249.95
JE2055	QC1478 VGA Monitor and GC1500 Card SAVE \$50.00!	\$649.95 \$599.95

Casper 14" EGA Monitor and Jameco EGA Card Package
for IBM PC/XT/AT and Compatible Computers

SALE!

The TM5154 EGA Monitor is ideal for text as well as CAD and other graphics applications. Features compact case with anti-glare screen for easy viewing. Monitor comes with a tilt/swivel base, cable and manual.



TM5154 Specifications: EGA/CGA compatibility • Input: DB9 (TTL) • Hor. Scanning freq.: 15.75-21.85kHz • Resolution: 720 x 350 (max.) • Bandwidth: 25MHz • Size: 15"W x 14.25"D x 14"H • Weight: 35 lbs. • One-Year Warranty

Part No.	Description	Price
TM5154	14" CGA/EGA Monitor.....	\$399.95 \$369.95
JE1055	EGA Card.....	\$149.95
JE1059	TM5154 & JE1055 SAVE \$40.00	\$499.95 \$479.95

Quadrant 14" Flat Screen Amber and Paper White Monitors
for IBM PC/XT/AT and Compatible Computers

Ideal for Desktop Publishing!

These new flat screen 14" Amber and Paper White monitors are ideal for desktop publishing and CAD applications where limited distortion is desired. They feature a compact case with an anti-glare screen, an inverse video switch, detachable tilt/swivel base, cable and manual.

Specifications: Input: • DB9 (TTL) • Bandwidth: 20MHz • Horizontal scanning frequency: 18.432kHz • Resolution: 720 x 348 (max.) • Size: 12.75"W x 12.2"D x 13.6"H • Weight: 16 lbs. • One-Year Warranty



QC1418P

Part No.	Description	Price
QC1418	14" Flat Screen Amber Monochrome Monitor.....	\$119.95
QC1418P	14" Flat Screen Paper White Monochrome Monitor.....	\$119.95

12" Amber Monochrome Monitor
for IBM PC/XT/AT and Compatible Computers

• Input: DB9-pin (TTL) • Bandwidth: 20MHz • Horizontal scanning frequency: 18.432kHz • Resolution: 720 x 348 • Size: 12.5"W x 12"D x 12"H • Weight: 19 lbs. • Compatible with the JE1050, JE1055 and JE1071 • Cable and Manual included



AMBER.....\$99.95

Casper 14" RGB Color Monitor
for IBM PC/XT/AT and Compatible Computers

• Input: DB9-pin (RGB) • Bandwidth: 21MHz • Horizontal scanning frequency: 15.75kHz • Resolution: 640 x 240 • Switch for Green or Color Screen • Size: 13.75"W x 14.25"D x 14.5"H • Weight: 27 lbs. • Compatible with the JE1052 and JE1055 • Cable and Manual included • One-year warranty.



HD55H.....\$239.95

• QUALITY COMPONENTS • COMPETITIVE PRICING • PROMPT DELIVERY • (415) 592-8097

NEW, ESDI Hard Drive!

HARD DISK DRIVES

NEW, SCSI Hard Drives!

From the World's largest manufacturer of personal system hard disks, comes a full range of drives to fit your needs. Seagate drives offer versatile storage solutions for today's PC, XT, AT or 386-based computer systems. The NEW Seagate SCSI (Scuzzy) Hard Drives are compatible with such popular systems as Macintosh, Tandy, Amiga and Atari. These new SCSI drives will also work with IBM PC/XT/AT/386 and compatibles when used with a SCSI host adapter (see inside back cover). Known for their quality and reliability, our Seagate hard disk drives are available with or without controller cards and come with easy to follow step-by-step instructions. The instructions will take you through mounting installation, formatting and partitioning. Jameco's hard disk kits come complete with everything you need, including controller card, cables, manual and software when necessary. All Seagate drives are backed by a One-Year Warranty.



With or without a Controller Card, Jameco has a Seagate Hard Disk Drive to fit your needs!

HH=Half Height, FH=Full Height

Part No.	Capacity	Style	Average Speed	Format	Drive Alone	W/8-Bit (XT) Controller	W/16-Bit (AT) Controller
*ST125N**	20Mb	3.5" HH	40ms	SCSI	\$299.95	.....	.....
*ST138N**	30Mb	3.5" HH	40ms	SCSI	\$349.95	.....	.....
*ST157N**	40Mb	3.5" HH	40ms	SCSI	\$399.95	.....	.....
*ST125	20Mb	3.5" HH	40ms	MFM	\$259.95	.....	.....
*ST138R	30Mb	3.5" HH	40ms	RLL	\$289.95	.....	.....
*ST157R	40Mb	3.5" HH	40ms	RLL	\$379.95	.....	.....
ST225	20Mb	5.25" HH	65ms	MFM	\$224.95	.....	.....
ST225XT	20Mb	5.25" HH	65ms	MFM	.....	\$269.95	.....
ST225AT	20Mb	5.25" HH	65ms	MFM	.....	.....	\$339.95
ST238	30Mb	5.25" HH	65ms	RLL	\$249.95	.....	.....
ST238XT	30Mb	5.25" HH	65ms	RLL	.....	\$299.95	.....
ST238AT	30Mb	5.25" HH	65ms	RLL	.....	.....	\$389.95
ST251	40Mb	5.25" HH	40ms	MFM	\$379.95	.....	.....
ST251XT	40Mb	5.25" HH	40ms	MFM	.....	\$419.95	.....
ST251AT	40Mb	5.25" HH	40ms	MFM	.....	.....	\$489.95
ST251-1	40Mb	5.25" HH	28ms	MFM	\$489.95	.....	.....
ST277	60Mb	5.25" HH	40ms	RLL	\$409.95	.....	.....
ST277XT	60Mb	5.25" HH	40ms	RLL	.....	\$449.95	.....
ST277AT	60Mb	5.25" HH	40ms	RLL	.....	.....	\$549.95
ST4096	80Mb	5.25" FH	28ms	MFM	\$629.95	.....	.....
ST4144	120Mb	5.25" FH	28ms	RLL	\$699.95	.....	.....

*5.25" installation kit available for IBM PC/XT/AT and compatibles - see below.

**Please note that these are SCSI drives for use with systems such as the Macintosh, Tandy, Amiga and Atari. SCSI host adapter required for use with the IBM PC/XT/AT or compatibles

PC/XT Compatible Kit!

NEW, 3.5" MFM, RLL and SCSI Drives!

NEW, 120Mb Drive!



ST225XT



ST157N



ST4144

525K 5.25" Frame Kit allows installation of Seagate 3.5" half height Hard Disk Drives in IBM PC/XT/AT or compatible computer cases.....\$12.95

MiniScribe 150 Megabyte ESDI Hard Disk Drive

The MiniScribe M3180E, ESDI (Enhanced Small Device Interface) will perform up to two times faster than MFM encoded drives and 1.5 times faster than RLL encoded drives. In addition, the newest generation of personal computers are featuring smaller footprints, lower profiles and are packed with high performance. The MiniScribe M3180E takes advantage of all these new features with superior compact design and performance. This half height drive will fit in virtually all IBM PC/XT/AT standard and baby computer cases, including Jameco's JE Series cases. Features superior shock, vibration and thermal performance due to the four point mounting system and enhanced baseplate design. Also, features low power dissipation of only 15 watts when idle. Requires ESDI controller such as the JE2041 ESDI controller

Specifications: • Track to track access time: 4.0 msec. • Average access time: 17 msec. • Data transfer rate up to 10 Mbit/second • Size: 5.75"W x 8"D x 1.63"H • Weight: 4 lbs.



150 Megabytes in a half height package!

M3180E..... **\$1149.95**

ESDI Hard & Floppy Disk Controller Card

for 80286/AT Compatibles and 80386 Based Computers

This ESDI (Enhanced Small Device Interface) is capable of handling two hard disk and two floppy disk drives. The JE2041 will control HDDs up to 1000Mb and any combination of two floppy 360K, 720K, 1.2Mb or 1.44Mb disk drives. The JE2041 boasts performance figures up to 2 times faster than MFM and up to 1.5 times faster than RLL Hard Disk Controllers.

Features: • Works on 16-bit 80286 or 32-bit 80386 machines • On-board preformat program and head-parking program • Cables included to connect one hard disk and two floppy disk drives • Manual Included • One-Year Warranty



JE2041..... **\$199.95**

Seagate SCSI Host Adapter

- SCSI (Scuzzy) host adapter for IBM PC/XT/AT and compatibles as well as 386 "Classic Bus" computers
- Extremely fast data transfer rate (up to 10 Megabits a second)
- Will control up to two SCSI hard disk drives
- Also supports other SCSI devices such as: scanners, printers, modems, mice, optical disks and tape drives
- On-board preformat & head parking program
- Cable and manual included
- One-Year Warranty



ST01..... **\$49.95**

• REFER TO CODE 4039 WHEN ORDERING • CALL (415) 592-8097

THE BUYER'S MART

A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

RATES: 1x—\$525 3x—\$500 6x—\$475 12x—\$425
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must

furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Brian Higgins at 603-924-3754.

ACCESSORIES

CUT RIBBON COSTS!

Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one inker! For crisp, black professional print since 1982. You can choose from 3 models: Manual E-Zee Inker — \$39.50
Electric E-Zee Inker — \$94.50
Ink Master (Electric) — \$189.00
1000's of satisfied users. Money-back guarantee.

BORG INDUSTRIES

525 MAIN ST., JANESVILLE, IA 50647
1-800-553-2404 Fax: 319-987-2251

Inquiry 576.

ARTIFICIAL INTELLIGENCE

NATURAL LANGUAGE C LIBRARY

Increase your market share! Use JAKE to add a natural language front end to your application. JAKE translates English queries and commands into C function calls and data structures. JAKE offers context-sensitive semantic processing; interfaces easily; <64K mem.

JAKE \$495. INTERACTIVE DEMO \$10

ENGLISH KNOWLEDGE SYSTEMS, INC.

5525 Scotts Valley Dr. #22, Scotts Valley, CA 95066
(408) 438-6922

Inquiry 581.

BAR CODE

PRINT BAR CODES AND BIG TEXT

On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 13 text sizes to 1" readable at 50'. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39. File Input & Scanned logos/symbols (PCX)—\$279. Other programs from \$49. 30-day \$\$ back.

Worthington Data Solutions

417A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

COMPANION AND EXTENDER

Place a keyboard and monitor up to 600' from your CPU with EXTENDER and COMPANION products. Keep a second Keyboard/Monitor at the CPU with COMPANION. Supports MDA, CGA, EGA, VGA, PS2. Uses single 3/4" cable.
Prices start at \$149.00 for EXTENDER and \$219.00 for COMPANION 25 ft. unit complete.

CYBEX CORPORATION

2800-H Bob Wallace, Huntsville, AL 35805
205-534-0011 International Fax # 205-837-9212

Inquiry 577.

BAR CODE READERS

For PC, XT, AT, & PS/2, all clones, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—\$399. Top rating in independent reviews. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. 30-day \$\$ back.

Worthington Data Solutions

417A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

WHOLESALES PRICE

Ribbons, Surge protector, CPU stand, Keyboard drawer, Monitor base, Mouse pad, Power center, Printer center, Toner Cartridge and much more.

First Accessories

1455 A Market St., #648, SF, CA 94103
415-569-8323

Inquiry 578.

muLISP™ 87 for MS-DOS

Fast, compact, efficient LISP programming environment. muLISP programs run 2 to 3 times faster & take 1/2 to 1/3 the space of other LISPs. 450 Common LISP functions, multi-window editing & debugging, flavors, graphics primitives, lessons & help, demo programs, comprehensive manual.

Soft Warehouse, Inc.

3615 Harding Ave., Suite 505, Honolulu, HI 96816
(808) 734-5801

Inquiry 582.

BAR CODE SOLUTIONS

Bar coding is so easy with our complete line of readers. Our PC-Wand readers emulate your PC keyboard or ASCII terminal, and are carried around taking inventory, entering road sales and checking time. Our bar code label printing software packages work with DOS and most matrix or laser printers. We also sell pre-printed labels. Our hardware can work with nearly every computer in the world.

International Technologies & Systems Corp.

635-C North Berry St., Brea, CA 92621
(714) 990-1880 FAX: 714 990-2503 TLX 6502824734 MCI

Inquiry 583.

BAR CODE

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM

Add bar codes and big graphics characters to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39, Epson, OKI, IBM dot matrix text up to 1/2". LaserJet up to 2". Font cartridges not required. \$179-\$239. 30-day \$\$ back.

Worthington Data Solutions

417A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

Inquiry 579.

BAR CODE SOFTWARE SOLUTIONS

ISD has software solutions that allow you to use bar codes for most anything. Like identifying products. Labeling packages. Or even managing assets and paperwork. You'll be able to speed and simplify data collection. Track products dock-to-stock. Streamline inventory control. And more.

Integrated Software Design, Inc.

171 Forbes Blvd., Mansfield, MA 02048
TEL: (508) 339-4928 FAX: (508) 339-2257
© 1989 Integrated Software Design, Inc.

Inquiry 584.

HP LASERJET II M-E-M-O-R-Y

1MB-2MB-4MB MEMORY EXPANSION BOARDS

Save 50%-60%
2-YEAR WARRANTY

STARION CORPORATION

(800) 782-8297 CA: (714) 750-2627

Inquiry 580.

PORTABLE READER

Battery-operated, handheld reader with 64K static RAM, 2x16 LCD display, 32-key keyboard, Real-Time-Clock. Wand or laser scanner. Program prompts and data checking thru its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Doubles as On-Line Reader. 30-day \$\$ back.

Worthington Data Solutions

417A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

WHEN EASE-OF-USE COUNTS

Reading bar codes should be as easy as a "quick flick of the wrist." But many bar code readers require you to flick and flick and Flick and FLICK until the bar code label is finally read. PERCON designed bar code readers that really are as easy as a "quick flick of the wrist."

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

BAR CODE

PERCON: THE BAR CODE SPECIALISTS

If you have questions about bar code technology, it's nice to know an experienced, friendly bar code specialist is only a phone call away. Want to know where to start or where to find hard-to-find bar code accessories? Call PERCON for answers.

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

5-YR. WARRANTY AT PERCON

PERCON decoders are now covered by a five-year limited warranty. That means you won't spend one cent replacing your PERCON bar code decoder for five full years. That's reliability you can count on!

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data! Choose from stainless steel wand or laser interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems

15127 N.E. 24th, Suite 333, Redmond, WA 98052
206-451-8966

DATA INPUT DEVICES

Bar Code, Magnetic Stripe Readers & SmartCard Encoder/Reader for microcomputers & terminals, including IBM PS/2 & others, DEC, Macintosh, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. UPC & 39 print programs, magnetic encoders, & portable readers are also available.

TPS Electronics

4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA
FAX: 415-856-3843

Inquiry 585.

VARIANT MICROSYSTEMS BAR CODE READERS DELIVER

WAND/LASER/MAGNETIC CARD CONNECTIVITY
• Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS2 and portables

- RS232 wedges for WYSE, Link, Kimtron terminals
- Bar code and label printing software
- Full two-year warranty
- 30-Day Money-Back Guarantee
- Extensive VAR/Dealer Discounts

3140 De La Cruz Blvd., Suite 200/Santa Clara, CA 95054/(408) 990-1880
FAX: 415-623-1372

Inquiry 586.

CAD/CAM

P-C-B ARTWORK MADE EASY!

Create and Revise Printed-Circuit-Artwork on your IBM or Compatible

- * Help Screens * Dip & Sip Library
 - * Printer and Plotter Artwork * Supports Mice
 - * Auto-Router available * ICON Menus
- Requirements: IBM or Compatible PC, 384K RAM, DOS 3.0 or later. PCBoards: \$99.00 DEMO: \$10.00

PCBoards

2110 14th Ave South, Birmingham, AL 35205
(205) 933-1122

Inquiry 587.

CASE

STATE OBJECT ORIENTED COMPILERS

The COMPEDITOR's use finite state and object oriented programming techniques to design, develop and document source programs in: Ada, Basic, C, Fortran and Pascal. IBM DOS 2. + 250K RAM.

Prices: \$200-\$300 (With Primer and Debugger)
Sampler \$75 (With All manuals & Credits)

AYECO 5025 Nassau Circle, Orlando
INCORPORATED FL 32808 (407) 295-0930

Inquiry 588.

CD-ROM

CD-ROM Drives & Titles Largest selection for PC & Mac. Microsoft Programmers Library & Drive \$995 Computer Library \$695 • Public Domain S/W \$99.

Drives from \$699. Hundreds of titles from \$29.
MC/VISA/AMEX, Money-back Guarantee.
Call or write for free 100-page catalog.

Get it all from "The Bureau"
Bureau of Electronic Publishing
121 Norwood Ave., Upper Montclair, NJ 07043
(201) 746-3031

Inquiry 589.

CD ROM, Inc.

Hitachi CD ROM 3500 PC/XT/AT internal kit	\$639
Hitachi CD ROM 1503S PC/XT/AT external kit	\$679
Hitachi CD ROM 1503S PS/2 external kit	\$799
NEC CD ROM Macintosh external kit	\$799
Laser Drive 510 WORM kit (654MB)	\$3,995
REO-650 Magneto-optical kit (650MB)	\$5,795
Source: (IBM)	\$99
Grolier Encyclopedia (IBM)	\$299
MacGuide (Mac)	\$89
PD ROM (Mac)	\$99

CD ROM, INC.

1120-B 10th St., Golden, CO 80401
303-278-8550

Inquiry 590.

CD-ROM/WE'LL BEAT ANY PRICE

All IBM/MAC drives/titles. Call for price list, monthly specials, PO's, international orders welcome. Special library, school, government pricing. COD, Visa, MC, Ames

CD-ROM SHOPPER

(201) 290-8288

1168 Elm Street
Rahway, NJ 07065

24 HR AUTO ORDER LINE

Inquiry 591.

Food/Analyst CD-ROM

Analyze foods, meals, and recipes for any number of persons based on the complete USDA food nutrient database. 4700+ foods, 80+ nutrients. See graphs, printed reports, summaries. Other titles and CD-ROM publishing services available.

Hopkins Technology

CD-ROM Publisher
421 Hazel Lane, Suite 104
Hopkins, MN 55343

(612) 931-9376 Compuserve 74017,614

Inquiry 592.

CD-ROM Developer's Lab

Multimedia production resource for Mac & PC developers & managers. Proven design, management, data prep, programming, premastering, and manufacturing techniques & specs from 18 leading companies. Demos of off-the-shelf tools for imaging, audio, animation (Mac). Real applications using Media-Mixer source tools. CD-ROM XA, PC or Mac \$795. Transportable \$845. Visa or MasterCard.

Software Mart, Inc.

4131 Spicewood Springs Road I-3, Austin, TX 78759
512-346-7887

Inquiry 593.

COMPUTER INSURANCE

INSURES YOUR COMPUTER

SAFWARE provides full replacement of hardware, media and purchased software. As little as \$39 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am-10 pm ET. (Sat. 9 to 5)

TOLL FREE 1-800-848-3469

(Local 614-262-0559)

SAFWARE, The Insurance Agency Inc.

Inquiry 594.

COMP. MAINT. CHEMICALS

Buy Direct

A full line of Computer Maintenance chemicals: Pressurized Duster, CRT Screen Cleaner, Hood & Housing, Anti-Static, Head & disc, Freon T.F. Solvent, Cleaning Diskettes, Wipes, Swabs. All at wholesale prices. Call Data-Chem at:

1-800-FON-6698

Inquiry 595.

COMPUTER SUPPLIES

COLOR RIBBONS

COLORS: Black, Red, Blue, Green, Brown

	BLACK	COLOR
NEC P2200	\$7.75	\$12.00
Okidata 390/391	7.00	9.00
Panasonic KXP-1124	6.75	7.75
Toshiba P351	5.00	6.00

PRICE & SPEC. SUBJECT TO CHANGE WHO NOTICE.

FOR OTHER RIBBONS CALL FOR CATALOG

RAMCO COMPUTER SUPPLIES

PO. Box 475, Manteno, IL 60950

(USA) 800-522-6922 * (CANADA) 800-621-5444 * 815-468-8081

Inquiry 596.

CROSS ASSEMBLERS

CROSS ASSEMBLERS

Universal Linker, Librarian

Targets for 36 Microprocessors

Hosts: PC/MS DOS, micro VAX, VAX 8000

ENERTEC, INC.

BOX 1312, 811 W. Fifth St.
Lansdale, PA 19446

Tel: 215-362-0966 Fax: 215-362-2404

Inquiry 597.

68000 CROSS ASSEMBLER

Assembles 68000/68010 code on a PC Compatible

- Very High Speed—2MB source code assembled per minute • Macros
- S-Records

Knowledge Based Systems, Inc.

2746 Longmire • College Station • Texas • 77840

Phone: (409) 696-7979 • Fax: (409) 696-7277
BBS: (409) 696-7055

Inquiry 598.

Professional Series

PseudoCode releases its PseudoSam professional Series of cross assemblers. Most popular processors. Macros, Conditional Assembly, and Include Files. Virtually unlimited size. For IBM PCs, MS-DOS 2.0 or greater. With manual for \$50.00. (MI res. 4% tax). Simulators and disassemblers also available. Shipping \$5, Canada \$10, Foreign \$15. Visa/MC.

KORE INC.

6910 Patterson, Caledonia, MI 49316 616-887-1444
30-Day satisfaction guaranteed or purchase price refunded

Inquiry 599.

THE BUYER'S MART

CROSS ASSEMBLERS

FANTASTIC SIMULATORS

For the 8048, 8051, 8080, 8085, & Z80 families. Full function simulation including ALL MODES of interrupts. Built-in disassembler. Better than expensive I.C.E.'s.

CROSS ASSEMBLERS

We support the 8048, 8051, 8080/8085, 8096 & Z80 families. Just \$75 each.

Lear Com Company

2440 Kipling St./Ste. 208, Lakewood, CO 80215
303-232-2226

Inquiry 600.

MACINTOSH CROSS ASSEMBLERS

µASM—available for most 8-bit MPUs. Fast. Full Mac interface. S or Hex output downloads to most EPROM programmers. Features macros, conditional ass'y, local and auto labels, symbol table cross-reference, module sectioning. Editor included. \$129.95 each plus S/H. MC/VISA. Technical bulletin available.

MICRO DIALECTS, INC., Dept B

P.O. Box 30014, Cincinnati, OH 45230
(513) 271-9100

Inquiry 601.

CROSS ASSEMBLERS

Macros, PC Compatible, Relocatable, Conditionals, Fast, Reliable from \$150 also: Disassemblers

EPROM Programmer Board

MICROCOMPUTER TOOLS CO.

Phone (800) 443-0779

In CA (415) 825-4200

912 Hastings Dr., Concord, CA 94518

Inquiry 602.

6800-Family Development Software

Our C Compilers for the 6800, 6801, 6809, & 68HC11 feature a complete implementation (excluding bit fields) of C as described by K&R and yield 30-70% less code than other compilers. Our Assemblers feature macros and conditional assembly. Linker & Terminal Emulator included.

Wintek Corporation

1801 South St., Lafayette, IN 47904

(800) 742-6809 or (317) 742-8428

Inquiry 603.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION

More than just a straight dump or ASCII transfer!

Word Processing, DBMS, and Spreadsheet data on Disks or Tapes transferred directly into applications running on Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters, and Electronic Publishing systems.

IBM PS/2 & Macintosh supported

#1 in the translation industry!

CompuData Translators, Inc.

3325 Wilshire Blvd., Suite 1202, Los Angeles, CA 90010

(213) 387-4477 1-800-825-8251

Inquiry 604.

DATABASE MGMT. SYSTEMS

dBASE file access from C

Code Base 4 is a library of C routines which gives complete dBASE or Clipper functionality and file compatibility. Use DOS, Unix, OS/2 or MS Windows.

\$295 with Source! FREE DEMO

Sequiter Software Inc.

Call (403) 439-8171 Fax (403) 433-7460

Inquiry 605.

DATA/DISK CONVERSION

RESULTS

You Can Depend On!

- Data Conversion
- Disk Duplication
- Optical Scanning

Computer Conversions

9580 Black Mountain Rd., Suite J, San Diego, CA 92126

619-693-1697

Inquiry 606.

DISK CONVERSIONS

Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Microm, NBI, CT, Exxon, WRDPLEX also WP, WS, MS/WRD, DW4, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.

FREE TEST CONVERSION

CONVERSION SPECIALISTS

531 Main St., Ste. 835, El Segundo, CA 90245

(213) 545-6551

(213) 322-6319

Inquiry 607.

FROM MACs TO MAINFRAMES. . .

Our 12 conversion systems support over 1000 formats

DISK INTERCHANGE SERVICE COMPANY

2 Park Drive • Westford, MA 01886

(508) 692-0050

Inquiry 608.

THE #1 CHOICE

in disk & tape conversion

for many leading corporations, government agencies, law firms, and companies in every industry—world-wide.

Free test • Satisfaction guaranteed

Call the helpful conversion experts

Graphics Unlimited Inc.

3000 Second St. North, Minneapolis, MN 55411

(612) 588-7571

Inquiry 609.

IBM PC ↔ HP

FILE COPY

IBM PC to HP File Copy allows IBM PCs, PS/2, compatibles to read, write files written by Hewlett-Packard Series 70, 80, 200, 300, 1000, 9000's. We offer custom work using our file copy utilities and program translators. Call for estimate, catalog, data sheet.

Oswego Software

312/554-3567

507 North Adams St.

Fax 312/554-3573

Oswego, Illinois 60543

Telex 858-757

Inquiry 610.

CONVERSION SERVICES

Convert any 9-track magnetic tape to or from over 2000 formats including 3 1/2", 5 1/4", 8" disk formats & word processors. Disk-to-disk conversions also available. Call for more info. Introducing OCR Scanning Services.

Pivar Computing Services, Inc.

165 Arlington Hgts. Rd., Dept #B

Buffalo Grove, IL 60089 (312) 459-6010

Inquiry 611.

DEMOS/TUTORIALS

INSTANT REPLAY III

Build Demos, Tutorials, Prototypes, Presentations, Music, Timed Keyboard Macros, and Menu Systems. Includes Screen Maker, Keystroke/Time Editor, Program Memorizer, and Animator. Rec'd *Great Reviews!* Simply the BEST. Not copy protected. No royalties. 60-day satisfaction money-back guar. IBM and Compatib: \$149.95 U.S. Chk/Crd Demo Diskette \$5.00

NOSTRADAMUS, INC.

P.O. Box 9252

Salt Lake City, Utah 84109 (801) 272-0671

Inquiry 612.

DISASSEMBLERS

80x86 .EXE/.COM to .ASM

• Accurately reconstruct, study & modify (64K+) programs with a minimum of input or editing of output.

• Assembly language output is MASM 5.x-compatible

• Exhaustive flow-trace distinguishes code from data.

• Best formats for each. Commented BIOS calls/DOS functions. SEGMENT/PROC/other vital pseudo-ops.

PC-DISnDATA (5 1/4" disk & manual) \$165

PRO/AM SOFTWARE

220 Cardigan Road, Centerville, OH 45459

(513) 435-4480 (9 A.M.—5PM EST M-F)

Inquiry 613.

SOFT-X-PLORE

See "BYTE's May '88 issue pg. 78." Disassemble 500 kb (*) program at 10,000/min. (*) in any file, ROM/RAM memory up to 80386 instruction set (*). SOFT-X-plore:

* is for MS/DOS 2.0+ systems

* uses 20 algorithms and seven passes (*)

* only \$99.95 plus S&H w/30-day guarantee.

To order call (800) 446-4656 or info (203) 953-0236

Or write: **RJSWANTEK INC.**

178 Brookside Rd., Newington, CT 06111

* best on the market MC/VISA accepted

Inquiry 614.

DISK COMPATIBILITY

IBM PCs USE Mac DISKS

MatchMaker lets you plug any Macintosh external floppy drive into an IBM PC. Half-size card and software lets you copy to/from, view directory, initialize, or delete files on the Mac diskette. Works with PCs, XT's, AT's, and compatibles. The easy way to move information!

\$149.00 Visa/MC/COD/Chk.

Micro Solutions Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115 815/756-3411

Inquiry 615.

DISK DRIVES

PS/2 DRIVES FOR PC's AT's

CompatiKit/PC \$279

CompatiKit/AT \$219

Built-in floppy controllers—no problem. Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes plus more! Call for further information or to place an order: VISA/MC/COD/CHECK.

Micro Solutions Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115 815/756-3411

Inquiry 616.

DISK DUPLICATION

SOFTWARE PRODUCTION

- Disk duplication
- Warehousing
- All formats
- Drop shipping
- EVERLOCK copy protection
- Fulfillment
- Label/sleeve printing
- 48-hour delivery
- Full packaging services
- Consultation & guidance

Star-Byte, Inc.

2880 Bergey Rd., Hatfield, PA 19440

215-997-2470 800-243-1515

Inquiry 617.

THE BUYER'S MART

DUPLICATION SERVICES

SOFTWARE DUPLICATION

- One-Stop Shopping
- Custom Packaging
- Copy Protection
- Technical Support
- Drop Shipping
- Fast Turnaround
- Competitive Pricing

SATISFACTION GUARANTEED
800-222-0490 NJ 201-462-7628

MEGAsoft

P.O. Box 710, Freehold, NJ 07728

Inquiry 618.

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

THE BUYER'S MART can help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

603-924-3754

Inquiry 619.

EDUCATION

B.Sc. & M.S. in COMPUTER SCIENCE

The American Institute for Computer Sciences offers an in-depth correspondence program to earn your Bachelor of Science and Master of Science degrees in Computer Science at home. BSc. subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. MS program includes subjects in Software Engineering and Artificial Intelligence.

AMERICAN INST. for COMPUTER SCIENCES
1704-BY 11th Ave. So., Birmingham, AL 35205
TOLL FREE 1-800-872-AICS

Inquiry 620.

Gradebook emulation
for
micro-computers
Da Poma GB

Available on all Apple II's
since 1982

Da Poma, Inc.

P.O. Drawer H, Hondo Texas 78861 (512) 426-5932

Inquiry 621.

ENTERTAINMENT

CRYPTO

- Challenging, Educational, and Entertaining
- Hundreds of Famous Quotations to Decipher
- Send and Receive Secret Messages
- Select Level of Difficulty, Edit, Customize
- Enhances Spelling, Typing and Vocabulary
- Ideal Gift for All Ages. User Friendly.
- Only \$19.95 (CA residents add 6%)

P. VALANDANI, INC.

95 Church St. #2309, Los Gatos, CA 95032
(408) 395-6372

Inquiry 622.

BEAT THE LOTTERY

With GAIL HOWARD'S SMART LUCK COMPUTER SYSTEMS
\$23.4 Million Florida Jackpot Just Won With Computer Wheel!
COMPUTER WHEEL™ - An absolute MUST for every serious lottery player.
5 1/4" - \$29.95 + \$2 s/h. (Add \$3 for 3 1/4")

COMPUTER ADVANTAGE™ - Proven to be the most successful number selection system ever devised for Lotto. 5 1/4" - \$39.95 + \$2 s/h. (Add \$1 for 3 1/4")

SMART LUCK COMPUTER SYSTEMS

Dept. 86, P.O. Box 1519, White Plains, NY 10602
1-800-876-GA-I-L (4245)

Inquiry 623.

ENTERTAINMENT

NEMESIS™ Go Master®

Go, a game of strategic elegance, has been a way of life in the Orient for over four thousand years. Many consider Go to be the secret of the Japanese businessman's success. "While chess is a game of war, Go is a game of market share" [President of Nikko Hotels].

"If you are interested in Go, buy this program."
Game of the Month J. Pournelle BYTE 7/87

Toyoego, Inc. The Leader in Computer Go.
75 Bedford St. #34-Y, Lexington, MA 02173, (617) 861-0488

Inquiry 624.

FLOW CHARTS

Flowchart/State Diagram for Engineers

Draw flowcharts or state diagrams with this MacDraw-like program on your IBM PC/AT/PS2 or compatible. All flowchart symbols are prebuilt and can be stretched to any size. Add your own symbols to the symbol library. Ellipses, curves with ending arrowheads, cut/paste, enlarge/reduce, drag, zoom out, undo, etc. Output to most printers, plotters, and desktop publishing software. Complete with Logitech Mouse for \$89. See our larger ad every other month.

Daytron Electronics Inc.

610 S. Sherman #104, Richardson, TX 75081 214-669-2137

Inquiry 625.

Flow Charting II+

For IBM and compatibles. It will amaze you with its speed, power and simplicity. 26 standard shapes with over 120 sizes — 10 text fonts — 4 line styles. Place text, lines and shapes anywhere on your chart. For only \$229 you'll never draw another chart by hand.

Patton & Patton

81 Great Oaks Blvd., San Jose, CA 95119
1-800-525-0082 Ext. 42 (Outside CA)
408-629-5376 Ext. 42 (CA/Int'l)

Inquiry 626.

WINDOWS FLOWCHARTER \$79

RFFlow is a professional drawing tool for flowcharts & org charts (requires Microsoft® Windows). 75 shapes automatically adjust in size. Move, copy, delete groups of objects. 7 levels of zoom. Move flowcharts to other applications via the Clipboard. Supports Windows printers, plotters, and cartridge or soft fonts. Call for trial disk.

RFF ELECTRONICS

1053 Banyan Court, Loveland, CO 80538
(303) 663-5767

Inquiry 627.

STRUCTURED FLOW CHART

NSChart creates Nassi-Shneiderman (structured) flowcharts from a simple PDL. Key words define structures & text strings appear in the chart. Easy to create, even easier to revise! Automatic chart sizing, text centering. Translators from many languages available. For Mac and IBM PC.

SILTRONIX, INC.

P.O. Box 82544, San Diego, CA 92138
1-800-637-4888

Inquiry 628.

FOREIGN LANGUAGES

LEARN SPANISH! LEARN JAPANESE!

A new, easy way to learn a foreign language. Complete interactive learning environment with pop-up dictionary, hypertext language reference, and full mouse support. Conversational emphasis. IBM compatible. Each course includes disks, manual, and pronunciation tape. Call for Demo disk or free brochure!

Traveler's Guild

315 W. Washington St. Dept. BY9, Marquette, MI 49855
24 hour order desk: **(906) 228-5030**

Inquiry 629.

FORTRAN TOOLS

TAME YOUR FORTRAN CODE!

Programming tools for MS-DOS FORWARN—an invaluable aid to Fortran program development! Finds common programming errors such as mismatched parameter lists and common blocks, and uninitialized variables. Prints detailed cross-references and call-tree diagrams. \$329

FORTRAN DEVELOPMENT TOOLS—Includes Pretty (indent, renumbers, changes GOTOs to IF-THEN-ELSE, etc.) and 6 more tools. \$129.

Quibus Enterprises, Inc.

106 N. Draper Avenue, Champaign, IL 61821
(217) 356-8676

Inquiry 630.

GRAPHICS

35mm SLIDES—In 24 Hours

We transform your PC-Graphics files into full-color high-resolution, 35mm slides and ship within 24 hours. Harvard, Pixie, Lotus, Freelance, and others supported. Files accepted by modem. Free Federal Express on all orders of 20+ slides. Only \$8 per slide. Call for literature or circle reader service number shown below.

Accent Presentations, Inc.

990 Highland Drive, Ste. 202, P.O. Box 1303, Solana Beach, CA 92075
1-800-222-2592

Inquiry 631.

The Graphics

IBM PC/PS2 program for superior WYSIWYG graphs/charts/slides. Flexible data input/edit. Lines/curves/regions/scatters/bars, more. Axis breaks/legend/segments/error bars, any style. Labels/symbols/boxes/arrows, more. Store fig templates. Fast professional output to lasers/ildemakers/plotters or export to WP5.0/Ventura etc. **FREE DEMO!** \$399

BIOSOFT, PO Box 580, Milltown, NJ 08850

(201) 613-9013 FAX: (201) 613-8860

Inquiry 632.

Explore Visual Perception

Use **Illusion Maker** to browse our database of optical illusions. Requires a PC, XT, AT or clone with EGA color or better. Menu driven system displays a wide variety of visual illusions. Ideal for psychology labs or curiosity seekers! Send \$9.95 (pp) for latest release. Texas res. add \$0.80 sales tax.

Illusion Software

1342 Oak Path, San Antonio, TX 78258

(512) 497-4665 (512) 521-0807

Inquiry 633.

RAINDROP™

FAST, compact PriScr™ Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 12 video graphic standards. Scale, rotate, colorize and more. **CALL** for user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library \$39.95+\$3 s/h.

RAINBOW TECHNOLOGIES

8106 St. David Ct., Springfile, VA 22153
(703) 440-0064

Inquiry 634.

HARD DRIVE REPAIR

HARD DRIVE REPAIR

WE WILL REPAIR YOUR HARD DRIVE AT A FRACTION OF THE COST OF REPLACING IT. FAST TURNAROUND!!! CALL FOR DETAILS.

H & W micro, inc.

528-C FOREST PARKWAY
FOREST PARK, GA 30050

(404) 366-1600

Inquiry 635.

THE BUYER'S MART

HARDWARE

CHIP CHECKER

- 74/54 TTL + CMOS
- 8000 Nat. + Signetics
- 144000 CMOS
- 9000 TTL
- 14-24 Pin Chips
- 3" + .6" IC widths

Tests/identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM-compatible version \$259. C128 + C64 version \$159.

DUNE SYSTEMS

2603 Willa Dr., St. Joseph, MI 49085
(616) 983-2352

Inquiry 636.

Equipment Monitor And Control

Ideal cost-effective computer can be used to perform data acquisition and control using a dumb terminal or create data files on a PC. Features 16 chan. A/D, 64 digital I/O lines, 4 timer/counters and 4 serial ports. Options 4 chan. D/A, clock, CMOS, Forth OS, and networking.

E-PAC 1000 + \$249.00 E-PAC 2000 + \$449.00

EMAC INC.

PO Box 2042, Carbondale, IL 62901
Phone: 618-529-4525 Fax: 618-457-0110

Inquiry 637.

FREE CATALOG

Protect your computer power from black-outs, brown-outs, audio/video hash and surges! Complete line of low-cost Emergency Power Supply units, Line Conditioners and Surge Suppressors prevent damage and loss of valuable data. Prevent errors, malfunctions and false printouts! Send for money-saving catalog today.

INDUST-TOOL

730 W. Lake St., Chicago, IL 60606
Phone 312-648-2191

Inquiry 638.

Macintosh® Parts & Repairs

Programs for the corporate, government, dealer and educational buyer. Call for kit.

Save up to 55% on Mac II CPU

800-274-5343 / 617-891-6851

Pre-Owned Electronics, Inc.

30 Clematis Ave. Waltham, MA 02154

Macintosh is a registered trademark of Apple Computer, Inc.

Inquiry 639.

NEED AN EXTRA SLOT FOR YOUR 8-BIT PC?

Add: LAN MODEM, Accelerator Card or

Fixed Disk and/or 3 1/2" Diskette

RMT's 2001-F2H2 Single Card Controller:

- Uses only one expansion unit
- Supports two 3 1/2" and/or 5 1/4" diskette drives
- Supports two fixed disk drives (up to 140 MB each)
- On-board BIOS, automatically handles any comb. of drives

RMT 2001-F2H2 THE SPACE ODYSSEY

RMT SYSTEMS, INC. (714) 863-1092

Inquiry 640.

LAPTOPS • APPLE • IBM

- | | |
|-------------|--------------|
| COMPAQ SLT | IBM PS2 |
| ZENITH | MACINTOSH |
| SHARP | LASERWRITER |
| TOSHIBA | IMAGewriter |
| NEC | HP LASERJET |
| PLOTTERS | EPSON |
| HARD DRIVES | FAX MACHINES |

Call UCC 213-921-8900 For Prices

13738 E. Artesia Blvd. 150 Cerritos, CA 90701

Fax 213-802-0831 International Orders Welcome

Inquiry 641.

HARDWARE/COPROCESSOR

DIGITAL SIGNAL PROCESSOR

DSP products for the IBM PC/XT/AT based on the TI TMS32010 and TMS320C25 up to 12 MIPS operation. Designed for applications in communications, instrumentation, speech, and numeric processing. Offered with 12 bit 110 KHz A/D and D/A and continuous-to-disk data acquisition & playback option. From \$850.

DALANCO SPRY

89 Westland Ave., Rochester, NY 14618
(716) 473-3610

Inquiry 642.

SC/FOX™ PARALLEL COPROCESSOR

PC/XT/AT/386 plug-in board with Forth software. 10 MIPS operation, up to 50 MIPS burst. 64K to 1M byte memory. Uses Harris RTX 2000™ RISC real-time CPU with 1-cycle multiply, 1-cycle 14-priority interrupts, two 256-word stacks, three 16-bit timer/counters, 16-bit I/O bus. Ideal for real-time control, signal and image processing, and multiple board operation. From \$2,295.

Optional SC/FOX Single Board Computer version for stand-alone operation. Eurocard size with software, starting at \$1,495.

SILICON COMPOSERS, INC. (415) 322-8763
210 California Ave., Suite K, Palo Alto, CA 94306

Inquiry 643.

HELP WANTED

VIDEO GAME PROGRAMMERS

The Leland Corporation, a Southern California based video game manufacturer (incl. Super Off-Road, Quarterbase Double Play, et al) has openings for experienced assembly language programmers. Game experience desired. Z-80 experience preferred 8502 a plus. Send resume w/salary requirements to: Software Manager, 1841 Friendship Drive, El Cajon, CA 92020-1180 or call Medo Moreno at (619) 582-7000.

Inquiry 644.

IMAGE PROCESSING

ZIP Image Processing

ZIP brings affordable, sophisticated image processing to the PC. Capture video from camera/VCR. Versions for ImageWise, Willow Pubs VGA, HRT 512x512, serial ImageWise (for PC/laptop/PS2) frame grabbers.

Call (314) 962-7833 to order (VISA/MC). ZIP starts at \$79, frame grabbers, \$398. 30-day money back guarantee.

Hogware Company

470 Belleview, St. Louis, MO 63119

(314) 962-7833

Inquiry 645.

INTERFACES

PC/XT/AT COMPATIBLE KEYBOARD CONTROLLERS

Control custom membrane or mechanical switch matrices of up to 512 keys. Connects to a standard PC/XT/AT keyboard port and sends standard or user-defined Bios Scan codes to your PC. An extra port on the USAR controller board allows you to use both a custom keyboard and a standard (83/84 or 101/102) keyboard simultaneously. No special software or device drivers required. The USAR controller board is powered by the PC. Low one time programming charge if customized key codes required. Large volume or limited runs. For further information call or write:

USAR CONSULTANTS, INC.

2160 North Central Road, Fort Lee, NJ 07024

Phone: (201) 947-6329 FAX: (201) 947-2264

Inquiry 646.

INVENTORY MANAGEMENT

STOCK-MASTER 4.0

Commercial grade inventory management software at micro prices.

- Supports all 12 transaction types
- Trend Analysis
- Quality Control
- Multiple Locations
- Purchase Order Tracking
- Open Order Reporting
- Serial/Lot # Tracking
- Stock Status Reporting
- Activity History Analysis
- Bill of Materials
- Purchase Order Writing
- Order Entry
- Material Requirements
- On Line Inquiry

Applied Micro Business Systems, Inc.

177-F Riverside Ave., Newport Beach, CA 92663 714-759-0582

Inquiry 647.

INVENTORY MANAGEMENT

dFELLER Inventory

Business inventory programs written in modifiable dBASE source code.

dFELLER Inventory \$150.00

Requires dBASE II or III, PC-DOS/CPM

dFELLER Plus \$200.00

with History and Purchase Orders

Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates

650 CR PPA, Route 3, Ishpeming, MI 49849

(906) 486-6024

Inquiry 648.

LANS

The \$25 Network

Try the 1st truly low-cost LAN

- Connect 2 or 3 PCs, XTs, ATs
- Uses serial ports and 5-wire cable
- Runs at 115K baud
- Runs in background, totally transparent
- Shares any device, any file, any time
- Needs only 14K of ram

Skeptical? We make believers!
Information Modes

PO. Drawer F, Denton, TX 76202

817-387-3339

Inquiry 649.

LAPTOP COMPUTERS

Laptop Savings

Laptops: Toshiba • Zenith • Nec • Sharp
• Epson • Mitsubishi • Compaq
Also Laptop Accessories: Modems, Fax Modems, External Drives, Portable Printers, Memory, Key Pads, Hard Drives, Batteries, and Auto Adapters.

Computer Options Unlimited

12 Maiden Lane, Bound Brook, NJ 08805

Phone: 201-469-7678 (Fax: 201-469-7544)

Hours: 9am/10pm 7 days Worldwide sales

Inquiry 650.

LAPTOP PERIPHERALS

LAPTOP BACKLIGHTS

Factory Installed • 90 Day Warranty

Toshiba, Amstrad, Sanyo, DG, Kaypro, IBM, HP, etc. \$295

The Portable Peripherals People

Axonix Corporation

(801) 466-9797

Inquiry 651.

TOSHIBA PERIPHERALS	T1000	T1200	T3100	T3100e
	T1600	10/20	T5100	T5100e
Battery Adapter (12V)	PX25T	PX3T	P80	P80+
Vehicle Battery Adapter	X2.5	S240B	A80	A80+
Built-in 2400psi Modem	M24C	—	M24EC	M24ES
Internal 2400psi Modem	S232T	—	—	—
Single COMMS Port Card	—	—	—	—
Dual COMMS Port Card	—	—	—	—
SCSI Interface Card	—	—	—	—

PRODUCT R&D Corporation

1194 Pacific St., Suite 201, San Luis Obispo, CA 93401

(805) 546-9713 or 800-234-5584

Inquiry 652.

LOTUS123 TEMPLATES FOR HOME FINANCIAL PLANNING

Yearly CHECKBOOK template records daily transactions, balances minimum of 4 accounts. Graphics included FREE, yearly PERSONAL BUDGET PLANNER, shows monthly totals based on weekly, monthly, yearly values. Reduce costly NSF bank charges, organize financial affairs. 5 1/4" 731/2" disk. Documentation, not copy protected. \$39.95 prepaid

Orion Consulting Services Inc.

2101 Islington Avenue, Suite 807

Weston, Ontario Canada M5P 3R2

416/248-9285

Inquiry 653.

THE BUYER'S MART

MAC PROGRAMMING TOOLS

MAC DEVELOPMENT TOOLS

Professional Programmers Extender: Standard Mac interface, lists, printing, graphics, tiling, Extender GraphPac: Quality color graphs. Line, bar, semi-log, customizable symbols.

INVENTION Software

(313) 996-8108

Inquiry 654.

MEMORY CHIPS

MEMORY CHIPS

41256-15-12-10	Call	51000 (1 Meg)	Call
4164-15	Call	51258 for Compaq 386	Call
4164-12	Call	8087-3-2	Call
41128 Piggy Back for AT	Call	80267-5-6-10	Call
41464-12 (64Kx4)	Call	80387	Call
414256 (256Kx4)	Call	NEC-V-20-8	Call
2754,27128,27256,27512	Call	Mouse	Call

Prices subject to change

ESSKAY 718-353-3353

Inquiry 655.

FREE INFORMATION

DRAM-SIMMS-MATH CO-PROCESSORS

TOLL FREE 24 HRS. 7 DAYS A WEEK 1-800-338-1531	DEDICATED TOLL FREE FACSIMILE LINE 24 HRS.—7 DAYS A WEEK 1-800-242-5751
--	--

DIRECT LINE MON-FRI 8-4 CST

1-402-691-8248

Best Prices in U.S.A.

McDonald and Associates
WHOLESALE DISTRIBUTOR THE CHOICE OF INDUSTRY PROFESSIONALS

Inquiry 656.

MONITOR INTERFACE

COMPUTER VIDEO GENERATOR

Test EGA, VGA, Multisync & Data Projectors with handheld monitor tester. From 15.7 KHz to 64.0 KHz, battery powered, 4 patterns, all plug-in with no adapter cables.

NETWORK TECHNOLOGIES INC.

800-RGB-TECH In OH: 216-543-1846
UK: 0244-880478 Paris: 01331-476-32789

See our Ad on page 372.

Inquiry 657.

NETWORKING

NETWORK BUSINESS SYSTEMS

Keycard Eliminator	\$99.
D C B Eliminator	\$99.
ELS Utilities	\$59.
Netcrack (lose password?)	\$99.
Getdisk (get BIOS drives)	\$59.
BIOS Tools (patch drive tbits)	\$99.

NETWORK BUSINESS SYSTEMS

1215 Woodhollow Drive, Suite 1104, Houston, TX 77057
(713) 783-4457

Inquiry 658.

So far Your Computers Have Been Talking to Each Other NOW Your Start Can as Well

CHAT — ACCESS

A Complete Chatting and Messaging Solution for 3Com, Novell, and Other Network. CHAT-ACCESS is the ultimate in user friendly software, enabling you to send messages, receive them and engage other logged-in users in full scale conversation. Using only 1 Kbyte of your workstation RAM (for TSR program), CHAT-ACCESS provides a list of logged in users and sends one or all of them a brief message. It also enables you to "CHAT" with another workstation through interactive windows that simultaneously display both sides of the conversation. CHAT-ACCESS operates on 3Com's 3PLUS, 3+OPEN (MS-DOS workstation), Novell NetWare and all other PC LANs that support NetBIOS.

Shany Computers Ltd.

Rechter Building, 4 Smilansky st., Natanya, Israel 42304
Tel: (972) (53) 333931 Fax: (972) (53) 342418

Inquiry 659.

NETWORKING

SHANY COMPUTERS, SOFTWARE THAT MAKES YOUR NET... WORK

CO/FILE+

An essential expansion to your MS-DOS and Network operating system so that you can run your existing single user applications with no modifications as multi-user applications running on your network. Using only 1-2 Kbytes of your workstation RAM, CO/FILE+ enables your single user applications to share common files on any MS-DOS 3.10 and higher LANs. Data is protected by automatic file or record level locking and unlocking.

Shany Computers Ltd.

Rechter Building, 4 Smilansky st., Natanya, Israel 42304
Tel: (972) (53) 333931 Fax: (972) (53) 342418

Inquiry 660.

NEURAL NETWORKS

"STATE OF THE ART

I recommend BrainMaker without reservation." Steve Gibson, INFOWORLD. "An ideal tool for learning this technology." Barry Simon, PC Mag.

Let us help you solve:

- Stock Forecasting • Data & Business Analysis • Video Recognition & OCR • Signal Analysis

10 times faster than any other neural net!!!

California Scientific Software

160 E. Montecito #E, Sierra Madre, CA 91024
(818) 355-1094 \$195 IBM PC, XT, AT, PS/2

Inquiry 661.

OBJECT ORIENTED TOOLS

OBJECT-ORIENTED TOOLKIT

TRIPLE your productivity with Complete C*

The only C object-oriented development utility with precompiler, foundation classes (source code included), make, integrated debugger, documentation generator, profiler, streamliner, and full technical support.

Introductory Price: \$269

Complete Computer Corporation

111 West 57th St., NY, NY 10019
212-582-2635

Inquiry 662.

OS/2 UTILITIES

INTEGRATED OS/2 PACKAGE

- Protected mode • Hot-key activated
- Background/foreground • Multi-sessioned shell
- Lightning fast text/binary forward/backward file lister
- Search directory trees for multiple strings
- Where file finder • Disk usage reports
- EGA/VGA mode support • Configurable colors
- Pop-up clock, calendar • On-line help

\$299.50 Check/MC/VISA

SASNAK SOFTWARE

P.O. Box 56, Dept. B, Lansing, KS 66043
(913) 651-1728

Inquiry 663.

PROGRAMMERS TOOLS

LAN Application Development

NPPC: High performance library routines callable from C and Assembler. High level interface permits rapid development of peer-to-peer, client/server, or multi-server NetBIOS applications under DOS. Synchronous or Asynchronous message control. Compact Code. Source Avail. No Royalty. NPPC \$495

Applied Software Technology

P.O. Box 397, Dpt. N, Los Gatos, CA 95031
(800) 678-1111 ext. N1

Inquiry 664.

HYPERINTERFACE™

Menu Creator™ — A program generator for menu-driven user interface. Excellent for complex menu systems. \$99.95. Advanced Library — Extended capability for data entry and advanced text-display control from your programs. \$99.95. FORTRAN, Pascal, C, BASIC supported. HYPERMATH™ — An application of Menu Creator* and the Advanced Library. FREE

Avanpro Corp.

P.O. Box 969, Pacific Palisades, CA 90272
(213) 454-3866

Inquiry 665.

PROGRAMMERS TOOLS

TLIB™ 4.12 Version Control

"TLIB" is a great system" — PC Tech Journal 3/88. Full-featured configuration mgmt for software professionals. All versions of your code instantly available. Very compact, only changes are stored. Check-in/out locks, revision merge, branching, more. Mainframe deltas for Pansophic, ADR, IBM, Unisys. Only \$99.95 + S&H, or 5-station LAN \$299.95 + S&H. MS-DOS VISA/MC

BURTON SYSTEMS SOFTWARE

P.O. Box 4156, Cary, NC 27519 (919) 856-0475

Inquiry 666.

Have Same 'C' Source for UNIX and DOS

D-ISAM—Unix standard indexed file management library for UNIX DOS and NETWORKS. Manages all locking. UNIX/DOS source \$595 (for both), DOS libs \$145

*W—Character windowing with COLORS, Line Graphics, Bells and more. You need not modify DOS code to work WELL on any UNIX terminal. UNIX/DOS source \$295 (for both), DOS libs \$95

BYTE DESIGNS

P.O. Box F195-76, Blaine, WA 98230
1-800-663-8547 or (604) 278-5200

*DOS libs available for Microsoft or Borland 'C' compilers

Inquiry 667.

Async Executive™ & Tutorial

Interrupt driven transmit & receive. Supports up to eight ports. Buffered I/O to 64K. 50 to 19200BPS. XON/XOFF. DTE/DCE. Modem controls. Transfer characters or blocks. Millisecond timing. Universal language interface. BIOS/DOS extension capabilities. MODEM wCRC. 300+ page comprehensive manual. Sample programs include a spooler written in C. For IBM PC/XT/AT & all compatibles. Software Developer's Kit: \$195. NO ROYALTIES

Shipping \$5, Canada \$10, International \$15

CIRRUS SOFTWARE, INC.

P.O. Box 51924, Dept. B, Palo Alto, CA 94303
(415) 949-1470

Inquiry 668.

ProPak 2.0

The Programmer's Productivity Pack

The most useful programmer's tools and utilities, smoothly integrated into a single package. Ideal for professional programmers, software developers, and students, too! Versions for MS-DOS, DESQview and OrmiView included. Powerful, flexible, and easy to use. Fully customizable! Full 30 day money back guarantee! Only \$79.95 plus S&H

Falk Data Systems

5322 Rockwood Ct., El Paso, TX 79932
(800) 326-5615

Inquiry 669.

WINDOWS APPLICATION PROGRAMMING ENVIRONMENT (WAPE)

WAPE is an INTERACTIVE CODE GENERATOR for over 450 MS-Windows system calls. Set of LIBRARY FUNCTIONS for windows, menus, dialog boxes, list boxes, and clip board. Built-in Menu Editor. Windows Application Development tools can be invoked from within WAPE. Context-sensitive ONLINE HELP available

INTERSOFT INC.

5285 SW Meadows Rd., Lake Oswego, OR 97035
(503) 639-3555

Inquiry 670.

FREE CATALOG!

QuickBASIC Libraries and Utilities
286, 386, PC/XT AWARD ROM BIOS
Hardware Upgrades

1-800-423-3400 or (412) 782-0384

KOMPUTERWERK, INC.

851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 671.

THE BUYER'S MART

PROGRAMMERS TOOLS

TURBO PLUS \$149.95

Programming tools for use with Turbo Pascal 5.0 & 5.5. Screen Painter, Code Generator, I/O Fields, Dynamic Menus, Programming Unit Libraries, OOP Support, and Sample Programs included. All routines work in both text and graphics modes! 60-day money back guarantee! Demo Disk avail. For IBM and compatibles.

Nostradamus Inc.

P.O. Box 9252, Salt Lake City, UT 84109-0252
(801) 272-0671

Inquiry 672.

GRAPHIC TOOLS LIBRARY

NOMA XGLIB: High speed. Window/viewport, arcs, splines, figure fill, borders, text scale, rotate, align, bitmaps, bitblt, pens, keyboard, mouse, image capture and processing. Animation. Over 150 functions. \$75.
PC_VDI: High speed text at any angle, size and position, outline fillable font factory, plots, charts and curve fit. **Free Demo Disk. \$395.** Both products ANSI compatible. Free drivers for printers, plotters, lasers. Hercules, CGA/EGA/VGA/VGA256, most boards. For all "C" compilers, FORTRAN, MS QuickBASIC, Manual.

NOVA INC.

P.O. BOX 68976, Schaumburg, IL 60168
312-882-4111

Inquiry 673.

Get INSIDE!

The best PC software performance tool is now better than ever with source line timing, caller timing and arbitrary event timing—all with microsecond accuracy and without source modification. The expanded DOS analysis mode identifies I/O bottlenecks. \$125

Call today for a free brochure and the latest list of supported compilers. 30-day guarantee. VISA/MC/COD

Paradigm Systems

P.O. Box 152, Milford, MA 01757
(800) 537-5043 In MA: (508) 478-0499

FREE BUYER'S GUIDE

Programmer's Connection is an independent dealer representing more than 300 manufacturers with over 800 software products for IBM personal computers and compatibles. We have serviced the professional programmer since 1984 by offering sound advice and low prices. Call or write today to receive your FREE comprehensive Buyer's Guide.

Programmer's Connection US 800-336-1166
7249 Whipple Ave. NW Canada 800-225-1166
North Canton, OH 44720 International 216-494-3761

Inquiry 674.

'C' DOCUMENTATION TOOLS

- **C-CALL \$59** Creates graphic-tree of caller/called structures, and files-vs-procedure table-of-contents
- **C-HDR \$59** Creates/inserts/updates headers for each procedure showing caller/called and identifiers
- **C-LIST \$39** List, action-diagram, reformat programs
- **C-REF \$49** Local/global/parameter cross reference
- **SPECIAL \$149** All 4 plus integrated C-DOC version

SOFTWARE BLACKSMITHS INC.

8064 St. Ives Way, Mississauga, ONT Canada L5N-4M1
(416) 858-4466

Inquiry 675.

PUBLIC DOMAIN

\$3.00 SOFTWARE FOR IBM PC

Hundreds to choose from, word processors, databases, spreadsheets, games, lotto, communications, business, music, bible, art, education, language and useful utilities for making your computer easier to learn. Most programs have documentation on the disk.

Free 125-page catalog.

BEST BITS & BYTES

P.O. Box 8245, Dept. B, Van Nuys, CA 91409
In CA: (818) 764-9503 800-245-BYTE

Inquiry 676.

PUBLIC DOMAIN

\$1 per DISK Sale

20 TOP IBM PC PD/SW DISKS
(360K) ONLY \$20 + \$3 S&H

QubeCalc, EDRAW, AutoMenu, Math Tutor, PC-DOS Help, Baker's Dozen, Languages, EZ-Form, PC-Style, PackDisk, PC-Stock, KidGames, Best Games, Home Inventory, PC-Outline, Form Letters, ImagePrint, SideWriter, PC-Prompt, Best Utilities.

BRIGHT FUTURES INCORPORATED

P.O. Box 1030, East Windsor, CT 06088
FREE CATALOG (\$1.50 per disk)

Inquiry 677.

FREE CATALOG PUBLIC DOMAIN/SHAREWARE

• 400 IBM PC & compatibles disks •

• 200 Amiga disks • 125 Atari 5T disks

PC disks as low as \$1.25 each, Amiga & ST as low as \$1.60 each! Rent or buy. Free shipping! Call toll free, write or circle reader service for FREE BIG CATALOG with full descriptions. Please specify computer—48-hr. turnaround!

Computer Solutions

P.O. Box 354—Dept. B, Mason, Michigan 48854
1-800-874-9375 (M-F 10-6 EST) 1-517-628-2943

Inquiry 678.

PUBLIC DOMAIN

FREE SOFTWARE CATALOG

Low as \$1.20/disk
Over 1000 quality IBM software
On 5.25" and 3.5" format
From outside U.S.A., except Canada,
please send US \$2.00 refundable with order.
For fast service, write to

SOFTSHOPPE

P.O. BOX 3678, Ann Arbor, MI 48106-3678
313-761-7638

Inquiry 683.

FREE CATALOG

\$1 IBM SOFTWARE

For your free 32-page Master Edition catalog featuring the best of IBM Shareware from just \$1 each, call or write today!

1-800-338-2118

SOFSOURCE

Box 828, East Lansing, MI 48826

Inquiry 684.

- CLIP ART
- GRAPHICS
- LASER FONTS
- CAD
- ELECTRONICS
- GAMES
- TRAVEL
- AUDIO/VIDEO
- SECURITY
- EDUCATION

For FREE CATALOG write to: CWI Information Services

P.O. BOX 4851, Anaheim, CA 92803
800-777-5636

Or telephone (714) 879-7917 24 HOURS!

Inquiry 679.

16 and 32 BIT MICROS

EDUCATIONAL TRAINING SYSTEMS in a notebook with power supply — for the Motorola 68000/68020/68881, TMS32010 DSP, Intel 8086/8087, A/D-D/A Converters, cross assemblers, serial interfaces with software, complete systems, documentation, schematic, operating system, cables. Starting Prices — \$230.00

Phone URDA, Inc.

1-800-338-0517

Inquiry 685.

REVIEWS

Find "Hands-on" Reviews in Seconds!

PC Reviews is an easy to use on-line database for NOVICES and PROS who need to locate and read "hands-on" reviews. Byte, Data Based Advisor, PC Today, PC Magazine, Computer Language, Info World and 35 more included. Natural language front-end helps define search terms. A perfect use for a modem. "Wonderful!", say users.

Competitive Technologies Group, Inc.

88 Fulton St. #2400, New York, NY 10038
(212) 463-8989 (201) 653-7688 8-N-1 for FREE DEMO

Inquiry 686.

SECURITY

EVERLOCK COPY PROTECTION

- Thwarts ALL Bit-copy Software
- Protect any COM/EXE w/o Source changes
- Shut down Debug Tracing & Disassemblers
- Install to Floppy, Hard Disk, or LAN
- Remotely reset Program Install-Count, Expire-Date or #Executes
- No damaged media or I/O plugs

For IBM and clones. \$195 & up. Free Info.

Az-Tech Software, Inc.

305 East Franklin, Richmond, MO 64085
(816) 776-2700
(800) 227-0644 FAX: (816) 776-8398

Inquiry 687.

Prima Data (the latest programs Club)

1.50 DISK + FREE BOOKS absolutely free

- 101 Computer Business Ideas
- The Computer Dictionary (NEW UPDATED)
- How to Get Started With Modems
- 10 Best IBM Utilities (and more BOOKS)

We Have the latest Best SHAREWARE & PUBLIC DOMAIN + Free CATALOG +

PRIMA DATA

P.O. BOX 1175, Cardiff, CA 92007 Tel: (619) 931-2520

Inquiry 681.

FREE IBM SOFTWARE

FREE CATALOG also contains SHAREWARE. 5/4 and 3 1/2-inch. All categories. ENGINEERING, CAD, DESKTOP PUBLISHING, LANGUAGES, UTILITIES, BUSINESS, GRAPHICS, SPREADSHEETS, WORD PROCESSORS, CHURCH, MEDICAL, HEALTH, EDUCATION, HOME.

SECTOR SYSTEMS COMPANY, INC.

Dept. B-6, 416 Ocean Avenue, Marblehead, MA 01945
(617) 639-2625

Inquiry 682.

THE ULTIMATE COPY PROTECTION

- Completely Menu Driven
- Defeats all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk Support
- Unlimited Metering
- FREE Demo Disk

STOPCOPY* \$325** STOPCOPY PLUS* \$450**
Your Valuable Software Investment

BBI COMPUTER SYSTEMS* (301) 671-1094
14105 Heritage Ln., Silver Spring, MD 20906 FAX: (301) 460-7545

Inquiry 688.

THE BUYER'S MART

SECURITY

BIT-LOCK® SECURITY

Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port-transparent security device. PARALLEL or SERIAL port. Complemented by economical KEY-LOCK™ and multifunctioned COMPULOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac)

MICROCOMPUTER APPLICATIONS

3167 E. Otero Circle, Littleton, CO 80122
(303) 922-6410/770-1863

Inquiry 689.

PC Security "Password"

With All the Computer Security Talk, **PASSWORD** is the Perfect Security Lock.

Password is a software program providing security for your PC. Password is Easy to understand and Simple to install, requires no reformatting. The boot limit option secures your hard disk. Password provides for up to 100 users with the supervisor controlling access to protected directories. Password is menu-driven with pop-up windows and help screens. The program provides an audit trail of users, and a screen blanking feature.

PASSWORD \$99.00 US Via. Mac, Amex

Nasdec International Inc.

2704-85 Garry Street, Winnipeg MB Canada R3C 4J5
PH: (204) 956-2798 FAX (204) 943-3702

Inquiry 690.

COPY PROTECTION

The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.

- Hard disk support
- No source code changes
- Customized versions
- LAN support
- New upgrades available

(408) 773-9680

SOFTGUARD SYSTEMS, INC.

710 Lakeway, Suite 200, Sunnyvale, CA 94086
FAX (408) 773-1405

Inquiry 691.

SOFTWARE/ACCOUNTING

PC TIME CLOCK

AutoTime is an Employee Management System that allows you to turn any PC into an Electronic Time Clock. AutoTime provides Time & Attendance, Job Costing, Payroll Interface, and Labor Distribution reporting. Network compatible. Prices start at \$495. Other Business Products: Network FAX, Absence Call-In, db-EDI.

Chase Technologies

1617 Kingman Ave., San Jose, CA 95128
(408) 998-2917

Inquiry 692.

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- PURCH ORDINVENTORY
- ORDER ENTRY
- ACCOUNTS RECEIVABLE
- JOB COSTING
- JOB ESTIMATING
- BILL OF MATLS
- SALES ANALYSIS
- PAYROLL
- ACCOUNTS PAYABLE

\$99 ea. + S&H

dATAMAR SYSTEMS Cred. Card-Check-COD

4876-B Santa Monica Ave.
San Diego, CA 92107 (619) 223-3344

Inquiry 693.

SOFTWARE/BUSINESS

DATA ENTRY SYSTEM

Heads-down data entry with two-pass verification for the IBM PS/2-PC/XT/AT & compatibles. Features include: Auto dup/skip, verify bypass, range checks, table lookups, a complete edit language. Fully menu driven. Price \$395

Call for our free 30-day trial period.

COMPUTER KEYES

21929 Makah Rd., Woodway, WA 98020
Tel: 206/776-8443 USA: 800/356-0203 Fax: 206/776-7210

SOFTWARE/BUSINESS

MILP88—MIXED-INTEGER LP

A general-purpose system for solving mixed-integer linear programs with up to 800 constraints and 4000 general integer or noninteger variables. Build MILP88 into your own programs with compiled Turbo Pascal units. MILP88 reads/writes Lotus worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Other features include interactive and batch operation, spreadsheet LP display and editing, an equation processor, problem/branch list storage, file I/O, download/load, report generator, and sensitivity analysis. \$148 with manual and 8087 support. \$299 with Turbo Pascal units.

Eastern Software Products, Inc.

P.O. Box 15328, Alexandria, VA 22309
(703) 360-7600

Inquiry 694.

LOW COST/HIGH QUALITY

Established, Powerful, Complete, Business Management Software Systems. Point-of-Sale/Inventory Control "SALES-PRO", Service and Repair, Video/Rental Store Management, Church Management, Accounting and Many more starting at \$39. For IBM PC Compatibles and the Atari ST.

HI-TECH ADVISERS

P.O. BOX 7524, Winter Haven, FL 33883-7524
1-800-882-4310 Fax #813-325-0375
Florida (813) 294-1885

Inquiry 695.

LOCATE HARD-TO-FIND BUSINESS AND STATISTICAL SOFTWARE

Econometrics • Biometrics • Cluster Analysis • Multivariate Analysis • Marketing Statistics • Experimental Statistics • ANOVA • Regression • Linear Programming • Project Planner • Forecasting & Time-Series • Sales & Market Forecasting • Quality Control and Industrial Experiments • Parameter and Tolerance Design • And Many More!

Lionheart Press, Inc.

P.O. Box 379, Alburg, VT 05440
(514) 933-4918 FAX: (514) 939-3087

Inquiry 696.

DATA ENTRY

KeyEntry III®, a complete Data Entry System that provides all the capabilities for designing data entry applications, controlling data flow, & monitoring/reporting operator activity & performance. Supports LAN and stand-alone environments. Evaluation copy (all programs & documentation) available. Call today for information!

Southern Computer Systems, Inc.

2732 Seventh Avenue South
Birmingham, AL 35233
(800) 533-6879/(205) 251-2985

Inquiry 697.

SOFTWARE/C BASIC

CBASIC ENHANCEMENTS

We carry CB86, many enhancements to it, and MB86 (the best Cbasic to C available). MB86 is faster and more robust than CB86 itself with 100% conversion. Can be used as a replacement for CB86 with no knowledge of C. Limited free sample conversion available. We also have replacements for Access Manager and Display Manager.

Minnow Bear Computers

P.O. Box 2233 Sta. A, Champaign, IL 61825-2233
(217) 344-1113 Fax (217) 328-6127

Inquiry 698.

SOFTWARE/CONSTRUCTION

FREE ESTIMATING SOFTWARE DEMO FOR SMALL BUILDERS & REMODELERS

Precision Estimating Light is brand new spreadsheet-based estimating software that combines powerful features in an easy-to-use package. Complete with 800 item database, you'll be estimating more accurately immediately. Call today for the free demo and literature — 503-644-8155.

Timberline Software

Inquiry 699.

SOFTWARE/ENGINEERING

Affordable Engineering Software

FREE APPLICATION GUIDE & CATALOG
Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Engineering Graphics • Signal Processing • Active/Passive Filter Design • Transfer Function/FFT Analysis • Logic Simulation • Microstrip Design • PC/MSDOS • Macintosh • VISA/MC

BV Engineering Professional Software

2023 Chicago Ave., Suite B-13, Riverside, CA 92507
(714) 781-0252

Inquiry 700.

MIDNIGHT ENGINEERING™

A new publication for entrepreneurial hardware and software engineers that will encourage and challenge you to personally develop and market your own products.

- PRACTICAL ARTICLES
- INSIGHTFUL INTERVIEWS
- DETAILED PRODUCT REVIEWS

call or write for a FREE copy of the premiere issue of Midnight Engineering.

DATArx

111 E. Drake Rd., Suite 7041, Fort Collins, CO 805025
303-223-2120

Inquiry 701.

Analog Circuit Simulation

- Schematic Entry
- SPICE Simulator
- Model Libraries
- Monte Carlo Analysis
- Parameter Sweeps
- Plotting/Graphics Output

Intusoft

The leader in low cost, full featured CAE software

P.O. Box 6607, San Pedro, CA 90734
(213) 833-0710 FAX (213) 831-3958

Inquiry 702.

SIMULATION WITH GPSS/PC™

GPSS/PC™ is an IBM personal computer implementation of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your simulations. Simulate complex real-world systems with the most interactive and visual yet economical simulation software.

MINUTEMAN Software

P.O. Box 1717Y, Stow, Massachusetts, U.S.A.
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 703.

Circuit Analysis — SPICE

- Non-linear DC & Transient; Linear AC.
- Version 3B1 with BSIM, GaAs, JFET, MOSFET, BJT, diode, etc. models, screen graphics, improved speed and convergence.
- PC Version 2G6 available at \$95.

Call, write, or check inquiry # for more info.

Northern Valley Software

28327 Rothrock Dr., Rancho Palos Verdes, CA 90274
(213) 541-3677

Inquiry 704.

FREE ENGINEERING MAGAZINE

Personal Engineering is a monthly magazine sent free of charge (USA only) to scientists/engineers who use PCs for technical applications. Topics each month include instrumentation • Data Acq/Control • Design Automation. To receive a free sample issue and qualification form either circle below or send request on letterhead to:

Personal Engineering Communications
Box 300, Brookline, MA 02146

Inquiry 705.

THE BUYER'S MART

SOFTWARE/ENGINEERING

ECA-2 Analog Circuit Simulation

ECA-2 Electronic Circuit Analysis is a high performance, interactive, analog circuit simulator. Available for a wide range of computers and operating systems.

ECA-2 Offers

- AC, DC, Transient, Fourier, Temperature
- Waveforms, Monte-Carlo
- 2 to 50 times faster than SPICE—Now with multiple plots!
- Over 500 nodes
- Full nonlinear simulator
- Built-in real time graphics

ECA-2 2.40 IBM PC \$775 FREE DEMO.

Turn-key Systems Available.

Tatum Labs, Inc.

3917 Research Park Dr. B-1, Ann Arbor, MI 48108
313-663-8810

Inquiry 706.

SOFTWARE/FORTRAN

EXPAND & EXTEND LIBS

122 FORTRAN callable routines. **EXPAND** allows DOS compilers access to LIM/EMS 3.2 or 4.0 expanded memory. **EXTEND** provides CGA, EGA, VGA, Hercules, HP, Tektronix, AutoCAD DXF graphics, access to BIOS/DOS functions plus additional utilities. **EXPAND** \$119, **EXTEND** \$149, both \$218.

DESIGN DECISIONS, INC.

P.O. Box 12864, Pittsburgh, PA 15241
(412) 941-4525

Inquiry 707.

SOFTWARE/GEOLOGICAL

GEOLOGICAL CATALOG

Geological software for log plotting, gridding/contouring, hydrology, digitizing, 3-D solid modelling, synthetic seismogram, fracture analysis, image processing, scout ticket manager, over 50 programs in catalog. Macintosh tool. Please call, or write, for Free Catalog!

RockWare, Inc.

4251 Kipling St., Suite 595, Wheat Ridge, CO 80033 USA
(303) 423-5645 Fax (303) 423-6171

SOFTWARE/GRAPHICS

New Fractal Software!

Now available, Barnsley's **Desktop Fractal Design System**, an interactive guide to designing fractal graphics. Also new publications by: Fiume—Raster graphics; Glassner—Ray tracing; Barnsley—Fractals; Ruelle—Chaos; and many more!

REQUEST OUR NEW CATALOG

Academic Press

ATTN: Book Marketing Dept. #35099
1250 Sixth Avenue, San Diego, CA 92101

Inquiry 708.

PC TECHNICAL GRAPHICS

TEKMAR is a graphics library for the **VGA, EGA** or Tecmar Graphics Master. Similar to PLOT-10, includes WINDOW, VIEWPORT, AXIS. Support for HP, Hi plotters. Curve fitting, complete plotting program. Log, semi-log, multi-axis, 3-D, contours. Jerry Fournelle (Aug 86 Byte): "As good as any I have ever seen..." Demo disks, literature available.

Advanced Systems Consultants

21115 Devonshire St. #329, Chatsworth, CA 91311
(818) 407-1059

Inquiry 709.

QuickGeometry Library

Many powerful math subroutines for CAD/CAM and graphics: LINES, ARCS, CIRCLES, ELLIPSES, NON-UNIFORM RATIONAL B-SPLINES WOFFSET (NURBS), INTERSECTION (even nested), ROTATE, SCALE, TRANSLATE, MIRROR, OFFSET, BREAK, TRIM, ENDPOINTS, TANGENT'S, CURVATURE, DXF I/O; lists: IBM PC comp MS-DOS 2+ \$199.00 + no S&H; incl C source, manual, support, 30-day guarantee.

Building Block Software

P.O. Box 1373, Somerville, MA 02144
(617) 628-5217

Inquiry 710.

SOFTWARE/GRAPHICS

PROFESSIONAL GRAPHICS FOR SCIENTISTS AND ENGINEERS

PC/MS-DOS • Macintosh

FREE 48-page Catalog

Linear/Log Scaling • Graphs with error bars • AUTO PLOT • BATCH Mode • Multiple Y-axes • Multiple data files • Auto/Forced Scaling • Full labeling • Built-in editor • 1-2-3 Interface • Curve fitting • Statistics • CGA, EGA & Hercules Compatible. 40 pen plotters supported.

BV Engineering Professional Software

2023 Chicago Ave., Suite B13, Riverside, CA 92507
VISA/MC (714) 781-0252

Inquiry 711.

NEW! TurboGeometry-Plus

Over 300 2D & 3D routines. Surfacing, Solids, HiddenLine, Volumes, Areas, Transforms, Perspectives, Tangents, Clipping, Decomp, & more. IBM PC/Comp, MAC, MSDOS 2+ Turbo Pascal, Turbo C, MSC & Turbo Pascal MAC. Manual \$199.95 or \$299.95 w/source. Foreign \$225 or \$325 w/source S&H Incl. VISA, MC, Chk, PO. 30 Day guarantee.

Disk Software, Inc.

2116 E. Arapaho Rd., #487, Richardson, TX 75081
214-423-7288 FAX 214-423-4465 800-636-7760

Inquiry 712.

TECHNICAL GRAPHICS

FROM ANY LANGUAGE

- Logarithmic, Time/Date & Linear Axes.
- Easy Curve Fitting and Data Smoothing.
- Supports all Video & Device Standards.
- 10 Curves with up to 8000 points each.
- Plus much much more...

Only \$95 Call Today 800-284-3381

Edmond Software, Inc.

5900 Mosteller Dr. #1125, Oklahoma City, OK 73112

Inquiry 713.

PEN PLOTTER EMULATOR

PLOT turns your dot matrix or laser printer into an HP pen plotter. Fast hi-res output. No jagged lines. Vary line width, color. Works with Autocad, Drafrix, etc. Supports NEC P5/P6, IBM Proprinter, Epson LQ/LFX, Toshiba, HP Laserjet, Okidata 29x/39x, Hercules/CGA/EGA/VGA. \$64 check/m.o.

Plot Corporation

24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 714.

POPULAR HGRAPH

SCIENTIFIC 2D & 3D graphic routines for IBM PC, VAX, SUN and Macintosh. Powerful, easy to use. Multiple fonts, device and machine independent. Uses max resolution. Links with FORTRAN, Pascal, C, Modula-2 and QuickBasic \$119.00

Custom software development, UGraph—the graphics editor available now!

Heartland Software, Inc.

234 S. Franklin, Ames, IA 50010
(515) 282-8216

Inquiry 715.

GRAPHICS PRINTER SUPPORT

AT LAST! Use the PrtSc key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer. GRAFPLUS supports all versions of PC or MS-DOS with IBM (incl. EGA, VGA), Tecmar, and Hercules graphics boards. \$49.95.

Jewell Technologies, Inc.

4740 44th Ave. SW, Seattle, WA 98116
800-628-2828 x527 (206) 937-1081

Inquiry 716.

SOFTWARE/GRAPHICS

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program.

GRAF/MATIC: screen routines \$135
PLOT/MATIC: plotter driver 135
PRINT/MATIC: printer driver 135

For the IBM PC, XT, AT & compatibles. We support a variety of compilers, graphics bds, plotters and printers.

MICROCOMPATIBLES

301 Prelude Dr., Dept. B, Silver Spring, MD 20901 USA
(301) 593-0683

Inquiry 717.

STANDARD GRAPHICS

NOVA XGLIB: Optimized Window/viewport, arcs, splines, figure fill, borders, text (scale, rotate, align), bitmaps, bitblt, keyboard, mouse, image capture. Over 150 functions. \$75.
PC_VDI: Outline fillable text, includes Segmentation. Free Demo Disk. \$395.
Both products ANSI CGI compatible, drivers for printer, plotter, HP laser. CGA/EGA/VGA. For most "C" compilers. MS FORTRAN, QuickBASIC. Demos, manual.

NOVA INC.

P.O. BOX 88976, Schaumburg, IL 60188
312-882-4111

Inquiry 718.

SOFTWARE/LANGUAGES

FORTH with DRUMA FORTH-83

Break the 64K barrier without speed/space penalty. Well designed, attractively priced. \$3 Standard.

- 1Mb+ automated memory management
- On-line documentation, ASCII/block files
- Many powerful and useful features
- Other products: windows, modules, profiler
- IBM PC/XT/AT & all compatibles

Write or call for FREE example diskette.

DRUMA INC.

8448 Hwy. 290 East E103, Austin, TX 78723
Orders: 512-323-0403 BBoard: 512-323-2402

Inquiry 719.

FORTRAN for Macintosh

Language Systems FORTRAN is a full-featured FORTRAN 77 compiler integrated w/MPW. Full ANSI FORTRAN 77 plus VAX-type extensions. SANE numerical calculations & data types incl. COMPLEX*16, 68000, 68020 and 68881 object code. Arrays greater than 32K. Link with Pascal, C, MacApp. \$359 w/MPW via air. MC/VISA/Check. MAC+, SE, Mac II, HD req.

Language Systems Corp.

441 Carlisle Drive, Herndon, VA 22070
(703) 478-0181

Inquiry 720.

EASY TO C

The C Workshop interactive software teaches you C. Do real C program exercises with built-in editor and compiler. Feedback guides you to solution. All you need to learn C, including our 384-page book. \$69.95 + \$5 Ship. PC compatibles.

MC/VISA/AE/Check.

Wordcraft

3827 Penniman Ave., Oakland, CA 94619
(800) 762-8003 (PST) (415) 534-2212 In CA

Inquiry 721.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i' = \sum_{j=0}^{n-1} [x_i' / \tau_j(\eta)] + \left(\frac{1}{k} \frac{F ds}{k \alpha \pm dx} \right)$$

- MathEdit constructs math equations to be inserted into WordPerfect Text and Manuscript documents.
- User-friendly interface—no new word processor needs to be learned.
- MathEdit—\$149

K-TALK COMMUNICATIONS

30 McMillan Ave., Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 722.

THE BUYER'S MART

SOFTWARE/MATHEMATICS

MATHEMATICIANS—ENGINEERS

Have you ever seen functions of a complex variable? Would you like to really understand differential operators like div, grad and curl? How about a peek into the fourth dimension? Call or write for information on our latest PC and Macintosh software.

Lascaux Graphics

3220 Steuben Ave., Bronx, NY 10467
(212) 654-7429

Inquiry 723.

SOFTWARE/MEDICAL

Medical Systems with ECS

PPM offers a complete line of medical software ranging from simple insurance claims processing to comprehensive A/R management. **PC CLAIM PLUS**—claims processing with ECS to over 100 major insurance carriers—30 day money back guarantee. **THRESHOLD**—complete A/R, patient billing, comprehensive practice management statistics.

CLAIM NET—Nationwide electronic claims clearinghouse transmits claims to over 100 insurance carriers. Software prices start at \$459.00. Dealer inquiries welcome.

Physicians Practice Management
350 E. New York, Indianapolis, IN 46204

800-428-3515 317-634-8080

Inquiry 724.

SOFTWARE/MUSIC

COMPLETE MUSIC SELECTION

Songwriters, arrangers, teachers and musicians. Explore the options of a MIDI set-up. All computers supported with the largest selection of software and hardware for various applications.

* Recording/Sequencing * Sound Editors
* Publishing * Cables * Computer-Aided Composition
* Education * Interfaces * Voices

Write for free catalog or call for free consultation.

MIX BOOKSHELF

8400 Hollis St., #12, Emeryville, CA 94608 (415) 653-3307

1-800-233-9604

Inquiry 725.

The ENTER-tainer Clip Music & Utility

300 Songs & Sound Effects - FUN & Educational!

By far the biggest & best collection on the market for DOS machines. Play like a jukebox through your PC speaker or clip & distribute in your own programs. **BASIC** source code included—no royalties required. Info-packed 172-page manual. 5.25" or 3.5" disks. Requires **BASIC 2.0** or later. \$29.95 + \$3.50 S/H MCVS/MO. Money-Back Guarantee!

PDI Music Software

PO Box 18655, Boulder CO 80308

(800) 727-4140 In Colorado (303) 440-4140

Inquiry 726.

SOFTWARE/PACKAGING

HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS

Cloth binders & slipcases like IBM's. Vinyl binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity imprinting. Bulk disks. Everything you need to bring your software to market. Disk and binder mailers. Much more! Low Prices! Fast service. Call or write for a **FREE CATALOG**.

Anthropomorphic Systems, Limited

376-B E. Saint Charles Rd., Lombard, IL 60148

1-800-DEAL-NOW 312-629-5160

Inquiry 727.

SAVE SAVE SAVE SAVE LET'S TALK PACKAGING

From Disk Labels to Manuals to Shipping Boxes—We are a complete packaging service. Everything you need to market your software. Call for our free catalog.

SOFCOM Printing and Packaging

10305 Reading Rd., Cincinnati, OH 45241

512-563-7136

Inquiry 728.

SOFTWARE/PRINTING

PRINTER GENIUS

Powerful memory-resident printer management • Control printer features from menus or within documents • Print spool-to-disk files or memory • Background print • File & directory browse • Edit small text • and more... • User friendly pop-up screens • 92-page manual • Preset for all printers • Completely flexible • PC MS-DOS • \$89 + \$4 S/H • VISA/MC

Nor Software Inc.

527 3rd Ave., Suite 150, New York, NY 10018
(212) 213-9118

Inquiry 729.

SOFTWARE/SCANNERS

Optical Character Recognition

Stop retyping. **PC-OCR**™ software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Panasonic and most other scanners. Supplied with 18 popular fonts. User trainable: you can teach **PC-OCR**™ to read virtually any typestyle, incl. foreign fonts. Proportional text, matrix printer output, Xerox copies OK. \$385. Check/VISA/MC/AmExp/COD.

Essex Publishing Co.

P.O. Box 391, Cedar Grove, NJ 07009

(201) 783-6940

Inquiry 730.

SOFTWARE/SCIENTIFIC

TableCurve—TableCode

Curve-Fit 211 Equations in a Single Step
TableCurve™ generates printed reports and Lotus, dBase, Quattro, Harvard Graphics, and Pagemaker/Ventura output. **TableCode**™ generates functions and calling code for C, Pascal, BASIC, FORTRAN, Modula-2 and dBASE languages.

Demo \$5, **TableCurve \$159, TableCode \$149 MCVS**

AISN Software

P.O. Box 32277, Phoenix, AZ 85064

602-266-1925

Inquiry 731.

Chaos/Nonlinear Dynamics

* Ordinary and Delay Differential Equation Solvers * Bifurcation Diagrams * 2- and 3-D Plotting, Sequential Magnification, Poincaré Sections * Next Maximum, 1-D & Circle Maps
* Phase Portraits with Multiple Initial Conditions * Spectral Analysis.
Fractal Dimensions, Lyapunov Exponents.

DS.I \$250.00 DS.II \$350.00

CHAOS IN THE CLASSROOM \$49.95

DYNAMICAL SYSTEMS, INC.

P.O. Box 35241, Tucson, AZ 85740, 602-825-1331

Inquiry 732.

C SCIENTIFIC LIBRARY

Extensive library of matrix, mathematical, and statistical routines. Developed and documented for use by technical specialists and C programmers in research, education, engineering, and scientific applications. Over 550 functions, superior documentation—four manuals, including Tutorial, Function Pages, and Example Programs. Includes Real and Complex Linear Algebra, Eigensystems, Differential Equations, Quadrature, Smoothing, Filtering and Prediction, MultiVariable Statistics, Multi-Dimensional Optimization, Linear Programming, Curve Fitting and Interpolations, etc. \$295 object only and \$365 with C source code.

EIGENWARE TECHNOLOGIES

13090 La Vista Dr., Saratoga, CA 95070 (408) 857-1184

Inquiry 733.

ORDINARY/PARTIAL DIFFERENTIAL EQN SOLVER

FOR THE IBM PC & COMPATIBLES

MICROCOMPATIBLES INC.

301 Prelude Dr., Silver Spring, MD 20901

(301) 593-0683

Inquiry 734.

SOFTWARE/SCIENTIFIC

OUR CATALOG WILL SAVE YOU TIME AND MONEY!

It describes (i) **GRAPH**, a \$79 scientific plotting program; (ii) **MINSOQ**, a powerful \$179 package for curve fitting and model development; (iii) **LAPLACE**, a simulation program employing numerical inversion of transforms (\$249); and (iv) **RRSTRIP** for exponential stripping (\$249). Call today for our free 16-page catalog with detailed technical application notes.

MicroMath Scientific Software

Salt Lake City, Utah 84121-3144

For orders or catalogs call: (800) 942-MATH

Inquiry 735.

Scientific/Engineering/Graphics Libraries

Turbo Pascal, Turbo C, Microsoft C
Send for **FREE** catalogue of software tools for Scientists and Engineers. Includes: Scientific subroutine libraries, device independent graphics libraries (including EGA, HP plotter and Laserjet support), scientific charting libraries, 3-D plotting library, data acquisition libraries, menu-driven process control software. Versions available for a variety of popular languages.

Quinn-Curtis

1191 Chestnut St., Unit 2-5, Newton, MA 02164

(617) 965-5660

Inquiry 736.

POWER FFT

High performance FFT routine library for the IBM-PC. Uses improved FFT, **Prime Factor**, and **General-N** algorithms to give unmatched performance. Over 6000 efficient lengths up to 64K points. Coded in assembly. Complex 1024 FFT in 135ms on Compaq 286MHz 385-387 or 868ms on 12MHz 286-8MHz 287. Forward/inverse, multidimensional and real transforms. Use with most C, FORTRAN, and Pascal products.

SOFFTEC

Introductory offer

\$85 plus \$3 shipping
P.O. Box 2363, Westford, MA 01886

Inquiry 737.

SOFTWARE/SECURITY

HANDS OFF THE PROGRAM®

OPERATING SYSTEM SECURITY
Secures subdirectories, files, printers and floppies
Keyboard lock — automatic or manual
Log PC boot, program exec, file opens, login/logout
Prevents DOS FORMAT and most viruses
Drive A: Boot Protection / Hard Disk Lock
IBM XT or 100% comp. — DOS V3.0+ — \$89.95 + \$3.75 SH

SYSTEMS CONSULTING INC.

P.O. BOX 111209, Pittsburgh, PA 15238

(412) 963-1624

Inquiry 738.

HANDS OFF THE BOARD™

1/2 SIZE SECURITY BOARD

Stop floppy boot — Require password to boot PC
Real-time disk encrypt — prevent boot sector virus
Prevent DOS FORMAT/FDISK and low-level formats
Set hard disk READ ONLY or turn ON/OFF
Turn floppies, printers and COM ports ON/OFF
IBM XT, AT Bus — DOS V3.0+ — \$149.95 + \$5.00 S/H

SYSTEMS CONSULTING INC.

P.O. BOX 111209, Pittsburgh, PA 15238

(412) 963-1624

Inquiry 739.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including Bitvec and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS \$149. XENIX \$249.

(702) 588-3737

Opt-Tech Data Processing

P.O. Box 678 — Zephyr Cove, NV 89448

Inquiry 740.

THE BUYER'S MART

SOFTWARE UTILITIES

VERIFY DISK INTEGRITY

Other disk testers "verify" that disk sectors can be read—VSCAN checks actual file contents for positive confirmation of disk and file system integrity. Pinpoints files with hidden damage due to program crashes, system lockup, etc. Quick scan function takes only seconds for a quick "checkup" of system functions.

ViroScan 2.01 \$39 + \$3 S&H

OMNICRAFT, INC.

15020 N. 74th St., Ste. C, Scottsdale, AZ 85260
(800) 531-9528 (602) 991-3652

Inquiry 741.

SOFTWARE/VOICE

TURBO WATSON

Turbo Watson is a complete set of tools for Turbo Pascal to access all the functions of the WATSON Speech Board. It is also a high level library of procedures to build voice response systems in minutes. A powerful ANSWERING MACHINE program is given as an example with source code. ONLY 99\$ Canadian. Visa/MC accepted.

ITI Logiciel

1425 Rene-Levesque W. Montreal, Can. H3G 1T7
(514) 861-5988

Inquiry 742.

STATISTICS

SX STATISTIX

PC Magazine Editors Choice!

- Easy to learn and use • Fast Free Support
- Money-Back Guarantee

At \$179 SX outperforms higher priced programs!

If you value your time and money, call today for FREE SX demo disk

612-631-2852

Analytical Software Box 13204, Roseville, MN 55113

Inquiry 743.

The BASS System™

Why use up 8 meg and 640K just to run a data step on your PC? Now you can run your data step code and statistical procs with a system that takes only 1 meg and 400K (and costs only \$399)! Free information.

BASS Institute, Inc.

P.O. Box 349, Chapel Hill, NC 27514
(919) 933-7096 or BB: (919) 968-6755 (N,8,1)

Inquiry 744.

Go with SOLO

Statistics and graphics for the PC. Quick and easy to use. All the popular statistics plus the latest in graphics. For business professionals for occasional use, researchers for basic statistics, or students. Satisfaction guaranteed! \$149 complete with graphics. Call today. VISA or MC.

BMDP Statistical Software, Inc.

1440 Sepulveda Blvd., Suite 316, Los Angeles, CA 90025
(213) 479-7799

Inquiry 745.

STATA

Stata 2.05 Now Available. More statistics, graphics and an all-new manual. Still only \$590. Quantity Discounts Available. New, lower academic price. \$20 Demo. Call toll-free for more information.

1-800-STATAPC

Computing Resource Center

10601 National Boulevard, Los Angeles, CA 90064
(213) 470-4341

Inquiry 746.

STATISTICS

DBMS/COPY

CONVERTS YOUR DATA INTO INFORMATION

Now your favorite stat package can access any database. DBMS/COPY can directly convert any database or spreadsheet file (ORACLE, PARADOX, dBASE, LOTUS etc.) into any stat package file (SAS, SPSS, SYSTAT, etc.) and vice versa. The PLUS version allows sorts, selections, and recalculations. \$195. 30-day guarantee. VISA/MC/AMEX/PO/COD.

CONCEPTUAL SOFTWARE INC.

P.O. Box 56627, Houston, TX 77256
(713) 667-4222 FAX: (713) 667-3FAX
1-800-STATWOW

Inquiry 747.

THE SURVEY SYSTEM

An easy-to-use package designed specifically for questionnaire data. Produces banner format, cross tabs & related tables, statistics (incl. regression) & bar charts. Codes and reports answers to open-end questions. All reports are camera-ready for professional presentations. CRT interviewing option.

CREATIVE RESEARCH SYSTEMS

15 Lone Oak Ctr. Dept. B, Peraluma, CA 94952
707-765-1001

Inquiry 748.

STATISTICS CATALOG!

Call for the catalog full of professional programs for general statistics, analysis of variance, regression, questionnaire analysis and quality control. Thoroughly tested and easy to use, the programs come with complete documentation. Programs available for PC or Apple II. Call toll free now for your free catalog.

HUMAN SYSTEMS DYNAMICS

9010 Reseda Blvd., Suite 222
Northridge, CA 91324
(800) 451-3030 (818) 993-8536 (CA)

Inquiry 749.

MINITAB's a PC of cake!

MINITAB's intuitive commands are easy to use and remember. Features descriptive statistics, regression, time series, chi-square, hi-res graphics, much more. PC version incl. LOTUS interface, data editor, network pricing. Call for FREE brochure.

Minitab, Inc.

3081 Enterprise Dr., State College, PA 16801
(814) 238-3280

Inquiry 750.

NCSS

Professional, easy to use, menu-driven statistical system. Used by over 5,000 researchers.

- 5.0 Statistical System—\$99
- 5.1 Graphics (2D & 3D)—\$59
- 5.3 Power Pac Supplement—\$49
- 5.4 Exp. Design/QC—\$49
- 5.5 Survival Analysis—\$59
- 5.6 Forecasting—\$69

We accept checks, POs, Visa, MC. Add \$3 s/h.

NCSS-B 801-546-0445
865 East 400 North, Kaysville, UT 84037

Inquiry 751.

SCA STATISTICAL SYSTEM

The only statistical software encompassing Forecasting & Time Series Analysis Quality and Productivity Improvement General Statistical Analysis

Available on both DOS and OS/2 operating systems. Call today for more information.

Scientific Computing Associates

4513 Lincoln Ave., Suite 106, Lisle, IL 60532, USA
Phone: (312) 960-1698 FAX: (312) 960-1815

STATISTICS

StatPac Gold™

StatPac Gold is the award-winning statistics and forecasting package that delivers. It's fast, flexible, easy to use and dependable. Time-tested and loaded with features. You be the judge. Get the facts! Call for your FREE brochure.

1-800-328-4907

Walonick Associates, Inc.

6500 Nicollet Ave. S., Minneapolis, MN 55423
(612) 866-9022

Inquiry 752.

UNINTERRUPTIBLE POWER

HOW TO PROTECT YOUR COMPUTER

And Make It Last Longer

FREE money-saving literature. What you need to know about UPS—uninterruptible power supply. How to get complete protection from power line problems. 350VA through 15KVA models from the world's largest manufacturer of single-phase UPS.

Best Power Technology, Inc.

P.O. Box 290, Necedah, WI 54646
(808) 565-7200 ext. 3737
TOLL FREE (800) 356-5794 ext. 3737

Inquiry 753.

UTILITIES

COPY AT TO PC—BRIDGE-IT 3.5

"CPW02PC" RELIABLY writes 300KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape back-up. Only \$79.00 + S/H
"BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 3 1/2" 720KB/1.44MB drives for PC/XT/AT without upgrading DOS/BIOS. Only \$39.00 + S/H
BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT \$129.00 + S/H VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS

655 Sky Way Suite 113, San Carlos, CA 94070
1-415-593-8777(CA) 1-415-593-7675 (FAX)
1-514-845-0818 (CANADA) 1-800-523-8777

Inquiry 754.

DELTA, the better text file comparison tool. Scrollable windowed presentations of file or directory comparisons, with a built-in editor window. Ideal for programmers! Requires DOS 2.0 or higher with at least 384K RAM. A hard disk is recommended. Order now. \$79.
DEMO available on our BBS

OPENetwork

POWER TOOLS FOR POWER USERS

215 Berklely Pl. (B-1), Brooklyn, NY 11217
718-638-2240 BBS: 718-638-2239

Inquiry 755.

Recover deleted files fast!

Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk, view, change or create formats, change a file's status, change data in any sector. MS-DOS \$75 U.S. Check/Credit card welcome.

QUAID SOFTWARE LIMITED

45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

Inquiry 756.

DATABASE UTILITIES

NORTAK Software Ltd. now offers a menu-driven ASSIST-like file utility for dBASE, Clipper, and FoxBASE. Self-contained (.EXE file), fast and simple to use.

SINGLE VERSION—\$35; 3-VERSION PACKAGE—\$60.
To order call:

SHOSHIN Systems Inc.

USA 1-800-267-0755 Canada 1-800-267-8856
Info Only 613-235-2310
VISA and MC accepted

Inquiry 756.

THE BUYER'S MART

UTILITIES

AppleWorks L IBM

CROSS-WORKS transfers both ways between Apple IIe/IIc/IIgs and IBM PC/XT/AT/PS-2 & compatibles. Exchange AppleWorks with WordPerfect (keeps formatting), Lotus 1-2-3 (keeps formulas), and dBase II/IV! Included cable plugs in serial ports for 19,200 baud transfers. Easy menu operation.

Phone (919) 878-7725 for free info packet.
SoftSpoken Co., PO Box 97623, Raleigh, NC 27624

Inquiry 757.

SAVE TIME and MONEY

with the RED Utilities. Programs include: Batch file compiler speeds batch files. Disk cache speeds hard and floppy disks. Printer spooler. Path command for data files. Wild card exceptions. Sort directories. Over 10 more programs. Only \$79.95. Order today! 30 day money-back guarantee. IBM PC. Visa/MC.

The Wenham Software Company
5 Burley St., Wenham, MA 01984 (508) 774-7036

Inquiry 758.

WORD PROCESSING

FARSI / GREEK / ARABIC / RUSSIAN

Hebrew, all European, Scandinavian, plus either Hindi, Punjabi, Bengali, Gujarati, Tamil, Thai, Korean, Viet, or IPA. Full-featured multi-language word processor supports on-screen foreign characters and NLQ printing with no hardware modifications. Includes Font Editor. \$355 dot matrix; \$150 add'l for laser. \$19 demo. S/H in U.S. incl'd. Req. PC, 640K, graphics. 30-day Guarantee. MC/VISA/AMEX

GAMMA PRODUCTIONS, INC.

710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401
213/394-8622 Tlx: 5106008273 Gamma Pro SNM

Inquiry 759.

DuangJan

Bilingual word processor for English and: Armenian, Bengali, Burmese, Euro/Latin/African, Greek, Gujarati, Hindi, Khmer, Lao, Punjabi, Russian, Sinhalese, Tamil, Telugu, Thai, Ukrainian, Viet, . . . Only \$109+\$5 s/h (foreign + \$12 s/h). Font editor included. For any IBM compatibles with dot-matrix & LaserJet printer. Demo \$9+\$1 s/h.

MegaChomp Company

3438 Cottman Ave., Philadelphia, PA 19149-1606
(215) 331-2748 FAX: (215) 331-4188

Inquiry 760.

WORD PROCESSING

PC-Write 3.0 — Shareware

Fast, full featured word processor for IBM PC. Now edits large files & multiple columns. Also spell check, mailmerge, networking, ASCII, and macros. Easy-to-use, optional menus. Supports 500 printers incl. lasers. Software, guide and tutorial on disk: \$19. Registration with manual, support newsletter and 2 free updates: \$99.

90-day money-back guarantee. VISA/MC.

Quicksoft 1-800-888-8088
219 First Ave. N., #224-BYTC, Seattle, WA 98109

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

THE BUYER'S MART

can help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

603-924-3754

Computers For The Blind

Talking computers give blind and visually impaired people access to electronic information. The question is how and how much?

The answers can be found in "The Second Beginner's Guide to Personal Computers for the Blind and Visually Impaired" published by the National Braille Press. This comprehensive book contains a Buyer's Guide to talking microcomputers and large print display processors. More importantly it includes reviews, written by blind users, of software that works with speech.

This invaluable resource book offers details on training programs in computer applications for the blind, and other useful information on how to buy and use special equipment.

Send orders to:

National Braille Press Inc.
88 St. Stephen Street
Boston, MA 02115
(617) 266-6160

\$12.95 for braille or cassette, \$14.95 for print. (\$3 extra for UPS shipping)

NBP is a nonprofit braille printing and publishing house.

REEL 9-TRACK GENIUS

OVERLAND DATA will bring out the GENIUS IN YOU when it comes to connecting your PC to the mini/mainframe world. OUR ENGINEERS DESIGNED the most successful tape drives, controllers and software in use today. Call the experts... ODI!

- DOS, XENIX, UNIX, NOVELL
- PC/XT/AT/386/PS2 & Compat.
- 800, 1600, 3200, & 6250 BPI
- Outstanding Customer Support
- 24 hour delivery available on Cipher, Qualstar, Anritsu & M4



Overland Data
"Experience Makes The Difference"

CALL ODI TODAY AT 1-800-PC-9TRAK

5600 Kearny Mesa Rd. • San Diego, CA 92111 • FAX: 619/571-0982
Phone #: 619/571-5555 • 1-800-729-8725

Connectivity Solutions

DCB

Universal converter; high capacity 64KB to 1 MB printer buffer with

parallel / serial input and output ports. Frees computer while doing printing. Converts data if required. Connects more than 1 computer to more than 1 printer.

DCI

Internal converter printer buffer for IBM or

compatibles computers. Built in microprocessor frees computer while printing. Serial and parallel outputs. Features include using any type of printer or using 2 printers software selectable.

MOP

Parallel interface card for PC, XT or AT with up to 4 output ports. Connect up to four different printers or plotters. Software selectable.

DCU

Universal data converter serial/parallel, parallel/serial. Completely programmable with software protocol.

MOS

Multi-serial interface for IBM or compatibles. Up to 8 serial ports. Interconnects computers, modems, printers, plotters, etc.

MIP

Multi-parallel input ports for PC, XT or AT with 8 ports. Allows up to 64 external data lines, 24 input/output control lines.

MAX-E-CON



Ultra high storage capacity suitable for LANs and multiple stand alone computers. Share or switch computers, printers, plotters, modems, etc.

Up to 24 serial / parallel input/output ports. System capacity : 512 KB RAM with 20 or 40 MB fast access hard disk. Basic model comes with 512 KB, 8 input ports (serial or parallel) and 4 output ports (parallel). Each port is completely independent and can use different speeds, protocols, etc. System status display (optional).



Call today for details
Phone (415) 968-8404
FAX # (415) 968-8390

Dealers inquires welcome

Maxima Corporation
970 Terra Bella Ave. Bldg. 3
Mountain View, CA 94043

9600bps MODEM



2400 bps MODEM \$95 30 DAY FREE TRIAL
ECONOFAX™ OR MNP-5...CALL

Many low cost modems are faulty or very error prone... **Not ours!!!**
PERFORMANCE "I have recently had a lot of trouble getting 2400 BAUD MODEMS to work...this one is working perfectly." R.T. Moreno Valley CA. **SUPPORT** "I get the impression that your company, indeed, bends over backwards to provide service to its customer." M.F., Selma CA. **SUPERIOR TECHNOLOGY...**The phone connection is the main source of data errors. **DYNAMIC IMPEDANCE STABILIZATION™, DIS™** (invented by CompuCom) improves signal quality and reduces these errors by up to 95% compared to a standard modem. Model 2400 (without DIS) at \$95 outperforms the low cost alternatives. the 24DIS at \$119 outperforms the challengers, regardless of cost. IBM internal, Hayes compatible, made in USA, 6 COM ports, internal speaker, five year warranty, EasyCom software, dealers inquire. *If you aren't totally satisfied, return within thirty days for a full refund!*

March '89 p102 **BYTE MAGAZINE**
CompuCom Corporation "Real deal...worked fine...quite a bargain!"
CALL (408) 732-4500 (800) 228-6648

Pay Less \$\$\$ for more Memory

- SIMMS MODULES
AST • APPLE • DELL • EVEREX • PS2 • COMPAQ
- EXPANSION BOARDS
COMPAQ • PS2 • HP LASERJET
- MEMORY CHIPS
64K • 256K • 1 MG
- INTEL MATH COPROCESSORS - FULL LINE

call: 714-855-0411
(FAX) 714-855-8504

23552 Commerce Center Drive, Suite L, Laguna Hills, CA 92653
ESTABLISHED 1985 • LOW, LOW PRICES • VISA • MASTERCARD
SAME DAY SHIPPING • CORPORATE & SCHOOL P.O.S. WELCOMED

Dynamic Electronics
STOCKING DISTRIBUTOR OF SEMICONDUCTORS

PC COMPATIBLE ENGINEERING

Annabooks gives you the **hardware, software, and firmware** information you need to design PC-compatible systems faster and better. And you have control of your design from the ground up -- our firmware and software products include **source code!** Plus all the utilities you need.

Do hardware design? **Declar Design's** 1M DRAM SuperSpec is the first of a series of hardware books you won't want to miss. And a PC Bus timing book is on the way! Start by getting these books:

AT BiosKit: an AT Bios with source code you can modify. With setup & debug. 380 pages with disk, \$199

XT BiosKit: Includes a debug. 270 pages with disk, \$99

Intel Wildcard Supplement for XT BiosKit: Includes ASIC setup, turbo speeds, 60 pages with disk, \$49

1M DRAM SuperSpec: Design your memory to all mfg's specs at once! Lots of timing diagrams & tables, \$79

PrmKit: Puts anything in Eprom or SRAM; DOS, your code, data, you name it! With source on disk, \$179

SysKit: Here's a debug/monitor you can use even with a brand X Bios. Includes source, of course. \$69

XT-AT Handbook: The famous pocket-sized book jam-packed with hardware & software info. \$9.95 ea. or 5 or more for \$5 each.

Software tools: You need MS C & MASM 5.1 for modifying the Kit products.

FREE Mention this ad when you order and get a **free XT-AT Handbook** by Chelizer & Foster! Hurry before we come to our senses and change our minds.

Annabooks

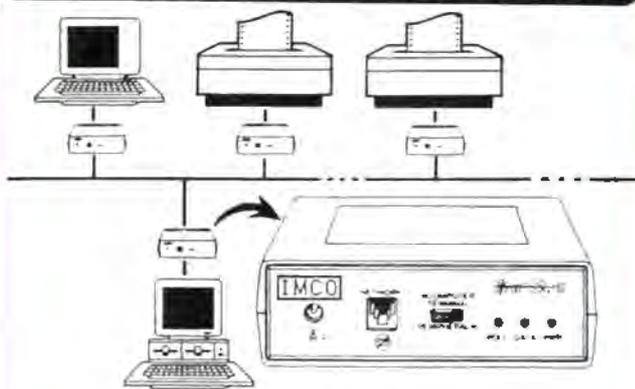
12145 Alta Carmel Ct Suite 250-262

San Diego, California 92128

(619) 271-9526 Money-back guarantee



RS-232 NETWORKING



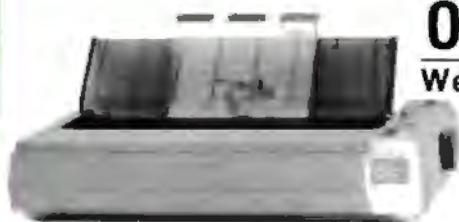
- Network up to 50 serial ports over a single pair of telephone wires in any topology transparent to all software. Built in menus and help screens
- Access any PC, printer, modem, plotter or minicomputer from your keyboard!!
- Choose print destination from within spread sheet or word processor with POP UP communications utility. Includes background PRINT SPOOLING and X/Modem.
- Uses existing telephone wires in most offices. Easy to install, train and use
- Add stand-alone BusDrivers, one at a time, at any point along the network, or use standard telephone splitters to add separate addressable ports to a single jack!
- **SPECS:** Distributed, packet-switched, full-duplex, asynchronous, RS-232 data network. Supports 50 devices, independent speeds up to 38,400 BPS (all devices may be simultaneously engaged in full-duplex conversation)

\$350 Per
BusDriver
(1 per port)

\$295 Each In
Six-Packs

IMCO

(508) 485-6950



OLIVETTI

We Print Better

**C
O
L
O
R**

PRINT SAMPLES

ABCDEFGHIJKLMNPOQRSTUVWXYZ #123456789

abcdefghijklmnopqrstuvwxy #123456789

ABCDEFGHIJKLMNPOQRSTUVWXYZ #123456789

abcdefghijklmnopqrstuvwxy #123456789

abcdefghijklmnopqrstuvwxy #123456789

PRINT SPEED

- 240 cps in high speed draft mode
- 180 cps in draft mode
- 60 cps in letter quality mode

LINE LENGTH

- DM 250: 80 columns at 10 cpi
- DM 250L: 136 columns at 10 cpi

EMULATIONS

- IBM Graphics Printer
- IBM Proprinter XL
- Epson FX 80/100 (Subset)
- Epson JX 80 (Subset)

BIT IMAGE MODE

- Horizontal resolution: 60, 72, 80
- 90, 120, 240 dpi
- Vertical resolution: 180 dpi

**PRINTERS
As Low As
\$289**

FUJACORP INC.
473 SARENA COURT #2
SANTA CLARA, CA 95054
FAX 408-496-5877

To order, please call:
800-345-4408 or
408-980-8181

We accept Visa and Master Card

**FASTER
THAN INTEL!**

**ATTENTION:
CAD/CAM, SPREADSHEET,
SCIENTIFIC APPLICATIONS**

SPEED UP YOUR PROCESSING

With The New IIT Math Coprocessor

- CMOS
- Consumes 1/6 the power of regular Intel
- 20%–10 times faster than Intel
- Perfect for Laptops
- Object Code & Plug Compatible with 80287 and 80C287A

Five Year Warranty
Call Now For Our
Low Price Information

We Also Carry
SIMM Modules for:
Compaq, PS/2,
AST, DELL,
& Macintosh



CUTTING EDGE ELECTRONICS

28201 MARGUERITE, STE. 10-232
MISSION VIEJO, CA 92692
714-249-3891 • FAX 714-249-3929

COMPARE OUR NEW LOWER PRICES AND SUPERIOR QUALITY

PCI-286-12

- 80286-12
- 1.2 MB Floppy Drive
- 640K RAM
- Serial / Parallel / Game
- 101-Key Enhanced Key Board
- SI = 13.3 (1 Wait)
- SI = 15.2 (0 Wait \$100 Option)
- 6/12 MHz Key Board Switchable
- WA2 HD & FD Controller
- 80287 SOCKET
- 200W POWER SUPPLY

MONO SYSTEM
• W/Mono Monitor
• 20 MB Hard Disk

\$1195

VGA COLOR SYSTEM
• W/VGA Card & Monitor
• 20 MB Hard Disk

\$1795

EGA COLOR SYSTEM
• W/EGA Card + Monitor
• 20 MB Hard Disk

\$1580



PCI-386-20

- 80386-20
- W/40 MB HD
- Mono System **\$1795**
- VGA **\$2295**

GAS PLASMA 286-12 _____ \$1999

- 80286-12 CPU
- SI = 13.3
- 3 1/2" FD 1.44 MB
- 20 MB HD ST-138
- LCD Screen (640 X 400)
- I/O Card Parallel/Serial/Game
- 640K RAM



GAS PLASMA 286-20 _____ \$2295

- CPU 80286-20
- SI = 23

LCD-286-10 PORTABLE _____ \$1395.00

- 10 MHz 80286 SI = 10.3
- 12 MHz SI = 13.3 (Option \$50.00)
- 16 MHz SI = 18 (Option \$250.00)
- 640K RAM
- LCD Screen 640 X 200 (Option 640 X 400 \$180.00)
- Super Twist & Back Lighting
- 86 Key Board
- External / Parallel / Game
- 1.2 MB Floppy drive
- 20 MB Hard Disk
- 80287 Socket
- 200 W Power Supply
- Side 15 1/4" X 9 1/2" X 8"
- 23 LBS



LCD-386-16 _____ \$2495

- 80386-16 MHz
- 40 MB Hard Disk
- 80387 Socket

LCD-386-20 _____ \$2595

- 80386 20 MHz
- 40 MB Hard Disk
- 80387 Socket

CRT-PORTABLE-286 _____ \$1295

- Compaq Type
- 80286 (10 MHz or 12 MHz)
- 12 MHz SI = 13.3 (Option \$50)
- 16 MHz SI = 18 (Option \$250)
- One 1.2 MB Floppy Drive
- 200 W Power Supply
- TTL Display 9" Amber
- AT Key Board
- Serial / Parallel / Game
- WA2 HD & FD Controller
- 20 MB Hard Disk



CRT-386-16 _____ \$2289

- 80386-16

CRT-386-20 _____ \$2389



PACIFIC COMPUTER

702 S. Del Mar Ave., #B,
San Gabriel, California 91776
(FAX) 818-286-8662

(818) 571-5548 (Technical support)

(800) 421-1102 (IN CA) ORDER ONLY

(800) 346-7207 (OUT CA)

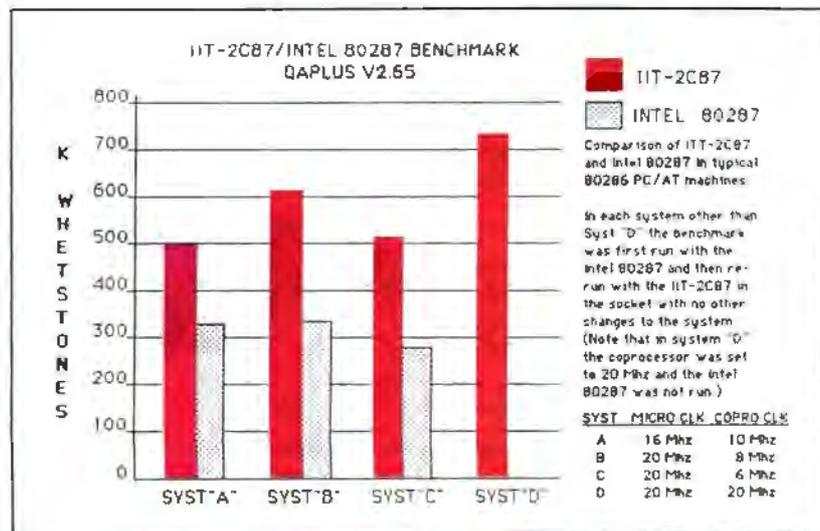
Mon - Sat
9:00 AM - 6:00 PM



*ALL SYSTEMS COME WITH ONE YEAR PARTS & LABOR WARRANTY

IIT's 287 Coprocessor

- Twice the speed of Intel's 80287 - 10 Mhz
- 100% Intel Compatible
- CMOS/NMOS Compatible
- Lower power for your laptop



PSI

2005 Hamilton Ave. #220
San Jose, CA 95125
800-622-1722
408-559-8544

HIGH QUALITY...LOW PRICE!

We've Built Our Reputation on This Premise for Almost a Full Decade.

Clone 286 With
LOW PRICE
\$1299 Complete System!

12MHz, 32MB HARD DRIVE, MONOCHROME MONITOR

Clone 286 With
MEDIUM SPEED
\$1969

12MHz, 48MB HARD DRIVE, EGA MONITOR

Clone 286 With
HIGH SPEED
\$2429 VGA Color!

16MHz, 65MB HARD DRIVE, VGA MONITOR



With MS-DOS 3.3 or 4.01 and GWBASIC \$75 or \$90 Extra

SATISFACTION GUARANTEED!
One year parts and labor. 30 day money back guarantee (except software and shipping).

MEMBER
INTERNATIONAL BUSINESS MACHINE ASSOCIATION

MMC
MEMBER COMPUTER MONITORING CORPORATION

SERVING YOU SINCE 1980

Standard Features of All Clone 286 Computers:

- 640K/1MB RAM Standard (see chart)
- 1:1 Interleave, 2 Floppy/2 Hard Disk Controller (798 Kb/s thru-put)
- 360K, 1.2M or 1.44M (3.5") Floppy Drive (your choice)
- 101 Key Enhanced Keyboard (Click-Tactile Option add \$20)
- 1 Parallel, 1 Serial, 1 Joystick Port
- 200 Watt Power Supply
- On-Board Clock/Calendar with Battery Backup
- FCC Certified
- System Reset Switch Located on Front Panel
- Setup in ROM
- 80287 Math Coprocessor Socket
- CPU Speed Switchable
- Fully Expandable
- Novell Compatible
- One Year Parts and Labor Warranty
- PC-Write - QModem - ExpressCalc - MasterMenu - HomeBase - MoneyMaster - Findex - Clone Utilities

CLONE VALUE CHART

	HERC MONO	VGA MONO	CGA COLOR	EGA COLOR	VGA COLOR
12MHz 32MB 55ms RAM	\$1295	\$1579	\$1459	\$1719	\$1879
48MB 40ms RAM	1309	1679	1559	1819	1979
65MB 40ms RAM	1499	1779	1659	1919	2079
85MB 28ms RAM	1599	1879	1759	2019	2179
12MHz 32MB 65ms RAM	\$1449	\$1729	\$1609	\$1869	\$2029
48MB 40ms RAM	1549	1829	1709	1969	2129
65MB 40ms RAM	1649	1929	1809	2069	2229
85MB 28ms RAM	1749	2029	1909	2169	2329
16MHz 32MB 65ms RAM	\$1649	\$1929	\$1809	\$2069	\$2229
48MB 40ms RAM	1749	2029	1909	2169	2329
65MB 40ms RAM	1849	2129	2009	2269	2429
85MB 28ms RAM	1949	2229	2109	2369	2529



TURBO CLONE

AT Style Keyboard **\$699** Save Now!

Standard Features:

- 8088 @ 4.77—
- 10MHz Turbo-speed Mainboard
- 640K RAM standard
- 8087 Socket
- 150-Watt pwr sup
- 360K Floppy Drive w/Disk Controller
- Hercules® Compatible Video Card
- HiRes TTL monitor (green or amber)
- 2-Parallel prt prts
- 1-Serial port (2nd optional at \$29)
- Game-Joystk prt.
- Clock/Calendar
- Fully Expandable
- PC-Write - QModem - ExpressCalc - HomeBase - MoneyMaster - Findex - Clone Utilities - AutoMenu
- FCC Class B Cert.
- Keyboard Lock
- LED's for Power, Turbo and Hard Disk Access
- 1 yr prts, lab war

OPTIONAL EQUIPMENT

Printers	Star NX-1000 144/36 cps, NLO	\$179	Star NX-1000 Rainbow (w/color)	\$239	Star NX-2400 170/57 cps, LQ, 24 pin	\$339	
Star NX-15 120/30 cps, NLO, wide	\$319	Star NB-15 300/100 cps, LQ, 24 wide	\$749	1200/300 baud internal modem	\$59	Clone EGA video board, 640 x 350 res	\$149
Star ND-15 160/45 cps, NLO, wide	\$389	Panasonic KX-P1180 192/36 cps, NLO	\$199	2400/1200/300 baud internal modem	\$99	Paradise VGA Plus 16, Hi-speed	\$259
Star NR-15 240/60 cps, NLO, wide	\$449	Panasonic KX-P1191 240/48 cps, NLO	\$259	Logitech Mouse (bus or serial)	\$69	The Complete Fax 9600 int FAX brd	\$449
Star NB24-10 180/60 cps, LQ, 24 pin	\$559	Part. KX-P1124, 192/63 cps, LQ, 24 pin	\$359	Microsoft Mouse (bus or serial)	\$108	Intel Above Brd LIM 4.0 EMS mem brd	\$439
Star NB24-15 (above, wide carriage)	\$579	IBM parallel cable, 10' molded ends	\$12	Logitech ScanMan (400 DPI)	\$219	Math coprocessors, all types, speeds in stock	

Save Your Data and Money, Too! Peripherals Sale!

Easy to Install!

This is the fastest floppy interface tape drive around!

60MB TAPE DRIVES

Up to 150MB Capacity

Works on PC, XT, AT's and 100% compatibles. Connects to the internal floppy (B:) connector or the optional adapter card (\$77). Comes complete with instructions and data compression software that allows up to 100MB data storage on a 40MB tape and 150MB on a 60MB tape.

External model now available for only \$99 extra!

250 Watt Model As Low As **\$279** Add \$23 shipping in the lower 48 states.

UNINTERRUPTABLE POWER SUPPLY

250 Watt Model As Low As **\$279** Add \$23 shipping in the lower 48 states.

250 Watt	120 Volt	\$279
300 Watt	120 Volt	399
300 Watt	120 Volt	499
300 Watt	120 Volt	639
1200 Watt	120 Volt	1099
1200 Watt	120 Volt	1449

230 volt units also available. Specify exact input voltage.

*Shipped motor freight collect.

Limited Time Only! Fantastic Prices Now On LOW COST HARD DRIVES For IBM and Tandy

5.25MB 95ms ST-504 MFM XT Kit	\$149	21.4MB 65ms ST-225 MFM XT Kit	\$249
32.7MB 65ms ST-238 12L XT Kit	\$279	42.8MB 40ms ST-251 MFM Kit 28ms Optional	\$379
40.1MB 40ms ST-157R RLL Bare 28ms Optional	\$329	94.9MB 28ms ST-296N SCSI Kit	\$599
65.5MB 40ms ST-277R RLL XT Kit 28ms Optional	\$429	122.7MB 28ms ST-4144R RLL Bare	\$699

Save on Low Cost Floppys!

Select the drive or drives you want, pick the enclosure and appropriate cable and we will assemble and test at no additional cost for you. All drives are brand new, not factory seconds, and carry a full one year parts and labor warranty. Add \$5 shipping and handling per drive.

360K 5.25" TEAC 55B bare	\$89
720K 5.25" TEAC 55F bare	79
1.2M 5.25" TEAC 55FH bare	79
360K 3.5" TEAC 35B bare	85
720K 3.5" TEAC 35F bare	85
1.44M 3.5" TEAC 35FH bare	79
5.25" mounting bracket for 3.5" drives (includes rails, signal and power adapter. Specify beige or black faceplate)	10
Dual 3.5" external case/power supply. Use with one or two 3.5" drives (horizontal)	\$49
Dual 5.25" same as above except vertical	\$9
IBM external floppy cable for C/D DB37 required	\$39

(Add \$10 for brushed Stainless Steel cover)

Save on 32MB & 49MB Hard Cards

32.7MB 48ms RLL	\$329	49.1MB 40ms RLL	\$429
-----------------	-------	-----------------	-------

These units are completely assembled with brand new drives and come ready to install. For IBM XT's, 100% compatibles and Tandy 1000/1000A, SL, SX, TL, TX. Please specify the exact make and model of your computer. One year parts and labor warranty.

SOFTWARE SPECTACULAR!

This list is only a small portion of our inventory! Call us for all of your software needs!

MS-DOS® BUSINESS SOFTWARE

Aldus Pagemaker v. 3.0	\$499
Borland Quattro (1-2-3 Clone)	159
Borland Sprint word processor	139
DAC Easy Bonus Pack	123
Dbase IV	499
Design CAD	162
Design CAD 3D v. 2.1	216
Formtool	55
Framework III v. 1.1	399
Gem Desktop Publisher v. 2.0 with GEM 3 Desktop	182
Generic CAD Level 3 with DotPlot	174
GrammarK III	54
Harvard Graphics v. 2.1	310
Lotus 1-2-3 v. 2.01	319
Peachtree Complete System II	174
Peachtree Double Bundle software for accounting	239
PFS First Choice v. 3.0	89
PFS Professional File v. 2.0	180
Publiskit!	122
Quicken	31
R Base for DOS v. 2.1	513
Rightwriter v. 3.1	52
Wordperfect v. 5.0	255
Wordperfect Library v. 2.0	70

UTILITIES/PROGRAMMING LANGUAGES

Autosketch	\$53
Deskview 386 with GEMM 386	116
Fastback Plus v. 2.01	115
Laplisk Plus v. 2.0	84
Microsoft C Compiler 5.1	289
Microsoft Macro Assembler 5.1	99
Microsoft Quick Basic Compiler 4.5	67
Microsoft Quick C Compiler	67
Microsoft Windows 286	67
Microsoft Windows 386	133
Norton Utilities Adv. Ed. v. 4.5	88
PC Tools Deluxe v. 5.0	48
Procomm Plus	46
Xtree Pro	59

GAMES

Chessmaster 2100	\$32
F-18 Stealth Fighter	44
Falcon AT	34
Kings Quest I, II, III or IV	31
Math Blaster Plus	28
Print Shop Bundle	37

Clone 286

3446 CLONE COMPUTERS
2544 W. Commerce St.
Box 223957
Dallas, Texas 75222-3957
Tel: 882761
Fax: 214-534-8303
For information or technical assistance call 214-527-5400

ORDER TOLL FREE
Mon.-Fri. 9-7; Sat. 10-3
Call from anywhere in the lower 48 states and Hawaii.

800-527-0347

VISA MasterCard
AMERICAN EXPRESS TeleCheck

25MHZ 80386 MOTHERBOARD

Faster Than The Everex Step™ I
6.2 Mips! \$1499 (0K) QTY 1

Features:

- *64K/256K Write Back Cache
- *Dual Read/Write Cache
- *Transparent Refresh
- *8MB maximum on motherboard
- *Supports 80387/Weitek
- *Compatible with UNIX, OS/2, and Novell
- *1 Year Full Warranty
- *72 HF In-Circuit Burn-In!



20 Mhz also available
 4.9 MIPS

SIMM Modules

256Kb x 9, 100ns-\$48
 1Mb x 9, 100ns-\$150

Same Day Shipping!

Technology Power Enterprise, Inc.
 40560 Fremont Blvd., Suite 118,
 Fremont, CA 94538

TEL (415) 823-9182 FAX (415) 823-9462

Novell, OS/2, and UNIX are registered trademarks

GANG PROGRAMMER Does 50,000 EPROMs A WEEK!



The only programmer under \$1000.00 that withstands heavy duty operation. Easy to use. Fastest possible programming speed. **GANGPRO-8™** is a sure bet when reliability is what you want. All this plus a one year warranty and update for only \$995.00!

LOGICAL DEVICES, INC.

1201 N.W. 65th Place
 Ft. Lauderdale, FL 33309
 (305) 491-7404
 1-800-331-7766

STAND-ALONE UNIVERSAL PLD PROGRAMMER

Costs Less, Performs More



Palpro-2x™ is an intelligent programmer supporting PLDs from a wide variety of sources. Works with any PC or computer using a serial port. FREE one year device update and warranty. Price \$795.00.

LOGICAL DEVICES, INC.

1201 N.W. 65th Place
 Ft. Lauderdale, FL 33309
 (305) 491-7404
 1-800-331-7766

Circle 285 on Reader Service Card

Circle 163 on Reader Service Card
 (DEALERS: 164)

Circle 165 on Reader Service Card
 (DEALERS: 166)



SEAGATE

FAX

ST-225 KIT	\$220	Toshiba 3300	\$798
ST-238 KIT	\$255	Toshiba 30600	\$1035
ST-251-0	\$311	Panafax F100	\$835
ST-251-1	\$327	Sharp UX	\$817

OTHERS

KEYBOARD 102 AT STYLE	\$35
KEYBOARD 102 AT STYLE W/CLICK	\$44
HAND SCANNER D.F.I. HS3000 PLUS	\$171
HAND SCANNER LOGITECH	\$169
SERIAL MOUSE LOGITECH	\$67
BUS MOUSE LOGITECH	\$72
MOUSE D.F.I.3. BUTTONS W/SOFTWARE	\$37
MOUSE D.F.I.3. BUTTONS NO SOFTWARE	\$31

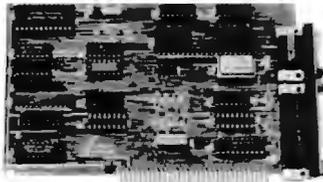
10 pieces or more, except fax,
 all products are 100% IBM compatible.
 Check for more items.

1-800-683-2255

Hagan Corporation
 8021 N.W. 14th St.
 Miami, FL 33126

Tel: (305) 477-3929
 Fax: (305) 477-4326
 TLX: 159292NAGAH UT

LSPC SERIAL/2 HIGH SPEED DATA COMMUNICATION CONTROLLER



- Synchronous Full Duplex Serial Controller (Z82530)
- Max Data Rate of 400 Kbps Externally Clocked
- Support For Two DMA Channels
- Designed For The IBM PC/AT™ Bus



IBM PC/AT is a trademark of International Business Machines, Inc.

Computer Modules, Inc.

2348C WALSH AVENUE/SANTA CLARA, CA 95051
 TEL: (408) 496-1881 FAX: (408) 496-1886

Circle 202 on Reader Service Card

Circle 342 on Reader Service Card

Circle 50 on Reader Service Card

Complete Telephone Management System

TeleGenie™

Sophisticated Voice Mail and Call Processing
 with High Quality REAL VOICE Digital Recording
 for your PC, XT, AT or Compatible

VOICE MAIL

- Forwards to Extensions Beepers/Cellulars
- Individual Greetings and Passwords - Multi-User - Box Capacity - Remote Touch-Tone Access
- Replay/Delete/Record/Edit



Includes circuit board, software, phone cable, and external speaker

ADVANCED CALL PROCESSING

- Unlimited Phonebook Database - Autodial/Redial Search/Sort - Caller/Computer Touch-Tone Interaction
- User-Definable Voice Prompted Menus - Call Forward/Call Distribution - In/Out Call Logging - Outbound Timed Calls - Automatic Attendant and More!

Enjoy the same benefits and features of systems costing thousands for only

\$279⁹⁵

800-637-3861

In CA 408/438-3883



Multiple Unit Discounts - Dealer Inquiries
 250 Technology Circle, Scotts Valley, CA 95066

4-MEGABIT PROGRAMMER for IBM XT/AT.....\$245



30-day money back guarantee
 2716 to 274001 incl. EEPROM/CMOS
 High speed programming algorithm
 Intel/Motorola/Binary files utilities
 87C51/51 & 41/42/48/49 adaptors (Optional)
 Eprom emulator adaptor 2716 - 27256
 Industrial Model \$398

4 Meg eproms available
 (Concom Restriction)
 One per customer

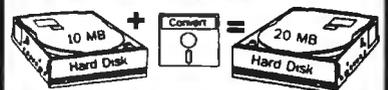
2370 Midland Avenue
 Unit A-28, Scarborough
 Ont. CANADA M1S 1P8

K.E.M.

Tel (416) 754-4585
 Fax (416) 754-7431
 HQ (604) 251-1514

Circle 157 on Reader Service Card

A Real Breakthrough—No Bull!



20 MB HARD DRIVE \$89

- Turn your 10 MB Hard Drive into a real 20 MB Hard Drive!
- Our easy to use software is not a file compression program and it's not memory resident!
- Use it once. It actually changes the physical characteristics of your 10 MB Hard Drive and makes it a permanent 20 MB Hard Drive.
- Your programs will work normally
- Works on any 10 MB hard Drive.
- It's true—Money Back Guarantee! Order CONVERT® today!

We pay S & H. Mail \$89 to:



3240 Duerber Ave. S.W. Canton, OH 44706
216-484-5320

Circle 281 on Reader Service Card

Circle 10 on Reader Service Card

IMAGING CARD



- Dual camera inputs
- Composite video in/out
- 256 x 240 resolution
- Digitize/display at frame speed
- 16 Meg. color palette out (DV-02)
- External trigger input option
- PC/XT/AT compatible
- Complete with software & library

DV-02 8-bit 256 gray levels . \$849
 DV-03 6-bit 64 gray levels . \$549
 VISA/MC Demo disk available

Control Vision

PO Box 596 Pittsburg KS 66762
 800/292-1160 316/231-6647

Circle 82 on Reader Service Card

New, Improved!

SIBEC-II



- Intel 80524H-BASIC CPU
 - PRN31 programmer
 - Now requires 5V supply only
 - Enhanced memory mapping
 - Supports 2K-64K devices
- to a total of 128K

Still only \$228.00 QTY 1

Call Now! (603) 469-3212

Programmed from PKDS1 80524H/2 parallel development
 kit supports 80524H, 80524H, 80524H, 80524H, BASIC
 complete \$295

Binary Technology Inc.

1000 1/2 St. Paul, MN 55101

Circle 38 on Reader Service Card

Diskette Sale

3.5" DS/HD Disks (2.0 MB)

\$1.89 200+



\$1.99 Less than 200

Sold 50 per pack. Black Shell, HD* Screen.

For use with: IBM PS/2 models
 30-286, 50, 60, 70, 80 and other
 2.0 MB 3.5" DS/HD drives.

Toll Free: 1-800-258-0028

Free Catalog.

Foreign Inquiries Invited.

Minimum Order \$25.00. S&H: F.O.B.

Grand Rapids, MI. Prices Subject to Change.



Precision Data Products™

P.O. Box 8367, Grand Rapids, MI 49518

313-645-4980 • 616-452-3457

FAX: 616-452-4914

Circle 229 on Reader Service Card

ULTIBOARD COMPUTER AIDED PCB DESIGN



The Ultimate PCB layout package featuring:

- Fast Trace Design Rule Check
- Layer Stack and Fabrication White Paper
- Automated by window, composed or not
- 32 layer support, drill & laser cut
- Customization per user
- Current and signal traces
- Full 3D layout
- Powerful placement tool
- Sub-minimum per layer trace

ULTIMATE TECHNOLOGY

ASK FOR YOUR FREE DEMO DISK

Circle 305 on Reader Service Card

DYNAMIC RAMS

SIMM	80/100	\$CALL
1MBIT	100ns	\$14.25
514256	100ns	\$14.75
41464	150ns	\$ 4.75
41256	120ns	\$ 4.50
41256	150ns	\$ 4.25
51258	100ns	\$ 5.50
4164	150ns	\$ 2.50

PROCESSORS	PRICE	RAMS	PRICE
80387-25	\$470.00	270101	\$ 20.00
80387-20	\$375.00	270112	\$ 13.00
80287-12	\$255.00	270112	\$ 8.00
80287-10	\$225.00	270256	\$ 5.25
80287-6	\$198.00	270256	\$ 4.75
8087-1	\$170.00	270256	\$ 4.50
8087-2	\$130.00	270256	\$ 4.25
V-30	\$ 12.75	2704	\$ 3.00
V-20	\$ 5.50	4084	\$ 3.00

I.C. EXPRESS

15358 Valley Blvd. City of Industry, CA 91746 Tel 818-269-2688

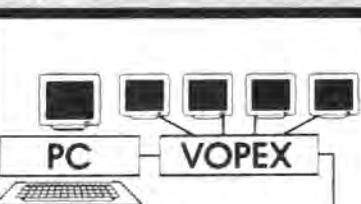
ORDER TOLL FREE (Mon-Fri 8-5 PST)

(800) 892-8889 • (800) 882-8181

CALL FOR CURRENT PRICES & VOLUME DISCOUNTS

Minimum order \$10.00. Shipping & handling. Sales tax (where applicable) \$1.00. ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

Circle 135 on Reader Service Card



KEYBOARD & MONITOR
 500 FEET AWAY - ALSO
 DRIVE MANY MONITORS
 AT ONCE - CALL FOR
FREE CATALOG

NTI NETWORK TECHNOLOGIES, INC.

19145 Elizabeth St., Aurora, OH 44202
 US 216-543-1646 or 800-RGB-TECH
 UK 0244-880478
 PARIS 331-47632789
 GENEVA 022-431124
 CANADA 416-677-6500
 MUNICH 0130811234

Circle 211 on Reader Service Card



DCI 286/12 IBM Compatible

- 30 Day Return/ 5 Year Extended Warranty!
- 80286 Processor Operating at 6/12 Mhz, 101 Keypunch
- 512K RAM expandable to 1 Mb on board, 01 WS
- 1.2 Mb or 1.44 Floppy Drive
- Western Digital WA2 HD/FD Controller
- Clock Calendar with 5 year battery
- 220 Watt Power Supply - 80287 FPP Support
- Either Full or Mini AT Case
- Made in USA, FCC A & B, True Phoenix BIOS

20Mb	40Mb	40ms	40Mb	28ms	80Mb	28ms
Mono 1181"	1314"	1346"	1594"			
EGA 1641"	1774"	1806"	2054"			
VGA 1774"	1908"	1940"	2188"			
SVGA 1872"	2005"	2037"	2285"			

DCI - (409) 756-0094 • 3708B West Davis • Conroe, TX 77304
 * All prices cash or check. Qty & Corp discounts available

Circle 90 on Reader Service Card

LOW-LOW-LOW

- hp Laserjet Printer Series II \$1650
- hp Scanjet Scanner + interface kit \$1355

IBM COMPAG APPLE A+ ACER
 EVEREX AST & other

XT/AT Compatibles & 386 Computers
 CALL for LOW PRICES

Gov't, Corporate, Schools, Dealers,
 & Export INQUIRIES WELCOME.

SURAX inc.

44862 Osgood Road, FREMONT, CA 94539
 PH: (415) 651-5101 FAX: (415) 651-5241
 1-800-543-1001
 VISA, Master Card accepted, w/e

Circle 280 on Reader Service Card

ALLCON Alarm-System

- < IS/CHANNEL!
- For PC/AT, Soft- & Hardware:
- 140 ch. TTL/sig. 1 board \$199
 - 320 ch. TTL/sig. 1 board \$399
 - 608 ch. TTL/sig. 2 boards \$599
 - 3 ch. TTL/sig. Composite output.
- Standard comes for boards only used
 Prog. time 600 sig. abs 15h Name 24 Char
 Speciality: Software for Controlling.

ALLregulator AB

Organel 9, S-415 00, Gårdsjöberg, Sweden
 Fax: +46 31 4347 30
 Tel: +46 31 4340 80
 Tech support system - tel time 8-12 am.
 Estab. 1967 VISA/MC CHECK

Circle 14 on Reader Service Card



PS/2 model 30/286	1895
PS/2 model 50/30 meg	2395
PS/2 model 70/60 meg	3695
PS/2 model 80/40 meg	4395
PS/2 model 70/120 meg	5595
PS/2 model 80/115 meg	Call
Call for other models	



386 S 40 meg	Call Call
386 20E - 40 meg	4295
286E 40 meg	Call
386 110 meg/25 MHz	7295
386 60 meg/25 MHz	5895
Portable III 40 meg/12 MHz	4095
CARD & MONITOR EXTRA	
Call for other models	

Macintosh

Mac-SE/20 Meg	2795
Mac-II/40 Meg	4195
Mac-SE-2DR	2295
Call for 60 and 100 Meg	
Lazer NT	3595
Lazer NTX	Call

LOW PRICE LEADER

SINCE 1983 LAP-TOP

Compaq SLT 286-20	Call
SLT 286-40	Call
Toshiba T1000	Call
T1200F	Call
T1200HB	Call
T1600	Call
T3100E	Call
T3200-40 Meg	Call
T5100	Call
Zenith Supersport	3195
286-20 Meg	Call
286-40 Meg	Call
8088-20 Meg	Call
Epson LT	Call
NEC Lap-Top	Call
Mitsubishi 286-20	2475

Toshiba Sale! Call for all!

Everex

Step 286 - 12 & 16 MHz & 20 MHz
1 Meg RAM
Set up utility in ROM
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call! for your configuration

Everex

Step 386-20 MHz & 16 MHz & 25 MHz
Up to 256K cache of very high speed RAM
2 Meg RAM, expandable to 16 Meg
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call!



AST 286 model 140X	2295
AST 286 model 80	1495
AST 386 model 300c	Call
AST 386 40 Meg	3195

CARD & MONITOR EXTRA
CALL FOR OTHER MODELS

WE STOCK

CITIZEN
OKIDATA
EVEREX
GOLD STAR

TOSHIBA
NEC
WYSE
HITACHI

PRINCETON GRAPHICS
SONY
ACER
HOUSTON INSTRUMENTS

AMDEK
HAYES
SAMSUNG
CALCOMP

PC MOUSE
MICROSOFT MICE
LOGITECH
MITSUBISHI

IRWIN & ARCHIVE
TAPE BACK
TAXAN
MAGNOVOX

BOARDS

Paradise VGA +	269
Vega VGA	299
ATI VGA Wonder	295
Everex EGA	159
Tatung 16 bit	249

SOFTWARE SPECIALS

dBase IV	455
Wordperfect	239
Aldus Pagemaker	495
Ventura Publisher	495
Clipper	435
Quatro	145



PRINTERS

EPSON	
LX-810/LQ-510	199/339
LX-800/LQ-500	195/315
LQ-850/1050	535/735
OKIDATA	
320/321	359/490
390/391	490/649

LASER PRINTERS

HP Laser II	1695
HP Desk Jet ±	695
Panasonic 4450	1395
Brother HL-8-E	1895
Nec LC 890	3195
PageLaser 12	\$\$\$\$\$
Canon Laser	Call

MONITORS

Nec Multisync IIA	525
Nec Multisync 3D	649
Nec Multisync Plus	899
Nec Multisync XL-19"	1995
Samsung EGA	359
Goldstar VGA	375

FAX MACHINES

Sharp FO 220	795
Sharp UX 350	1249
Canon	Call
Brother	Call
Richo	Call
Murata	Call

Intel Coprocessors

8087-3	105
8087-2	145
80287-8	225
80287-10	265
80387-16	395
80387-20	475
80387-25	525
80387-33	625

TOSHIBA

321-SL/341-SL	439/595
351-SX 350 CPS	929
BROTHER	
1709-9 PIN	425
1724-24 PIN	595

MODEMS

Everex 1200 Int	89
Everex 2400 Int	159
Hayes 1200 B	299
More in Stock	Call

WE ACCEPT CASHIER CHECKS, MONEY ORDERS, VISA, MC, AmEx
3% charge on VISA, MC & 5% on American Express

EXPORTS Available

COMPUTERLANE

HOURS:
M-S 9-6

1-800-526-3482 (Outside CA)
(818) 884-8644 (In CA)
(818) 884-8253 (FAX)

22107 ROSCOE BLVD.
CANOGA PARK
1/2 BLOCK W. OF TOPANGA
CA 91304

CORPORATE ACCOUNTS WELCOME
CALL FOR VOLUME DISCOUNTS
CONSULTANTS CALL FOR PRICING

Prices subject to change without notice

Compaq is a Registered Trademark of Compaq
IBM is a Registered Trademark of International Business Machines

ICs PROMPT DELIVERY!!!
 SAME DAY SHIPPING (USUALLY)
 QUANTITY ONE PRICES SHOWN FOR JULY 30, 1988

OUTSIDE OKLAHOMA NO SALES TAX

DYNAMIC RAM			
SIMM (1)	256Kx36	80 ns	\$300.00
SIMM	1Mx9	70 ns	200.00
SIMM (2)	1Mx9	80 ns	170.00
SIMM	256Kx9	80 ns	75.00
1Mbit	1Mx1	100 ns	13.75
41256	256Kx1	60 ns	7.50
41256	256Kx1	80 ns	6.50
41256	256Kx1	100 ns	4.75
41256	256Kx1	120 ns	4.25
4464	64Kx4	120 ns	5.00
41264 (3)	64Kx4	120 ns	11.95
EPROM			
27C1000	128Kx8	200 ns	\$22.00
27512	64Kx8	200 ns	9.50
27256	32Kx8	150 ns	7.25
27128	16Kx8	250 ns	4.50
STATIC RAM			
62256P-10	32Kx8	100 ns	\$21.50
6264P-12	8Kx8	120 ns	5.95
6116AP-12	2Kx8	120 ns	4.50

OPEN 6 DAYS, 7:30 AM-10 PM SHIP VIA FED-EX ON SAT.

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY: 11:30 AM

MasterCard VISA or UPS CASH COD

MICROPROCESSORS UNLIMITED, INC.
 24,000 S. Peoria Ave.
 BEGGS, OK 74421 (918) 267-4961

No minimum order. Please note: prices subject to change! Shipping insurance extra up to \$1 for packing materials.

EZ-WRITER
 (E)EPROM Multiprogrammer™
 DATA I/O 212* Performance
 For Only **\$995.**
 100% USA Made

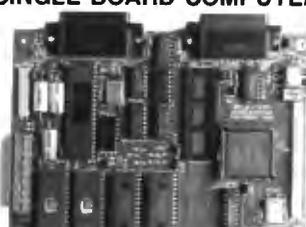


- Supports (E)EPROMs up to 40-pins.
- Stand-alone or Remote.
- 40-pin Micros Opt.
- SET/GANG 4 (E)EPROMs Opt.
- Parallel port for Fast Up/Down Load.
- 256K bytes, expandable to 16 megabits.

BYTEK 1-800-523-1565
 In Florida (407) 994-3520
 Fax: (407) 994-3615

* DATA I/O is a registered trademark of DATA I/O Corporation

8051, 8096, 68HC11, 68008
SINGLE BOARD COMPUTERS



We feature a series of single board computers for process control applications. Available as bare boards or assembled and tested. Optional EPROM resident System Monitors and BASIC interpreters are also available.

ALLEN SYSTEMS
 2346 Brandon Road
 Columbus, Ohio 43221
 614-488-7122

Circle 193 on Reader Service Card

Circle 51 on Reader Service Card

**RS-232C/422A USERS:
 BI-DIRECTIONAL CONVERTER
 for EXTENDED USE**

Convert RS-232C to RS-422A and/or RS-422A to RS-232C

only **\$49.95**



MODEL 422CON

Guaranteed satisfaction. Bi-directional, first-quality, versatile converter. Extends cable lengths up to 4,000 feet! Bit rates up to 90K Baud. (Two B & B RS-422CON Converters can extend your RS-232C capability up to 4,000 ft.)

Includes male DB25P connector for RS-232C and includes female DB25S connector for RS-422A. No handshake lines connected.

Requires 12V DC at 100 ma. Optional power supply available for only \$14.95.

Order Direct from Manufacturer TODAY and SAVE!!
SAME-DAY SHIPMENTS! MONEY-BACK GUARANTEE!

Request our FREE catalog listing B & B ELECTRONICS' comprehensive line of RS-232C interface and manufacturing equipment.

* Terms: Visa, MC, cash orders preferred. P.O.'s from qualified credit firms accepted. 8% handling and 6% sales tax.

B & B electronics
 4002J Baker Road, P.O. Box 1040 • Ottawa, IL 61350
 Phone: 815-434-0846

THE DXFHandler.
 by IMAGENET

The global converter for AutoCAD 10 DXF files!



ELIMINATE THE HOURS OF PAINSTAKING LABOR INVOLVED IN IMPORTING AUTOCAD RELEASE 10 DXF FILES INTO YOUR PRESENT CAD SOFTWARE!

The "DXFHandler" was created to resolve the incompatibility of 3-D AutoCAD Release 10 DXF files with prior versions of AutoCAD and other CAD packages that accept this data translation file (DXF) format.

Now: AutoCAD is a registered trademark of Autodesk, Inc.
 CV CADDS & CV Personal Designer are registered trademarks of ComputerVision/Prime, Inc.

\$ 79.95

IMAGENET
 SYSTEMS, INC.
 200 Brevard Avenue Cocoa, Florida 32922
 (407) 632-4333 Fax (407) 632-7632

OVER STOCK!!
High Density Dynamic SIM/SIP Modules

Price List

Package	Organization	Unit Price
Apple	(1 Mega Bit (DIP) x 8)	\$155
Apple	(1 Mega Bit (DIP) x 8)	158
IBM	(1 Mega Bit (SOJ) x 8)	160
IBM	(1 Mega Bit (SOJ) x 8)	160
IBM	(1 Mega Bit (SOJ) x 9)	160
IBM	(1 Mega Bit (SOJ) x 9)	175
IBM	(1 Mega Bit (SOJ) x 8)	305
IBM	(1 Mega Bit (SOJ) x 8)	163
IBM	(1 Mega Bit (SOJ) x 8)	168
IBM	(1 Mega Bit (SOJ) x 9)	179
IBM	(1 Mega Bit (SOJ) x 9)	183
IBM	(1 Mega Bit (SOJ) x 18)	310

TermoTrol Corp.
 Subject to prior sale.
 Call 1-800-345-4184 or 213-284-3242
 order by phone MC Visa Amex or C.O.D.
Two Year Warranty

Circle 32 on Reader Service Card

Circle 340 on Reader Service Card

Circle 287 on Reader Service Card

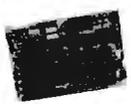
TOSHIBA LAPTOPS!

FACTORY - DIRECT PRICES

Rock-Bottom prices and immediate availability on all Toshiba laptops and accessories. We are Toshiba's largest factory-direct dealer in all of California. All orders ship in 24 hours! Printers, Lancards, both dedicated and non-dedicated modems, tape back-ups, battery packs, memory boards, etc. Just a few samples of options available. Call today for a complete list of all options and most current pricing.

TOTE-A-LAP
 1501 El Camino Real
 Belmont, CA 94002
 415-591-1671

80386-20 COMPUTER - KIT SYSTEM \$1999



- Intel 80386-20 CPU, 16/20/24 MHz clock rates, 0 wait states.
- 1 MB SDRAM RAM, expandable to 8 MB on board, total 16 MB system.
- 40 MB hard disk and 1.2 MB floppy drive with controller.
- SuperEGA Card, AMI Bios.

- Two serial port and one parallel printer port.
- 6 expansion slots.
- Sockets for 80287/80387/Watttek 1167.
- 200 Watts power supply, case, and enhanced 101-key keyboard.
- OS/2, WINDOW386 UNIX compatible.

386-25 COMPUTER - KIT SYSTEM. CALL FOR PRICE

- Intel 80386-25 CPU with 32 KB CACHE memory
- 20/25 MHz clock rates.
- 32 bit 4MB/6MB DRAM module on board.
- 8 expansion slots.
- VGA Legal BIOS, OS/2, WINDOW386 UNIX compatible.
- 40 MB hard disk, 1.2 MB floppy controller.
- EGANGA card, 200 watts power supply, case, enhanced 101-key board.
- Sockets for 80287/80387/Watttek 1167.

OTHER PRODUCTS

KDS208 SINGLE BOARD CONTROLLER. **\$275.00**
 Intel 8052 based single-board controller with 10 bit 8 channel A/D converter, 40 KB memory, 24 PIO

EPROM WRITER CARD: 2764/27128/27256/8750/8751 **\$265.00**

KUSTEM DATA SERVICES, INC.
 4 HUDSON COURT, CRANBURY, NJ 08512
 TEL: (609) 799-2963 FAX: (609) 799-5416

UNIVERSAL PROGRAMMER



Programs (E)EPROM, PAL, EPLD, GAL, PEEL, FPL, BIPOLAR, 8748/51 SERIES.

Tests TTL, CMOS and DVS RAM.

\$ 545 Complete. (U.S. only)

- Programs (E)EPROMs upto 2MBits and 16 Bit wide.
- 16Bit- and 32Bit- WORD SPLIT & 4-GANG adaptor.
- programs PALs (22V10) from AMD, MMI, TLINS, SAMSUNG.
- supports PALASM2/CUPL/ABEL/LOCAD JEDEC files.
- supports VERIFICATION using TEST VECTORS.
- programs GALs & FPLs from LATTICE, SGS, NS, SIGNONETICS.
- supports RALs in GAL (16V8, 80V8) devices.
- programs EPLDs from INTEL, ALTERA, ATMEL, CYPRESS.
- programs PEELs from ICT, HYUNDAI, GOULD (253,273).
- programs BIPOLAR PROMs.
- programs SINGLECHIPs 8748, 8751, 87C51 SERIES including 87C451, 87C751, 63701X/V/V, 63703V with adaptors.
- tests ICs (TTL, CMOS) & MEMORYS (upto 1MB) with USER-DEFINABLE TEST PATTERN GENERATION.
- High-Speed, Parallel Interface & S/W Upgradable for New Parts.

XELTEK 1-800-541-1975 (Toll Free Order)
 473 SAPENA CT #26 TEL: (408) 727-6995
 SANTA CLARA, CA 95054 FAX: (408) 727-6996
 COD, VISA, MC, AMEX

Circle 297 on Reader Service Card

Circle 341 on Reader Service Card

Circle 323 on Reader Service Card

BEST BUYS FOR 14 YEARS!

JADE COMPUTER



Turbo-88

Monitor Optional

\$498

—A PROVEN BEST SELLER—

- 8088 microprocessor running at 10 MHz or 4.77 MHz
- 640KB
- 5.25" 360KB RAM Drive
- Dual diskette drive controller
- Parallel printer port
- Eight XT expansion slots
- 150 watt power supply
- 8087 socket
- Front panel display
- 101 Key enhanced keyboard
- Serial RS-232C port
- Game Port
- Clock/Calendar

Monitor & Hard Drive Options

Floppy Only	20 Megabyte	30 Megabyte
\$648	\$798	\$848
\$748	\$898	\$948
\$998	\$1148	\$1198

JADE COMPUTER

PRO-286



12 MHz
\$798

20 MHz
\$998

Monitor Optional

—286 POWERHOUSE—

- 80286 processor running at 12 MHz or 20 MHz
- Zero wait state
- 512K RAM expands to 4 MB
- 1.2 MB or 1.44 MB drive
- Hard/Floppy controller
- Six 16-Bit & Two 8 Bit expansion slots
- 80287 socket
- Clock/Calendar
- 101-key enhanced keyboard
- 200 watt power supply
- Norton S.I. 13.7/20.3
- Landmark 16/25.9
- One Year Warranty

Monitor & Hard Drive Options (12 MHz)

Floppy Only	40 Megabyte	80 Megabyte
\$928	\$1278	\$1498
\$1298	\$1648	\$1898

For 20 MHz System Add \$198

JADE COMPUTER

Super-386



20 MHz
\$1578

25 MHz
\$1878

Monitor Optional

25 MHz Cache
\$2498

—FIRE BREATHING 386—

- 80386 processor running at 20 MHz or 25 MHz
- 1 MB RAM expands to 6 MB
- 384K Shadow RAM
- 1.2 MB or 1.44 MB drive
- 1:1 Interleave Hard Disk
- /Floppy Disk controller
- 80387 socket
- Full size case
- One 32-Bit, Five 16-Bit Two 8-Bit slots
- 101 key enhanced keyboard
- 200 watt power supply
- Clock/Calendar
- Norton S.I. 23/31.6/31.6
- Landmark 25.5/32.6/43.5

Monitor & Hard Drive Options (20 MHz)

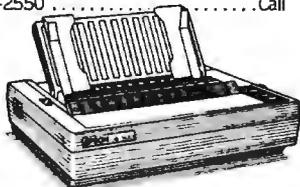
Floppy Only	40 Megabyte	80 Megabyte
\$1698	\$2958	\$2298
\$1998	\$2398	\$2678

For 25 MHz add \$298

25 MHz Cache add \$898

EPSON

- LX-810\$188
- FX-850Call
- FX-1050Call
- LQ-510\$328
- LQ-850Call
- LQ-950Call
- LQ-1050Call
- LQ-2550Call



Panasonic

- KX-1180\$178
- KX-1191\$238
- KX-1124\$318

Daisywheel Printer

40 CPS **\$199**

Plotter \$688

List Price \$1795
Roland DXY-980
8 PEN 230mm/SEC
.05mm Resolution
HPGL Compatible
Electrostatic Hold Down
Parallel and Serial Input
Digitizing Capacity

Surge Protector

- S.L. Waber 6 outlet\$18
- Isobar 4 outlet\$48
- Isobar 8 outlet\$68
- Isobar modem protector\$24

TrippLite Line Stabilizer

- 600 Watt Line Conditioner\$98
- 1200 Watt Line Conditioner\$158
- 1800 Watt Line Conditioner\$188

TrippLite Battery Back-up

- 450 Watt UPS\$398
- 750 Watt UPS\$498
- 1200 Watt UPS\$698

intel

- 8087\$88
- 8087-2\$118
- 8087-1\$158
- 80287\$128
- 80287-8\$198
- 80287-10\$228
- 80287-12\$278
- 80387-SX\$318
- 80387-16\$348
- 80387-20\$388
- 80387-25\$488
- 80387-33\$598

IIT Coprocessors In Stock _____ Call

Modems

- 1200 internal w/software\$48
- 2400 internal w/software\$88
- 1200 baud external\$88
- 2400 baud external\$148
- 2400 PS/2 internal\$198
- Intel 2400B for PS/2\$278

Mouse

Opto Mechanical With Software **\$29**

Logitech

- LogiMouse Serial\$68
- LogiMouse Hi-Res. Bus\$88
- LogiMouse Hi-Res. Serial\$98

Scanner

- Complete Hand Scanner\$98
- LogiTech Scan Man248
- Diamond Flower HS-3000 Plus\$228



California

Torrance, Costa Mesa, Woodland Hills
Kearny Mesa, Sunnyvale

Texas

Addison, Houston

Georgia Arizona
Smyrna Phoenix

Not all items in stock at our nine retail locations.

JADE COMPUTER

4901 W. Rosecrans Ave. Box 5046 Hawthorne, California 90251-5046 213-973-7707

Continental U.S.A. 1-800-421-5500 Inside California 1-800-262-1710



We accept checks, credit card or purchase orders from qualified firms and institutions. No surcharge on credit card orders. CA., TX, GA. & AZ. residents add sales tax. Prices and

availability subject to change without notice. Shipping and handling charges via UPS ground 50¢/lb. UPS air \$1.00/lb. Minimum charge \$4.00. Fax machine 1-213-675-2522

3 1/2 INCH 1.4 MB DISKS FOR ONLY ONE DOLLAR!

New Invention Makes It Possible!

Do you use the new, high capacity, 3 1/2 inch disks? If so, you have paid four, five, even six dollars per disk! Byte for byte, that is as much as SIX TIMES the 'old' 360K floppies. Now you can convert all your programs, data, and files to the new format, WITHOUT PAYING THESE PRICES!

HOW IS THIS POSSIBLE? Have you ever tried to format a regular, 'low density' 3 1/2 inch disk to 1.44 MB? Of course you have! It doesn't work! The computer gives an invalid media error. Our company was putting in a large network of IBM Clones. We have grown from a small company to a million-dollar corporation in two short years, and we didn't do it by wasting money. So, of course, we tried to use the cheap, 720K disks. Total failure.

ENTER OUR CRACKPOT ENGINEER. Our Crackpot Engineer wondered what was the difference between the disks. He tore them apart, analyzed the media. He found NO DIFFERENCE WHATSOEVER! Yet, they would not format. Why? Then he started examining the plastic housing. And he found the difference. It is NOT in the media, IT IS IN THE PLASTIC CASE!

TOTAL FAILURE! Our Crackpot Engineer (among other things, he invented the Electronic Flea Collar) sent a brand-new 720K disk to our machine shop, and asked them to modify it. They did... and the DISK IMMEDIATELY FORMATTED! But, within 10 minutes of use, it totally failed. It lost data all over the place. Back to the drawing board. The disk was dis-assembled and examined. It was found that, in performing the conversion, a microscopic piece of plastic had entered the housing, and totally ruined the disk. It was obvious that, if the conversion could be done reliably, it required extreme precision.

ENTER OUR OTHER CRACKPOT ENGINEER. Our president is a mechanical engineer. One of the best in the country. While a research scientist at Colorado School of Mines, he completely revolutionized the field of water jet drilling. He tackled the problem. Finally he came up with a solution - a precision tool which could perform the modification EVERY TIME and leave no plastic particles which would damage the disk!

MONTHS OF TESTING. We then commenced on a testing program. We modified and formatted thousands of disks, and tested them for data integrity. Out of one thousand disks, one would not format, two had one bad track. NOT ONE LOST ANY DATA! We then put a disk on a computer with a bat file which copied data to a disk, read and checked every byte, then copied the data back to the disk. The program ran 24 hours a day, for TWO SOLID WEEKS without even one error! We were finally convinced that the procedure was reliable enough for a product.

OUR OFFER. Here is our irresistible offer. Purchase our DoubleDisk Converter for the price of \$39.95. If you are not COMPLETELY SATISFIED, return the DoubleDisk. You will receive a FULL REFUND! What is more, if a disk ever does not convert properly, send us the disk, and we will send you a 1.44MB disk from a major manufacturer in exchange!

YOU CAN'T LOSE! You will save MORE THAN THE PURCHASE PRICE IN CONVERTING ONLY YOUR FIRST TEN DISKS! From that point on, it is all profit. After converting only 100 disks, and after deducting the cost of the DoubleDisk, you will have saved AT LEAST \$425.00! Quite a return for an investment of only \$39.95!

CREDIT CARDS AND CHECKS ACCEPTED! Purchasing our DoubleDisk is easy! Simply call our 800 number. We accept all major credit cards. Or, return the coupon below, and we will ship you one immediately. We Will gladly accept your personal check.

24 HOURS **ORDER TOLL FREE - 1-800-537-4226** 7 DAYS
(In Colorado call 303-872-8945)

YES! I want to try your DoubleDisk on your UNCONDITIONAL MONEY BACK GUARANTEE! I enclose only \$39.95 plus \$3.50 Shipping and Handling (California residents add \$2.40 Sales Tax) for each DoubleDisk Converter. If I am not COMPLETELY SATISFIED, I will return the DoubleDisk for a FULL REFUND! If any disk ever fails to convert, I will send it to you and you will IMMEDIATELY send me a 1.44MB Disk in exchange!

Name _____ Address _____

City _____ State _____ Zip _____ Telephone _____

Send To: Biological Engineering, Inc., DoubleDisk Offer
2674 Main Street, Ventura, CA 93003 Phone 805-644-1797



1.2 MB
49¢ IN LOTS OF 100

5.25" DS/HD 1.2 MB ... DK. BLUE - 69¢
PACKED IN LOTS OF 100 WITH TYVEK SLEEVES & TABS

5.25" DS/HD 1.2 MB, Sleeves & tabs - BLACK
Lots of 100 - 49¢ Lots of 50 - 59¢

5.25" DS/DD 360K, Sleeves & Tabs
Lots of 1,000 - 21¢ Lots of 200 - 25¢

3.5" DS/DD 720K (1MB) 55% Clip. Level
Lots of 100 - 79¢ Lots of 50 - 85¢

3.5" DS/DD 720K (1MB) 70% Clip. Level
Lots of 500 - 89¢ Lots of 25 - 99¢

3.5" DS/High Density 1.44MB (2MB)
Lots of 100 - \$2.50 Lots of 25 - \$3.00

AMERICAN GROUP

800-288-8025
12132 Sherman Way
N. Hollywood CA 91605 • VISA-MC

Circle 18 on Reader Service Card

Modular I/O board

Single-slot Qua Tech PXB-721 for PC-AT has 72 digital I/O lines. Connect three choices of data acquisition modules. Supports Labtech Notebook™

For order info, call:
1-800-553-1170



QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

Labtech Notebook is a trademark of Laboratories Technologies Corp.

Circle 239 on Reader Service Card

E/EPROM & MICRO PROGRAMMER

\$895



- EP-II40 includes: software, cable, user's manual, 2 free software update coupons, toll-free technical support, one-year warranty & a unconditional 30-day money back guarantee
- Programs 24-, 28-, 32- & 40-pin E/EPROMs
- Supports 874X & 875X series microcontrollers
- Connects to a standard parallel port
- 32-pin model, EP-II32, available for \$695

The Engineer's Programmer™

CALL TODAY 800-225-2102

BP MICROSYSTEMS
10681 Haddington, #190, Houston, TX 77043
713/461-9430 FAX 713/461-7413

Circle 49 on Reader Service Card

SIMMS

1 MB X 9 - 80/100NS
256K X 9 - 80/100NS
1Mbit, 41256, 4164, 41464

Get The Memory You Need
At The Price You've Waited For.

FAST SERVICE
LOWEST PRICES IN USA

914-565-7080

VISA C.O.D. M/C
VOLUME DISCOUNTS AVAILABLE
CALL TODAY FOR LOW PRICE QUOTE

DELTA COMPUTING TECH. CORP.
292 North Plank Rd. Newburgh, NY 12550
PH# 914-565-7080 FAX 914-565-7082

Via L. Landucci No 26
50136 Florence Italy
PH# 39 55 678 045
FAX 39 55 666 942

UPGRADE YOUR 386 TODAY!!

Circle 94 on Reader Service Card

2 parallel, 2 serial, 1 board

Qua Tech DSDP-402 for PC-AT has two parallel ports, and two serial ports for any combination of RS-232, 422, and 485 communication. All ports address selectable. Interrupts sharable and selectable.

For order info, call:
1-800-553-1170



QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

Circle 240 on Reader Service Card



EDITOR'S CHOICE

VOICE MAIL

- ◆ Voice Mail System
- ◆ Call Processing
- ◆ Telemarketing
- ◆ Order Processing
- ◆ Call Distribution
- ◆ Programmers Tool Kit

Complete Systems
BGM UTL \$295
Starting at PLUS 6 S/H
(415) 652-9600

TALKING TECHNOLOGY, INC. TTI
4383 PIEDMONT AVE., OAKLAND, CA 94611

Circle 283 on Reader Service Card

3M

* FREE! FLIP'N'FILE FORMATTED DISKS AT UNFORMATTED PRICES!!

DS-DD	Limited Quantity While Supplies Last!	DS-HD
5.79*	5 25" 3M Diskettes 10/Box	*11.29
11.39*	3 50" 3M Diskettes 10/Box	*26.49
17.99	8 00" 3M Diskettes 10/Box	19.99

DC-2000 14.49 DC-600A 20.49
DC-300XLP 18.49 DC-6150XTD 21.49

3M Compac Tape™ 1/2" DEC TK-50 Tape-min 10... 25.95
IBM 3480 Tape Cartridge-min 30 5.85
3M Mag. Tape with seal 2400'-min 10 12.70



BASF

Quantity Discounts Available

DS-DD	DS-HD	
4.99	5 25" BASF Diskettes 10/Box	7.89
9.39	3 50" BASF Diskettes 10/Box	23.99

.32 BASF 5 25" DS-DD No-Logo Bulk with Tyvek sleeves, labels & W/P
.29 BASF Branded 5 25" 1S/2D/48TPI Diskettes

BASF Mag Tape 2400' 10.50



Verbatim DataLifePlus

Teflon/Preformatted

DS-DD	DS-HD	
5.79	5 25" DataLifePlus 10/Box	11.29
11.29	3 50" DataLife Plus 10/Box	26.49
6.49	Verbatim DataLife Color Disks 5 25" 2S/2D 10/Box	

DYAN PRECISION

DS-DD	DS-HD	
6.75	5 25" DS/DD 10/Box	3.39
10.50	5 25" DS/HD 10/Box	6.39
11.89	3 50" DS/DD 10/Box	9.49
28.65	3 50" DS/HD 10/Box	23.49

MAXELL

*FREE Audio Cassette

5 25" DS/DD	5 25" DS/HD	3 50" DS/DD	3 50" DS/HD
5.79	11.39	11.59	26.99

3M HIGHLAND

5 25" DS/DD	3M Highland Diskettes	5 25" DS/HD
3.69	10/Box	6.79
3 50" DS/DD		3 50" DS/HD
9.29	Brand Name 10/Box	22.49

KAO Color Diskettes

5 25" DS/DD	5 25" DS/HD	3 50" DS/DD	3 50" DS/HD
.32*	.72*	.79	2.95
*5 25" Color add 4c for Tyvek sleeves & labels			
2MB Box/10			
23.49			

No-Logo Bulk Diskettes

5 25" DS/DD	5 25" DS/HD	3 50" DS/DD	3 50" DS/HD
.27*	.55*	.77	1.95
*Bulk diskettes include sleeves, labels and w/p tabs			

TERMS: No surcharge on VISA, Mastercard or AMEX. C.O.D. only add \$3.00. PO's accepted from recognized institutions on Net 30. Bank draft, T/T or J/C acceptable. Shipping: \$4/100 or fewer disks. Restored shipping charges on large quantities. Price quoted for case (100 disks) quantities less than a case add 5% (Min. order \$25.00 Min. order on PO's \$150.00)

Toll Free Order Line: **1-800-523-9681** Information Line: **1-801-255-0080**
TXL-9102404712 FAX-801-572-3327



DISK COTECH

DISKCO TECHNOLOGIES, INC.
213 Cottage Avenue
P.O. Box 1339 Sandy, Utah 84091

VOICE MASTER KEY[®] VOICE RECOGNITION SYSTEM FOR PC/COMPATIBLES & TANDY 1000 SERIES A FULL FEATURED VOICE I/O SYSTEM

GIVE A NEW DIMENSION TO PERSONAL COMPUTING. . . The amazing **Voice Master Key System** adds voice recognition to just about any program or application. Voice command up to 256 keyboard macros from within CAD, desktop publishing, word processing, spread sheet, or game programs. Fully TSR and occupies less than 64K. Instant response time and high recognition accuracy. Voice recognition tool-box utilities are included. **A genuine productivity enhancer!**

SPEECH RECORDING SOFTWARE. . . Digitally record your own speech, sound, or music to put into your own software programs. Software provides sampling rate variations, graphics-based editing, and data compression utilities. Create software sound files you can add to macros for voice recognition verification response. **A complete, superior speech and sound development tool.**

SOFTWARE CONVERSION CODES. . . The **Voice Master Key System** operates a growing list of third party talking software titles using synthesized phonetics (text-to-speech) or digitized PCM, ADPCM, and CVSDM encoded sound files. **Voice Master Key System does it all!**



EVERYTHING INCLUDED. . . **Voice Master Key System** consists of a plug-in card, durable lightweight microphone headset, software, and manual. Card fits any available slot. External ports consist of mic inputs and volume controlled output sockets. **High quality throughout, easy and fun to use.**

ONLY \$149.95 COMPLETE

**ONLY \$89.95 FOR TANDY 1000 SL/TL MODELS—
SOFTWARE PACKAGE ONLY.**

Requires Tandy Brand Electret microphone.

ORDER HOTLINE: (503) 342-1271

Monday-Friday, 8AM to 5PM Pacific Time

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Specify computer type and disk format (3 1/2" or 5 1/4") when ordering. Add \$5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C & F quotes. **30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED. ONE YEAR WARRANTY ON HARDWARE.**

CALL OR WRITE FOR FREE PRODUCT CATALOG



COVOX INC. 675-D Conger St.
Eugene, Oregon 97402 U.S.A.
TEL: 503-342-1271 • FAX: 503-342-1283

VIDEO FRAME GRABBERS



MODEL	RESOLUTION	
HRT 256-4	256 x 256 x 4	495
HRT 256-8	256 x 256 x 8	795
HRT 512-8	512 x 512 x 8	995
HRT 512-24	512 x 512 x 24	1995

- IBM PC/AT COMPATIBLE
- DIGITALIZE IN REAL TIME
- COMPOSITE VIDEO IN
- 24 BIT RGB OUT except model HRT 256-4
16 level gray scale out
- SOFTWARE LIBRARY OF IMAGE ANALYSIS ROUTINES
- FREE SOFTWARE UPGRADES TO REGISTERED OWNERS
- FULL CREDIT ON UPGRADE PURCHASE IN FIRST YEAR
RETURN OLD BOARD AND JUST PAY DIFFERENCE



HRT

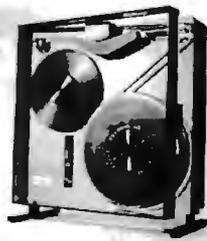
HIGH RES TECHNOLOGIES
P.O. BOX 76
LEWISTON, N.Y. 14092

PHONE 416-497-6493

FAX 416-497-1988

Circle 129 on Reader Service Card

**ALL NEW !!!
9 TRACK TAPE SUBSYSTEM
for IBM PC/AT/386
complete for only
\$2,595.00
1 YEAR WARRANTY**



- IBM/ANSI compatible at 800*/1600/3200 bpi
- Controller, cables and software included
- Interfaces for PS/2*, Xenix* and DEC*
- SCSI*, AT or MCA* Bus I/O at 25/50/100 ips
* optional

AKSystems Inc.

20741 Marilla St. Chatsworth CA 91311
TEL: 818/709-8100 FAX: 818/407-5889

Circle 13 on Reader Service Card

Terminal Emulation

TEK 4105/4010

- Tektronix 4105
- Tektronix 4010/4014
- VT220, VT102
- Picture files
- VGA and EGA support
- High resolution hardcopy

VT220

- VT220, VT102 emulation
- File transfer
- 132 column modes
- Color support
- Hot key

■ ■ ■ **Diversified Computer Systems, Inc.**

3775 Ins Avenue, Suite 1B
Boulder, CO 80301 (303) 447-9251
FAX 303-447-1406

Trademarks VT102 VT220 DEC Tektronix Teletronics Inc.

Circle 101 on Reader Service Card

Industrial Control Systems
Intelligent Terminals
Diskless Systems

ROMDISK

For the IBM PC, XT,
AT PS/2 and PC DOS* or MS DOS*

**SOLID STATE DISKETTE AND DRIVE EMULATORS
New Dual Disk Models**

- NEW PC/2 Dual disk model—up to 1.2MB of read only EPROM memory or 770K of EPROM as the primary "boot" diskette with a secondary diskette with up to 770K of SRAM of read/writes memory.

ROMDISK PCE MODEL STANDARD FEATURES

- In-board and interchangeable Cassette models using EPROM, Flash EPROM and SRAM technology.
- On-board EPROM programmer—simply copy a diskette to program the EPROMs.
- Two Autoboot modes, a File (read) and a Programming mode—automatic disk drive designation set-up during booting.
- Flash EPROM models are electrically erasable. SRAM models are battery backed. EPROM models are ultraviolet erasable.
- List prices with memory ICs from \$295. OEM prices and models available OEM with or without memory ICs.



CURTIS, INC.

2887 North Palmyra Ave. • St. Paul, MN 55113
612/631-4812 Fax 612/631-9006

*IBM PC, XT, AT, PS/2 and PC DOS are trademarks of IBM. MS-DOS is a trademark of Microsoft.

Circle 87 on Reader Service Card



**Sure
it's insured?**

SAFWARE[®] Insurance provides full replacement of hardware, media and purchased software. As little as \$39/yr. covers:
• Fire • Theft • Power Surges
• Earthquake • Water Damage • Auto Accident

For information or immediate coverage call
1-800-848-3469

In Ohio call 1-614-262-0559



SAFWARE, The Insurance Agency Inc

Circle 255 on Reader Service Card

**a complete 80386
system for only**

\$1995

- ☞ 1meg ram
- ☞ 40 meg. hard drive
- ☞ TTL mono. monitor
- ☞ Parallel & Serial Ports
- ☞ Expand to 16 meg.
- ☞ 1 year warranty
- ☞ 30 day moneyback

Call for other systems and configurations at similar savings.

Scioto Computers

1-800-283-8616

Circle 262 on Reader Service Card

ACP Selected Top 10 Mail Order

Call ACP toll-free 1-800-FONE-ACP • 1-800-366-3227



LOW COST IBM/COMP BOARDS

ACP Advanced Cards/IBM	
ACP Mono or Color w/print port	49.
ACP EGA/350	129.
ACP SuperEGA/480	159.
ACP VGA/480	159.
ACP VGA/256, 256K	179.
ACP SuperVGA, 16 bit	249.
DFI Multi I/O, 2s.p./c,clk/XT	109.
ACP Six-Pak compatible/XT,OK	99.
ACP 286 Accelerator/XT	199.
ACP Multi I/O w/floppy contr./XT	59.
Dual Floppy ctrl/rt, 44MB/AT/XT	69.
ACP Serial I/O card/XT	29.
ACP Parallel I/O card/XT&AT	29.
ACP Serial I/O card/AT	39.
ACP Game adapter port/XT&AT	29.
ACP EPROM programmer/4 ports/179	
ACP 576K Card, OK/XT	59.
ACP AT Protolype card	25.
DFI 3.0Mb Multi I/O/10MHz/AT	129.
DFI 2000 2MB/AT	119.
DFI SuperMulti I/O w/floppy/AT	69.
DFI Megabit 2Mb uses/1Mb dRAM	99.
DFI NEC00 Ethernet/Novell approved	169.
DFI Rambank 2/PS2 50, 60	149.
No Slot Clock/IBM	45.

Fastwrite VGA, 16-bit 286.
VramVGA, 449.

INPUT DEVICES-MICE

Advanced PC Keyboards	
5160 84key XT/AT switchable	49
5161 101key XT/AT switchable	56.
KEYTRONICS	
KB5511 Deluxe IBM w/99 keys	139.
KB101 101 key/AT	110.
MB101 101 key/XT,AT,PS2	79.
LOGITECH	
Bus Mouse PC/XT/AT NEW!	99.
Serial Mouse PC/XT/AT NEW!	109.
Serial Mouse PS2 NEW!	99.
MICROSOFT	
Bus Mouse w/PC Paintbrush	99.
Serial Mouse w/PC Paintbrush	99.
Serial PS2 w/PC Paintbrush	99.
MSC Technologies	
PC Mouse serial PC/XT/AT	98.
PS2 Mouse serial	98.
PC Mouse Bus PC/XT/AT	98.

the Complete PC Half Page Scanner



Scans a 4" width with 200dpi resolution, includes the powerful SmartScan editing software and it's now available from ACP for under \$200.

MICROPOLIS	
1355/145Mb, ESDI, FH, 28ms	1149.
1335/70Mb, MFM, FH, 29ms	589.
MAXTOR	
XT 1085/70Mb, FH, MFM, 27ms	799.
XT 1140/120Mb, MFM, 27ms	1495.
XT 4360E/330Mb, ESDI	2549.
1524/1124	549/349.
Panasonic 4450 Laser	1419.
STAR	
NX 1000: 80 col, 9 pin	199.
NX 1000, Rainbow, 80 col.	269.
NX 2400, 80 col, 24 pin	299.
TOSHIBA	
P321SL, 24pin, 216cps	468.
P341SL, 24pin, 216cps	589.
P351SX	969.
Expresswriter 301/31	339/409.
Toshiba Pagelaser 12	
High volume laser printer	2499.

kit w/sw(3 users)	799.
(network for less than \$300/node)	
ViaNet LAN software	85.
Starhub	340.
Ethercard PLUS	269.
Ethercard PLUS TP	
(twisted pairs)	409.
Ethercard PLUS-PS2	
(microchannel)	419.

PLOTTERS

HOUSTON INSTRUMENTS	
DMF52/32MP, etc.	call.
SCANCAD	call.
DMP56A/61,62,695	call.
CALCOMP	
1023	3635.
1042	7535.
1042	6475.
1044	9910.
KURTA	
1212 IS1	419.
1212 IS2	12x17
36x48	2888.
4 bit cursr	79.
SUMMASKETCH	
12x12	399.
12x18	649.

DISKETTES/ACCESSORIES	
POLAROID	
5-1/4" DSDD	13.
5-1/4" DSHD	14.
3-1/2" DSDD	15.
3-1/2" DSHDD	38.
FUJII	
5 1/4" DSDD	7.
5 1/4" DSHD	16.
3 1/2" DSDD	19.
3 1/2" DSHDD	39.
BULK	
5 1/4" DSDD box of 100	35.
5 1/4" DSHD box of 100	59.
3 1/2" DSDD box of 100	139.
3 1/2" DSHD box of 100	259.

MODEMS-&COMMUNICATIONS

Advanced MODEMS	
1200baud w/software(int)	49.
1200baud w/software(ext)	87.
2400baud w/software(int)	96.
2400baud w/software(ext)	139.
COMPLETE PC	
CFAX 4800 PC fax board	267.
CFAX 9600 PC fax board	437.
Hand Scan 400	
200,300,400dpi resolution	178.
FullPage Scanner	548.
Complete Answering Machine	227.
HAYES	
1200/2400 (internal)	298/439.
Smartmodem 2400 (external)	429.
Personal Modem 2400	188.
INTEL	
Connection Coprocessor	699.
optional 2400baud Modem	219.
2400B Modem2, 50z,60,70,8	319.
2400B Classic Modem2	269.
MIGENT	
Pocket MODEM 1200	call/79.
PRACTICAL PERIPHERALS	
1200/2400 (internal)	64/149.
1200/2400 (external)	79/178.
PROMETHEUS	
2400G (external)	188.
1200B/2400B (internal)	79/149.
MONITORS-TERMINALS	
AMDEK	
410A/1280	149/699.
IBM MONITORS	
8530/8512	199/499.
8513/8514	549/1195.
NEC	
Multisync II/Multisync Plus	595/887.
Multisync 2A/Multisync 3D	499/720.
Multisync XL 20(1024x768)	2099.
Monograph sys (1024x1024)	1499.
SAMSUNG-IMTEC	
1256A 12" amber TLT mono	88.
1457A14" amber flat screen	128.
1457W14" white flat screen	135.
1464K14" CGA/RGB Color	248.
1453 14" VGA Color	375.
1453Q 14" Multisync Color	375.
1457 15" Fullpog white w/card	699.
WYSE	
WY60/WY50 14" terminal	329/399.
WY60/WY150	419/419.



• New Case Design for the '90's!
• New Low Prices on 386 models!

Advanced 386 Clones save\$\$
Advanced 386/20 base system 1795.
Advanced 386/20 Mono/40Mb 1795.
Advanced 386/25 base system 2099.
Advanced 386/20 Mono/40Mb 2649.
Advanced 286 Clones save\$\$
Advanced 286/10 bare bones 299.
Advanced 286/12 bare bones 399.
Advanced 286/12 base system 649.
Advanced 286/12 base system 999.
Advanced XT Clones save\$\$
Advanced XT/10 bare bones 179.
Advanced XT/10 base system 549.
call for options & details.....

SOFTWARE

Aldus Pagemaker/IBM	488.
Aldus Pagemaker/Mac	399.
Adobe Illustrator 88	299.
Ashton Tale dBase III	449.
Ashton Tale dBase IV	488.
Ashton Tale Signmaster	149.
Ashton Tale Ultimate Advtl	299.
Borland Quattro	188.
Borland Paradox	488.
CAI SuperProject Plus 3.0	288.
CAI SuperCalc V	329.
Central Copy II/PC	29.
DAG Easy Light	49.
Digital DB Publisher 1.04	449.
FOX Forbes & Dev v2.1	239.
Genie CADD v1.0	45.
Gibson Spinwrite	45.
Intuit Quicken v3.0	45.
Lotus 1-2-3 Rel 3.0	329.
Lotus 1-2-3 v 2.2	329.
Lotus 1-2-3 v 2.0	99.
Lotus Symphony	369.
Lotus Symphony	449.
Micrografic Draw	266.
Micrografic In-a-Vision	329.
Micropro Wordstar Pro rel 5	229.
Micropro Wordstar 2000 rel.3	189.
Micromin RBase 5000	339.
Microsoft Excel	339.
Microsoft Windows 286	69.
Microsoft Windows 386	149.
Microsoft Word	239.
Microsoft Works	119.
Microsoft Chart	249.
Nantucket Clipper	488.
Norton Utilities	69.
Norton Commander	59.
Norton Adv. Utilities	85.
Quarterdeck DesignView Bundle	149.
SCO Xenix O/S 286 v2.2 PS/2	489.
SCO Xenix O/S 386 v2.2 PS/2	489.
SPC Harvard Graphics v2.1	289.
SPC First Choice v3.0	99.
Symantec O&A v3.0	239.
Symantec Timeline v3.0	339.
Symantec Grandview	189.
Traveling Software Laplink III	89.
Xerox Ventura Publisher	499.
WordPerfect 5.0	224.

COMPUTERS-CLONES

AST Research	
AST Bravo, Mono w/20Mb	1288.
AST 286, Mono Sys w/20Mb	1997.
AST 386C, Mono w/40Mb	3399.
call for all AST models.....	
EPSON	
NEW! LT Laptop	call.
Equity I, II	call.
HYUNDAI	
Hyundai286/Turbo10TE	call.
SHARP	
4641 Laptop	2399.
TOSHIBA LAPTOPS	
1100 Laptop	669.
12100FB/1200HB	1449/1995.
T1600/3100E	3395/2899.
T3200 286 full keypad,40Mb	3495.
T5100/5200	4295/5095.
ZENITH	
Supersport Model2/Model20	call.
(more Zenith next column)	
Supersport 286	call.
Model20/Model40	call.
TurboSport 386/386 w/modem/call	

MOTHERBOARDS

XT Turbo w/BIOS/8MHz	89.
XT Turbo w/BIOS/10MHz	99.
1Mb 80ns	23.
1Mb 70ns	25.
256x9 120ns 79.	256x9 80ns 99.
64kx1	22.
1Mbx9 SIMM Module 120ns	225.
1Mbx9 SIMM Module 100ns	245.
1Mbx9 SIMM Module 80ns	245.

CHIPS & SIMM MODULES

256K 120ns	7.
256K 100ns	8.
1Mb 120ns	20.
1Mb 100ns	21.
1Mb 80ns	23.
1Mb 70ns	25.
256x9 120ns 79.	256x9 80ns 99.
64kx1	22.
1Mbx9 SIMM Module 120ns	225.
1Mbx9 SIMM Module 100ns	245.
1Mbx9 SIMM Module 80ns	245.

ACPs with built-in line of CHIPS IIT

COPROCESSOR CHIPS	
INTEL	
8087	97.
8087-1	196.
8087-2	142.
8087-6	185.
Wrietek call IIT 80C287/10	288.

VIDEO-GRAPHICS-PS BOARDS

AST Research	
Xform/286, 512K, 10MHz	575.
Advantage 2/386, OK, PS/2	398.
Advantage 2, 512K, PS/2	458.
Advantage AT, 128K	278.

Laptops for less.

Why ACP sells more... **TOSHIBA**

• Pricing • Service • Availability

ACP won't be undersold for Toshiba laptops & printers.

Rampage2-286,512K,Mod50/60	599.
Rampage Plus/MC/512K,PS/2	499.
Rampage Plus/286/512K,AT	419.
AST Sixpak/ps, 64K	339.
AST Hotshot 286 accelerator	129.

FLOPPY DISK DRIVES

SONY	
3 1/2" Micro Floppy 1.44Mb	105.
TEAC	
55B/360K Floppy/PC/XT/AT	77.
TOSHIBA AMERICA	
FDD4403 3 1/2" 720K w/kit	79.
3 1/2" 1.44Mb w/kit	98.
ND040 360K Floppy black bezel	79.
ND045 6 300K Floppy beige	79.
ND080E-G 1.2Mb AT beige	89.

EXTERNAL FLOPPY DRIVES

5 1/4" 360K for PS/2	188.
5 1/4" 1.2Mb for PS/2	219.
5 1/4" 360K for Laptop	188.
1.44 Mb Universal Drive	259.
REMOVEABLE DISK DRIVES	
IOMEGA Drives	
Bermoulli 20Mb PS/2	899.
Bermoulli 44Mb internal 5 1/4"	1099.
Bermoulli Dual44Mb ext 5 1/4"	2289.
Bermoulli 20Mb internal 5 1/4"	1099.
Bermoulli Dual20Mb ext 5 1/4"	1799.
Tri-pak 20Mb cartridge 5 1/4"	189.
Tri-pak 20Mb cartridge, 8"	255.
PC2/50 Adapter card	149.
PC3B/50 Adapter card	229.

HARD DISK DRIVES

Advanced DriveCard	
ACP 20Mb DriveCard	288.
ACP 30Mb DriveCard	359.
OKDATA	
ML390/391	489/659.
ML393/393C	995/1095.
PANASONIC	
1080/1191	199/257.
1592/1595	427/487.

TAPE BACKUP/VIDEO

ALPHACOM	
VCR Videotrax	
tape backup card	289.
VCR Videotrax	
tape backup PS/2	349.
IRWIN	
2020 20Mb backup(internal)	325.
2040 20Mb backup(internal)	425.
445A 40Mb backup(external)	499.
ARCHIVE	
XL5540 40Mb internal/AT	359.
XL5540e 40Mb external/AT	499.

PRINTERS-LASERS

CITIZEN	
120D	149.
180D	179.
MP500	369.
MPS500	519.
DICONICS/KODAK	
150N/300P	349/449.
EPSON	
DF5000	call.
L8050	599.
LX810	189.
L01050	call.
FX850	349.
OJ950	call.
FX1050	449.
LQ2550	call.
L0510	359.

IBM PRINTERS

Proprieter II, 240cps	419.
Proprieter III	579.
Proprieter X24E, 240cps 24pin	649.
Proprieter XL24E, 240cps 24p	799.

NEC

P2200, 24pin(360x360dpi)	349.
PS200/5300	549/718.
LC890 Silentwriter	3395.

OKDATA

ML390/391	489/659.
ML393/393C	995/1095.

PANASONIC

1080/1191	199/257.
1592/1595	427/487.

IBM MONITORS

8530/8512	199/499.
8513/8514	549/1195.

NEC

Multisync II/Multisync Plus	595/887.
Multisync 2A/Multisync 3D	499/720.
Multisync XL 20(1024x768)	2099.
Monograph sys (1024x1024)	1499.
SAMSUNG-IMTEC	
1256A 12" amber TLT mono	88.
1457A14" amber flat screen	128.
1457W14" white flat screen	135.
1464K14" CGA/RGB Color	248.
1453 14" VGA Color	375.
1453Q 14" Multisync Color	375.
1457 15" Fullpog white w/card	699.

WYSE

WY60/WY50 14" terminal	329/399.
WY60/WY150	419/4

EVERYTHING 30% to 90% OFF LIST PRICE

CAT™ 10MHZ

BASE SYSTEM

- 256K (Opt. 640K) • 150 Watt Power Supply • AT Style Keyboard & Case
- 4.77 or 8 MHz Keyboard Selectable
- Floppy Disc Controller
- 8087 Socket • 360K Floppy Drive
- 1 Year Warranty



\$34900

CAT 386 SYSTEM

- 12" Amber Monitor with Graphics Interface Card
- 1.2 Meg Floppy Drive (expandable to 8 Meg)
- 1 Meg of Memory
- Parallel, Serial & Clock

20MHz **\$159500**

CAT™ 286-10MHZ

BASE SYSTEM

- 512K Exp. to 1 MEG • 200 Watt Power Supply • AT Style Keyboard
- Western Digital Controller • 1.2 Meg Floppy • Legal Bios w/manuals • Systems Documentation • 1 yr. w. Clock/Calc
- 10MHz DTK Motherboard



\$69900

11.3 MORTONS BL

8088 XT Compatible

640 K Upgrade	129 ⁰⁰	Clock Calendar	24 ⁰⁰
12" Amber Monitor w/Interface	139 ⁰⁰	Parallel & Serial Ports	39 ⁰⁰
DOS 4.01 w/GW BASIC	89 ⁰⁰	Additional Drives	See Below

SYSTEM OPTIONS

640 K Upgrade	49 ⁰⁰	14" EGA Monitor w/Interface	549 ⁰⁰
512K Upgrade	108 ⁰⁰	Novel Network Call 12 Mhz add	100 ⁰⁰
12" Amber Monitor w/Interface	139 ⁰⁰	14" Color Monitor w/Interface	289 ⁰⁰

COPROCESSORS

8087 5MHz or less	89 ⁰⁰
8087-2 8MHz	129 ⁰⁰
8087-1 10MHz or less	179 ⁰⁰
80287 6-8MHz	139 ⁰⁰
80287-8 8-10MHz	209 ⁰⁰
80287-10 10MHz	239 ⁰⁰
80C287-12 12MHz	299 ⁰⁰
80387-16 16MHz	369 ⁰⁰
80387-20 20MHz	439 ⁰⁰
80387-25 25MHz	549 ⁰⁰
90387-33 33MHz	649 ⁰⁰
80387SX 16MHz	399 ⁰⁰

MORE UPGRADES

Description	150NS	120NS	100NS	80NS
64 x 1	274	294	324	404
64 x 4	474	524	574	674
256 x 1	304	474	494	504
1 Meg x 1	1204	1374	1474	1574
256 x 4	1204	1404	1504	1704
64x4 Video	604	704	804	1104
1 Meg Video	2044	2144	2244	2344
8K x 8 Static	704	804	904	1104

The above Memory Upgrades come in ZIP Form. Please specify if you need ZIP. Soy - PLCC - Flat Pack or if you need Noble Mode

RAM UPGRADES FROM THE RAM SPECIALISTS

Description	Eqv. IBMPS2 Part #	For Model #	Meads Low Price
128K Upgrade	70 x 8955	25	59 ⁰⁰
512K Upgrade	30F 5348	30T286	189 ⁰⁰
2MB Upgrade	30F 5360	30T286	599 ⁰⁰
1MB Module	6450603	70-E61 & 121	239 ⁰⁰
2MB Module	6450604	70-E61 & 121	579 ⁰⁰
2MB Mem. Board	6450608	70-A21	899 ⁰⁰
1MB Mem. Board	6450375	80-041	419 ⁰⁰
2MB Mem. Board	6450379	80-111 & 311	899 ⁰⁰
8MB Mem Bd. w/OK	1497259	502 & 60	429 ⁰⁰
8MB Mem Bd. w/OK	6450605	70 & 80	1299 ⁰⁰

HARD DRIVES

Model	Capacity	Interface	Meads Low Price
ST125	20Meg	40 Mil 1/2 Ht 3 1/2" Drive only	258 ⁰⁰
ST138	30Meg	40 Mil 1/2 Ht 3 1/2" Drive only	299 ⁰⁰
ST225	20Meg	w/cont. & Cables	269 ⁰⁰
ST238	30Meg	w/cont. & Cables	289 ⁰⁰
ST251	40Meg	1/2 HT 40 Mil w/software, Drive only	359 ⁰⁰
ST251-1	40Meg	28 Mil Sec. Drive only	389 ⁰⁰
ST277R	60MB	40 Mil 1/2 Ht	469 ⁰⁰
ST4026	20Meg	Full Ht 40 Mil	299 ⁰⁰
ST4038	30Meg	40 Mil Full Ht	399 ⁰⁰
ST4053	40MB	28 Mil Full Ht	519 ⁰⁰
ST4096	80Meg	Full Ht w/software	639 ⁰⁰

MODEMS BY EVEREX™

EV-923 EverCom 12 300/1200 bps Bitcom Software	69 ⁰⁰
EV-941 EverCom 24 2400 Baud Int. Bitcom Software	139 ⁰⁰
EV-945 External 2400 Baud	189 ⁰⁰
EV-942 2400 PS2	229 ⁰⁰
EX-955 FAX Card	349 ⁰⁰

MNP ADD \$20

MORE MODEMS...

1200 Baud Internal w/Software CPI	54 ⁰⁰
1200 Baud External fully Hayes Compatible, Everex	99 ⁰⁰
2400 Baud Internal 1/2 card w/software CPI	99 ⁰⁰
2400 Baud External Fully Hayes Compatible, Zoom	129 ⁰⁰

COMPAQ

Description	Eqv. Compaq Part #	For Model #	Meads Low Price
1MB Add-on Module	113131-001	Deskpro 386/20/25/20E/286E	359 ⁰⁰
1MB Add-on Module	113646-001	Deskpro 386S	369 ⁰⁰
4MB Add-on Module	113132-001	Deskpro 386/20/25/20E/286E	899 ⁰⁰
4MB Add-on Module	112534-001	Deskpro 386S	999 ⁰⁰
1MB Memory Exp. Bd.	113644-001	Deskpro 386/20e	499 ⁰⁰
1MB Memory Exp. Bd.	113633-001	Deskpro 386S	489 ⁰⁰
4MB Memory Exp. Bd.	113645-001	Deskpro 386/20e	1399 ⁰⁰
4MB Memory Exp. Bd.	113634-001	Deskpro 386S	1399 ⁰⁰
1MB Mem. Upgrade Kit	107651-001	Portable 386	499 ⁰⁰
1MB Memory Exp. Bd.	117428-001	286E	499 ⁰⁰
4MB Memory Exp. Bd.	117429-001	286E	1399 ⁰⁰
1MB Upgrade Bd.	110295-001	SL1286	599 ⁰⁰
4MB Upgrade Bd.	108070-001	386/16	1399 ⁰⁰

IBM & Compaq boards & Modules come with 1 year warranty and are manufactured on a 2nd party board.

Intec MONITORS

1256A 12" Amber w/Tilt & Swivel Base	89 ⁰⁰
1257 12" Amber Flat Screen 720 x 350	99 ⁰⁰
1484 14" Color 640 x 200, 16 colors	239 ⁰⁰
1453 14" EGA 640 x 350, 64 colors/31	369 ⁰⁰
1455N EGA 720x480 Multisync Compatible	449 ⁰⁰

VIDEO CARDS BY EVEREX™

EGA EV/659, 640 x 350	119 ⁰⁰
VGA Viewpoint 16 Bit 256	269 ⁰⁰

MORE VIDEO CARDS...

MonoGraphics or Color Graphics 44⁰⁰

SIMMS MODULES (add \$20 for SIPP Version)

Description	150NS	120NS	100NS	80NS
64 x 9 IBM & Compatibles	19 ⁰⁰	29 ⁰⁰	34 ⁰⁰	39 ⁰⁰
256 x 8 For Apple Products	39 ⁰⁰	44 ⁰⁰	49 ⁰⁰	59 ⁰⁰
256 x 9 IBM & Compatibles	42 ⁰⁰	49 ⁰⁰	54 ⁰⁰	74 ⁰⁰
1Meg x 8 For Apple Products	139 ⁰⁰	149 ⁰⁰	164 ⁰⁰	189 ⁰⁰
1Meg x 9 For IBM & Compatibles	149 ⁰⁰	159 ⁰⁰	169 ⁰⁰	189 ⁰⁰

WESTERN DIGITAL CONTROLLERS

WX-1 8 Bit 1/2 Sized for XT	79 ⁰⁰
MMZ 16 Bit Full Sized Hard/Floppy	119 ⁰⁰
WD-27X 8 Bit RLL 1/2 Size	89 ⁰⁰
WAH 16 Bit Hard Drive Controller	129 ⁰⁰
RA2 16 Bit RLL Hard/Floppy for AT	159 ⁰⁰
MEAD Floppy Disk Controller for XT	19 ⁰⁰
MEAD 1.2 Meg & 360K Controller for XT, 720K-1.44	69 ⁰⁰
Cable Set for Hard Drive Only	5 ⁰⁰

Mitsumi FLOPPY DRIVES

360K 1/2 Ht. PC Compatible - Mitsumi	69 ⁰⁰
1.2 Meg Black Face - Mitsumi	89 ⁰⁰
720K 3/2" Drive w/5 1/4" mounting - Mitsumi	89 ⁰⁰
1.44 Meg 3 1/4" Drive w/5 1/4" mounting - Mitsumi	109 ⁰⁰
360K Tandem TM100-2 Full Ht. (The Original IBM)	89 ⁰⁰
160K Tandem TM100-1 Full Ht	69 ⁰⁰
External Case w/Power Supply 2, 1/2 HTs or 1 Full	149 ⁰⁰

EVEREX™ TAPE BACKUPS

40MB Mini Cartridge, 1.8MB/min, XT (DC 2000)	339 ⁰⁰
40MB Mini Cartridge, 3.6MB/min, AT (DC 2000)	339 ⁰⁰
60MB Streaming Cassette, 5MB/min w/cont (DC600)	649 ⁰⁰
60MB Streaming 600A, 5MB/min w/Full cont (DC600)	849 ⁰⁰
125MB Streaming Cartridge, 5MB/min w/Full cont	1119 ⁰⁰
DC2000 24 ⁰⁰	External Add 195 ⁰⁰
DC600 24 ⁰⁰	

Liquidation Below Dealer Cost — New With Warranties

LETTER QUALITY PRINTER

DAISYWHEEL PRINTER MANUFACTURED BY C.I.TOH

Why pay \$1149 for a C.Itoh

STARWRITER™ F-10

When our 40 cps letter quality daisywheel printer from the same manufacturer is only

\$39900

ea.

OPTIONS	STANDARD FEATURES
<ul style="list-style-type: none"> • 6 ft. Serial Cable \$ 19⁰⁰ • Bidirectional Tractor 149⁰⁰ • Cut Sheet Feeder 199⁰⁰ • Serial to Parallel Converter 99⁰⁰ 	<ul style="list-style-type: none"> • 40 CPS • Accepts Paper to 15 inches • Form Length and Pitch Set from Control Panel • Industry compatible ribbon, primewheels and control commands • RS232 Serial Interface

MICROSOFT MOUSE

- In Port with Bus Interface
- Fully IBM Compatible (of course)
- Includes Showpartners and Paint Brush

List \$199 Mead **\$7900** 10 for \$740

KRAFT MONITOR

FREE TILT SWIVEL BASE

- 14" Flat Screen • Paper White Phosphorus
- TTL Monochrome & Composite Interface

List \$199 Mead **\$9900** 10 for \$950

MEAD HOSTLIST

PRINTER KXP 1124 Panasonic	329 ⁰⁰
MONITOR NEC Multisync 2A	498 ⁰⁰
MODEM Hayes Smartmodem 2400 Int	388 ⁰⁰
SYSTEMAST Premium 286 Model 70	1398 ⁰⁰
BOARDS Paradise VGA Plus	248 ⁰⁰
SOFTWARE Fastrax The Desk Organizer	29 ⁰⁰

AT STYLE / XT CASE

- 2 Bay Standard AT Style Case
- Keylock Power and Hard Drive LED's

List \$99 Mead **29⁰⁰** 10 for \$240

WESTERN DIGITAL

WD1003/RAH - R11 HOC For AT 16 Bit, Full Sized R11	List 199 ⁰⁰ Mead 99 ⁰⁰
WD1005-WAH - 16 Bit ESD Controller for AT 2 to 1 Interleave	List 269 ⁰⁰ Mead 99 ⁰⁰

PARADISE MONO EGA

Auto Switch Monochrome EGA Card, 640x350 EGA, MDA, CCA, Herc.

List 319⁰⁰ Mead 99⁰⁰

CLOSEOUTS/OVERSTOCK

Wordstar Professional 5.0	149 ⁰⁰
Epson Universal Printer Stand	9 ⁰⁰
DC300A Used	5 ⁰⁰
SideKick Plus 1.0 by Borland	69 ⁰⁰
10Meg w/controller & cables	179 ⁰⁰
2764 Intel Eprom	2 ⁰⁰

800-654-7762

SALES: 7 a.m. - 5 p.m. PST
702-294-0204

CUSTOMER SERVICE / ORDER STATUS:
9 a.m. - 4 p.m. PST

FAX 702-294-1168

WE ALSO PURCHASE EXCESS INVENTORY - FAX LIST

MEAD COMPUTER

Quantity Pricing Available - CALL

We Accept International Orders

Purchase Orders from Universities, Government Institutions, Fortune 1000 and Qualified Firms.

NO SURCHARGE FOR MC/VISA

TERMS:
MC • VISA • COD • CASH

Purchase Orders from Qualified Firms
Personal Checks • AE add 4% • COD add \$3.00
20% Restocking Fee on Non-Delictive Returns within 15 days

SHIPPING: (min 6⁰⁰) UPS

Z80 HD64180 MICROPROCESSORS

C Compiler
Assembler/Linker
Remote Debug
Realtime Kernel
Emulator
PC Coprocessors
Proto Board

Integrated Software/Hardware Targeted
for Z80/64180 Development on PC/XT/AT

NEW! C-Compiler-Version 2-intro offer
Free Technical Brief on Request

Assembler/linker (only)	\$195.00
In-circuit Emulator	\$995.00
Source/symbolic debugger	\$195.00
Standalone Proto Board (64180µP)	\$295.00
PC Coprocessors--many versions, please inquire	

Z-World Engineering

1340 Covell Blvd, Suite 101
Davis, CA 95616

(916) 753-3722

fax: 753-5141



In Germany: 08131/1687

Circle 324 on Reader Service Card

Data Acquisition Processor™



Onboard Intelligence For IBM PC/XT/AT/386

- 16 MHz 80C186 for general processing
- 20 MHz DSP56001 for digital signal processing
- Sustained digital signal processing of 10 MIPS
- FFT and FIR filtering without programming
- Acquires analog and digital inputs to 235K s/s
- Buffers and processes input data as required
- Updates analog or digital outputs to 250K s/s
- Over 100 commands without programming
- Custom commands may be written in C

Call for FREE Demo Diskette

MICROSTAR

(206) 881-4286

2863 152 Ave. N.E.

Redmond, WA 98052

LABORATORIES

FAX (206) 881-5494

Circle 194 on Reader Service Card

16-BIT RESOLUTION ANALOG-TO-DIGITAL CONVERTER 12,000 SAMPLES/SEC for IBM PC, XT & AT SINGLE PIECE PRICE \$475

We manufacture a broad line of data acquisition and control hardware and software for Apple and IBM computers.

Call for quotes on custom hardware or complete systems.

LAWSON LABS, INC.

5700 RAIBE ROAD
COLUMBIA FALLS, MT 59912
800-321-5355 or 406-387-5355



Circle 161 on Reader Service Card

SAVE ON 9 TRACK TAPE SYSTEM

FOR IBM PC/XT/AT
& PS-2



- Mainframe to PC Data Transfer
- High Speed Backup
- All Software, Complete System
- Service and Support, easy Installation

call (818) 343-8505 or write to:

CONTECH Computer Corp.
P.O. Box 163 Torrance, CA 91350

CONTECH

Circle 81 on Reader Service Card

8051 SBC \$99^{oem} Single Board Computer

FEATURES: 8031, RAM and ROM Sockets, 8 bit I/O, RS 232 port, optional UART, and Expansion Bus. Size: 3.5" x 6.0", +5Vdc only.
OPTIONS: 8032, CMOS, 18 MHz, NV Memory, Monitor Firmware and High Level Languages.
Development Board.....\$199

8031 ICE \$199

Our emulator provides most of the features of an 8031 In-Circuit-Emulator at a significantly lower price. It assists in integration, debug and test phases of development. Commands include: disassembly, trace, breakpoints, alter register/memory, and load Intel Hex file.

8051 Simulator Program.....\$99
IBM PC/XT/AT Software simulation of 8051 µC.

HTE

HiTech Equipment Corporation
9400 Activity Road
San Diego, CA 92126
(619) 566-1892

Circle 131 on Reader Service Card

AVPROM™ \$295

For IBM-PC's & compatibles, menu-driven AVPROM programs EPROMs up to 8x faster than serially-connected units (20 sec. for 2764).

- Programs 2716 thru 27512A.
- 4- and 10 socket gang versions too. Call for prices.

For complete specs, free 32 pg. development tool catalog, call

800-448-8500.
or 207-236-9055

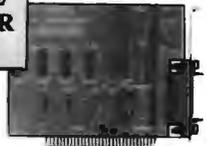
AVOCET
SYSTEMS, INC.

120 Union St., Rockport, ME 04856

Circle 31 on Reader Service Card

Circle 52 on Reader Service Card

LOW COST INTERFACE CARDS FOR PC/XT/AT



RS-485/422 Card [PC485] \$95/125

- Serial Async. Communication up to 4,000ft; 2 or 4 wires; NS16450 UART.
- Can be configured as COM1-COM4; Maximum Baud Rate 56KB.
- Flexible configuration options. RTS or DTR control of transmission direction.
- Full/Half duplex operation. Supports hardware handshaking (RTS,CTS).
- Dual drivers/receivers; Handles 64 devices; Compatible with most comm. strvr.
- High speed version available (supports baud rates up to 256KB) - \$165
- DIN9 or phonojack. Sample communication software available - \$39/59

IEEE-488 Card [PC488A] \$145

- Includes INSTALLABLE DOS DEVICE DRIVERS and support for BASIC.
- Additional Support for ASSEMBLY, C, Pascal and FORTRAN - \$50.
- IRQ (1-6). DMA channel 1 or 2. Up to 4 boards per computer.
- Compatible with most IEEE-488 Software packages for IBM-PC (e.g. ASYSTANT-GPIB, Lotus Measure). Compatible with NT's GPIB-PCIA.

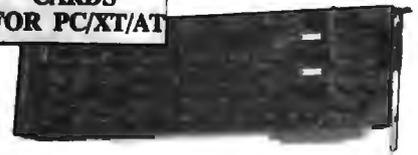
IEEE-488 Card [PC488B] With Built-In Bus Analyzer \$345

- Software Support for BASICA, QuickBASIC and GWBASIC.
- Additional libraries for C, Pascal, FORTRAN, Assembly available - \$95 (all)
- Over twenty high level IEEE-488 functions supported. Implements full range of Talker, Listener, Controller, Serial and Parallel Poll, Service Request, Pass Bus Control and Remote Programming functions.
- Powerful menu-driven BUS ANALYZER can be run in the background while ASB programs or commands are executed; Features Program Stepping, Break points, real time bus data capture (4K buffer), instant screen toggling.
- Complete Controller/Talker/Listener capability. Based on TI's TMS-9914.
- Memory-resident Printer Port Emulation Utility included. (LPT1-3).

IEEE-488 Card [PC488C] With Built-In Bus Analyzer \$445

- NEC-7210 based card (compatible with Nat. Instruments PCIB/PCIA)
- Supports all the features of the PC488B card. Includes the same utilities.

LOW COST DATA ACQUISITION & CONTROL CARDS FOR PC/XT/AT



12 BIT A/D/A + DIO + Counter \$295

- A/D converter: 16 single-ended channels; 12 bit resolution; Conversion time less than 30 µsec; Built-in programmable pacer; Input range: ±5V, ±1V.
- D/A converter: 2 channels; 12 bit resolution; 0 to +5V Output Range.
- Digital I/O: 16 Input / 16 Output channels; All I/Os TTL compatible.
- Counter: 1 channel programmable interval counter/timer; Uses Intel 8253.
- Software Support: LabDAS (\$195/495), ASYST, LABTECH, UnkelScope.

14 BIT A/D/A + DIO + Counter \$495

- A/D converter: 16 differential channels; 14 bit resolution; Conversion time less than 40 µsec; Built-in programmable pacer; Input range: ±5V, ±1V.
- D/A converter: 1 channel standard (2nd optional); 14 bit res.; ±5V Range.
- Digital I/O: 16 Input / 16 Output channels; All I/Os TTL compatible.
- Counter: 1 channel programmable interval counter/timer; Uses Intel 8253.
- Software: LabDAS (\$195/495), ASYST, LABTECH, UnkelScope.

FAST A/D/A + DIO + Counter \$895

- A/D converter: 16 single ended or 8 differential channels; 12 bit resolution; Programmable scan rate; Built-in interrupt and DMA control circuitry; Conversion speed 66,000 samples/sec (standard), 100,000 samples/sec (optional).
- Input ranges: Bipolar ±10V, ±5V, ±2.5V, ±1V, ±0.5V; Unipolar 10.5, 2.1V.
- D/A converter: 2 channels; Resolution: 12 bits res; Settling time: 5µsec; ±5V
- Digital I/O: 16 In; 16 Out; 16 In; TTL compatible; All I/Os TTL compatible.
- Counter: 1 channel 16 bit programmable interval counter/timer; Uses Intel 8254. Provides pacer clock.
- Software: LabDAS (\$195/495), ASYST, LABTECH, UnkelScope.

DIGITAL I/O + Counter \$160

- Input: 32 TTL compatible channels; Input load is 0.2 mA at 0.4V.
- Output: 32 TTL compatible channels; Sinks 24mA(0.5V); Sources 15mA(2.0V)
- Counter/Timer: DC to 2.6MHz; 3 channels; 16 bit counters; 6 counting modes.
- Breadboard area for prototyping.

STEPPER MOTOR CARD \$395

- Capable of independent and simultaneous control of up to 3 stepper motors.
- Speed: Programmable from 3.3 PPS to 3410 PPS; Built-in acceleration control.
- Output Mode: One clock (Pulse, Direction) or two clock (CW, CCW pulses)
- Step position Read-back; Opto-isolated outputs; Crystal based timing.
- Includes 8 bit digital input/output port.

MC / VISA / AMEX

Call today for datasheets!



B&C MICROSYSTEMS INC.

355 WEST OLIVE AVE., SUNNYVALE, CA 94086
TEL: (408) 730-5511 FAX: (408) 730-5521

Circle 53 on Reader Service Card

YOUR MEMORY UPGRADE SPECIALISTS

WE ACCEPT
AMERICAN
EXPRESS



Special of the Month

386 MOTHERBOARD - Uses CHIP'S TECHNOLOGY Chip Set
386-16 w/9K \$995 386-20 w/9K \$1195
Upgrade your memory with our low priced SIMM'S

ESTABLISHED 1976

SIMM SIPP MODULES

1 MG X 9- for IBM TYPES
1 MG X 9-120 NS\$175
1 MG X 9-100 NS\$185
1 MG X 9-80NS\$219
1MG X9-70NS\$289

256 X 9- for IBM TYPES
256 X 9-120NS\$59
256 X 9-100NS\$75
256 X 9-80NS\$89
256 X 9-60NS\$109

APPLE SIMM MODULES

1 MG X 8- for APPLE
1 MG X 8-120NS\$169
1 MG X 8-100NS\$179

256 X 8- for APPLE
256 X 8-120NS\$59
256 X 8-100NS\$69

PS-2 SIMM'S

256 X 9 (FOR PS2)
256 X 9-120NS\$79
256 X 9-100NS\$95

MODEL 30-286

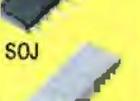
1 mg x 9-100\$229

PS-2MODEL 70&90 SIMM

1 MG X 9-100NS\$249
1 MG X 9-80NS\$299
2 MG X 9-80NS\$679

VIDEO RAM FOR VGA CARDS

64 x 4(150NS)\$7
64 X 4(120ns)\$10
64 X 4(100ns)\$13



D-RAM

1 MG X 1
1 MG X 1-120 NS\$14
1 MG X 1-100 NS\$15
1 MG X 1-70 NS\$20
1 MG X 1-80NS\$18

256 X 1
256 X 1-150 NS\$5.00
256 X 1-120 NS\$5.50
256 X 1-100NS\$6.00
256 X1-80NS\$7.00
256 X 9-70NS\$7.50
256 X 1-60NS\$8.00

256 X 4
256 X 4-120 NS\$15
256 X 4-100 NS\$17
256 X 4-80NS\$21

54 X 1
4164-150NS\$1.40
4164-120NS\$2.10
4164-100NS\$2.40

64 X 4
4464-150 NS\$5
4464-120 NS\$6
4464-100NS\$7
4464-80NS\$9

256 X 4 STATIC COL
514258-10\$25

256 X 1 STATIC COL
51258-10\$7.50
51258-80\$9.00
51258-70\$9.50

Compaq 386 Memory
1 mg-expansion\$399
4 mg\$1300

Daughter BD Mod 70-80
1 mg (6450375)\$429
2 mg (6450379)\$929

MATH CO-PRO

8087-3(5MHZ)\$88
8087-2(8MHZ)\$118
8087-1\$168
80287-5\$128
80287-8\$195
80287-10\$218
80C287-12\$299
80C287-16\$320
80C87-20\$375
80C87-25\$478
80C87-33\$649

CPU CHIPS

8088\$5.00
80286-8LCC\$49
80286-10LCC\$59
80286-12LCC\$69
80386-16\$180
80386-20\$280
80386-25\$439
V-20 (8MHZ)\$7.50
V-20 (10MHZ)\$10.00

CACHE

80385CALL

MAC CHIPS

68881-16 Math Co\$169
68881-20 Math Co\$179
68882-16\$149
68882-20\$199

RAM TESTER

only \$139
Tests the following memory chips:
64K X 1 256 X 1
64K X 4 256 X 4
4M X 1 1M X 4
The RTI can help anyone come through the frustrating process of identifying bad (or good) D-RAM chips.

MEMORY EXPANSION BOARDS

ORCHID

RAMQUEST II-Z - Up to 2MB with 9K for PS2 MOD 50, 50Z & 60 - EMS and OS/2 Compatible - Uses 1MG D-RAM\$209

RAMQUEST EXTRA - Up to 8MB - for PS2 MOD 50, 60,70 & 80, EMS & OS/2 Compatible - Has 2 serial ports - Uses 256K of 1MB SIMM'S\$319

RAMQUEST EXTRA-16/32 - up to 8MB - For PS2 MOD 50, 50Z, 60, 70 & 80- Fully Supports 16 BIT & 32 BIT-1 serial & 1 par - EMS & OS/2 Compatible- Uses 256K of 1MB SIMM'S\$319

RAMQUEST XT/AT -Up to 8 MB- For XT, AT, PS2 MOD25,30 - 8 BIT or 16 BIT - Uses 256K or 1MB SIMM'S\$259

TINY TURBO 286-High speed Half-slot Accelerator for PC/XT- 3 times faster with an 8 MHZ 286 CP -80287 9KT\$239

JET 386 - Hyper speed Accelerator for AT- 3 times faster with 16 MHZ 386 CPU - 80387 9KT\$895

BOCA RESEARCH

For PS2
BOCARAM 30 - with 9K RAM\$129
Expands to 2MG - Uses 1MG X 1 D-RAMS

BOCARAM 50/60 with 9K RAM\$179
Expands to 4 MG with Software
Uses 1 MG X 1 D-RAMS

BOCARAM MCA 50Z with 9K RAM\$189
Expands to 2 MG - Uses 1 MG X 1 D-RAMS

BOCA MCA Parallel Card\$99
BOCA MCA Serial/PAR\$169

EVEREX

MINI-MAGIC - #EV138 - 576K Memory Card\$59
for PC & AT with 0K - Uses 64K & 256K D-RAM

RAMIII 4000 - #EV-136 - 4MB EMS\$249
Extended Memory card with 0 K-Uses 1 MGD-RAMS

IBM

1497259 - For PS-2 MOD 50/60\$439
with 0K Expands to 8MB
Uses 256K SIMMS (IBM only)

6450605 - For PS-2MOD 70/80\$1299
with 2 MG Expands to 8 MB
Uses 2MG SIMMS (IBM only)

6450203 - For AT - Has 512K RAM\$129

IDEA ASSOCIATES

IDEA max 80 - for PS2 MOD 70/80Call
Expands to 8MB
Uses 256K or 1MG SIMMS

IDEAsupermax/MC - for PS2 MOD 50/60Call
Expands to 8MB/2 Extended memory/2SER/EMS
Uses 256 or 1MG SIMMS

IDEAmax/MC - for PS2 MOD 50/60 & 80Call
Expands to 12MB Extended memory with software
Uses 1MG SIMMS

UNITEX

3MG Multifunction - for AT\$149
Expands to 3MG - has SER/PAR PORT
Uses 1MG D-RAMS

384 Multi-function Card for PC/XT\$89
Expands to 384K - has SER/PAR/CLK/Game port
Uses 64K or 256K D-RAMS

VIDEO ADAPTER

ATI

EGA Wonder 800\$239
Supports EGA, MDA, CGA & Hercules

VIP VGA - 800 X 560\$275
Supports VGA, CGA, MDA & Hercules

VIDEO 7

Fastwrite VGA\$349
256 D-RAM, 800 X 600, 640 X 480
Supports VGA/EGA/MDA/CGA & Hercules

V-RAM VGA\$519
256 K V-RAM, 1024 X 768, 800 X 600

VEGA Deluxe\$239
640 X 480 Multi-sync

VEGA Pro\$319

ORCHID

DESIGNER 800 VGA\$229
800 X 600 - 16 Colors

PRODESIGNER VGA\$319
Supports 1024 X 768 - 16 Colors

PRO DESIGNER VGA PLUS\$399
Same as Prodesigner - Has downloadable fonts

UNITEX

MONOCHROME GRAPHICS CARD\$41
with par port • MDA/CGA/Hercules

COLORGRAPHICS CARD\$41
RGB Color with Par Port • EGA/MDA/CGA/Hercules

EGA CARD\$149

640 X 480, 16 Colors, EGA/MDA/CGA/Hercules

VGA CARD\$199

800 X 600, 16 Colors • VGA/EGA/MDA/CGA/

TERMS AND CONDITIONS

No Surcharge for MC/VISA Terms: MC • VISA • COD • CASH • AMEX add 4%
Purchase Orders from qualified firms 20% restocking fee on non-defective returns
Prices Subject To Change



2852 F Walnut - Tustin, CA 92680
Phone: 714/730-5232 • FAX#: 714/838-8593
Customer Service #: 714/730-9527



TOLL FREE OUTSIDE CA: 1/800/533-0055

99% OF ALL ORDERS SHIPPED SAME DAY

EZ-ROUTE VERSION II



**SCHEMATIC TO PCLAYOUT \$500
INCLUDES AUTO ROUTER**

EZ-ROUTE Version II from AMS for IBM PC, PS/2 and Compatibles is an integrated CAE System which supports 256 layers, trace width from 0.001 inch to 0.255 inch, flexible grid, SMD components and outputs on Penplotters as well as Photo plotters and printers.

Schematic Capture \$100, PCB Layout \$250, Auto Router \$250
FREE EVALUATION PACKAGE

30 DAYS MONEY BACK GUARANTEE
1-800-972-3733 or (305) 975-9515

ADVANCED MICROCOMPUTER SYSTEMS, INC.
1321 N.W. 65 Place - Ft. Lauderdale, FL 33309

9-Track Tape Subsystem for the IBM PC/XT/AT



Now you can exchange data files between your IBM PC and any mainframe or mini-computer using IBM compatible 1600 or 6250 BPI 9-Track tape. System can also be used for disk backup. Transfer rate is up to 4 megabytes per minute on PCs and compatibles. Subsystems include 7" or 10 1/2" streaming tape drive, tape coupler card and DOS compatible software. For more information, call us today!

QUALSTAR*

9621 Irondale Ave., Chatsworth, CA 91311
Telephone: (818) 882-5822

Circle 54 on Reader Service Card

PC BASED UNIVERSAL DEVICE PROGRAMMER \$595-895

- Programs EE/PROMs, PALs, GALs, IFLs, EPLDs, MICROs, BIPOLARS.
- Software driven pin drivers. DIA generated programming voltages.
- Upgradable for virtually any future programmable devices up to 40 pins.
- Self-sustent operation. No additional modules or plug-in adapters required
- Includes user friendly MEMORY BUFFER FULL SCREEN EDITOR.
- Friendly Menu-Driven interface. Device selection by P/N and manufacturer.
- Supports 8/16/32 bit word, Intelligent I & II, Quick Pulse programming.
- Functional testing, Register-Preload, FUSEMAP EDITOR for logic devices.
- File formats accepted: Intel Hex 86/88, Techron Hex, Motorola S, JEDEC.
- Customer support via voice line, dedicated BBS or fax. Full 1 year warranty.
- Base price includes Interface card, cable, Memory device library and 1 year, free updates. Additional Device Libraries (Logic, Micros, Bipolars) \$95 ea.
- Libraries updates available every 6 mo. and can be received via floppy or BBS

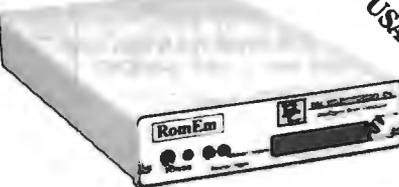
PC BASED 8-SOCKET GANG PROGRAMMER \$595

- Handles all memory devices to 32 pins. (Upgradeable up to 8 megabit parts).
- FULL SCREEN BUFFER EDITOR plus all applicable features from above
- Customer support via voice line, dedicated BBS or fax. Full 1 year warranty.
- Includes PC Interface card, Memory device library and 1 year free updates.



UNIVERSAL RS-232 PROGRAMMER \$345-595

- Programs EE/PROMs, FlashEeproms, ZPRams, Intel Micros, Memory Cards.
- Stand-Alone Mode for EE/Prom and Memory Card Duplication / Verify.
- All 24/28/32 pin EE/PROMs to 4 MBits (upgradeable to 32 megabits).
- Micros: 8741/A, 2/A, 4, 8, 9, 51, CS1, CS1FA/B, 52, 53, 55, CS21, CS41, 9761
- Memory Cards: Seiko/Epson, Fujitsu, Mitsubishi (Integrated Adapter Included)
- Modular design: Firmware easily upgradeable; 4 socket Gang module available
- On-Board Programming capability; Custom interface modules available
- User friendly Menu-Driven Interface Program for IBM-PC and Macintosh.
- Can be operated with any computer containing an RS-232 serial port.
- Optional built-in Eraser/Timer module (\$50); Top cover conductive foam pad.
- OEM open board programmer configurations available (from \$245).
- Customer support via voice line, dedicated BBS or fax; Full 1 year warranty.



INTELLIGENT PC ROM EMULATOR \$395

- Emulates 2716 through 27512 EPROMs (2k to 64k bytes) with a single unit.
- Connects to the standard parallel printer port. Uses standard printer cable.
- Intelligent features include: Reset Output, Address Compare, Address Snapshot, Trigger Input. Memory buffer editing capability. Selectable workzones.
- User friendly software. Command set includes: Load, Write, Display, Run, Type, Edit, Fill, Run-Command-File, Monitor, Port, Reset, Help, Calculator.
- FAST data loading via parallel printer port (65k bytes in less than 10 seconds)
- Cascadeable up to 8 units. Includes interface cable with Trigger and Reset clips
- CMOS version with standard 9V battery backup available (\$495). After downloading the program from the host computer, the CMOS emulator version can be disconnected and used in stand-alone mode for firmware testing.
- File formats accepted: Binary, Intel Hex, Motorola S.

MC / VISA / AMEX

Call today for datasheets!



B&C MICROSYSTEMS INC.

355 WEST OLIVE AVE., SUNNYVALE, CA 94086
TEL: (408) 730-5511 FAX: (408) 730-5521

Circle 21 on Reader Service Card



New, Gridless, 100% Autorouting
Create schematics and PCBs quickly and simply with HIWIRE-Plus® and your IBM PC. With the new, gridless, multilayer autorouter (AR) for HIWIRE-Plus, creating printed-circuit layouts is even faster. AR and HIWIRE-Plus are each \$895 and come with 30-day money-back guarantees. Credit cards welcome.

WINTEK

Corporation

1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428

Circle 320 on Reader Service Card

PC PRODUCTIVITY

NEW

EMU-TEK™

4200 Plus

Turn your PC into a
Tektronix Graphics Terminal

**FTG DATA
SYSTEMS**

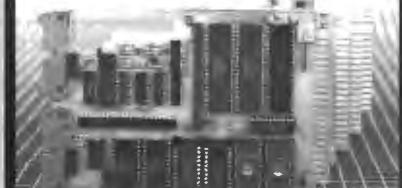
(800) 962-3900

10801 Dale St., Stanton, CA 90680

Circle 117 on Reader Service Card

Circle 241 on Reader Service Card

6809 Single Board Computer



6809 MPU, 2 serial ports, 4 parallel ports, RAM, EPROM, real-time clock, watchdog timer, 44-pin 4.5" x 6.5" PCB
EXPANSION MODULES: RAM, EPROM, CMOS RAM/battery, analog I/O, serial I/O, parallel I/O, counter/timer, IEEE-488, EPROM programmer, floppy disks, cassette, breadboard, keyboard/dsplay.

WINTEK

Wintek Corp
1801 South Street
Lafayette, IN 47904
317-742-8428

Circle 321 on Reader Service Card

EPROM PROGRAMMER CROSS ASSEMBLERS



MODEL
SX151

RS232C OR STAND ALONE (all models), Communication protocol: XMODEM, HEX, and BIN. Programs: EEPROMS, 2716 - 27512 and CMOS. Programs (w/adapter): 25XX, 27101 (and above), 68701, 68705, 68764/6, 8741/2, 8744, 8748/9, 8751/2, 8755, 87252, and CMOS. More available soon. Model SX151 \$214 (assembled with case). Other models are available from \$49 (kit).

Cross assemblers by PseudoCode for IBM-PCs, \$50. Z80, 1802, 6502, 68001/2/3/5/8/9/11, 68000/8/10, 8048/9, 8051/2, 8080/5, 8096, and more soon. Simulators and disassemblers also available.



KORE, Inc.

6910 Patterson S.E.
Caledonia, MI 49316
(616) 887-1444

\$5 for shipping (USA), plus \$3.00 COD.

Circle 156 on Reader Service Card

A-BUS™ MAGIC

Classroom to advanced industrial applications.

Be a Wizard in your Lab, Factory, College, Home...

It used to be difficult and costly to do process control, robotics, data acquisition, monitoring and sensing with your computer. Now the low-cost A-BUS system makes it easy to do almost any project you can imagine.

Versatility. A-BUS cards handle most interfacing, from on/off switching, to reading temperatures, to moving robot arms, to counting events, to sensing switches...

Adaptability. The A-BUS is modular, allowing expansion well beyond your needs. It works with almost any computer, or even as a remote data station with the new serial adapters.

Simplicity. You can start using the A-BUS in minutes. It's easy to connect, and software is a breeze to write in any language.

Reliability. Careful design and rugged construction make the A-BUS the first choice in specialized I/O.

An A-BUS system consists of: - An A-BUS adapter plugged into your computer - A cable to connect the adapter to 1 or 2 A-BUS function cards. - The same cable will also fit an A-BUS Motherboard for expansion to up to 25 cards in any combination.



NEW: REMOTE A-BUS! Use the new Serial (RS-232) Adapter or Processor to control any A-BUS system. Cards can be up to 500 ft away using phone type cable, or off premises using a modem. Call or send for the new A-BUS Catalog which covers all the products.

Important

All A-BUS Systems: ♦ Come assembled and tested ♦ Include detailed manuals with schematics and programming examples ♦ Can be used with almost any language (BASIC, Pascal, C, assembler, etc.) using simple "IN" and "OUT" commands (PEEK and POKE on some computers) ♦ Can grow to 25 cards (in any combination) per adapter ♦ Provide jumper selectable addressing on each card ♦ Require a single low cost unregulated 12V power supply ♦ Are usually shipped from stock. (Overnight service is available.)

About Alpha Products

Founded in 1976 for the purpose of developing low cost I/O devices for personal computers. Alpha has grown to serve over 70000 customers in over 60 countries. A-BUS users include many of the Fortune 500 (IBM, Hewlett-Packard, Tandy, Bell Labs, GM...) as well as most major universities. A-BUS products are U.S. designed, U.S. built, and serviced worldwide. Overseas distributors: England: Calky Science Assoc. Ltd., Merseside, 051 342 7033. Australia: Brumby Technologies Pty. Ltd., NSW, 759 1638. France: Coserm, Rungis, 46 86 64 75

Inputs, Outputs, etc.

Analog Input: 8 analog inputs. 0-5.1V in 20mV steps (8 bits). 0-100V range possible. 7500 conversions/second. **AD-142: \$142**

12 Bit A to D: Analog to digital converter. Input range -4V to +4V, expandable to 100V. On-board amplifier, Resolution 1mV. Conversion time 130ms. 1 channel. (Expand to 8 channels with the RE-156 card.) **AN-146: \$153**

Relay Card: 8 individually controlled industrial relays each with status LED's (3A at 120VAC contacts, SPST). **RE-140: \$142**

Reed Relay Card: 8 reed relays (20mA at 60VDC, SPST). Individually controlled and latched, with status LEDs. **RE-158: \$109**

D/A converter: 4 Channel 8 Bit D/A converter with output amplifiers and separate adjustable references. **DA-147: \$149**

24 line TTL I/O: Connect 24 input or output signals (TTL 0/5V levels or switches). Variety of modes. (Uses 8255A) **DG-148: \$72**

Digital Input: 8 optically isolated inputs. Input can be 5 to 100V voltage levels or switch closures. **IN-141: \$65**

Digital Output Driver: 8 outputs: 250mA at 12V. Drive relays, solenoids, stepper motors, lamps, etc. **ST-143: \$78**

Clock with Alarm: Powerful clock/calendar. Battery backup. Timing to 1/100 sec. Alarm relay, LED and buzzer. **CL-144: \$40**

Touch Tone Decoder: Each tone is converted into a number which is stored on the board. **PH-145: \$87**

A-BUS Prototyping card: 4x4.5" card. Will accept up to 10 I.C.s. With power & ground bus. **PR-152: \$16**

Counter Timer: Three 16 bit counters/timers. Use separately or cascade for long (48 bit) counts. **CT-150: \$132**

Call our application engineers to discuss your project.

Motion Control

Smart Quad Stepper Controller: The world's finest. On board microprocessor controls four motors simultaneously. Uses simple English commands like "MOVE ARM 10.2 (INCHES) LEFT". For each axis, you control coordinates (absolute or relative), ramping, speed, units, scale factors, etc. Many inputs for limit switches, etc. On the fly reporting of speed, position... Built in drivers for small motors (such as MO-103 or 105). **SC-149: \$299**
Options: ▶ 5 amp/phase power booster for 1 motor: **PD-123: \$49**
▶ Remote "teach" keypad for direct motor control: **RC-121: \$34**



A large A-BUS system with two Motherboards Adapter in the foreground plugs into PC,XT,AT type slot.

Stepper Driver Kit: For experimenting with stepper motors. Includes 2 MO-103 motors and a ST-143 dual driver PA-181: **\$99**

Stepper Motors: (4 phase, unipolar)
MO-103: 2 1/4" dia. 1/4" shaft. 7.5"/step. 12V. 5 oz-in torque. **\$15**
MO-104: 2" dia. 1/4" shaft. 1.8"/step. 5V. 60 oz-in torque. **\$45**
MO-105: 1.7" square. 2" shaft. 3.75"/step. 12V. 6 oz-in. **\$15**

A-BUS Adapters

▶ Can address 64 ports and control up to 25 A-BUS cards.
▶ Require one cable. Motherboard required for more than 2 cards.

A-BUS Parallel Adapters for:

IBM PC/XT/AT & compatibles: Uses one short or long slot. **AR-133: \$69**
Apple II, II+, IIe: Plugs into any slot inside. **AR-134: \$52**
Commodore 64, 128: Plugs into Expansion Port on back. **AR-139: \$48**
TRS-80 Model 102, 200: Uses 40 pin "System bus". **AR-136: \$78**
Model 100 (Tandy portable): Plugs into socket on bottom. **AR-135: \$75**
TRS-80 Model 3.4, 4D Y-Cable: available if 50 pin bus is used. **AR-132: \$54**
TRS-80 Model I: Plugs into 40 pin expansion bus. **AR-131: \$39**
Tandy Color Computers: Fits ROM slot, Multipak or Y-Cable. **AR-138: \$45**

A-BUS Cable: Necessary to connect any parallel adapter to one A-BUS card or to first motherboard. 50 pin. 3 ft. **CA-163: \$24**
Special Cable for two A-BUS cards **CA-162: \$34**

Serial Adapter: Connect A-BUS systems to any RS-232 port. Allows up to 500 ft from computer to A-BUS. **SA-129: \$149**

Serial Node: To connect additional SA-129/A-BUS systems to a single RS232 serial port (max 16 nodes). **SN-128: \$49**

Serial Processor: same as above plus built in BASIC for off-line monitoring, logging, decision making, etc. **SP-127: \$189**
Use SA-129 or SP-127 with modems for remote data acquisition.

Motherboard: Holds up to 5 A-BUS cards in sturdy aluminum frame with card guides. A sixth connector allows (using cables CA-161: \$12) additional Motherboards to be added. **MB-120: \$108**

Power Supply: Power pack for up to 4 cards. **PS-128: \$12**

Complete Catalog Available

For Orders and Info call (203) 656-1806
Weekdays from 9 to 5 EST or FAX 203 656-0756

Ordering Information: We accept Visa, Mastercard, Checks, and M.O. C.O.D. is \$4 extra. Purchase orders are subject to credit approval. CT residents add 7.5% sales tax. Shipping: \$4 per order (usually UPS ground). UPS 2nd Day Air: \$4 extra. Next Day service available. Canada: \$6 per order (Airmail). Outside US and Canada: Add 10% of order total.



ALPHA Products

242-B West Avenue, Darien, CT 06820

Circle 15 on Reader Service Card

9600 bps MODEM**V.32 MNP class 5**

High speed, error free data communications without proprietary protocols. Effective throughputs up to 19.2K bps. \$999



- 9600/4800/2400/1200/300 bps full duplex data transfer
- Fully V.32/V.22bis/V.22 and Bell 212A/103J compliant
- MNP class 5 error correction and data compression
- Automatic speed detection in Originate & Answer modes
- Two-wire dial and two-wire leased line connections
- Enhanced AT command set
- Non-volatile memory storage

Computer Friends, Inc.

14250 NW Science Park Dr., Portland OR 97229

Call Toll Free 800-547-3303

Over 120,000 sold since 1982



Never buy another ribbon !!!
\$68.50

Universal Cartridge Maclnker

Save thousands of dollars per year and always get a perfect printout, in black or with any of our colored inks Universal Cartridge Maclnker is \$68.50. Multicolor adapters for multicolor cartridges. We support over 24,000 printer brands & have a complete range of accessories, color cartridges, OCR, heat transfer, and indelible inks. Customers vary from individuals to Fortune 500 companies. Ask for free catalog.

Computer Friends 1-800-547-3303

14250 NW Science Park Dr., Portland OR 97229
tel. (503)626-2291 - fax (503)643-5379

Circle 72 on Reader Service Card

REAL WORLD I/O
For PC/XT/ATs


- DG24 • 24 line digital I/O, 10 MHz 8255 \$95
AD500 • 8 channel 12-bit (plus sign) integrating A/D, programs of 1, 10 & 100, 7 digital I/O lines \$239
AD100 • Single channel version of AD500, 10 digital I/O lines. Same programmable gains, 700 meg input Z. \$149
AD1000 • 8 channel 12-bit A/D, 25 us, sample & hold, 5.5 MHz timer/counters, 24 digital I/O lines \$295
ADA300 • 8 channel 8-bit 25 us A/D, single D/A sample & hold, 24 digital I/O lines \$239
AD200 • 4 channel 12-bit 125 us A/D, 5.5 MHz timer/counters, 24 digital I/O lines \$239
DA600 • Fast settling dual bipolar D/A \$179
PD200 • Prototype board w/ address decoder, manual \$99

All boards include BASIC, Pascal, C, and Fortran drivers.

30 day return, 1 year warranty. Call for "Real World Interfacing" application notes.

Real Time Devices, Inc.

P.O. Box 906 State College, PA 16804

(814) 234-8087

Circle 248 on Reader Service Card

9-Track Tape
For Your
IBM PC/XT/AT/PS-2™

Read 1600 bpi 9-track tapes from a micro, mini or mainframe in EBCDIC or ASCII as mirror image or by individual files.

Use the 2000 PC™ for disk backup, data interchange or archival storage.

PC/XT/AT/PS-2 are trademarks of IBM. 2000 PC is a trademark of Digi-Data.



DIGI-DATA CORPORATION
2540 Kirtley Ave. #2000
Houston, TX 77050
(713) 492-3750
Telex: 87540
First In Value

Circle 97 on Reader Service Card

EX-SAMPLE+™

An expert system using AI strategies to compute sample size in statistical research. It provides a critique upon completion.

\$250.00

(plus shipping and handling)

VISA, MC, AMEX, PO and Personal Checks accepted

The Idea Works, Inc.

Call toll-free

1-800-537-4866

Missouri residents call

314-445-4554

FAX 314-445-4589

IDEA WORKS

Circle 288 on Reader Service Card

MARYMAC®


of Discounting
Computers, FAX
& Cellular Phones

Radio Shack® Tandy®
SCO

We will meet or beat...
GUARANTEED LOWEST PRICES

MARYMAC INDUSTRIES INC.
22511 Katy Fwy.

Katy (Houston), TX 77450

1-713-392-0747 FAX (713) 574-4567

Toll Free 800-231-3680

Circle 174 on Reader Service Card



5 1/4 DD

6²⁵
PER BOX

5 1/4 HD

11³⁰
PER BOX

3 1/2 DS

11⁹⁵
PER BOX

3 1/2 HD

28⁹⁵
PER BOX
IBM**DISKETTES**

5.25 DS 6023450 — 14.60

5.25 HD 6109660 — 32.50

3.50 DS 6404107 — 23.95

3.50 HD 6404078 — 45.95

2 D-1024 1669045 — 33.95

RIBBONS

PROPRINTER (6328829) — 5.60

PROPRINTER XL (1040150) — 7.99

PROPRINTER XL24 (1040475) — 8.10

PROPRINTER XL24 (1040414) — 11.90

PROPRINTER II (6328829) — 5.60

MONO PRINTER (1040440) — 12.95

QUIETWRITER (1299790) — 9.45

QUIETWRITER III (1299933) — 13.95

DISPLAYWRITER (1299463) — 8.95

5 1/4 DS

6⁸⁰
PER BOX

3.5 DS

12⁷⁵
PER BOX

3.5 HD

29⁹⁵
PER BOX

5 1/4 HD

10⁹⁵
PER BOX

the
Diskette Connection™

● Delaware 1-800-451-1849
P.O. BOX 10247, WILMINGTON, DE 19850

● Oklahoma 1-800-654-4058
P.O. BOX 1674, BETHANY, OK 73008

● Nevada 1-800-621-6221
P.O. BOX 12396, LAS VEGAS, NV 89112

Minimum order \$20.00. No Surcharge on Visa MasterCard™. COD orders add \$3.00. Surface Shipping UPS add \$4.00 per 100 for 3 1/2 or 5 1/4 add \$4.00 per 100 for 8" US Mail delivery add \$2. Prices subject to change without notice.

FAX (405) 495-4598

IEEE 488 Solutions

- Hardware & software interfaces for PC, AT, 386, PS/2, Macintosh, SUN, HP & DEC
- IEEE converters to SCSI, RS-232, RS-422, modem, Centronics, digital I/O & analog I/O
- IEEE extenders, expanders & buffers
- IEEE drivers for DOS, UNIX, Lotus 1-2-3, Symphony & Quattro.

Call or send for your
FREE Technical Guide

Demo disks and application notes available

Please see our ad on page 328

Otech

(216) 439-4091

Telex 619282R864 • Fax (216) 439-4093
Otech, Inc. • 25971 Canton Road
Cleveland, Ohio 44146

Circle 144 on Reader Service Card

EVEREX

COMPUTER SYSTEMS DIVISION

Step 386/25/20/16MHz • Step 286/20/16/12MHz
IN STOCK
Call for best price

INTEC 386/25MHz Motherboard \$1495.00

- Intel 386-25MHz CPU • 64K cache upgradeable to 256K • Up to 8MBEG on board with SIMM • AMI High speed BIOS • LANOMAPK 43.5MHz, PM -6.2MBPS • 80387 and Waitak support • As Fast as Northgate 386/25 • Call for quantity discount

AGI System from Everex

386	3000D	20MHz/0w/1M	\$1895
	3000A	18MHz/0w/1M	\$1895
	3000G	SK/18MHz/0w	\$1470
286	1800R	8MHz/512K	\$780
	1700A	10MHz/512K Baby	\$800
	1800A	10MHz/512K	\$850
	1900B	10MHz/512K	\$1090
	1700C	12MHz/1M Baby	\$1125
	1800C	12MHz/1M	\$1195

We carry full line of Everex products.
Hard disk and monitors, CALL

Schwab Computer

"Authorized Dealer of Everex System Division"
7300 E. El Camino Real, Sunnyvale, CA 94087
408-245-8666 FAX 408-241-1279

Circle 258 on Reader Service Card

Cross-32 Meta Assembler

Table based macro cross-assembler using the manufacturer's assembly mnemonics.

Includes manual and MS-DOS assembler disk with tables for all of the following processors:

1802	64180	65C02	65816
6801	6805	6809	68HC11
680XD	80X86	COP400	COP800
8048	8051	8085	8096
TMS320	TMS370	Z8/Z80	...MORE

Users can create tables for other processors!

Generates listing, symbol table and binary. Intel, or Motorola hexcode.

Free worldwide airmail shipping & handling.

Check, MO, VISA or MC: US\$199 or CN\$249

Universal Cross-Assemblers

POB 384, Bedford, NS
Canada B4A 2X3
(902) 864-1873

Circle 307 on Reader Service Card

PAL/EPROM PROGRAMMER for PC

VERSION 2 of Software and Hardware \$475

- Programs 30 and 24 pin MM1, NS, TL, Altera, Cypress, Rascal, Passives PALs, EP16 (UV erasable), polarity, and RA types.
- Functions include: read, write, verify, protect, edit, erase, and file load and save of program.
- JEDEC files supported.
- 2716-27512 EPROMs.
- Functions include: read, write, verify, blank check, M/LO split, edit in ASCII, HEX, or Decimal.
- INTEL Hex and Motorola 'S' Record file support.



200/100 MHz LOGIC ANALYZER for PC

LA27100	\$1299
LA27200	\$1899

- 24 Channel mode with 4K Address • 4 Channel mode with 16K Address
- Internal Rate from 300MHz to 2700 or 100MHz to 2700 to 250 Hz
- External Clock from DC to 50 MHz • 16 Level Triggering Sequence
- Threshold Voltage Level at TTL, BCL, or -5V to +14V variable • Data Display as Timing Diagram or State List • Simulated Data and Setup Info.

(201) 994-6669

Link Computer Graphics, Inc.
4 Sparrow Dr., Livingston, NJ 07039



Circle 162 on Reader Service Card

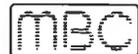
Data Acquisition Interfaces for IBM PC/XT/AT & PS/2

NEW 1989



FREE CATALOG

- PC Based Instruments
- Motion Control
- Frame Grabber Boards
- Industrial Data Acquisition
- Communications Interfaces
- Software Packages



440 Mytes Standish Blvd., Taunton, MA 02780
(508) 860-3000 TLX. 503969 FAX (508) 860-0479

Circle 187 on Reader Service Card

8051 68HC11 EMULATORS



For info call:

Australia	(02) 654 1873
Austria	(0222) 38 78 38
Belgium	+31 1850-18133
Denmark	(02) 65 81 11
Finland	90-452 1255
France	(01) 69 412 801
Great Britain	0962-73 3140
Israel	(03) 484832
Italy	(011) 7710010
Korea	(02) 784 7841
New Zealand	(09) 392464
Portugal	(01) 83 58 70
Scandinavia	+46 40922425
Singapore	065 743-2086
Spain	(93) 217 2340
Switzerland	(01) 740 41 05
Taiwan	(02) 7840215
West Germany	06131-1687
U.S.A. FAX	(408) 378-7869

NOHAU
CORPORATION

51 E. Campbell Ave.,
Campbell, CA 95008
(408) 866-1820

See our ad on page 328.

Circle 213 on Reader Service Card

MULTI-USER UNIX SYSTEM V ON A 286

The Opus532 Personal Mainframe allows you to implement AT&T UNIX System V on your IBM AT, XT or compatible PC.

The Opus532 Personal Mainframe consists of:

- Opus5-a complete port of AT&T UNIX System V
- Opus32-a 32 bit coprocessor board based on the HS32000 chip set with 2MB of memory
- Opus software that integrates the Opus UNIX coprocessor sub-system into the PC-DOS environment.

We have these high performance boards available at substantial reduction from list. Please Call Ken Eng @ 703-827-6674 or Fred Manhartberger @ 703-827-6611.

ST SYSTEMS
1577 Spring Hill Rd.
Vienna, VA 22180

Circle 269 on Reader Service Card

Advertise your computer products through
BYTE BITS
(2" x 3" ads)

For more information call Mark Stone at
603-924-6830

BYTE

One Phoenix Mill Lane
Peterborough, NH 03458

Circle 345 on Reader Service Card

California Digital

17700 Figueroa Street • Carson, California 90248



OPTICAL WORM
\$895

Write Once Read Many... California Digital has just purchased hundreds of Information Storage's ISI/525WC optical WORM drive. Chosen "Editors Choice" by PC Magazine, (March 29, 1988) the 525 provides 230 megabytes of random accessible data on each doubled sided floppy cartridge. (manually flipped). Optical storage is the perfect medium for maintaining "on line" programs or other static data. Also ideal for sending to field offices, catalogs, part lists or any data where random accessibility is required.

The ISI/525 is available in external or internal configuration. Supplied with one cartridge, ESDI/PC controller, cable and transparent optical software. For additional information, contact Steven in our technical support department (213) 217-1947. The ISI/525 is a current production drive.

Dest Scanner \$559

Image scanning for OCR text, photographs, and line art. High resolution 300 DPI. The DEST PC Scan Plus/651 is capable of rendering photographs to 32 halftone shades. Also inputs text directly from printed pages to ASCII files or directly into most word processing programs. Electronic status display. Available for both Macintosh (SCSI) or the IBM-PC. Please specify 115 or 230 volt. Original price was over \$3000, now is your chance to purchase a DEST scanner for only \$559.

NEC/890 Laser \$3095

PC Magazine has chosen the NEC-890 best laser printer of the year (Jan 12, 1988). And its obvious why: the printer is Postscript, Hewlett Packard, and Apple compatible, and comes standard with three megabytes of memory. The 890 accepts data from parallel, serial and Apple-Talk devices.

Roland 980 \$695

The DXY 980 is an eight pen, size "B" flat bed plotter. This unit is fully HP 7470/7475 compatible and accepts both parallel and serial inputs. Digital LED coordinate display, 0.5mm step resolution and electrostatic paper holder are only some of the outstanding features on this quality plotter.

CD-ROM Complete Kit \$539

Doctor, lawyer, Indian chief... Virtually every industry and profession is disseminating information on CD-ROM. One compact disk, the same size as an audio disk, can store over 500 megabytes of data in High Sierra format.

Below is a listing of some of the CD-ROM drives currently available from California Digital. The best value is the Eclipse 430 external drive. The CDS/430 includes PC/XT interface, cables, sampler software and MS/DOS extension. It also offers an audio output feature for multimedia presentations. The system is Manufactured in Japan by one of the World's largest producers of magnetic storage equipment. A super value at only \$539.

Eclipse 430 external system	\$539	NEC interface kit for above	159
Hitachi 1503S External system	695	Sony CD/510 internal drive only	559
Hitachi 3500 Internal system	595	Sony 6101 external drive only	795
Hitachi internal drive only	519	Sony 230B interface kit	159
NEC CDR-77 External drive only	695	Panasonic LF5000 "write once"	1895
NEC CDR-80 Internal drive only	639	Panasonic interface kit for above	359

Saba Scanner \$359

The Saba Scanner inputs a printed page of evenly spaced text in less than three seconds. Included OCR software allows your computer to transfer printed pages into ASCII files or directly to spreadsheets and most word processing programs. Archival data, legal briefs... No problem. Simply insert the page into the Saba and in seconds the document is digitized into your computer and ready for editing. Also does line drawings that do not require gray tones. Limited quantities available. Original price \$1299, now only \$359.

SCANNERS

SABA SCANNERS		
page scanner with OCR software	1299	359
hard held scanner with OCR soft	799	159
DEST SCANNERS		
PC/651 scan + 32 shades	3995	559
2000 edge feed scanner	835	719
MICROTECH300G 256 gray scales	2195	1759
DPI HandScan 300 with Halo	359	199
PRINCETON GRAPHICS LS-300	1095	999
PANASONIC		
RS505 image page scanner	1499	999
RS506 Page scanner	1899	1259

PRINTERS

HEWLETT PACKARD		
Laser Printer II, 300x300	2995	1659
Laser Printer II/D double sided	3995	2695
QMS PS/810 2 Meg, .35 ions, Post/S	5495	3879
APPLE Laser Writer NT	4550	3659
NEC890 Postscript, 3 meg	4975	3095

DIGITIZERS

HITACHI		
HOG 1212 Puma 12x12"	595	359
HOG 1515 15x15"	969	659
Tiger 1111C, 12x12 stylus extra	727	487
HOG 3648, 36x48"	5357	3995
SUMMAGRAPHICS		
Imager 1201 plus 12x12"	599	379
TR 3648, 36x48"	4748	3729
KYE Genius Tablet w/4 but. mouse	599	279
CALCOMP		
25180, 12x18"	1275	999
91480, 36x48"	4118	3399

MicroSoft Mouse

Your choice, MicroSoft "import Buss Mouse" or "Serial Mouse". The industry standard, but price \$150, now available for only \$59 includes software and manual. Packaged in OEM boxes.

\$59

OUTSTANDING PLOTTERS

HOUSTON INSTRUMENTS		
DMP 41 single pen, 3 lbs, C&D	2995	2295
DMP 52 single pen, 16 lbs, C&D	3295	2495
DMP 56C size A-E, 16 lbs	5695	3095
DMP61 single pen, 32 lbs, A-D	4295	3095
PC695A 4 pen, size "B", 3 lbs	799	595
CARBONET PLOTTERS		
1023 Artisan A-D, 8 pen, 30 lbs	4895	3795
1043GT size A-E, 8 pen, 24 lbs	7995	5495
HEWLETT PACKARD		
7475A 8 pen size "B"	1895	1495
7550A 8 pen size "B", 32 lbs	3900	2895
7595A 8 pen, size A-E, 24 lbs	9990	7595
HITACHI PLOTTERS		
672/XD 4 pen, size "B"	895	565
675 size "A-D" 8 pen	5600	3995
FUJITSU Imagegraph, 6 pen, 11x 32"	1295	895
KLONLINE PLOTTERS		
LP3700 size E, 10 lbs	4195	3195
LP3700MP 8 pen size "E" 10 lbs	4695	3495
ROLAND PLOTTERS		
DX1960 flatbed size "B" 8 pen, 9 lbs	1795	995
DPX2000 size "C" 8 pen with stand	2995	2195
DPX3000 size "D" 8 pen with stand	4995	3495
ENTER COMPUTER		
SP500 size "B" 6 pen	995	659
SP1000 single pen size A-D	3995	2795
SP1800 8 pen, A-D, 32 lbs	4695	3399
JOL 850, size "C" one meg. memory	3945	2799
VERSA-CAD 6524 Electrostatic	16,900	13799
HUMONICS		
5460 size "A-D"	2495	1899
5860 size "A-D" 8 pen	7495	6759
CAD SOFTWARE		
AUTOODEK		
AutoSketch version 10	2995	2195
AutoSketch Std 8, Enhanced 2.0	59	79
VERSA-CAD Designer	2995	1995
GENERIC CAD level 1	49	35
AMERICAN SM. BUS'N. Design Cad.	299	179

40 Meg. Tape Back-up

\$239

Head Crash, Power Spikes or just poor disk maintenance... Don't loose data because you didn't back up... the Alloy/40 is an inexpensive way to save and restore files in the event that your data has been destroyed. This 40 megabyte half height tape back up manufactured by North America's largest producer of data retrieval equipment. No need to purchase a separate tape controller... the Alloy/40 attaches directly to your existing floppy disk controller. Supplied software allows your computer to back up any time Day or Night. Come back in the morning and 40 megabytes of irreplaceable data has been stored on one Scotch DC/2000 data cassette. Back up entire hard disk, modified files only, or by file name. Loss of data is inevitable but when you are backed up on an Alloy/40 its not a catastrophe.

EGA Color Monitor

\$219

Ideal for CAD/CAM and Desk Top publishing applications. The Roland CD/240 color monitor has a resolution of 720 pixels by 400/480 lines on a 31mm dot pitch 12, non-glare screen. VGA specifications in text mode. EGA in graphic mode. California Digital has made a special purchase and is able to offer the CD/240 EGA/VGA RGB color monitor for only \$219. Full featured, 132 column, multi-resolution video color adapter card available for only \$139 additional. Comparable card package would retail for \$1095.

40 Megabyte Hard Disk Kit

\$397

Forty megabyte internal hard disk drive, controller and cables all for only \$397. The kit includes the a 40 millisecond Miniscribe 3650 drive and a half slot Western Digital controller.

DISK DRIVES

5" DISK DRIVES	3 1/2" DISK DRIVES
TEC501 1/2 height sgl. side.....39	SONY MP-73W, 1.44 Meg.....139
TEC504 1/2 ht. double sided.....99	TEAC 235HF 1.44 Meg.....99
TANDON 101/4 full ht. 96 TPI...99	5 1/4" Form Factor Kit.....20
TEAC FD55BR half height.....89	8" DISK DRIVES
TEAC FD55FR 96 TPI, half ht. 119	QUME 842 double sided.....189
TEAC FD55FR for IBM AT...109	QUME 841 single sided.....99
PANASONIC 455 Half Height.....89	SHUGART 851R dbl. sided.....319
PANASONIC 475 1.2 Meg./AT...99	SHUGART 801R sgl. sided.....259
Fujitsu 5 1/4" double sided.....69	SIEMENS 1007R sgl. sided.....119
Dual enclosure for 5 1/4" drives 69	REMEX RFD4000 dbl. sided.....189

Color Graphics Terminal

Lear Siegler 7107

\$659

\$3985

Thirteen inch color graphic terminal is both VT-100/51 and Tektronix 4010/4014 compatible. The 7107 offers a palette of 4,096 colors on a 640 pixel by 480 line non-glare black screen. Horizontal pan and image zoom, to 16 times original size make the 7107 the ideal terminal for CAD/CAM applications.

Five Inch Winchester Disk Drives	Winchester Controllers for IBM/PC
Price does not include controller. each two +	XEBEC 1220 with floppy controller 159
SEAGATE 225 20 Meg. 1/4 Ht. 239 229	DTC 5105XC 119
SEAGATE 238 30 Meg. RLL 259 249	OMTI 5527 RLL controller 99
SEAGATE 251/151 M. 28ms. 459 445	ADAPTEC 2070 RLL controller 99
SEAGATE 4096 96 M. 35ms. 559 539	ADAPTEC 2372A 1/1 internal 159
MINISCRIBE 8425 25 M. 65ms. 239 227	WESTERN DIGITAL WD/1002W2 89
MINISCRIBE 3650 50M 61 ms. 319 309	WESTERN DIGITAL 1003WAH or WA2 139
MINISCRIBE 6085 90 meg. 459 435	WESTERN DIGITAL 1007/WA2 ESDI 239
MINISCRIBE 3053 25 ms. 1/2 ht. 359 339	• SCSI/SASI Winchester Controllers •
FUJITSU 2242 86 M. 35ms. 1299 1229	XEBEC 1410A 5 1/4" foot print 239
FUJITSU 2243 86 M. 35ms. 1695 1619	WESTERN DIGITAL 1002-05E 5 1/4" 229
RODMEX RO-204E 53 Meg. 895 859	OMTI 20L 89
MAXTOR XT1140 140 Meg. 1495 1459	• Winchester Accessories •
MAXTOR XT2190 192 Meg. 1919 1875	Dual floppy enc. and powersupply 59
TOSHIBA MK56 70 M. 30ms. 1289 1229	Winchester enclosure and supply 139
CONTROL DATA WREN "V" call	Switching power supply 49

MMC MICROCOMPUTER MARKETING COUNCIL DIRECT MARKETING ASSOCIATION

master charge VISA

8:00 AM to 5:00 PM Pacific Time

Every year since 1973, customers from virtually every nation in the free World have chosen California Digital for their data processing requirements. If **your computer, California Digital has it...** complete minisystem or just one microchip. California Digital offers over 10,000 unique computer products. Regardless of how specialized your data processing requirements... California Digital is your one stop shopping solution.

TECHNICAL & CALIFORNIA (213) 217-0500
TOLL FREE ORDER LINE
(800) 421-5041

Telex # (213) 217-1951

PROMETHEUS

2400 BAUD MODEM \$99⁹⁵



- HAYES COMPATIBILITY
- AUTO DIAL ANSWER
- SELF-TEST ON POWER UP
- FULL AND HALF DUPLEX
- TOUCHTONE OR PULSE DIALING
- 2ND PHONE JACK
- PRO-241

DFI HANDY SCANNER—400 DPI \$199⁹⁵



- QUICKLY SCANS UP TO 4" WIDE IMAGES • 100, 200, 300, 400 DPI (BOTH DIRECTIONS) • B&W & 3 HALF-TONE MODES • 32 LEVELS OF GRAY SCALE • HERCULES, CGA, EGA AND VGA COMPATIBLE
- INCLUDES HALO DPE AND IMAGE EDITOR SOFTWARE
- HS-3000
- OCR-SOFT CHARACTER RECOGNITION SOFTWARE \$99.95

UPRIGHT CASE \$299⁹⁵



SPACE SAVING DESIGN HOLDS ALL SIZES OF MOTHERBOARDS AND INCLUDES:

- 250W POWER SUPPLY • MOUNTS FOR 3 FLOPPY & 4 HARD DRIVES
- TURBO & RESET SWITCH • LED SPEED DISPLAY • POWER & DISK LED'S
- ALL HARDWARE, FACEPLATES & SPEAKER

CASE-100

CASE-FLIP FOR 8088 MB'S \$39.95

CASE-SLIDE FOR 8088 MB'S \$39.95

CASE-70 FOR 286 MB'S \$89.95

CASE-50 FOR MINI 286 MB'S \$59.95

CASE-JR MINI-286 W/150W PS \$149.95

DFI SERIAL MOUSE \$39⁹⁵



- 3 BUTTON OPTO-MECHANICAL
- 200 D.P.I. • 5-1/2" CABLE
- USES SERIAL PORT COM 1/2
- INCL. SOFTWARE DRIVERS

DMS-200E

MOUSE & HALO-DPE SOFTWARE

DMS-200 \$59.95

LOGITECH MICE



- THREE BUTTON SERIES 9
- 320 DPI RESOLUTION
- SERIAL PS/2 COMPATIBLE

LOGC9 SERIAL MOUSE \$98.95

LOGC9-P SERIAL MOUSE WITH PAINTSHOW \$109.95

LOGC9-PBL SERIAL MOUSE WITH PUBLISHER \$149.95

LOGC9-PC SERIAL MOUSE WITH PAINT.CAD \$154.95

LOGB9 BUS MOUSE \$89.95

LOGB9-P BUS MOUSE WITH PAINTSHOW \$104.95

LOGB9-PBL BUS MOUSE WITH PUBLISHER \$139.95

LOGB9-PC BUS MOUSE WITH PAINT.CAD \$149.95

MODULAR PROGRAMMING SYSTEM

INTEGRATED MODULAR SYSTEM EASILY EXPANDS! ALL MODULES USE A COMMON HOST ADAPTOR CARD—USE JUST ONE SLOT TO PROGRAM EPROMS, PROMS, PALS & MORE

HOST ADAPTOR CARD \$29.95

- UNIVERSAL INTERFACE FOR ALL THE PROGRAMMING MODULES!
- SELECTABLE ADDRESSES PREVENTS CONFLICTS
- MOLDED CABLE

MOD-MAC

UNIVERSAL MODULE \$499.99

- PROGRAMS EPROMS, EEPROMS, PALS, BI-POLAR PROMS, 8748 & 8751 SERIES DEVICES, 16V8 AND 20V8 GALLS (GENERIC ARRAY LOGIC) FROM LATTICE
- NS, SGS • TESTS TTL, CMOS, DYNAMIC & STATIC RAMS • LOAD DISK, SAVE DISK, EDIT, BLANK CHECK, PROGRAM, AUTO, READ MASTER, VERIFY AND COMPARE
- TEXTUOL SOCKET FOR 3" TO 6" IC'S (8-40 PINS)

MOD-MUP

VGA COMPATIBLE PACKAGE \$499



NEW LOW PRICES!

- 720 X 540 MAX RESOLUTION, 640 X 480 IN 16 COLORS, 528 X 480 RESOLUTION IN 256 COLORS • IBM STYLE MONITOR
- VGA, EGA, CGA, AND MGA COMPATIBLE
- VGA-PKG (INCLUDES VGA CARD AND MONITOR)

VGA MONITOR \$359

- 14" ANALOG VGA • GLARE RESISTANT SCREEN • 720 X 480
- TILT/SWIVEL BASE • FRONT MOUNTED POWER SWITCH

VGA-MONITOR

RELISYS MULTISYNCH \$429

- FULL FEATURED MULTISYNCH MONITOR WITH UNLIMITED COLORS • 800 X 560 RESOLUTION, 14" NON GLARE DISPLAY
- AUTO SWITCHING • TTL/ANALOG VIDEO INPUT
- JDR-MULTI

EGA SPECIAL! CARD & MONITOR—JUST \$479

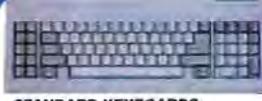
EGA-MONITOR 14" RGB MONITOR \$339.00

JDR-RGB 14" RGB MONITOR TILT/SWIVEL BASE \$239.95

JDR-MONO 12" TTL MONOCHROME—GREEN \$69.95

JDR-AMBER 12" TTL MONOCHROME—AMBER \$69.95

QUALITY KEYBOARDS



STANDARD KEYBOARDS:

BTC-5060 AUTOSENSE FOR XT/AT \$59.95

MAX-5060 W/TACTILE FEEDBACK \$64.95

ENHANCED KEYBOARDS:

BTC-5339 AUTOSENSE FOR XT/AT, AUTOREPEAT \$69.95

K103-A AUDIBLE "CLICK" STYLE \$84.95

MAX-5339 MAXI-SWITCH W/TACTILE FEEDBACK \$84.95

MODULAR CIRCUIT TECHNOLOGY

NEW LOW PRICES!

DRIVE CONTROLLERS:

MCT-FDC FLOPPY DISK CONTROLLER \$29.95

MCT-FDC-HD 1.44 MB FLOPPY CONTROLLER \$49.95

MCT-HDC HARD DISK CONTROLLER \$79.95

MCT-RLL RLL CONTROLLER \$89.95

MCT-FH FLOPPY/HARD CONTROLLER \$139.95

MCT-AFH 286/386 FLOPPY/HARD \$149.95

MCT-AFH-RLL 286/386 RLL CONTROLLER \$199.95

DISPLAY ADAPTOR CARDS:

MCT-MGP MONOCHROME GRAPHICS \$59.95

MCT-CG COLOR GRAPHICS ADAPTOR \$49.95

MCT-EGA ENHANCED GRAPHICS ADAPTOR \$149.95

MCT-VGA-8 8-BIT VGA, ANALOG ONLY \$199.95

MCT-VGA-16 16-BIT VGA, 1024X768 RES. \$329.95

MCT-MGMI0 MONOGRAPHSICS MULTI I/O \$119.75

MCT-MGAIO 286/386 MONOGRAPHSICS I/O \$99.95

MULTIFUNCTION CARDS:

MCT-MIO MULTI I/O FLOPPY CONTROLLER \$79.95

MCT-I/O MULTI I/O CARD \$59.95

MCT-AMF 286/386 MULTIFUNCTION \$139.95

MCT-AIO 286/386 MULTI I/O CARD \$59.95

MEMORY CARDS:

MCT-RAM 576K RAM CARD \$59.95

MCT-EMS EXPANDED MEMORY CARD \$129.95

MCT-AEMS 286/386 EMS CARD \$139.95

HARD DISKS

20 MB \$199

30 MB \$219

40 MB \$319

28 MS \$389

60 MB \$389

80 MB \$569

KITS

20 MB \$249

30 MB \$279



Seagate

NEW LOW PRICES!

SIZE	MODEL	AVG. SPEED	FORM FACTOR	DRIVE ONLY	XT KIT	AT F/H KIT
20MB	ST-225	65 MS	5-1/4"	\$199	\$249	\$309
20MB	ST-125	40 MS	3-1/2"	\$259	\$299	\$373
30MB RLL	ST-238	65 MS	5-1/4"	\$219	\$279	\$379
30MB RLL	ST-138	40 MS	3-1/2"	\$289	\$339	\$429
40MB	ST-251	40 MS	5-1/4"	\$319	\$369	\$429
40MB	ST-251-1	28 MS	5-1/4"	\$389	\$439	\$499
60MB RLL	ST-277	40 MS	5-1/4"	\$389	\$449	\$549
80MB	ST-4096	28 MS	5-1/4"	\$569	—	\$679

150MB ESDI \$1095 DRIVE KIT

5-1/4" HARD DISK, FLOPPY/HARD CONTROLLER, CABLES, MOUNTING HARDWARE & SOFTWARE. 1355-PKG

1.44 MB 3-1/2" DRIVE \$99⁹⁵



- ULTRA HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- FDD-1.44X BLACK FACEPLATE
- FDD-1.44A BEIGE FACEPLATE
- FDD-1.44 SOFT SOFTWARE DRIVER \$19.95

1/2 HEIGHT FLOPPY DISK DRIVES:

FD-55B 5-1/4" TEAC DS/DD 360K \$99.95

FD-55G 5-1/4" TEAC DS/HD 1.2M \$129.95

FDD-360 5-1/4" DS/DD 360K \$69.95

FDD-1.2 5-1/4" DS/HD 1.2M \$95.95

MOTHERBOARDS

UPGRADE YOUR MOTHERBOARD!

25 MHZ 386 \$1049

- 1025 MHZ
- 16 MB RAM CAPACITY - 8MB ON BOARD(O.K.), 8 MB RAM CARD
- USES 256K OR 1MB DRAMS
- 8 SLOTS: 1X32-BIT RAM
- 2X 8-BIT & 5X 16-BIT
- SHADOW RAM FOR BIOS
- VIDEO • AMI BIOS
- INTERLEAVED MEMORY
- ADJUSTABLE BUS SPEEDS

MCT-386MB25 10/20 MHZ 386 \$849.00

MCT-386MB20 8MB RAM CARD (OK) \$149.95

MCT-386-M

12 MHZ MINI-286 \$299

- AT COMPATIBLE • KEYBOARD SELECTABLE 9/12MHZ
- EXPANDABLE TO 4MB ON-BOARD WITH 1MB DRAMS (OK)
- SIX 16-BIT & TWO 8-BIT SLOTS • AMI BIOS • LED SUPPORT

MCT-M286-12 6/10 MHZ MINI-286 \$269.95

MCT-M286 8/16 MHZ 286 \$489.95

MCT-M286-20 10/20 MHZ 286 \$589.00

MCT-XMB STANDARD 4.77 MHZ 8088 \$87.95

MCT-TURBO 4.77/8 MHZ 2078 \$95.95

MCT-TURBO-10 4.77/10 MHZ SINGLE CHIP 8088 \$99.00

EPROM PROGRAMMER \$129⁹⁵



- PROGRAMS 27XX AND 27XXX EPROMS UP TO 27512
- SUPPORTS VARIOUS PROGRAMMING FORMATS & VOLTAGES • SPLIT OR COMBINE CONTENTS OF SEVERAL EPROMS OF DIFFERENT SIZES
- READ, WRITE, COPY, ERASE, CHECK & VERIFY
- SOFTWARE FOR HEX AND INTEL HEX FORMATS
- MOD-EPROM

JDR MICRODEVICES, 2233 BRANHAM LANE, SAN JOSE 95124
 LOCAL (408) 559-1200 FAX (408) 559-0250 TELEX 171-110
 RETAIL STORE: 1256 S. BASCOM AVE., SAN JOSE, CA
 (408) 947-8881 HOURS: M-F 9-7 SAT. 9-5 SUN. 12-4

Terms: Minimum order \$10.00. For shipping & handling include \$3.50 for ground and \$4.50 for air. Orders over 1 lb and foreign orders may require additional shipping charges—please contact the sales department for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sales. A full copy of our terms is available upon request. Items pictured may only be representative.

ORDER TOLL FREE 800-538-5000

EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

INQUIRY #	COMPANY	PAGE	INQUIRY #	COMPANY	PAGE	INQUIRY #	COMPANY	PAGE
	ACCLER8 TECHNOLOGY	17		DELTA LOGIC	17	981	JASMINE TECHNOLOGIES	127
1181	ACIUS	291	1137	DIGITAL COMMUNICATIONS ASSOCIATES	49	1075	KIMTRON	148
1182	ADVANCED DATA SERVERS	291	1073	DIGITAL RESEARCH	17, 148		KINETICS	235
852	ADVANCED LOGIC RESEARCH	165	1194	DOME SOFTWARE	291			
1183	AKER	291	1116	DYNABOOK TECHNOLOGIES	49	987	LENNANE ADVANCED PRODUCTS	81
1071	ALLOY COMPUTER PRODUCTS	148	1120	E-MACHINES	49	889	LIGHTSHIP SOFTWARE	202
1184	ALPHA SOFTWARE	291	1101	EASTMAN KODAK	49, 123	1076	LINK TECHNOLOGIES	148
1185	AMERICAN DATA BANKERS	291	1131			1106	LOGITECH	103
887	APPLE COMPUTER	49, 202, 235, 333	1129	EIGHTEEN EIGHT LABORATORIES	49		LOTUS DEVELOPMENT	17, 91
1135	APRICOT COMPUTERS	95		88OPEN CONSORTIUM	17	984	MARTIN HELLER	131
890			1112	ELECTROMAP	103	1158	MATHSOFT	68
891			986	ELECTRONIC ARTS	81	966	MDBS	291
1149	ARGONAUT SYSTEMS	68	1114	EMERSON COMPUTER	49	1146	MEDIA CYBERNETICS	68
1072	ARNET	148	1119	EVEREX SYSTEMS	49		MICROFOCUS	17
1132	ARRESDEST COMPUTER PRODUCTS	49	1139	EXCELAN	49	965	MICRORIM	291
1186	ASAP	291				1107	MICROSOFT	17, 103, 227
1187	ASHTON-TATE	259, 291		FEDERAL AVIATION ADMINISTRATION	17	1130	MICROTOUCH SYSTEMS	49
851	AST RESEARCH	173	1118	FLANDERS RESEARCH	49		MIT	17
	AT&T	17	1126	FORTE	49		MITSUBISHI	17
	AUTOCOMPUTER	17		47TH STREET COMPUTERS	17		MORTICE KERN SYSTEMS	315
	AUTODESK	17	1200	FOX SOFTWARE	291		MOTOROLA	17
990	AWARD SOFTWARE	81		FRAME TECHNOLOGY	17	967	NANTUCKET	291
			1153	FRONTLINE SYSTEMS	68		NEC	17
1188	BLYTH SOFTWARE	291		FUJITSU	17	1138	NORTON-LAMBERT	49
	BOLT BERANEK AND NEWMAN	17	1161	GAMMALINK	68	968	NOVELL	227, 235, 259, 291
1150	BORLAND INTERNATIONAL	17, 68, 259, 291	885	GENUS MICROPROGRAMMING	183	969	ODESTA	291
1189			1155	GIMEOR	68		OKI ELECTRIC	17
1081	BRIER TECHNOLOGY	323	1111	GOLDEN BOW SYSTEMS	103		OLYMPUS SOFTWARE	17
884	BRIGHTBILL-ROBERTS	189	883	GOOD SOFTWARE	197		OPEN SOFTWARE FOUNDATION	17
1109	BRODERBUND SOFTWARE	103	1115	GRID SYSTEMS	49		OPUS SYSTEMS	17
	BROWN-WAGH PUBLISHING	17	1195	GUPTA TECHNOLOGIES	259, 291	977	ORACLE	259, 291
1190	CALTEX SOFTWARE	291				1121	OUTPUT TECHNOLOGY	49
	CAYMAN SYSTEMS	235	985	HAMILTON LABORATORIES	131		PHAR LAP	17
1079	CC:MAIL	143	1165	HDC COMPUTER	68		PIONEER SOFTWARE	17
1160	CENTRAL POINT SOFTWARE	68		HITACHI AMERICA	17		POQET COMPUTER	17
1191	CLARION SOFTWARE	291	1082	HOLMES MICROSYSTEMS	323	970	POWERBASE SYSTEMS	291
1145	CLEAR SOFTWARE	68				1199	PRECISION	291
1108	CMC RESEARCH	103	1084	IBM	17, 49, 227, 235, 267, 323	979	PROGRESS SOFTWARE	291
	COMEAU COMPUTING	315	1136					
1142	COMPUCOM	49	1196	INFORMATION BUILDERS	291		QUADRATRON SYSTEMS	17
	COMPUTER & BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION	17	1197	INFORMIX SOFTWARE	291	1113	QUANTA PRESS	103
1143	COMPUTONE PRODUCTS	49	1083	INSITE PERIPHERALS	323			
1192	CONDOR COMPUTER	291	856	INTEGRATED INFORMATION TECHNOLOGY	202	971	RAIMA	291
1157	CUBE SYSTEMS CONSULTING SERVICES	68	1074	INTEL	17	1152	REALITY TECHNOLOGIES	68
				INTELLIGENT GRAPHICS	148	972	RELATIONAL TECHNOLOGY	291
1080	DA VINCI SYSTEMS	143		INTERGALACTIC USERS GROUP	17	973	REVELATION TECHNOLOGIES	291
	DATA GENERAL	17	886	INTERNATIONAL SOFTWARE	202		ROCHESTER INSTITUTE OF TECHNOLOGY	17
1193	DATAEASE INTERNATIONAL	291	1198	INTERSYSTEMS	291			
	DAYNA COMMUNICATIONS	235						

COMING UP IN BYTE

The following articles are in the works for upcoming BYTE issues. Most will appear in October, but, computers being what they are and magazines being what they are, nothing is carved in stone.

PRODUCTS IN PERSPECTIVE:

More and more users are turning to optical storage devices—write-once and erasable—for archiving gigabytes of data. We look at both types of drives, for both the Mac and the PC, in the October **Product Focus**.

System reviews in October will cover two new Micro Channel architecture—bus 80386SX machines from IBM and American Mitac.

Now that 32-Bit QuickDraw is available for your Mac, a printer capable of reproducing its output sounds like a good idea. We look at such a printer, Tektronix's ColorQuick, in a **peripheral review**.

Software reviews: At long last, BYTE gets the opportunity to evaluate release 3.0 of Lotus 1-2-3. Is it enough to hold off improving competition? For the Mac, we look at Silicon Beach Software's SuperCard, which improves and expands on HyperCard.

IN DEPTH:

We'll be covering **optical technologies**. While we tend to think of these as something from the future, we have in fact had optical technologies for some time. Lasers and their many implementations (e.g., printers, LCDs, and LEDs) are an optical technology. So are CD-ROMs and other forms of optical storage. And we are constantly seeing announcements of some of the elements of optical computing: signals, interconnections, and forms of packaging. Even optical computing itself is being accomplished with varying amounts of success in academic laboratories. Indeed, rather than being something from the future, optical technologies appear to be one of the roads to it.

FEATURES:

This year marks the twenty-fifth anniversary of BASIC and the fifteenth anniversary of Bill Gates and Paul Allen's seminal implementation of BASIC for microcomputers. In our October issue, we'll present an **anniversary retrospective on BASIC** by Bill Gates.

We'll also take a look at **helical scan technology**, a method of storing data on magnetic tape that owes a great deal to the consumer VCR.

With the advent of desktop publishing, the **design of digital typefaces** has become increasingly important. We'll show how digital fonts are designed and implemented in a variety of systems.

Also, look for the regularly scheduled features of our columnists in both the **Expert Advice** and **Hands On** departments, industry news in **Microbytes**, new hardware and software of note in **What's New**, and the latest in noteworthy items tested by BYTE staffers in **Short Takes**. Readers outside North America, take note that the international **Short Takes**, **Features**, and **What's New** sections of your copies are bonuses, not substitutes for items appearing in the domestic version of the magazine.

INQUIRY #	COMPANY	PAGE
	ROLAND	17
	RYAN MCFARLAND	17
989	SAMNA	81
	SANTA CRUZ OPERATION	117
	SANYO/ICON	17
1156	SCHLUMBERGER TECHNOLOGIES	68
1124	SCOTT INSTRUMENTS	49
1085	SHARP ELECTRONICS	17, 323
1148	SILICON BEACH SOFTWARE	68
974	SMALL COMPUTER	291
988	SOLUTIONS INTERNATIONAL	81
	SONY	17
	STATWARE	17
	SUN MICROSYSTEMS	17, 235
	SUN MOON STAR	17
975	SYBASE	259, 291
982	SYMANTEC	68, 127
1147		
889	SYSGEN	177
1110	TAESUNG INDUSTRIES	103
	TEN X TECHNOLOGY	17
888	THE COMPLETE PC	202
1077	THE SOFTWARE LINK	148
	THOMSON-CSF	17
1140	TIARA COMPUTER SYSTEMS	17, 49
1086	TOSHIBA AMERICA	123, 323
1103		
	TOSHIBA COMPUTER SYSTEMS	17
1105	TRAVELING SOFTWARE	103
	U.S. DEPARTMENT OF TRANSPORTATION	17
	U.S. MEMORIES	17
983	UNDERWARE	131
	UNIPRESS	17
1141	UNIVERSAL DATA SYSTEMS	49
	VISIX SOFTWARE	17
1123	VOICE PROCESSING	49
1164	WANG LABORATORIES	68
948	WESTERN DIGITAL	202
976	WORDTECH SYSTEMS	291
1078	WYSE TECHNOLOGY	148
978	XDB SYSTEMS	291
1087	XIRCOM	123, 323
1104		
1102	ZENITH DATA SYSTEMS	123

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Alphabetical Index to Advertisers

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	
8	2001 SALES	280	84	DELTA COMPUTING TECH.	377	170	LOGITECH	282
9	2001 SALES	280	95	DIGIBOARD	317	171	MANNESMANN TALLY	205
10	ACS COMMUNICATIONS	370	95	DIGITAL EQUIPMENT CORP	242, 243	172	MANNESMANN TALLY	205
	ADOBE	207	378	DIGITAL PRODUCTS, INC.	241	173	MAP INFO	78
11	ADVANCED COMPUTER PROD.	379	96	DIGITALK	54, 55	174	MARYMAC	385
18	ADVANCED LOGIC RESEARCH	2, 3	97	DIGI-DATA	385	175	MATHSOFT, INC.	51
17	ADVANCED LOGIC RESEARCH	2, 3	98	DISKOTEC	377	178	MATRIX SOFTWARE	246
12	ADVANTAGE SOFTWARE	107	99	DISKETTE CONNECTION	385		MAXCIMA CORPORATION	368
13	AK SYSTEMS	378	101	DIVERSIFIED COMPUTER	378	178	MAXON	172
	ALLEN SYSTEMS	374	102	DYNAMIC ELECTRONICS	366	179	MAXON	172
14	ALLREGULATOR AB	372		ECOSOFT	70	180	MCGRAW-HILL BOOKSTORE	281
15	ALPHA PRODUCTS	384	103	ELITE MICROSYSTEMS, INC.	185		MCGRAW-HILL NRI	178A-B
18	AMERICAN GROUP	377	104	ELTECH RESEARCH	164	181	MEAD COMPUTER	380
20	AMERICAN SMALL BUS. COMP	130	105	EMERALD COMPUTERS, INC.	35	182	MEDIA CYBERNETICS	182
	AMPRO	115	377	EMERSON	218	183	MEDIA CYBERNETICS	182
21	AMS	383	378	EMERSON	218	184	MEGA DRIVE	265
22	ANNABOOKS	387	106	EOTRON	119	185	MEGATEL COMPUTER	156
23	ARA-TECH, INC.	263	107	EOTRON	119	188	MERRITT COMPUTERS	74
26	ATI TECHNOLOGIES	145	108	EXECUTIVE PHOTO & SUPPLY	290	187	METRABYTE	386
27	ATI TECHNOLOGIES	307	109	FLAGSTAFF ENGINEERING	102	188	MEXTEL	180
370	ATTACHMATE CORP.	239	110	FLAGSTAFF ENGINEERING	102	189	MEXTEL	180
29	AVOCET SYSTEMS, INC.	79	111	FLAGSTAFF ENGINEERING	102	190	MICRO PRESS	174
30	AVOCET SYSTEMS, INC.	192	112	FLAGSTAFF ENGINEERING	102	384	MICROCOM	231
31	AVOCET & QUELO	381	113	FORESIGHT RESOURCES	157	192	MICRONICS	275
32	B & B ELECTRONICS	374	114	FORESIGHT RESOURCES	157	193	MICROPROCESSORS UNLTD	374
33	BAYTECH	188	115	FORTRON	39		MICROSOFT	6, 7
34	BAYTECH	188	118	FORTRON	39	194	MICROSTAR LABORATORIES	381
35	BE AWARE, INC.	330	117	FTG DATA SYSTEMS	383		MICROWAY	163
36	BE AWARE, INC.	330	379	FTP SOFTWARE	220	195	MICROWAY	301
37	BINARY ENGINEERING	38	118	FUJACORP, INC.	367	385	MICROWAY LAB	232
38	BINARY TECHNOLOGY	372	119	GATEWAY 2000	10, 11	19	MITAC	181
39	BIOLOGICAL ENGINEERING	376	120	GENERIC SOFTWARE	179	196	MITSUBISHI	168, 169
450	BIX	312, 313	121	GENERIC SOFTWARE	179	197	MITSUBISHI	168, 169
	BIX	134	122	GENESIS DATA SYSTEMS	330	198	MIX SOFTWARE	337
	BIX	293	123	GENESIS DATA SYSTEMS	330	199	MKS	314
42	BLAISE COMPUTING	47	124	GOLDEN BOW	264		MONTGOMERY GRANT	116
43	BOCA RESEARCH	196	125	G-TEK, INC.	303	200	MULTI-MICRO	251
44	BOCA RESEARCH	196	126	G-TEK, INC.	303	201	MULTI-MICRO	251
45	BOLT SYSTEMS	132	127	HAMMERLY COMP. SERV.	254	202	NAGAN CORP.	370
46	BOLT SYSTEMS	132	128	HAMMERLY COMP. SERV.	255	203	NANAO	304
47	BORLAND INTERNATIONAL	13		HEWLETT-PACKARD PERIPH.	46A-H	204	NANAO	304
48	BORLAND INTERNATIONAL	13		HEWLETT-PACKARD PERIPH.	48J	334	NANTUCKET	335
49	BP MICROSYSTEMS	377	129	HIGH RES. TECHNOLOGIES	378	292	NATIONAL INSTRUMENTS	CIII
	BUYERS MART	354, 365	130	HIMS COMPUTERS	322	205	NATURAL MICROSYSTEMS	46
	BYTE BACK ISSUES	344	131	HITECH EQUIPMENT CORP.	381	206	NEC HOME ELECTRONICS USA	19
50	BYTE BITS	370	132	HORSTMANN SOFTWARE	256	211	NETWORK TECHNOLOGIES	372
345	BYTE BITS	386	133	HORSTMANN SOFTWARE	256	212	NOHAU CORPORATION	326
	BYTE BOOK CLUB	288, 289	134	HYPERKINETIX	155	213	NOHAU CORPORATION	386
	BYTE SUB. MESSAGE	281		IBM-AIX PRODUCT	14, 15		NORTHGATE COMPUTER	170, 171
	BYTE SUB. SERVICE	46		IBM-PS/2 PRODUCT	27	214	NORTHGATE COMPUTER	294, 295
51	BYTE COMPUTER CORP.	374		IBM-PS/2 PRODUCT	26, 29	214	NORTON-LAMBERT	59
	BYTEWEEK/NEWSLETTER	403		IBM-SAA DIV.	193	215	NU-MEGA TECHNOLOGIES	201
	B&C MICRO	381		IBM-SAA DIV.	194, 195	216	OKIDATA	122
53	B&C MICRO	381	135	IC EXPRESS	372	386	ON-LINE STORE	234
54	B&C MICRO	383	340	IMAGENET SYSTEMS	374		ORACLE	57
28	CADRE TECHNOLOGIES INC.	31	136	IMCO MANUFACTURING	367	217	OST	106
	CALIFORNIA DIGITAL	387	137	INFORMIX	45	218	OVERLAND DATA, INC.	366
55	CAPITAL EQUIPMENT CORP.	108	136	INFORMIX	45	219	PACIFIC COMPUTERS	368
56	CAPITAL EQUIPMENT CORP.	109	390	INTEGRAND	240	220	PARA SYSTEMS	89
57	CENTURY SOFTWARE	186	380	INTELLICOM, INC.	224	221	PARSONS TECHNOLOGY	87
58	CH PRODUCTS	113	381	INTELLICOM, INC.	224	222	PATTON & PATTON	110
59	CH PRODUCTS	113	140	INTELLIGENCE WARE, INC.	71	223	PERISCOPE	125
	CLEO COMMUNICATIONS	219	382	INTERNATIONAL COMP. GROUP	225	225	PERSONAL TEX	162
61	CLONE COMPUTER	369	142	IO COMM	302	227	PI COMPUTER	176
338	COMMUNICATION RES. GROUP	342	143	IO TECH	328	229	PRECISION DATA PRODUCTS	372
339	COMMUNICATION RES. GROUP	342	144	IO TECH	328	230	PRINCETON PUBLISHING LABS	181
62	COMPACT DISK PRODUCTS	41	145	JADE	379	231	PROGRAMMERS PARADISE	80, 81
65	COMPACT ASSISYS	133	146	JAMECO	346, 347	232	PROGRAMMERS WHOLESALE	44
66	COMPACOM	366	146	JAMECO	346, 349	233	PROHANCE TECH., INC.	399
67	COMPUSAVE	371	146	JAMECO	350, 351	233	PROTECH MARKETING	43
68	COMPUSERVE	129	146	JAMECO	352, 353	236	PSI	368
	COMPUTER BOOK CLUB	256A-B	150	JB SOFTWARE	325	234	P.C. BRANDS	135
70	COMPUTER BOOK CLUB	257		JENSEN & PARTNERS	105	235	P.C. BRANDS	136, 137
71	COMPUTER DSCNT WREHSE	26	151	JYACC, INC.	281	236	P.C. BRANDS	138, 139
72	COMPUTER FRIENDS	385	8	J.D.R. MICRODEVICES	388, 389	237	P.C. BRANDS	140, 141
73	COMPUTER FRIENDS	385	7	J.D.R. MICRODEVICES	388, 389	238	QMS	159
74	COMPUTER MAIL ORDER	100, 101	152	KADAK PRODUCTS	74	239	QUA TECH	377
742	COMPUTER MODULES	370	332	KAYPRO	331	240	QUA TECH	377
78	COMPUTER SYSTEMS RES.	20, 21	333	KAYPRO	331	241	QUALSTAR CORPORATION	383
79	COMPUTERLANE	373	383	KEA SYSTEMS	229	242	QUANTUM SOFTWARE SYS.	69
80	COMPUTRADE	88	163	KISS COMPUTING	187		QUARTERDECK	208A-B
81	CONTECH COMPUTER CORP.	381	154	KMW SYSTEMS CORP.	191	207	QUARTERDECK	208, 209
82	CONTROL VISION	372	155	KNOWLEDGE GARDEN	401	208	QUARTERDECK	208, 209
83	CORECO, INC.	338	158	KORE, INC.	383	209	QUARTERDECK	208, 209
83	CORPORATE COMPUTERS OF IOWA	82, 83	341	KUSTEM DATA SERVICES	374	210	QUARTERDECK	208, 209
84	CORPORATE COMPUTERS OF IOWA	82, 83	157	K.E.M. ELECTRONICS	370	210	QUARTERDECK	208, 209
85	COUNT DISK	187	158	LAHEY COMPUTER SYSTEMS	42	387	RACET	238
86	COVOX	378	159	LANTANA	176	388	RACET	238
371	CSS LABORATORIES, INC.	228	160	LANTANA	176	243	RADIO SHACK	CIV
372	CSS LABORATORIES, INC.	228	161	LAWSON LABS	381		RAIMA	53
373	CUBIX CORPORATION	215		LIBRARY OF COMP. & INFO SCI 32A-B	8		RAIMA	114
374	CUBIX CORPORATION	215		LIBRARY OF COMP. & INFO SCI 32, 33	33	244	RAINBOW	118
87	CURTIS, INC.	378	162	LINK COMPUTER GRAPHICS	386	245	RAINBOW	118
88	CUTTING EDGE	367	163	LOGICAL DEVICES	370	246	RAINBOW	339
89	DATA TRANSLATION, INC.	85	164	LOGICAL DEVICES	370	247	RAINBOW	339
375	DATABILITY SOFTWARE SYS	217	165	LOGICAL DEVICES	370	248	REAL TIME DEVICES	385
90	DCI	372	166	LOGICAL DEVICES	370	392	ROSE ELECTRONICS	237
91	DELL COMPUTER	CII, I	167	LOGITECH	86, 87	393	ROSE ELECTRONICS	237
	DELL COMPUTER	64A-B	168	LOGITECH	86, 87	249	RUPP CORPORATION	253
92	DELL COMPUTER	65	169	LOGITECH	282	250	RUPP CORPORATION	253
251	RUPP CORPORATION	253						
252	RUPP CORPORATION	253						
253	RUPP CORPORATION	253						
254	RUPP CORPORATION	253						
255	SAFEWARE	378						
256	SANG COMPUTERSYSTEME	120						
257	SANTA CRUZ OPERATION	83						
258	SCHWAB COMPUTER	386						
259	SCIENTIFIC ENDEAVORS	310						
260	SCIENTIFIC ENDEAVORS	310						
261	SCIENTIFIC ENDEAVORS	310						
262	SCIOTO COMPUTERS	378						
	SOFTWARE DEV. SYS.	83						
263	SOFTWARE LINK	78, 77						
264	SOFTWARE LINK	78, 77						
265	SOFTWARE SECURITY	147						
266	SOTA TECHNOLOGY	99						
267	SPECTRUM	94						
268	SPSS	287						
269	ST SYSTEMS CORPORATION	386						
270	STATSOFT	111						
271	STERLING CASTLE	34						
272	STERLING CASTLE	34						
	STORAGE DIMENSIONS (N. AMERICA)	340, 341						
274	STORAGE DIMENSIONS (N. AMERICA)	340, 341						
335	STORAGE DIMENSIONS (INTERNATIONAL)	340, 341						
336	STORAGE DIMENSIONS (INTERNATIONAL)	340, 341						
275	STSC	343						
276	SUMMAGRAPHICS	24, 25						
277	SUMMAGRAPHICS	24, 25						
278	SUMMAGRAPHICS	24, 25						
279	SUPERSOFT	80						
280	SURAH, INC.	372						
281	SWIRLSOFT	370						
282	S'NW COMPUTER	274						
283	TALKING TECHNOLOGY	377						
284	TATE PUBLISHING	23						
285	TATE PUBLISHING	23						
286	TATUNG	271						
287	TECHNOLOGY POWER	370						
288	TELEBIT	142						
289	TERMOTROL	374						
290	THE IDEA WORKS	385						
291	THE SMALL COMPUTER CO.	256						
292	THOMAS CONRAD	233						
293	TMI, INC.	146						

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Index to Advertisers by Product Category

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
HARDWARE		802 HARDWARE PROGRAMMERS		420 FINLUX IS-29		832 FAX MACHINES	
800	ADD INS	31	AVOCET & QUELO 381	429	INTERQUADRAM IS-5	476	COMPFAK, INC. MW-7
401	ACER IS-40,41	38	BINARY TECHNOLOGY 372	203	NANAO 304	477	COMPFAK, INC. MW-7
517	ADVANCED DIGITAL CORP. PC-3	49	BP MICROSYSTEMS 377	204	NANAO 304		
518	ADVANCED DIGITAL CORP. PC-3	51	BYTEK COMPUTER CORP. 374	230	PRINCETON PUBLISHING LABS. 181		
15	ALPHA PRODUCTS 384	54	B&C MICRO 383	284	TATUNG 271		
404	AMDS IS-19	156	KORE, INC. 383			833 TERMINALS	
23	ARA-TECH, INC. 263	157	K.E.M. ELECTRONICS 370			105	EMERALD COMPUTERS, INC. 35
26	ATI TECHNOLOGIES 145	162	LINK COMPUTER GRAPHICS 386			460	UNITECH IS-20
407	BLUJE CHIP TECHNOLOGY IS-60	163	LOGICAL DEVICES 370	809 NETWORK HARDWARE			
43	BOCA RESEARCH 196	164	LOGICAL DEVICES 370	10	ACS COMMUNICATIONS 370	834 SYSTEMS	
44	BOCA RESEARCH 196	165	LOGICAL DEVICES 370		* CLEO COMMUNICATIONS 210	402	ACME TECHNOLOGY CORP. IS-57
52	B&C MICRO 381	166	LOGICAL DEVICES 370	371	CSS LABORATORIES, INC. 226	16	ADVANCED LOGIC RESEARCH 2,3
53	B&C MICRO 381	323	XELTEK 374	372	CSS LABORATORIES, INC. 226	17	ADVANCED LOGIC RESEARCH 2,3
55	CAPITAL EQUIPMENT CORP. 108			373	CUBIX CORPORATION 215		* ALLEN SYSTEMS 374
56	CAPITAL EQUIPMENT CORP. 109	803 INSTRUMENTATION		374	CUBIX CORPORATION 215		* AMPRO 115
342	COMPUTER MODULES 370	167	METRABYTE 386	414	DATEX IS-10	405	AQUARIUS SYSTEMS, INC. IS-43
82	CONTROL VISION 372			95	DIGIBOARD 317	519	BI-LINK PC-7
86	COVOX 378	804 KEYBOARDS/MICE			* DIGITAL EQUIPMENT CORP. 242,243	536	BITWISE DESIGNS. NE-20
87	CURTIS, INC. 378	59	CH PRODUCTS 113	376	DIGITAL PRODUCTS, INC. 241	537	BITWISE DESIGNS. NE-20
88	CUTTING EDGE 387	90	CH PRODUCTS 113	136	IMCO MANUFACTURING 367	520	CDS ADV. COMP. PROD. PC-13
413	C&D TECHNOLOGY, INC. IS-50	408	CHERRY-MIKROSCHALTER GMBH IS-56,57	380	INTELLICOM, INC. 224	78	COMPUTER SYSTEMS RES. 20,21
106	EOTRON 119	188	MEXTEL 180	381	INTELLICOM, INC. 224	80	COMPUTRADE 88
107	EOTRON 119	189	MEXTEL 180	553	L&W MICROCOMPUTING NE-13	412	COPAM ELECTRONICS CORP. IS-47
117	FTG DATA SYSTEMS 383	337	PROHANCE TECHNOLOGIES, INC. 399	554	L&W MICROCOMPUTING NE-13	83	CORPORATE COMPUTERS OF IOWA 92,93
422	GAMMA PRODUCTIONS IS-12	276	SUMMAGRAPHICS 24,25	384	MICROCOM 231	84	CORPORATE COMPUTERS OF IOWA 92,93
463	GENOA IS-14	277	SUMMAGRAPHICS 24,25	385	MICRO/M2 LAB. 232	90	DCI COMPUTERS 372
125	G-TEK, INC. 303	278	SUMMAGRAPHICS 24,25	211	NETWORK TECHNOLOGIES 372	91	DELL COMPUTER CII,1
126	G-TEK, INC. 303	528	WINTIME TECHNOLOGY (USA) PC-10	217	OST 106	92	DELL COMPUTER 65
129	HIGH RES. TECHNOLOGIES 378	327	ZEOS INTERNATIONAL 199	392	ROSE ELECTRONICS 237		* DELL COMPUTER 84A-B
427	INES IS-38			393	ROSE ELECTRONICS 237	104	ELTECH RESEARCH 164
430	INTERQUADRAM IS-7	805 MASS STORAGE		449	SCANDEC TRIBUTOR IS-49	115	FORTRON CORP. 39
142	IO COMM 302	13	AK SYSTEMS 378	390	THOMAS CONRAD 233	116	FORTRON CORP. 39
143	IO TECH 328	39	BIOLOGICAL ENGINEERING 376	560	TRANS-M CORP. NE-5	545	FOUNTAIN TECHNOLOGIES. NE-7
144	IO TECH 386	81	CONTECH COMPUTER CORP. 381	561	TRANS-M CORP. NE-5	119	GATEWAY 2000 10,11
432	KAP IS-37	97	DIGI-DATA 385			546	HALSKAR SYSTEMS. NE-12
154	KMW SYSTEMS CORP. 191	184	MEGA DRIVE 285	810 POWER SUPPLIES		547	HALSKAR SYSTEMS. NE-12
161	LAWSON LABS 381	439	MICROTRONICS TRADE SERV. IS-22	377	EMERSON 216	424	HAUPPAUGE COMPUTER IS-2
	* MAXCIMA CORPORATION 366	440	NIPPON COLUMBIA CO, LTD. IS-39	378	EMERSON 216	549	HERTZ COMPUTER NE-3
176	MAXON 172	216	OVERLAND DATA, INC. 366	220	PARA SYSTEMS 89	130	HIMS COMPUTERS 322
179	MAXON 172	241	QUALSTAR CORPORATION 383			131	HITECH EQUIPMENT CORP. 381
438	MICROMINT, INC. IS-18	387	RACET 236	811 PRINTERS/PLOTTERS		425	HWA HSIN IS-26
104	MICROSTAR LABORATORIES 381	388	RACET 238	118	FUJACORP, INC. 387		* IBM-PS/2 PRODUCT 27
206	NEC HOME ELECTRONICS USA 19	273	STORAGE DIMENSIONS N. AMER 340,341		* HEWLETT-PACKARD PER. 48A-H	332	KAYPRO 331
212	NOHAU CORPORATION 326	274	STORAGE DIMENSIONS N. AMER 340,341		* HEWLETT-PACKARD PER. 48I-J	333	KAYPRO 331
213	NOHAU CORPORATION 388	274	STORAGE DIMENSIONS N. AMER 340,341	171	MANNESMANN TALLY 205	153	KISS COMPUTING 187
217	OST 106	335	STORAGE DIMENSIONS INT'L 340,341	172	MANNESMANN TALLY 205	341	KUSTEM DATA SERVICES 374
224	PERISCOPE 125	336	STORAGE DIMENSIONS INT'L 340,341	238	OMS 159	185	MEGATEL COMPUTER 156
225	PERISCOPE 125			295	TOSHIBA 75	192	MICRONICS 275
227	PI COMPUTER 146	806 MISCELLANEOUS		296	TOSHIBA 75	19	MITAC 161
446	PRICE TREND LIMITED IS-28	32	B & B ELECTRONICS 374	489	ZERICON MW-11	198	MITSUBISHI 188,169
228	PSI 368	33	BAYTECH 188	529	ZERICON PC-15	197	MITSUBISHI 168,169
239	QUA TECH 377	34	BAYTECH 188	513	ZERICON SO-10	200	MULTI-MICRO 251
240	QUA TECH 377	73	COMPUTER FRIENDS 385			201	MULTI-MICRO 251
248	REAL TIME DEVICES 385	415	DIETRICH POS-EQUIPMENT IS-62	812 SCANNERS/DIGITIZERS			* NORTHGATE COMPUTER 170,171
249	RUPP CORPORATION 253	139	INTEGRAND 240	331	CORECO, INC. 338		* NORTHGATE COMPUTER 294,295
250	RUPP CORPORATION 253	431	INWIN DEVELOPMENT, INC. IS-44	89	DATA TRANSLATION, INC. 85	507	OCTAGON TECHNOLOGIES, INC. SO-5
251	RUPP CORPORATION 253	188	MERRITT COMPUTERS 74	109	FLAGSTAFF ENGINEERING 102	508	OCTAGON TECHNOLOGIES, INC. SO-5
252	RUPP CORPORATION 253	464	T.S. MICROTECH IS-54	110	FLAGSTAFF ENGINEERING 102	227	PI COMPUTER CORP. 146
253	RUPP CORPORATION 253	309	VICTORY ENTERPRISES 42	111	FLAGSTAFF ENGINEERING 102	446	PRICE TREND LIMITED IS-28
254	RUPP CORPORATION 253			112	FLAGSTAFF ENGINEERING 102	482	P&L COMPUTER SYSTEMS. MW-4
266	SOTA TECHNOLOGY 99	807 MODEMS/MULTIPLEXORS		167	LOGITECH 66,67	483	P&L COMPUTER SYSTEMS. MW-4
269	ST SYSTEMS CORPORATION 386	27	ATI TECHNOLOGIES 307	188	LOGITECH 66,67	243	RADIO SHACK CIV
558	TELETEK NE-10	66	COMPUCOM 386	509	SQUARE FIELD SO-7		* RENEGADE NE-8
559	TELETEK NE-10	72	COMPUTER FRIENDS 385	510	SQUARE FIELD SO-7	256	SANG COMPUTERSYSTEME 120
524	TELETEK PC-11	216	OKIDATA 122			262	SCIOTO COMPUTERS 378
525	TELETEK PC-11	286	TELEBIT 142	813 SOFTWARE SECURITY		453	SIEMENS IS-33
301	TRUEVISION 285	296	TOUCHBASE SYSTEMS 36	411	CONTROL TELEMETRY IS-38	266	SOTA TECHNOLOGY 99
462	WINTECH ENTERPRISE IS-32			418	FAST ELEKTRONIK GMBH IS-46	285	TECHNOLOGY POWER 370
		808 MONITORS		233	PROTECH MARKETING 43	290	TMI, INC. 146
801	DRIVES	244	RAINBOW 118	244	RAINBOW 118	329	TOSHIBA 37
62	COMPACT DISK PRODUCTS 41	245	RAINBOW 118	245	RAINBOW 118	330	TOSHIBA 37
164	MEGA DRIVE 265	246	RAINBOW 339	246	RAINBOW 339	457	TRIANGLE DIGITAL IS-60
439	MICROTRONICS TRADE SERV. IS-22	247	RAINBOW 339	247	RAINBOW 339	303	TUSSEY COMPUTER PROD. 329
		285	SOFTWARE SECURITY 147	285	SOFTWARE SECURITY 147	562	USER FRIENDLY NE-2
						563	USER FRIENDLY NE-2
						312	VNS 276
						313	VNS 332

READER SERVICE

Inquiry No.	Page No.
316 WELLS AMERICA	212
317 WELLS AMERICA	279
318 WELLS AMERICA	279
321 WINTEK CORPORATION	383
322 XEC PRODUCTS	86
325 ZENITH DATA SYSTEMS	327
326 ZEOS INTERNATIONAL	72,73
391 ZEOS INTERNATIONAL	218,219

SOFTWARE

814 IBM/MSDOS APPLICATIONS Business/Office

409 CLARION SOFTWARE	IS-21
410 CLARION SOFTWARE	IS-21
498 DAYTRON ELECTRONICS	SO-4
120 GENERIC SOFTWARE	179
121 GENERIC SOFTWARE	179
122 GENESIS DATA SYSTEMS	330
123 GENESIS DATA SYSTEMS	330
* IBM-SAA DIV.	193-195
137 INFORMIX	45
138 INFORMIX	45
140 INTELLIGENCE WARE, INC.	71
552 INTERACTIVE TECHNOLOGY	NE-11
334 NANTUCKET	335
441 NOVELL	IS-23
* ORACLE	57
522 PEOPLESMTIH SOFTWARE	PC-2
* RAJMA	53,114
24 TATE PUBLISHING	23
25 TATE PUBLISHING	23
289 THE SMALL COMPUTER CO.	258

815 IBM/MSDOS APPLICATIONS Scientific/Technical

37 BINARY ENGINEERING	38
498 DAYTRON ELECTRONICS	SO-4
124 GOLDEN BOW	284
132 HORSTMANN SOFTWARE	256
435 LOGIC PROGRAMMING ASSOC.	IS-44
175 MATHSOFT, INC.	51
292 NATIONAL INSTRUMENTS	CHII
222 PATTON & PATTON	110
259 SCIENTIFIC ENDEAVORS	310
260 SCIENTIFIC ENDEAVORS	310
261 SCIENTIFIC ENDEAVORS	310
267 SPECTRUM	94
268 SPSS	287
270 STATSOFT	111

818 IBM/MSDOS APPLICATIONS Miscellaneous

288 THE IDEA WORKS	385
--------------------	-----

817 IBM/MSDOS — CAD

20 AMERICAN SMALL BUS. COMP	130
21 AMS	383
113 FORESIGHT RESOURCES	157
114 FORESIGHT RESOURCES	157
305 ULTIMATE TECHNOLOGY	372
319 WINTEK CORPORATION	9
320 WINTEK CORPORATION	383

818 IBM/MSDOS — LAN

370 ATTACHMATE CORP.	239
375 DATABILITY SOFTWARE SYS.	217
* ELONEX	IS-9
379 FTP SOFTWARE	220
382 INTERNATIONAL COMP. GROUP	225
214 NORTON-LAMBERT	59
454 SOFTTEK COMPUTER	IS-82
557 SUMMA COMPUTER	NE-19
511 SUMMA COMPUTER	SO-1

819 IBM/MSDOS — GRAPHICS

* ECOSOFT	70
-----------	----

Inquiry No.	Page No.
173 MAP INFO	78
275 STSC	343

820 IBM/MSDOS — LANGUAGES

47 BORLAND INTERNATIONAL	13
48 BORLAND INTERNATIONAL	13
96 DIGITALK	54,55
* JENSEN & PARTNERS	105
151 JYACC, INC.	261
158 LAHEY COMPUTER SYSTEMS	42
* MICROSOFT	6,7
328 ZORTECH	283

821 IBM/MSDOS — UTILITIES

29 AVOCET SYSTEMS, INC.	79
30 AVOCET SYSTEMS, INC.	192
35 BE AWARE, INC.	330
36 BE AWARE, INC.	330
42 BLAISE COMPUTING	47
45 BOLT SYSTEMS	132
48 BOLT SYSTEMS	132
28 CADRE TECHNOLOGIES INC.	31
540 CONCEPTUAL SOFTWARE	NE-15
541 CONCEPTUAL SOFTWARE	NE-15
417 DR. HUGGLE & PARTNER	IS-53
499 DTG, INC.	SO-11
500 DTG, INC.	SO-11
542 DTG, INC.	NE-18
543 DTG, INC.	NE-18
127 HAMMERLY COMPUTER SERVICE	254
128 HAMMERLY COMPUTER SERVICE	255
133 HYPERKINETIX	155
134 HYPERKINETIX	155
426 I X I LTD.	IS-60
340 IMAGENET SYSTEMS	374
504 ISLAND SYSTEMS	NE-16
150 JB SOFTWARE	325
151 JYACC, INC.	261
159 LANTANA	176
160 LANTANA	176
169 LOGITECH	282
170 LOGITECH	282
436 MASHOV SOFTWARE EXPORT	IS-31
182 MEDIA CYBERNETICS	182
183 MEDIA CYBERNETICS	182
198 MIX SOFTWARE	337
199 MKS	314
215 NU-MEGA TECHNOLOGIES	201
221 PARSONS TECHNOLOGY	87
522 PEOPLESMTIH SOFTWARE	PC-2
207 QUARTERDECK	208,209
208 QUARTERDECK	208,209
209 QUARTERDECK	208,209
210 QUARTERDECK	208,209
* QUARTERDECK	208A-B
455 SOFTWARE CONSTRUCTION	IS-81
271 STERLING CASTLE	34
272 STERLING CASTLE	34
279 SUPERSOFT	80
281 SWIRLSOFT	370
289 TRAVELING SOFTWARE	266
302 TURBO POWER	334
* VERMONT CREATIVE SOFTWARE	16
324 Z WORLD	381

822 IBM/MSDOS — COMMUNICATIONS

57 CENTURY SOFTWARE	188
338 COMMUNICATION RESEARCH GP	342
339 COMMUNICATION RESEARCH GP	342
101 DIVERSIFIED COMPUTER	378
383 KEA SYSTEMS	229
205 NATURAL MICROSYSTEMS	48
445 PERICOM	IS-27
283 TALKING TECHNOLOGY	377
458 TRITON TECHNOLOGIES	IS-59
459 TRITON TECHNOLOGIES	IS-59

823 OTHER APPLICATIONS Business/Office

322 XEC PRODUCTS	86
------------------	----

Inquiry No.	Page No.
824 OTHER — CROSS DEVELOPMENT	
* SOFTWARE DEVELOPMENT SYS.	83
307 UNIVERSAL CROSS-ASSEMBLER	386

825 MAIL ORDER/RETAIL

516 3-F ASSOCIATES, INC.	PC-9
11 ADVANCED COMPUTER PRODUCT	379
12 ADVANTAGE SOFTWARE	107
14 ALLREGULATOR AB	372
18 AMERICAL GROUP	377
* BUYERS MART	354,365
* CALIFORNIA DIGITAL	387
61 CLONE COMPUTER	389
65 COMPUCLASSICS	133
67 COMPUSAVE	371
71 COMPUTER DISCOUNT WAREHSE	126
538 COMPUTER EXPERT	NE-14
539 COMPUTER EXPERT	NE-14
74 COMPUTER MAIL ORDER	100,101
505 COMPUTER WHOLESALER CLUB	SO-3
506 COMPUTER WHOLESALER CLUB	SO-3
79 COMPUTERLANE	373
478 DAKOTA COMPUTER	MW-5
94 DELTA COMPUTING TECH.	377
416 DISK STAR	IS-30
98 DISKOTEC	377
99 DISKETTE CONNECTION	385
102 DYNAMIC ELECTRONICS	386
544 ELECTRIFIED DISCOUNTERS	NE-1
108 EXECUTIVE PHOTO & SUPPLY	290
423 GREY MATTER	IS-3
481 HARD DRIVES INT'L	MW-9
503 HARD DRIVES INT'L	SO-9
548 HARVARD INFO SYSTEMS	NE-4
550 HY-TEC	NE-17
551 HY-TEC	NE-17
135 IC EXPRESS	372
145 JADE	375
148 JAMECO	348,347
148 JAMECO	348,349
148 JAMECO	350,351
148 JAMECO	352,353
521 JB TECHNOLOGIES	PC-5
6 J.D.R. MICRODEVICES	388,389
7 J.D.R. MICRODEVICES	388,389
174 MARYMAC	385
437 MAYFAIR MICROS	IS-36
181 MEAD COMPUTER	380
193 MICROPROCESSORS UNLTD.	374
* MICROWAY	183
195 MICROWAY	301
* MONTGOMERY GRANT	116
555 M.S.C.	NE-9
202 NAGAN CORP.	370
386 ON-LINE STORE	234
219 PACIFIC COMPUTERS	368
556 PC LINK CORPORATION	NE-6
229 PRECISION DATA PRODUCTS	372
231 PROGRAMMERS PARADISE	80,61
232 PROGRAMMERS WHOLESALER	44
234 P.C. BRANDS	135
235 P.C. BRANDS	136,137
236 P.C. BRANDS	138,139
237 P.C. BRANDS	140,141
448 QUOTHA 32	IS-62
258 SCHWAB COMPUTER	386
451 SCOTTSDALE SYSTEMS	IS-17
452 SCOTTSDALE SYSTEMS	IS-17
* SOFTLINE CORPORATION	IS-35
523 SOFTWARE ENGINEERING STOR	PC-16
280 SURAH, INC.	372
282 S'N'W COMPUTER	274
287 TERMOTROL	374
485 THE NEXT WORKS	MW-1
486 THE NEXT WORKS	MW-1
297 TOTE-A-LAP	374
528 TRAN COMPUTER NETWORK	PC-1
527 TRAN COMPUTER NETWORK	PC-1
304 T.P.C.	200

Inquiry No.	Page No.
484 UNDERWARE ELECTRONICS	MW-3
512 UNDERWARE ELECTRONICS	SO-12
306 UNIXEX	382
* US DIGITAL	SO-7
461 USA SOFTWARE	IS-13
314 WAREHOUSE DATA	311
487 Y.E.S. MULTINATIONAL	MW-12
488 Y.E.S. MULTINATIONAL	MW-12

826 EDUCATIONAL/INSTRUCTIONAL

403 ADDISON-WESLEY	IS-45
22 ANNABOOKS	387
406 BIX	IS-48
* BYTE BACK ISSUES	344
50 BYTE BITS	370
345 BYTE BITS	386
* BYTE BOOK CLUB	288,289
* BYTE PUBLICATIONS	IS-58
* BYTE PUBLICATIONS	IS-64
* BYTE SUB. MESSAGE	281
* BYTE SUB. SERVICE	48
* BYTEWEEK/NEWSLETTER	403
* BYTEWEEK/NEWSLETTER	SO-2
* BYTEWEEK/NEWSLETTER	IS-2
* BYTEWEEK/NEWSLETTER	PC-4
62 COMPACT DISK PRODUCTS	41
* COMPUTER BOOK CLUB	256A-B
70 COMPUTER BOOK CLUB	257
* DEXPO WEST 89/EXPOCONSUL	PC-6
428 INFOSYSTEM '89	IS-52
155 KNOWLEDGE GARDEN	401
* LIBRARY OF COMP&INFO SCI	32,33
* LIBRARY OF COMP&INFO SCI	32A-B
180 MCGRAW-HILL BOOKSTORE	281
* MCGRAW-HILL NRI	178A-B
447 QA TRAINING	IS-51
308 UNIVERSITY OF MARYLAND	184
* UNIXWORLD	MW-12
* UNIXWORLD	PC-12
* UNIXWORLD	SO-8

827 DESKTOP PUBLISHING

* ADOBE	207
176 MATRIX SOFTWARE	248
190 MICRO PRESS	174
443 PACIFIC DATA PRODUCTS	IS-25
444 PACIFIC DATA PRODUCTS	IS-25
226 PERSONAL TEX	162

828 MISCELLANEOUS

85 COUNT DISK	187
255 SAFEWARE	378

829 OPERATING SYSTEMS

8 2001 SALES	280
9 2001 SALES	280
* IBM-AIX PRODUCT	14,15
152 KADAK PRODUCTS	74
242 QUANTUM SOFTWARE SYS.	69
257 SANTA CRUZ OPERATION	83
454 SOFTTEK COMPUTER	IS-82
263 SOFTWARE LINK	76,77
264 SOFTWARE LINK	76,77
269 ST SYSTEMS CORPORATION	386

830 ON-LINE SERVICES

* BIX	134,293
450 BIX	312,313
68 COMPUSERVE	129
479 DATASOLVERS, INC.	MW-2
480 DATASOLVERS, INC.	MW-2

REQUEST FREE INFORMATION BY FAX

Attention BYTE Readers!! Now you can fax your requests for free product and advertiser information featured in this issue.

Just fax this page to 1-413-637-4343. You'll save time because your request for information will be processed as soon as your fax is received.

1 Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.

2 Check off the answers to questions "A" through "C".

3 Print your name, address, and fax number clearly on the form.

4 Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name _____
 Title _____
 Company _____
 Address _____
 City _____
 State/Province _____ Zip _____
 Country _____
 (_____) (_____) _____
 Phone Number Fax Number

A. What is your level of management responsibility?
 Senior-level Management
 Other Management
 Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)
 Administration
 Accounting/Finance
 MIS/DP/Information Center
 Product Design and Development
 Research and Development
 Manufacturing
 Sales/Marketing
 Purchasing
 Personnel
 Education/Training
 Other: _____

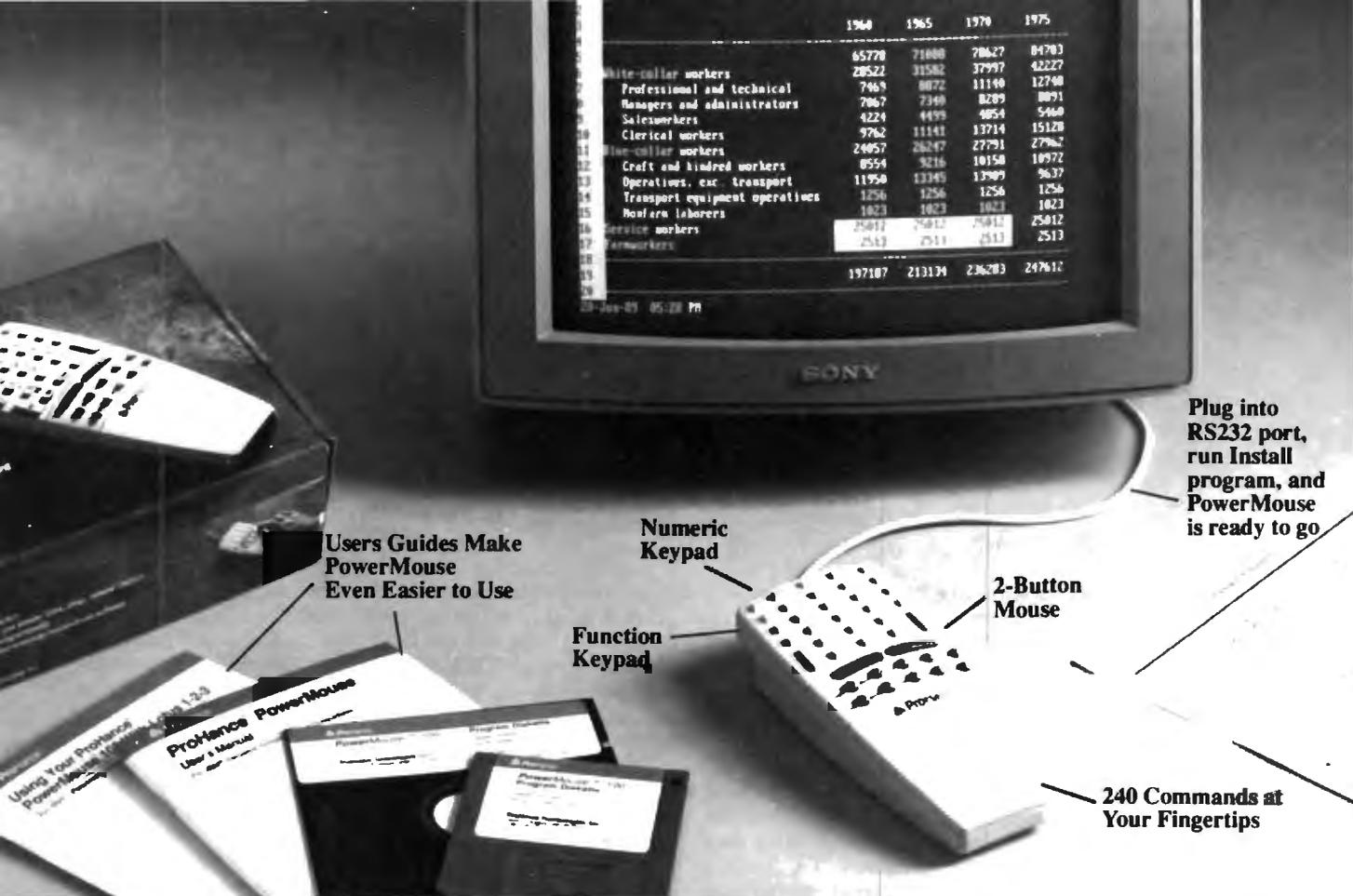
C. Please indicate your organization's primary business activity: (Check one.)

Computer-Related Businesses:
 Manufacturer (Hardware, Software)
 Computer Retail Stores
 Consultants
 Service Bureau/Planning
 Distributor/Wholesaler
 Systems House/Integrator/VAR
 Other: _____

Non-Computer-Related Businesses:
 Manufacturing
 Finance, Insurance, Real Estate
 Retail/Wholesale
 Education
 Government
 Military
 Professions (Law, Medicine, Engineering, Architecture)
 Consulting
 Other Business Services
 Transportation, Communications, Utilities
 Other: _____

I already subscribe to BYTE.
 Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580
581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740
741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860
861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920
921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940
941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980
981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060
1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120
1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160
1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180
1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200



SAVE TIME AND HASSLE! GUARANTEED!

Introducing PowerMouse™

The PowerMouse is a unique productivity tool that combines the smooth operation of a mouse with a 40-key keypad, allowing you to:

- Replace up to 240 lengthy keystroke sequences with the press of a button.
- Replace cursor keystrokes with a flick of the wrist.
- Cut down on going back to the keyboard.
- Virtually eliminate leaving your work to go to the edge of the screen to pick up commands.

Yet PowerMouse is as simple to learn, use, and remember as a calculator.

Mouse-Friendly and Keyboard Smart

The PowerMouse is a lot like a keyboard - press a key, the command is executed. Yet all your cursor keystrokes are replaced with a simple flick of the wrist. And best of all, it works with your existing keyboard-driven software without changing its look, feel, or operation.

PowerMouse is Straightforward

PowerMouse plugs into a RS232 port (COM1 or COM2). The software converts the touch of each button into a command as defined by a PowerMacro™ table. Unlike conventional macros, PowerMacros allow fluid cursor control to be an integral, natural part of your commands.

"I've run whole sessions where I haven't taken my hand off the mouse to use the keyboard"

—John Couleur, computer consultant, as quoted in ComputerWorld

PowerMouse comes ready to run out of the box with:

- Lotus 1-2-3, Allways, Symphony, Quattro, and Lucid
- WordPerfect, WordStar and Volkswriter
- Harvard Graphics
- Also available...PowerCAD for AutoCad V10

You can also adapt PowerMouse to your specific needs or for use with other programs. PowerMacro tables are stored as text files. Simply create or edit PowerMacros with the supplied editor (or any text editor). You can have as many PowerMacro tables as your disk can hold.

30-Day Trial Period Money-Back Guarantee

The best way to understand PowerMouse is to try it. There's no risk; if you are not completely satisfied, return it within 30 days for a full refund.

PowerMouse sells for an introductory price of \$195.00 (\$225.00 list). PowerMouse with PowerCad sells for \$245.00 (\$295.00 list). Call toll free and charge your purchase to your Visa or MasterCard. Or return the coupon below. We pay for UPS blue label shipping anywhere in the continental U.S.

To Order Call 1-800-345-9111 ext. 18

ProHance Technologies, Inc.
1307 S. Mary Avenue #104, Sunnyvale, CA 94087

I want to try PowerMouse on your no-risk money-back guarantee. PowerMouse \$195.00 (California residents \$208.65 tax included).

Call 1-800-345-9111 ext. 18

or send this coupon with your check or credit card number to ProHance Technologies at the address below.

Name _____ Company _____

Address _____

City _____ State _____ Zip _____ Phone _____

5 1/4" Disk 3 1/2" Disk

Check Enclosed Visa MasterCard

Card No. _____

Expiration Date _____

\$195⁰⁰

ProHance

ProHance Technologies, Inc.
1307 S. Mary Avenue #104, Sunnyvale, CA 94087
408-746-0950

9101

Circle 337 on Reader Service Card

PRINT QUEUE

Hugh Kenner

Putting Mike in a Box

**THE RISE OF THE EXPERT COMPANY:
How Visionary Companies Are Using Artificial Intelligence
to Achieve Higher Productivity and Profits**

by Edward Feigenbaum, Pamela McCorduck, and H. Penny Nii

In 1972, Hubert Dreyfus wrote the book *What Computers Can't Do*, which he says is pretty well anything that draws on diffuse experience. One story tells how a computer struck back by beating Dreyfus at chess. Still, chess experience, as he might have retorted, is anything but diffuse; it's fiercely concentrated, and experts have a monopoly. What they know can be arranged for a system to consult by way of decision trees.

The same, we're now learning, is true of other sorts of experience. How does your doctor decide you need a triple bypass? In the years I've been asking doctors a like question over the dinner table, I've not heard one coherent answer. What they know, they don't seem to know how they know. Yet, yes, it's formulable knowledge, so reducible to hard questions and hard answers that an expert system called MYCIN could simulate a huge range of diagnostic expertise. MYCIN, which dates from 1976, drew on more pooled experience about bacterial infections and optimal treatments than any one internist likely had, and it never suffered from distraction or sagging attention. It's become the stock instance of AI doing something useful at last.

You can buy an expert-system skeleton called 1st-Class for your microcomputer—no toy, it's one of several AI shells in use at DuPont—and use it to set up a savvy question-and-answer tree for a subject that concerns you. The manual's example: "I've a 7-oz package that must be in Omaha tomorrow (which isn't a Saturday), so what's my best gamble?" (Answer: Express Mail; but if the deadline is prior to 10:30 a.m., try Federal Express.) That draws on the know-how of a shipping-room expert. Call him Jack: 1st-Class has provided Jack-in-a-Box.

What Jack-in-a-Box advises you could figure out for yourself, if not as fast, from a master list of rates and schedules. The Mike-in-a-Box kept at DuPont is more interesting. Round the clock a massive

distillation system runs, and the output *must* be 99.99 percent pure. A turnkey operation, you'd think? No. "The distillation column had to be watched constantly, and complex purges decided on the spot." The only man who had really mastered the art was an engineer named Mike. For 10 years, the routine for humbling smart-aleck upstarts was to place them where they had to do Mike's job.

Then, in a month of interviews, Mike's subtle web of understanding got transferred to an expert system. In effect, Mike is now available 24 hours a day and will stay on call long after he's retired. The savings are \$100,000 a year.

Paging through the case histories found in *The Rise of the Expert Company*, I was struck by the commonness of Mike dependency, how often there's one crucial person who gets phoned at midnight about a crisis. And the very fact that help can be delivered over the phone makes it likely that an expert

system can simulate the crucial person. On the screen, just as on the phone, questions are prompted by your answers to previous questions. Once the data is deemed sufficient, there's a recommendation. One expert said the chief benefit he'd received from AI was being able to count on unbroken sleep.

Another aspect of Mike dependency is this: The years that were steeping Mike in savvy also swept him toward retirement, so let's pray we can soon count on someone else showing comparable learning skills. Expert systems never retire, and they are readily modified as parameters are altered.

"The same corporate streamlining that affected most American firms in the early 1980s has reduced staff at DuPont by 30 percent since 1981, but that represents a loss of perhaps 70 percent in experience, since much of that reduction was through early retirement. A few hundred of those early retirees

continued



Knowledge Processing



**Don't leave your users
lost in a maze of
information!**

A knowledge processor communicates knowledge - the natural extension of everything we do on a computer.

It's the intelligent integration of everyday resources like data, text, logic, graphics, and video that turns information into knowledge.

KnowledgePro is the first knowledge processor. It combines a high-level, object-oriented programming language with hypertext and expert systems technology.

KnowledgePro gives you a total development environment with the tools you need to create intelligent multi-media applications.

PC Magazine, Holland... *"KnowledgePro is the first of a new generation of software, the knowledge processor...it has the power of, for example, Pascal or PROLOG, but the programmer isn't troubled with the technical details."*

PC Week, USA... *"It's rare, but every so often a PC application comes along that breaks new ground and creates a fundamentally different way to use computers. According to its corporate users...KnowledgePro does just that."*

Infoworld... *"We don't live in a computational world. If we're going to move knowledge around we need tools...The same person who will learn macros in Lotus can learn this."*

KnowledgePro costs \$495 with no runtime fees. It runs on IBM PC, XT, AT and PS/2 compatible machines with 640k of memory and a hard disk. A working demo with a 100 page manual is available for \$33 including shipping (\$38 foreign) with credit towards purchase of the full system.

Find out what knowledge processing is all about. Call 518-766-3000 (FAX 518-766-3003) or write to Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123, USA. Amex, Visa or M/C accepted.

KnowledgePro[®]
The intelligent way out

Circle 155 on Reader Service Card

Another
intelligent
tool from



are being brought back to have their expertise captured in expert systems that will help do the jobs they used to do themselves." And they love it. The AI people point to "the immortality syndrome."

The capture technique can vary. At Nippon-Kokan Steel, where it may take 20 years to train a blast-furnace operator (someone whose readings of several thousand sensors can keep the beast from dumping or else choking up), the very best operator came to be known as "God," and setting up an expert system so all the furnaces could be as well run as God's meant

The prime narrative theme of the book is how a mere hint that we might, ah, "automate Mike" impinges on corporate sociology. Knuckles whiten.



winkling out of him knowledge "even he didn't know he had." He's like those physicians I've talked to. At the other extreme, there exist Mikes who are so articulate you just turn on the tape recorder and stand back.

American Express, DEC, DuPont, Texas Instruments, Schlumberger, IBM, Toyota, Fujitsu, Westinghouse . . . they all have AI systems stowed away here and there (and decentralized DuPont has several hundred). Given the evident benefits of an automated Mike at strategic junctures, it all sounds open-and-shut. It wasn't and isn't. The prime narrative theme of the book is how a mere hint that we might, ah, "automate Mike" impinges on corporate sociology. Earflaps are buttoned, eyes averted. Knuckles whiten. Why?

Managers tend not to realize how dependent they are on a tiny platoon of Mikes, or how fragile that dependence is. (We've a system working here, haven't we?) Then there's the NIH (not invented here) syndrome: We know our business, let eggheads tend to theirs. Or the mention of Lisp and Prolog turns eyes glassy. Or you're talking about spending money, and we're comfortable where we are, amid a smooth payroll flow. Worst, if word gets to Mike himself prematurely, he'll panic. *Me?* replaced by a *robot*?

No, he won't be replaced, he'll be assisted; it's important to have the word reach him in that form, so put that he'll crave the assistance. Generally, in scenario after scenario, what has paid off in happy Mikes and million-dollar savings has been the zeal of some middle-level person who understood just the right way to keep persisting.

At American Express, a man named Robert Flast worked month in, month out, against all manner of corporate obstruction, until a system was in place that automates the vetting of an unexpected credit request phoned in by, say, a book dealer in

Paris. In effect, it automates a 5-inch-thick manual of which humans were supposed to recall any relevant detail in a 70-second time frame. (Say "no" wrongly, and you've lost a transaction. Say "yes" wrongly, and you've pointed yet another file to the bad-debt basket.) The annual yield of the AI system, which simply lets a human decide from improved information, is estimated at \$27 million. (And a human who doubts the system's recommendation can ask it to outline its reasons.)

And at Northrop Aircraft, Ken Lindsay and Bob Joy took the "Ken and Bob Show" (an Apple on a dolly, with a demonstration program hacked in BASIC) to office after office in building after building till they'd gotten agreement that a system called ESP could automate the immensely intricate and often wasteful process of scheduling the flow of 20,000 parts into a jet fighter (speedup factor: 12 to 18).

And at Texas Instruments, a man named Harry Tennant landed the firm a \$50 million Air Force contract when the firm wasn't yet convinced that its newly formed AI division had been a good idea. Stories about MYCIN ("but when you've heard those stories once you don't want to hear them again"), demonstrations of Lisp prototyping ("but Lisp can seem to be all about matching parentheses")—such had been about the state of the action when Uncle Sam came fishing for a system whereby decision makers who were too far along in their careers to bother with computer language could query a big database in plain English. TI asked for a data sample, the Air Force obliged, and Tennant had a demonstration program running in five days. He even makes it sound easy: "I worked late one night."

The Rise of the Expert Company is chatty and ill-structured and laden with redundancy and badly needs an index—but is still worth your time. Whether *Natural Computation: Selected Readings*, which is edited by Whitman A. Richards, merits your time depends on you. It's a fat paperback compilation of college-course readings, replete with sentences like—hold your breath—

"Human walking is a very complicated activity in which the cyclic movements of the lower extremities translate the body in the forward direction. These movements are due to the action of muscles, which in turn are coordinated by the nervous system."

True, and human writing results from twitching of the fingers. These are learned papers, with coauthors and academic addresses and kudos to granting bodies. What they're about, though, isn't risible: efforts to get a computational handle on all manner of human activity, starting with vision. That was AI's old plenary dream, before expert systems (in the purist view) reduced it to compacted instruction manuals. Have a look at #4 on the Cartoon Algorithm, which addresses from another angle the art historian Ernst Gombrich's classic question: How do we recognize a caricature when most "information" is missing and what's left is demonstrably wrong? Or at #12, where a Connection Table shuttles the reader between visual and verbal presentations, not omitting freaks like Milne's heffalump and Penrose's triangle. Or at . . . well, *you go and look.* ■

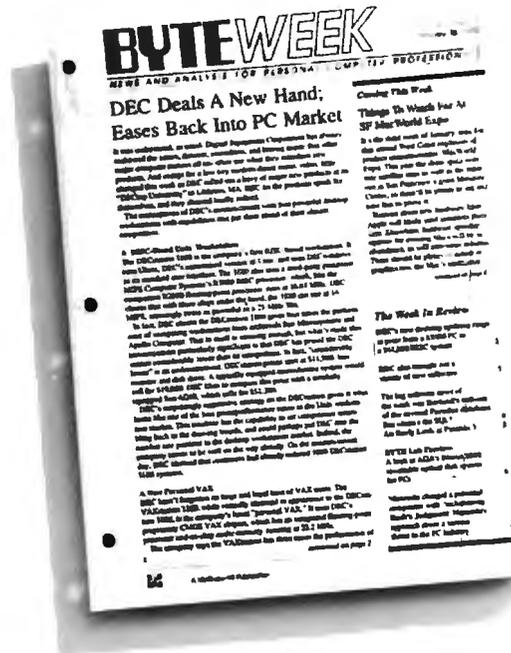
The Rise of the Expert Company, Times Books, New York: 1988, 322 pages, \$19.95

Natural Computation, MIT Press, Cambridge, MA: 1988, 561 pages, \$25

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times and Harper's. His recent books include A Sinking Island and Mazes. He can be contacted on BIX as "hkenner."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Quality In... Quality Out



No matter how well acquainted you are with making important personal computing decisions—decisions that may involve hundreds of thousands of dollars—the value of those decisions is only as good as the value of your information. Without quality information—it's hard to make quality decisions.

BYTEweek, McGraw-Hill's new weekly newsletter for professionals in the personal computer industry, is devoted to giving you that quality information through its timely and compact one-stop news format.

This new publication provides you with short, easy-to-read selections of the most important news and technological developments of the past week. And BYTEweek interprets this news with in-depth commentary and analysis.

Subscribe to BYTEweek for quality information. Remember, quality in...quality out.

Subscribe now and take advantage of the special one-year charter subscription rate of \$395 (\$495 outside the U.S. and Canada). This special price represents a savings of \$100 off the regular rate. Your subscription includes 50 issues plus a free three-month subscription to BIX—a \$49 value. Through BIX you can directly access the Microbytes Daily news service and communicate with other BIX users.

Don't miss this opportunity! In the U.S., call BYTEweek's toll-free number: **1-800-258-5485**, in N.H. and outside the U.S., call: 1-603-924-9281.

BYTEweek offers a *money-back guarantee* if you're not completely satisfied.

BYTEWEEK 

News and Analysis for Professionals in the Personal Computing Industry
One Phoenix Mill Lane, Peterborough, NH 03458



A bold new proposal for matching high-technology people and professions

Over the years, the problem of finding the right person for the right job has consumed thousands of worker-years of research and millions of dollars in funding. This is particularly true for high-technology organizations where talent is scarce and expensive. Recently, however, years of detailed study by the finest minds in the field of psychoindustrial interpersonal optimization have resulted in the development of a simple and fool-proof test to determine the best match between personality and profession. Now, at last, people can be infallibly assigned to the jobs for which they are truly best suited.

The procedure is simple: Each subject is sent to Africa to hunt elephants. The subsequent elephant-hunting behavior is then categorized by comparison to the classification rules outlined below. The subject should be assigned to the general job classification that best matches the observed behavior.

Classification Guidelines

Mathematicians hunt elephants by going to Africa, throwing out everything that is not an elephant, and catching one of whatever is left. Experienced mathematicians will attempt to prove the existence of at least one unique elephant before proceeding to step 1 as a subordinate exercise. Professors of mathematics will prove the existence of at least one unique elephant and then leave the detection and capture of an actual elephant as an exercise for their graduate students.

Computer scientists hunt elephants by exercising Algorithm A:

1. Go to Africa.
2. Start at the Cape of Good Hope.
3. Work northward in an orderly manner, traversing the continent alternately east and west.
4. During each traverse pass.
 - a. Catch each animal seen.
 - b. Compare each animal caught to a known elephant.
 - c. Stop when a match is detected.

Experienced computer programmers modify Algorithm A by placing a known elephant in Cairo to ensure that the algorithm will terminate. Assembly language programmers prefer to execute Algorithm A on their hands and knees.

Engineers hunt elephants by going to Africa, catching gray animals at random, and stopping when any one of them weighs within plus or minus 15 percent of any previously observed elephant.

Economists don't hunt elephants, but they believe that if elephants are paid enough, they will hunt themselves.

Statisticians hunt the first animal they see n times and call it an elephant.

Consultants don't hunt elephants, and many have never hunted anything at all, but they can be hired by the hour to advise those people who do. Operations research consultants can also measure the correlation of hat size and bullet color to the efficiency of elephant-hunting strategies, if someone else will only identify the elephants.

Politicians don't hunt elephants, but they will share the elephants you catch with the people who voted for them.

Lawyers don't hunt elephants, but they do follow the herds around arguing about who owns the droppings. Software lawyers will claim that they own an entire herd based on the look and feel of one dropping.

Vice presidents of engineering, research, and development try hard to hunt elephants, but their staffs are designed to prevent it. When the vice president does get to hunt elephants, the staff will try to

ensure that all possible elephants are completely prehunted before the vice president sees them. If the vice president does see a nonprehunted elephant, the staff will (1) compliment the vice president's keen eyesight and (2) enlarge itself to prevent any recurrence.

Senior managers set broad elephant-hunting policy based on the assumption that elephants are just like big field mice, but with deeper voices.

Quality assurance inspectors ignore the elephants and look for mistakes the other hunters made when they were packing the jeep.

Salespeople don't hunt elephants but spend their time selling the elephants they haven't caught, for delivery two days before the season opens. Software salespeople ship the first thing they catch and write up an invoice for an elephant. Hardware salespeople catch rabbits, paint them gray, and sell them as desktop elephants.

Validation

A validation survey was conducted about these rules. Almost all the people surveyed about these rules were valid. A few were invalid, but they are expected to recover soon. Based on the survey, a statistical confidence level was determined. Ninety-five percent of the people surveyed have at least 67 percent confidence in statistics. ■

ACKNOWLEDGMENT

This study has benefited from the suggestions and observations of many people, all of whom would prefer not to be mentioned by name.

Peter C. Olsen is a registered professional engineer and a lieutenant commander in the Coast Guard Reserve. He can be reached on BIX as "pcolsen."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

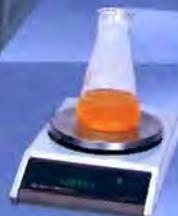
DOS + QuickBASIC or C + Instrumentation Code Generation = ?

There's only one solution...

LabWindows



VXI



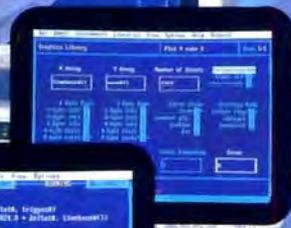
RS-232



PIB



Plug-in Boards



Are you using a DOS-based personal computer for controlling instrumentation? Do you want the best available software tools for acquiring and analyzing data using standard DOS programming languages? If your answer to these questions is yes, LabWindows® is just the solution you're looking for. The unique LabWindows function panel interface lets you interactively control your instrumentation hardware and collect data, as well as automatically generate Microsoft® C or QuickBASIC program code for your application.

With LabWindows you can control GPIB, RS-232, or VXI instruments, or plug-in data acquisition cards for PS/2 and PC-AT computers. For standalone instrument users, the LabWindows instrument library has over 50 ready-to-use instrument drivers so you can program your instrument using intuitive instrument-specific function panels, without knowing the instrument inside-out.

Because acquiring data is only one element of your application, LabWindows has a complete set of QuickBASIC and C compatible libraries for data analysis, presentation, and storage. Manipulate arrays, create a histogram, or use the optional Advanced Analysis Library to perform operations such as Fast Fourier Transforms, digital filtering, and curve

fitting. Give your programs a big performance boost using the specially optimized LabWindows analysis routines for computers with an 80387 numeric coprocessor. For your data presentation and storage needs, use the LabWindows Graphics Library to create multiplot graphs, bar charts, or scatter plots, and use the Data Formatting Library for data logging and file operations.

If you're looking for the right tools to take maximum advantage of your DOS computer using QuickBASIC or C for data acquisition and analysis, there is only one solution...LabWindows. Call National Instruments at (800) IEEE-488 to speak with a sales or applications engineer about how LabWindows can help you.

Ask for a FREE Catalog



NATIONAL INSTRUMENTS®
The Software is the Instrument™
12109 Technology Blvd.
Austin, Texas 78727-6204
(512) 794-0100

NATIONAL INSTRUMENTS OF JAPAN (03) 788-1922 •
NATIONAL INSTRUMENTS OF FRANCE (1) 486 53370 •
NATIONAL INSTRUMENTS UNITED KINGDOM (06) 355-23545 •
ARGENTINA (1) 46-5776 • AUSTRALIA (2) 736-2888 • BELGIUM (2) 466-8199 • CANADA
(416) 890-2010, (613) 596-9300, (514) 747-7878, (403) 295-0822, (604) 988-2195 • CHILE (2) 225
3689 • DENMARK (2) 251-122 • FINLAND (0) 372 144 • GREECE (1) 361-1283 • HONG
KONG (2) 0426-2707 • IRELAND (846) 661-414, (3) 427-2282 • ISRAEL (3) 324 298 • ITALY
(2) 984-91071-2-3 • KOREA (2) 776-5340 • MEXICO (5) 660-4323 • THE NETHERLANDS (7)
099-6360 • NEW ZEALAND (9) 444-2645 • NORWAY (2) 53-1250 • PORTUGAL (1) 545-313 •
SINGAPORE (65) 336-4713 • SOUTH AFRICA (011) 787-0473 • SPAIN (1) 455-8112 •
SWEDEN (8) 792-1100 • SWITZERLAND (6) 552-8949 • TAIWAN/THE REPUBLIC OF
CHINA (02) 703-6280 • THAILAND (2) 234-9330 • WEST GERMANY (89) 80-7081

The Tandy® 5000 MC

Our most
powerful 386™
based computer.



The remarkable Tandy 5000 MC Professional System is pure performance, from the Intel® 80386 processor operating at 20 MHz to the high-speed memory with cache controller that provides RAM-fast access to your data.

With the 5000 MC, you have the high-performance platform needed to take full advantage of industry-

standard MS-DOS® applications, powerful new MS® OS/2 programs or multiuser SCO XENIX® software.

Operating at 20 MHz, the 5000 MC cuts through the big jobs like database management, large spreadsheets and sophisticated graphics. And with its IBM® Micro-Channel™ compatible architecture, it's the ideal high-end PC workstation.

The Tandy 5000 MC has power to share. It's system architecture provides high performance in data-transfer rates when the 5000 MC is configured within a 3Com workgroup or a XENIX multiuser environment.

The Tandy 5000 MC is the new alternative in personal computing. From the broadest selection of PCs made in America.

Tandy Computers: Because there is no better value.™

Intel and 386/TM licensed from Intel Corp. IBM/Reg. TM and Micro Channel/TM IBM Corp. MS, MS-DOS and XENIX/licensed from Microsoft Corp.

Radio Shack®
COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

Circle 243 on Reader Service Card